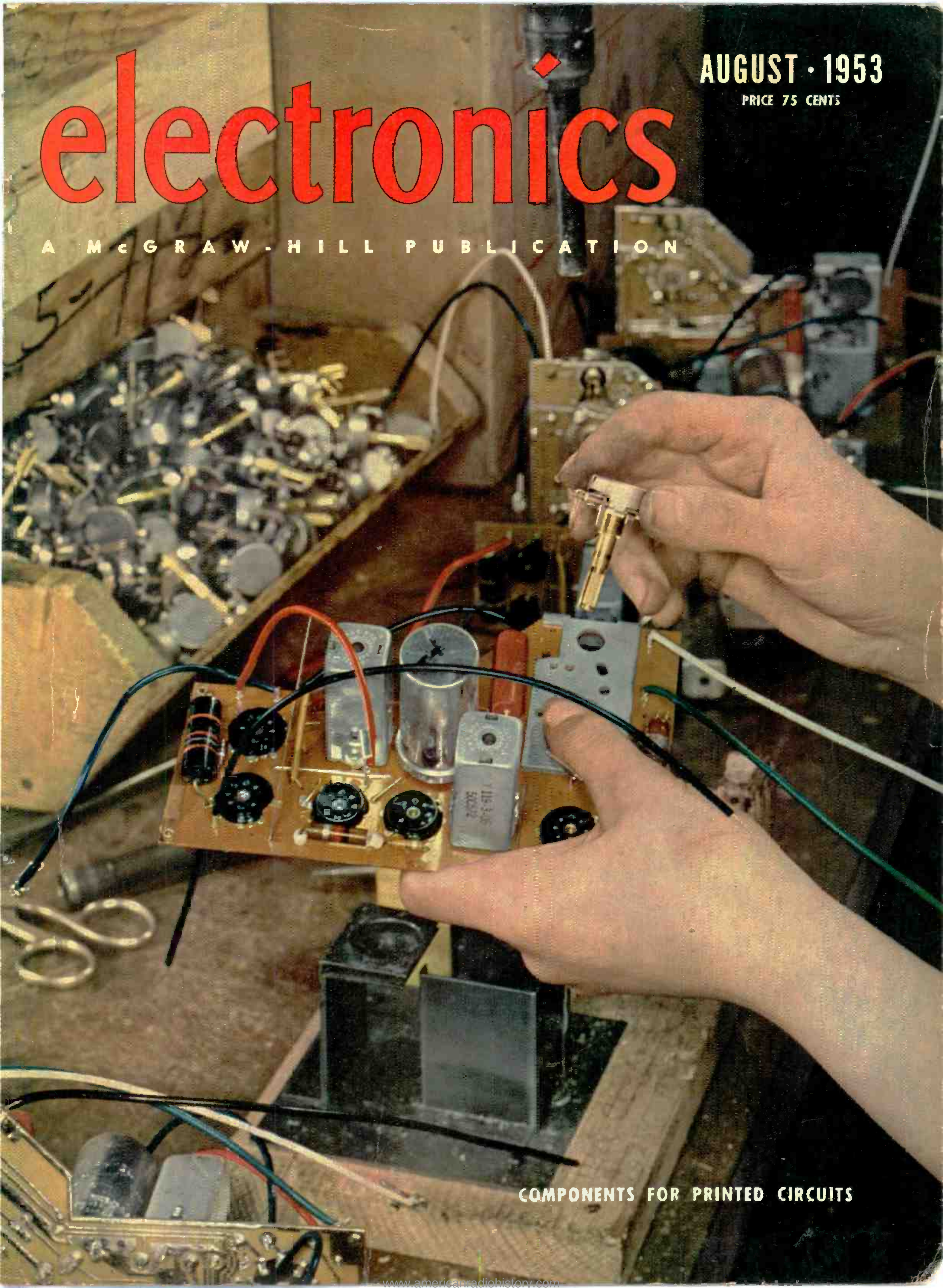
electronics

AUGUST · 1953

PRICE 75 CENTS

A McGRAW-HILL PUBLICATION



COMPONENTS FOR PRINTED CIRCUITS

www.americanradiohistory.com

New "M" Type Toroids Maximum Q Minimum Size

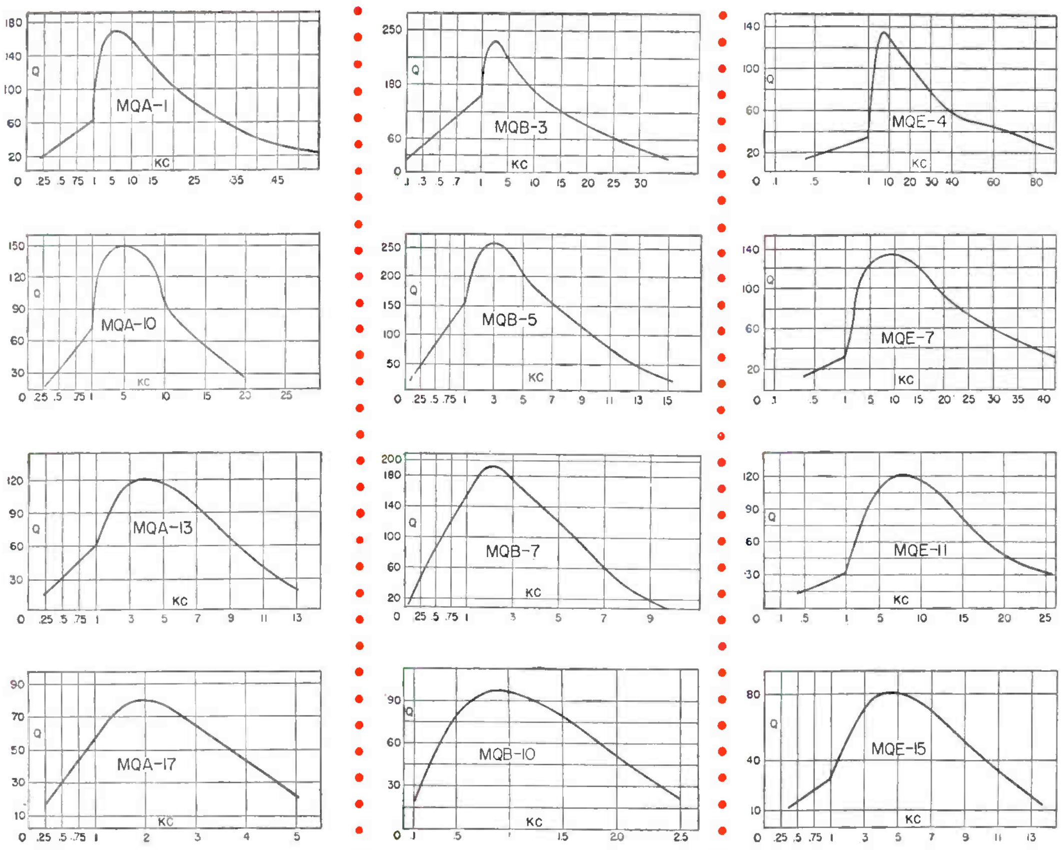
UTC Permalloy Dust Toroids have been the standard of the industry for over 15 years. The MQ series of coils provide the highest Q factor in their class (see curves below), with miniaturized dimensions. All units are **hermetically sealed** to MIL-T-27 Specifications.

The stability is excellent. For the MQE-7 the inductance change is less than 1% for voltages from .1 to 3 volts. The MQA-13 change is less than 1% for applied voltages from .1 to 20 volts. The MQB-5 change is less than 1% for applied voltages from .1 to 50 volts. DC is permissible through the coil (values listed below). Inductance is virtually independent of frequency temperature and vibration.

Hum pickup is extremely low due to the toroidal winding structure, with windings uniformly spread over the core. The case is of high permeability, affording additional shielding such that close spacing of units can be effected, the coupling attenuation being approximately 80 DB.

Other values of inductance than those listed are available on special order at the price of the next higher listed value.

TYPICAL Q CURVES



MQA TYPES

Type No.	Inductance	*DC Max.
MQA-1	7 mhy.	250
MQA-2	12 mhy.	200
MQA-3	20 mhy.	150
MQA-4	30 mhy.	125
MQA-5	50 mhy.	100
MQA-6	70 mhy.	80
MQA-7	120 mhy.	60
MQA-8	.2 hy.	50
MQA-9	.3 hy.	40
MQA-10	.5 hy.	30
MQA-11	.7 hy.	25
MQA-12	1 hy.	20
MQA-13	1.5 hy.	17
MQA-14	2.5 hy.	13
MQA-15	4 hy.	10
MQA-16	6 hy.	9
MQA-17	10 hy.	7
MQA-18	15 hy.	5
MQA-19	22 hy.	4

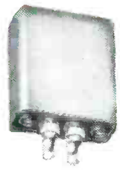
*This value of D.C. (MA) will drop the coil inductance 5%. Values of D.C. below this will show proportionately (linear) less inductance drop. For example, MQE-1 will drop ½% in L with 13.5 MA.

MQB TYPES

Type No.	Inductance	*DC Max.
MQB-1	10 mhy.	400
MQB-2	30 mhy.	250
MQB-3	70 mhy.	170
MQB-4	120 mhy.	120
MQB-5	.5 hy.	60
MQB-6	1 hy.	40
MQB-7	2 hy.	30
MQB-8	3.5 hy.	22
MQB-9	7.5 hy.	16
MQB-10	12 hy.	11
MQB-11	18 hy.	9
MQB-12	25 hy.	8

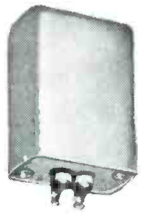
MQE TYPES

Type No.	Inductance	*DC Max.
MQE-1	7 mhy.	135
MQE-2	12 mhy.	100
MQE-3	20 mhy.	80
MQE-4	30 mhy.	65
MQE-5	50 mhy.	50
MQE-6	70 mhy.	40
MQE-7	100 mhy.	35
MQE-8	150 mhy.	30
MQE-9	.25 hy.	22
MQE-10	.4 hy.	17
MQE-11	.6 hy.	14
MQE-12	.9 hy.	12
MQE-13	1.5 hy.	9
MQE-14	2 hy.	8
MQE-15	2.8 hy.	7.2



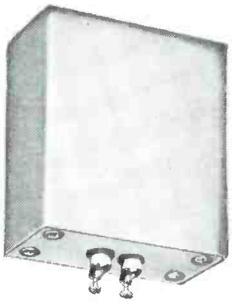
MQE CASE

Length .... 1 1/16"
Width .... ½"
Height .... 17/32"
Unit Weight .... 1.5 oz.



MQA CASE

Length .... 1 9/32"
Width .... 1 1/16"
Height .... 1 23/32"
Unit Weight .... 4 oz.



MQB CASE

Length .... 2 9/16"
Width .... 1 13/16"
Height .... 2 13/16"
Unit Weight .... 14 oz.

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y.. CABLES: "ARLAB"

www.americanradiohistory.com

electronics

AUGUST • 1953
A McGRAW-HILL PUBLICATION

COMPONENTS FOR PRINTED CIRCUITS—Designed with blade-type terminals that extend through panel for later mechanized dip-soldering, a Chicago Telephone Supply Corp. volume control is fitted into printed-circuit chassis of a Hallicrafters clock radio (see p 202) .... *COVER*

W. W. MacDONALD, *Editor;* **VIN ZELUFF,** *Managing Editor;* John Markus, A. A. McKenzie, James Fahnestock, *Associate Editors;* William P. O'Brien, John M. Carroll, William G. Arnold, William E. Pettit, David A. Findlay, *Assistant Editors;* Marilyn Wood, *Editorial Assistant;* Gladys T. Montgomery, *Washington Editor;* Harry Phillips, *Art Director;* Eleanor Luke, *Art Assistant*

KEITH HENNEY, *Editorial Director*

H. W. MATEER, *Publisher;* **WALLACE B. BLOOD,** *Manager;* R. S. Quint, *Buyers' Guide Manager;* N. F. Cullinan, *Promotion & Research Assistant;* H. E. Hilty, *Classified Manager;* D. H. Miller, James Girdwood, *New York;* Wm. S. Hodgkinson, *New England;* Warren W. Shew, *Philadelphia;* C. D. Wardner, *Chicago;* J. L. Phillips, *Cleveland;* T. H. Carmody, R. C. Alcorn, *San Francisco;* Carl W. Dysinger, *Los Angeles;* Robert H. Sidur, *Atlanta*

August, 1953 ELECTRONICS Vol. 26, No. 8

Member ABC and ABP

Published monthly with an additional issue in June by McGraw-Hill Publishing Company, Inc., James H. McGraw, 1860-1948), Founder. **Publication Office, 99-129 North Broadway, Albany 1, N. Y.**

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42 St., New York 36, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publication Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to Electronics—Subscription Service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from persons engaged in theory, research, design, production, maintenance and use of electronic and industrial control components, parts and end products. Position and company connection must be indicated on subscription orders.

Single copies 75¢ for United States and possessions, and Canada; $1.50 for Latin America; $2.00 for all other foreign countries. Buyers' Guide $2.00. Subscription rates—United States and possessions, $6.00 a year; $9.00 for two years. Canada, $10.00 a year; $16.00 for two years. Other western hemisphere countries, $15.00 a year; $25.00 for two years. All other countries $20.00 a year; $30.00 for two years. Entered as second class matter August 29, 1936, at the Post Office at Albany, N. Y., under act of Mar. 3, 1879. Printed in U.S.A.

Copyright 1953 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved.

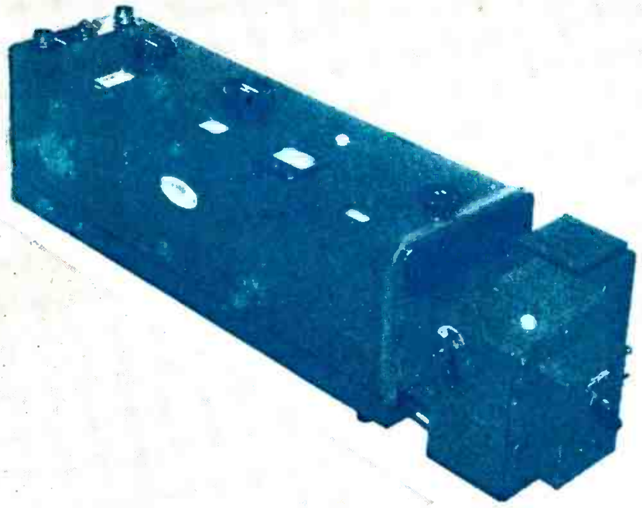
BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; McGraw-Hill House, London, E.C. 4; Washington, D. C. 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; 1321 Rhodes-Haverty Bldg., Atlanta 3, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.

www.americanradiohistory.com

The Beckman Model DU is considered the key precision instrument for spectrophotometric analysis—a technique which is fast revolutionizing the fields of investigative and control chemistry.

Based on the spectral light characteristics of liquids, solids and gases, precision spectrophotometry quickly and accurately analyzes thousands of varied materials, both qualitatively and quantitatively . . . providing data which is vital for accurate, economical product and process control.

Whatever the material — be it orange juice, metal alloys, lubricating oils, fertilizers or vitamins — chances are you'll find modern spectrophotometry playing a key role in its efficient and economical production, processing or control.



The Sorensen Model E-6/2-5 Nobatron, With Regulation Accuracy of ±0.01%, Gives Stability of Batteries With None of the Disadvantages.

When you use a Beckman Spectrophotometer you expect the *utmost* in performance. And you get it — so long as the power supply is dependable.

The Sorensen Model E-6/2-5 Nobatron *is dependable.* It has been specifically designed to provide your Beckman with 2 and 6 volts DC, *plus or minus 0.01%,* with that accuracy maintained *indefinitely* and *continuously!*

No more replacing or recharging storage batteries! No more uncertain results because of voltage drop! To you this means no more interrupted work schedules, no more time-consuming re-runs!

The stability of the E-6/2-5 Nobatron is accomplished electronically, with no moving parts and a minimum of tubes. Two years' rigorous testing of prototype instruments have yielded results far exceeding specifications. Write for information today.

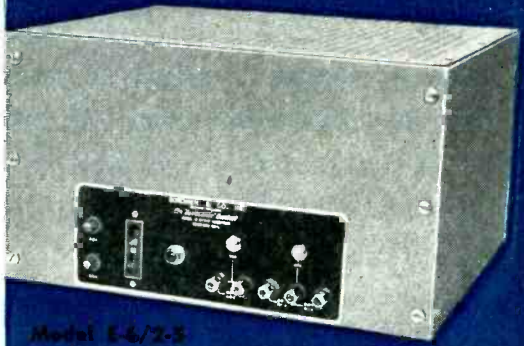
SORENSEN

SORENSEN AND COMPANY
375 FAIRFIELD AVE., STAMFORD, CONN.

here's the

IDEAL POWER SOURCE

FOR YOUR BECKMAN MODEL DU QUARTZ SPECTROPHOTOMETER



Model E-6/2-5

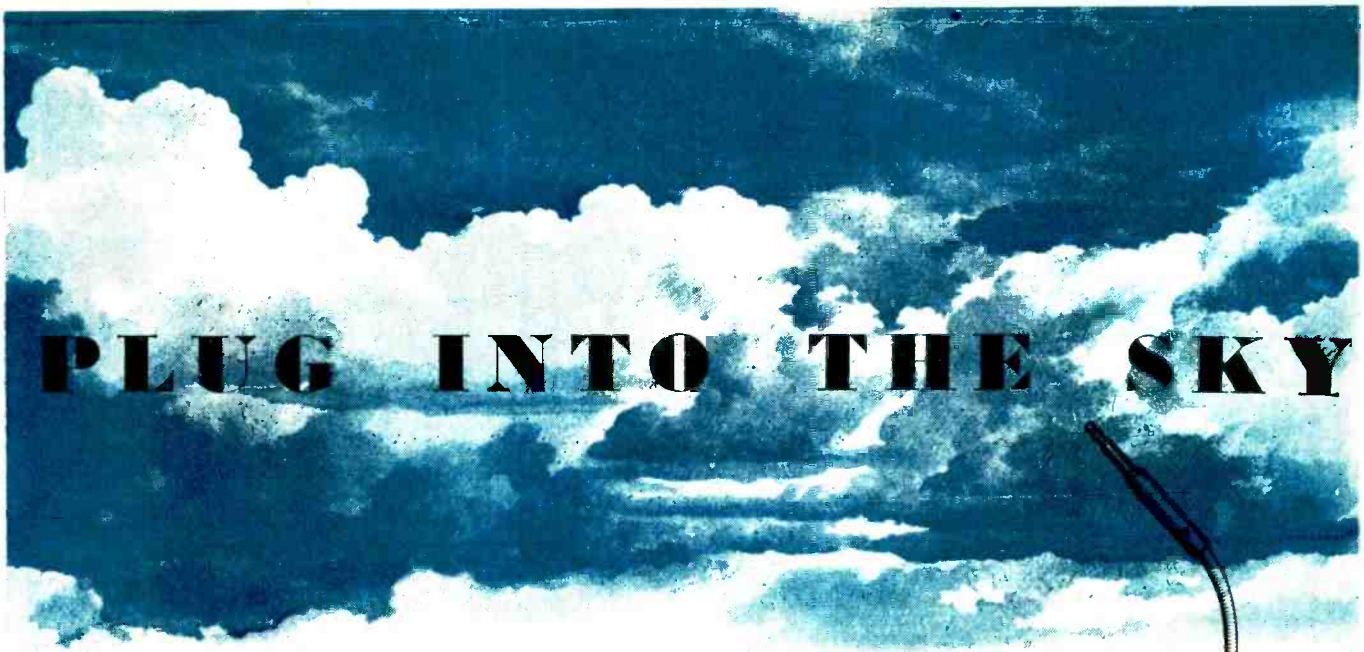
SPECIFICATIONS

Input voltage range	95-130VAC, 1φ, 50-60 cycles
Output	
#1 for lamp	6VDC adjustable ±10% at 3 amperes
#2 for filament	6VDC at 100 Ma.
#3 for bias	2VDC adjustable ±10% at 100 Ma.
Filtering	
#1	1% max.
#2 & 3	0.05% max.
Regulation accuracy	±0.01% against line-changes
Time constant	0.1 seconds under most severe line change

Sizes: 17 x 12¼ x 17 self contained
19 x 12¼ panel for relay rack mounting
Weight: Approximately 90 pounds
Meters: No meters are provided due to the extreme regulation accuracy involved.

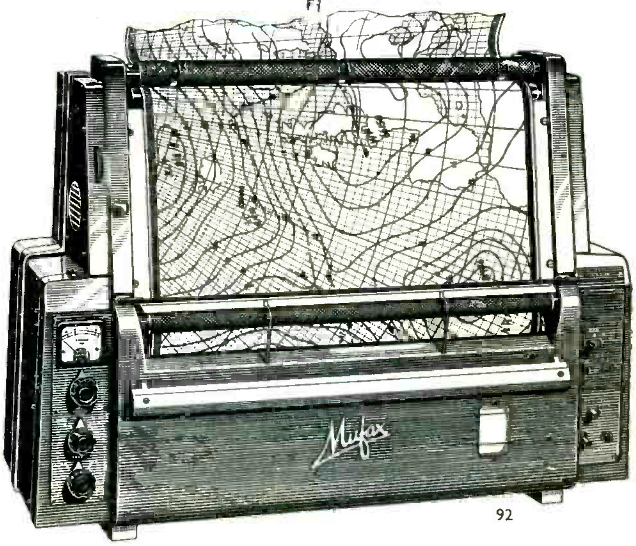
FOR THE LATEST AND BEST IN ISOTRONICS

www.americanradiohistory.com



Well, not exactly, but you can hook-up to receive weather charts measuring 18″ x 22″ for hours at a time without an operator.

If the weather is your concern, or indeed if the transmission of any graphic material—drawings, newspapers, legal documents—is a problem, maybe we can help you; write now.

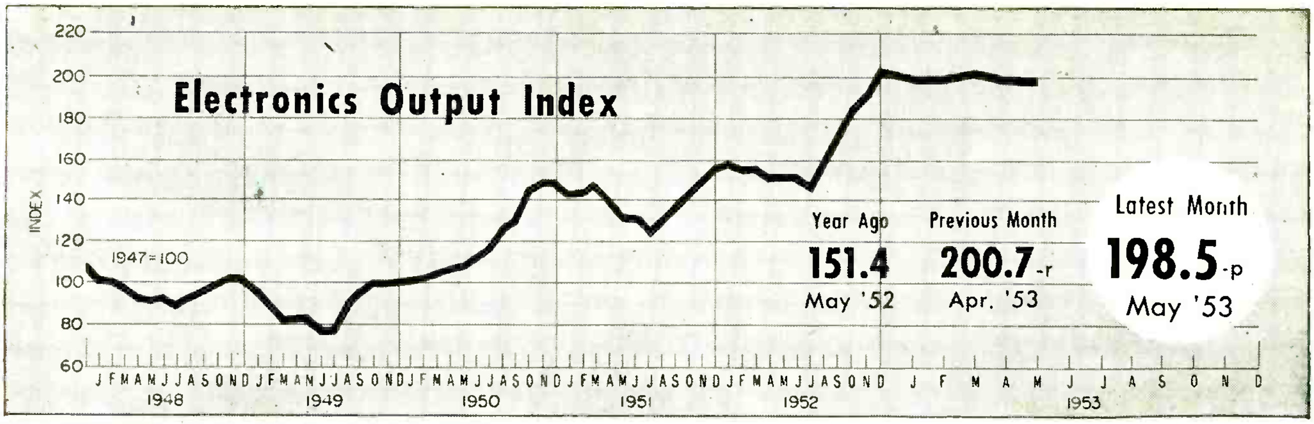


18″ MUFAX CHART RECORDER TECHNICALITIES

Maximum chart size	18″ wide x 22″ long
Index of co-operation	576
Helix speed	1 or 2 r.p.s.
Scanning rate	96 lines/inch
Maximum input signal (black)	+5 to —15 db ref 1mW
Signal frequency	AM: 1500c/s FM: 1500c/s black 2300c/s white
Power supply	95 — 125V, 60c/s or 200—250V, 50 c/s.

MUIRHEAD & CO. LIMITED · BECKENHAM · KENT · ENGLAND

www.americanradiohistory.com



FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago May '52	Previous Month Apr. '53	Latest Month May '53
Television sets	309,375	567,878	481,936
Home sets	288,927	286,974	278,156
Clock Radios	115,588	187,394	129,391
Portable sets	128,351	201,476	204,065
Auto sets	215,478	483,092	497,379

RECEIVER SALES

(Source: RTMA)	May '52	Apr. '53	May '53
Television sets, units	......	319,721	244,191
Radio sets (except auto)	......	412,802	716,407

RECEIVING TUBE SALES

(Source: RTMA)	May '52	Apr. '53	May '53
Receiv. tubes, total units	23,636,484	41,342,599	37,253,308
Receiving tubes, new sets	15,807,449	30,441,417	27,261,346
Rec. tubes, replacement	4,178,292	8,236,990	7,422,621
Receiving tubes, gov't.	2,433,605	1,167,234	723,852
Receiving tubes, export	1,217,138	1,496,958	1,845,489
Picture tubes, to mfrs.	247,724	721,283	579,332

SEMICONDUCTOR SALES

(Source: RTMA)	May '52	Apr. '53	May '53
Germanium Diodes	......	2,450,015	1,466,362

INDUSTRIAL TUBE SALES

	Quarterly Figures		
(Source: NEMA)	Year Ago 1st '52	Previous Quarter 4th '52	Latest Quarter 1st '53
Vacuum (non-receiving)	$11,320,000	$12,790,000	$11,340,000
Gas or vapor	$3,100,000	$3,480,000	$3,140,000
Phototubes	$500,000	$760,000	$930,000
Magnetrons and velocity modulation tubes	$8,460,000	$10,510,000	$10,070,000
Gaps and T/R boxes	$2,450,000	$2,090,000	$2,050,000

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago June '52	Previous Month May '53	Latest Month June '53
Sets in Use—total	17,627,300	23,930,000	24,292,600

BROADCAST STATIONS

(Source: RTMA)	June '52	May '53	June '53
TV Stations on Air	108	189	198
TV Stns CPs—not on air	0	266	285
TV Stns—Applications	716	611	572
AM Stations on Air	2,355	2,445	2,458
AM Stns CPs—not on air	65	130	126
AM Stns—Applications	323	244	250
FM Stations on Air	629	591	580
FM Stns CPs—not on air	19	20	21
FM Stns—Applications	9	9	8

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	May '52	Apr. '53	May '53
Aeronautical	32,852	38,887	42,213
Marine	35,476	39,745	40,076
Police, fire, etc.	10,965	12,956	13,238
Industrial	13,056	16,515	16,850
Land Transportation	4,966	5,769	5,830
Amateur	110,931	110,884	111,011
Citizens Radio	1,175	2,074	2,124
Disaster	65	189	189
Experimental	357	432	439
Common carrier	970	1,144	1,193

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Apr. '52	Mar. '53	Apr. '53
Prod. workers, comm. equip.	326,500	417,300	414,200
Av. wkly. earnings, comm.	$63.75	$66.42	$66.58
Av. wkly. earnings, radio	$59.51	$64.24-r	$64.08
Av. weekly hours, comm.	40.3	41.0	40.6
Av. weekly hours, radio	39.7	40.4	39.8

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	June '52	May '53	June '53
Radio—TV & Electronics	288.9	295.3	271.5
Radio Broadcasters	276.7	287.3	266.0

p—provisional; r—revised

FIGURES OF THE YEAR

		Totals for First Five Months		
	1952 Total	1952	1953	Percent Change
Television set production	6,096,279	1,957,083	3,309,757	+ 69.1
Radio set production	10,934,872	4,469,432	6,102,711	+ 36.7
Television set sales	6,144,990	1,868,994	2,344,811	+ 25.5
Radio set sales (except auto)	6,878,547	2,366,049	2,568,080	+ 8.6
Receiving tube sales	368,519,243	135,818,064	200,654,663	+ 47.7
Cathode-ray tube sales	6,120,292	1,559,334	3,633,288	+132.9

www.americanradiohistory.com

INDUSTRY REPORT

electronics—AUGUST • 1953

'Copters Need Navigational Aids

New electronic system with street-by-street precision needed for flights in fog

BEGINNING of sixteen regularly scheduled helicopter passenger flights daily from New York's three metropolitan airports in July served to emphasize the growing need for better electronic navigational aids for rotating-wing aircraft.

As yet, no single electronic system appears to meet the requirements of lightness, operation-by-pilot simplicity and street-by-street navigational accuracy during instrument flying weather. These are the conclusions of the recent Helicopter Symposium of the International Air Transport Association, recently held in San Juan, Puerto Rico for exchange of information between airline operators, pilots, metropolitan helicopter operators, manufacturers and government authorities from 20 different countries.

▶ **Landing Aids**—Forseeing operation by a one-man crew, European operators asked for simple presentation of data that could be easily read by the pilot alone and would increase in accuracy as the heliport is approached.

Going still further, U. S. carriers desired versatility adequate to simulate visual conditions at all times. For navigation between many points in an area of up to 150 square miles, such as for mail pickups, it was felt that something in the nature of a radar pictorial display might be required.

Talk-down radar had been tried as a landing aid for helicopters, but was found to be highly dependent on the kind of landing site and its surroundings. The vhf talking beacons, while simple and omnidirectional, were felt to be insufficiently accurate for landing purposes.

Tetrode Transistors Available August 15

Sylvania-developed point contact units perform functions of two triodes

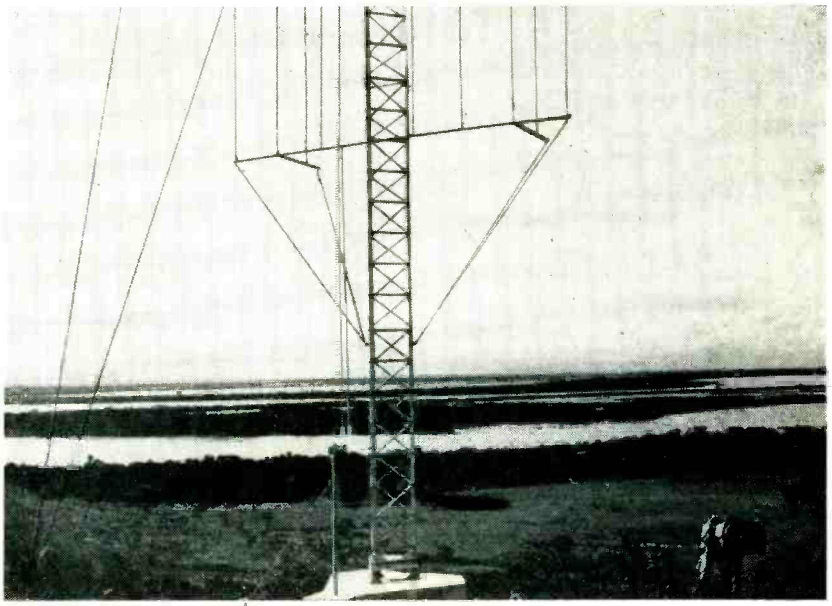
COMMERCIAL availability of tetrode and pentode point-contact transistors was announced July 21 by Sylvania. The tetrode units are to hit the market August 15, with pentodes following by the end of the current year.

The tetrode and pentode units have two and three emitters respectively, and with appropriate circuitry they are comparable to multipurpose tubes.

Preliminary tests on circuits using the multiemitter transistors prove their usefulness in certain types of computer circuits.

Radio Helps Big Steel Move an Iron Mountain

DEPLETION of America's reserves of high-grade iron ore has sent steel men scurrying to far-flung places. An estimated 400-million tons of high-grade ore in the ground brought U. S. Steel to the



Massive antenna helps span vast Venezuelan jungle for U. S. steel

www.americanradiohistory.com

Orinoco-delta country of Venezuela. Shipments of ore, moving 2,000 miles by rail and water to the giant Fairless Works in Morrisville, Pa., are expected to start next year.

► **Communications**—Setting up a vast mining operation in an underdeveloped region required first an adequate communications network. Links have been established by the Orinoco Mining Co., Big Steel's Venezuelan subsidiary. A high-frequency voice and teletype circuit links the company's offices in Caracas with Ciudad Bolivar, nearest large town to the mine. Very-high-frequency radio-telephone circuits linking Ciudad Bolivar; the mine, Cerro Bolivar; and the shipping point, Puerto Ordaz form a 206-mile triangle.

A mountain-top repeater station at Piacoa relays vhf signals to tugs, dredges and quarter boats engaged in dredging a deep-water channel in the Orinoco River.

► **Railroad**—Space radio will be used to control the railroad during its normal operation. A 90-mile single-track railroad built to move the ore to Puerto Ordaz will have four sidings controlled electronically by signals passed over vhf radio. Two of the robot sidings will be controlled by radio transmitters located near the mine. The remaining sidings will be switched by transmitters located near Puerto Ordaz. Control-point will be Puerto Ordaz and a broad-band 88-mc trunk will link the two transmitting stations.

The system is an adaptation of CTC or centralized traffic control used on many American railroads,

► **Background**—Remote switching by space radio has been tried before by railroads but never relied upon for full-time operation. The present system grew out of tests conducted in 1946 on the Pennsylvania Railroad. Success of the Orinoco Mining Company's electronically controlled railroad may help prove out radio for remote train control and possibly enlarge greatly the scope of electronics in the railroad industry.

TYPICAL COLOR TV STATION EQUIPMENT PRICES

Color Network Operating Equipment	
2 Color Stabilizing amplifiers	$2,800
1 Tri-color monitor including kine	3,000
1 Low frequency phase correction network	1,500
1 High frequency phase correction network	1,250
1 Lower subcarrier color notch filter	2,700
Associated equipment under $1,000	3,130
Total	$14,380

Color Test Equipment	
1 Convergence dot generator	$1,750
1 Color monitor analyzer	1,650
1 Linearity checker	1,750
1 Color signal analyzer	1,900
1 Burst-controlled oscillator	1,550
1 Color bar generator (rack mounted)	2,250
1 TO-524-D television oscilloscope	1,180
Associated equipment under $1,000	200
Total	$12,230

Sync Generator Equipment	
1 Color frequency standard	$1,600
1 Burst flag generator	800
1 TG-1A studio sync generator	4,453
Associated equipment under $800	627
Total	$7,480

Color Slide Camera Chain	
1 Slide camera pickup unit inc. iris control, optics, slide holder & photocells	$1,770
1 Monitor auxiliary	3,000
1 Slide camera table top, kine mounting, rack & kinescope	2,120
1 Deflection chassis	1,500
1 Channel amplifier	2,600
1 Slide camera gamma amplifier	1,650
1 Colorplexer	2,820
1 Tri-color monitor including kine	3,000
1 Monochrome control monitor with CRO & kine	3,100
5 WP-33B power supply	2,880
Associated equipment under $1,500	6,938
Total	$31,378

Color Film Chain	
1 Projector, 16mm fast pull down including sound head and accessory audio and mechanical items	$19,150
1 Projector table top, kine mounting racks and kinescope	2,650
1 Channel amplifier	2,600
1 Colorplexer	2,820
1 Tri-color monitor including kine	3,000
1 Monitor auxiliary	3,000
1 Monochrome control monitor with kine and CRO	3,100
5 WP-33B power supply	2,880
Associated equipment under $2,000	10,198
Total	$49,398

Color Studio Camera Chain	
1 Color camera less image orthicons	$21,600
1 Viewfinder including hood and kine	3,400
1 Camera channel amplifier	4,225
1 Monitor auxiliary	3,000
1 Monochrome control monitor with kine & CRO	3,100
1 Colorplexer	2,820
1 Tri-color monitor including kine	3,000
5 WP-33B power supply	2,880
1 Heavy duty pedestal	2,400
1 Set of three matched image orthicons	5,700
Associated equipment under $2,000	14,455
Total	$66,580

SOURCE: RCA ESTIMATES

BROADCASTERS look at the investment side of the picture as . . .

Transmitter Makers Gird for Color

RCA and GE announce that complete color equipment will be ready in 1954

AVAILABILITY of compatible color television broadcast equipment within the next year was indicated by RCA and GE when they announced prices and delivery dates late last month. Du Mont and Federal, other major manufacturers of tv station equipment, have not as yet disclosed their plans but indications are that they will wait for final FCC approval of compatible color tv standards before making such plans known.

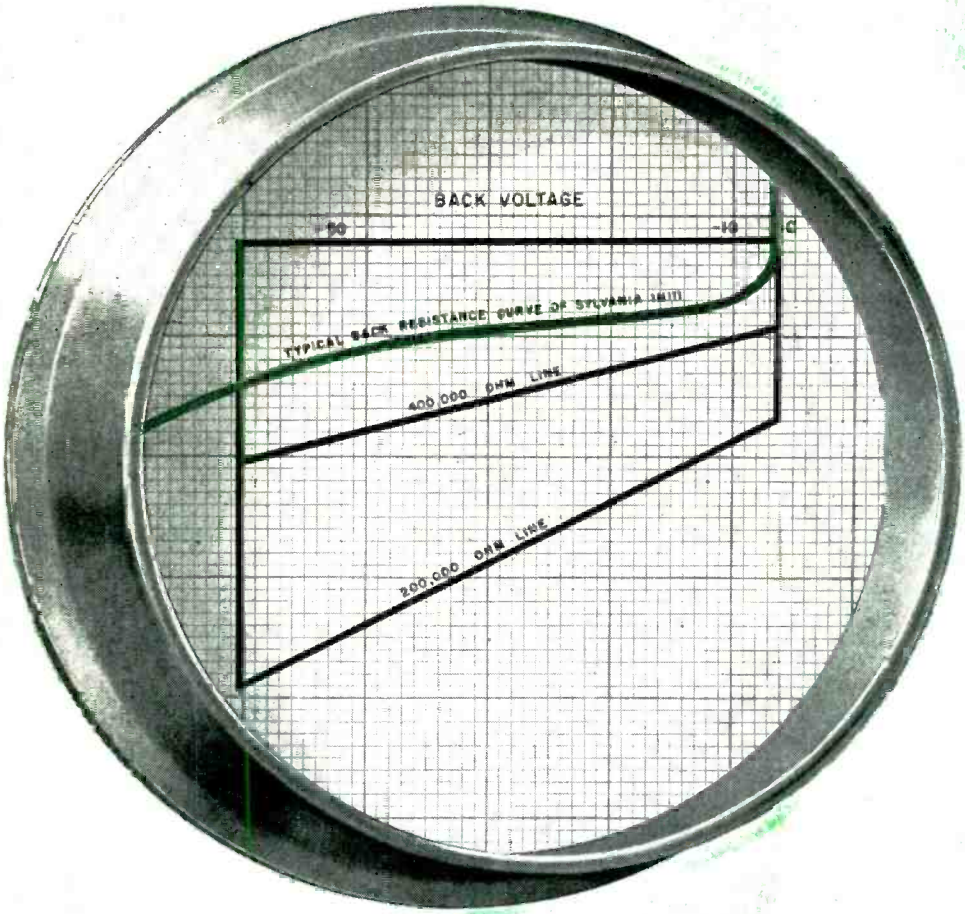
► **RCA**—Ready to accept custom orders for complete compatible color tv broadcast equipment for delivery in the spring of 1954, RCA states its equipment will be similar to that used for field tests in New York and will be designed to operate in accordance with present signal specifications of the National Television System Committee. As soon as final standards have been adopted by FCC, large-scale production of commercial-type color equipment will begin.

With a July 30, 1953, deadline set for ordering the equipment listed in the box above, RCA's Engineering Products Department says that orders have been coming in at a good rate despite the possibility that present prices could be 2 or 3 times higher than

(Continued on page 8)

www.americanradiohistory.com

Sylvania Computer Crystal Diodes



1N111
1N112
1N113
1N114
1N115

All Dynamically Tested at 55° C. For High Back Resistance and Stability

Sylvania Types 1N111, 1N112, 1N113, 1N114 and 1N115 were designed specifically for computer use. All Sylvania's Computer Diodes are tested at raised temperatures simulating actual operating conditions. To insure maximum stability and life, all units are tested for evidence of drift and hysteresis. Each diode is hermetically sealed in glass and is designed so that it may conveniently be soldered or clipped into a circuit.

Mail this coupon Today

SYLVANIA

LIGHTING · RADIO · ELECTRONICS · TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building
St. Catherine Street, Montreal, P. Q.

Sylvania Electric Products Inc.
Dept. 3E1008, 1740 Broadway, New York 19, N. Y.

Please send me data sheets on Sylvania Computer Crystal Diodes.

Name____________________

Address____________________

City__________ Zone____ State____

Want more information? Use post card on last page.

www.americanradiohistory.com

those later to be set for quantity production. Most of the orders so far received are for film or slide operation rather than for the less expensive network-only equipment.

▶**GE**—In a statement to its district sales managers, General Electric lists its color broadcast equipment schedule in three phases: network, slide-film and studio.

• Cost of equipment needed to rebroadcast network color programs is estimated at $13,800. Items of equipment include a gamma amplifier, stabilizing amplifier, color monitor, transmitter kit, de-modulator kit, diplexer kit, wave-form kit and stock items. An additional stabilizing amplifier is recommended at $1,600 and if a 2,000-mc relay is involved, a modification kit is required at approximately $560. Cost of test equipment is about $5,000. It is estimated that this equipment will be available during the first quarter of 1954.

• For slide-film transmission, GE divides equipment into three groups. To originate slide programs only, cost of equipment is set at $39,500. Equipment needed includes camera channel, calibration monitor console, sync color adaptor and sync generator kit, color utility amplifier group, color monitor, monitor switching unit, bar generator, stock items and slide projector assemblies.

For 16-mm film projection only, cost of equipment needed is estimated at $49,500 and includes 16-mm projector assemblies and all items listed for slide operation except the slide projector assemblies.

Cost for both slide and 16-mm film projection is $68,500. Slide-film equipment availability is planned for the second quarter of 1954.

• To originate studio color programs, GE estimates that the studio camera channel and associate switching equipment will run about $69,500. Equipment for this type of operation is based on a relay switching system and includes a studio camera channel with camera and view-finder, central console with color monitor, rack and associate equipment, calibration monitor console, monitor switching unit and stock items. A dolly is not included with the channel. Availability is scheduled for the fourth quarter of 1954.

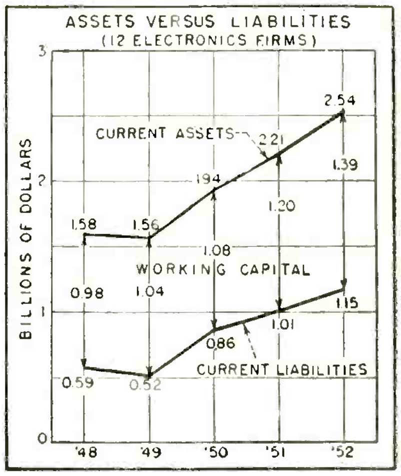
Electronic Companies View Working Capital

Current assets exceed liabilities by growing amounts but ratios are down

TREND in working capital for all manufacturing companies has moved steadily upward in the past few years and companies in the electronics field have followed the same course. For 12 major companies in the industry, working capital increased nearly a half billion since 1948. The increase last year was the largest for the period with a rise of 0.19 billion over the 1951 total.

▶**Ratio**—Despite the rise in working capital for electronic manufacturers surveyed, which seems to indicate an improving financial position, the ratio of current assets to current liabilities has moved downward to a low point in the past five years. In 1952 and in 1951 the ratio for the firms surveyed stood at 2.2 while in the previous three years it ranged between 2.3 and 3.0. These figures follow closely those for the entire electrical equipment industry as reported by SEC which shows a current ratio of 2.1 for 1952 and 2.0 for 1951.

▶**Cash**—Current assets include cash, government securities, receivables, inventories and other current assets payable within a year. The relation of these components to current liabilities gives further evidence of the liquidity or ability to convert assets promptly into cash. Taking cash alone for the companies surveyed and comparing it to current liabilities shows the following ratios: 1948, 0.78; 1949, 1.0; 1950, 0.69; 1951, 0.57; 1952, 0.62. Thus, as with current asset ratios, the cash ratios for the 12 companies show a downward trend.



▶**Debts**—Reasons for the decline in the ratios of current assets to current liabilities in recent years is attributed to a number of factors. The rise in short-term debt is one of them. Companies have had to have more money to keep pace with the increasing costs of doing business.

Federal income and excess profits taxes have also affected the ratios and kept current liabilities climbing along with current assets. For the companies surveyed, current liabilities doubled during the five-year period while current assets increased 1.7 times.

TV Manufacturers Show New Lines

Industry hits high order volume with full array of new radio and tv sets

NO SUMMER slump is occurring in introductions of new tv models by the radio-tv industry. At press time 25 companies had introduced new models.

The average line contains about 30 new models. Philco leads the parade with a total of 47.

Most of the manufacturers dis-

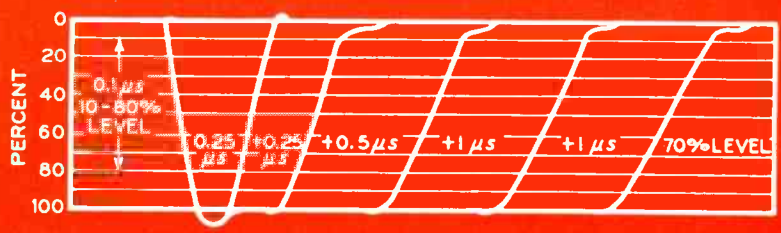
(Continued on page 10)

www.americanradiohistory.com

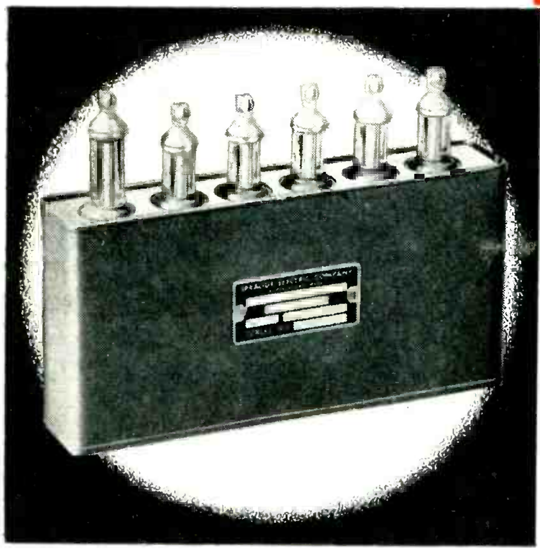
UNIVERSAL

PULSE-FORMING NETWORK H-850

Typical Wave Shapes of Network



on Resistance Load



Sprague, on request, will provide you with complete application engineering service and assistance for optimum results in the design and use of Pulse-Forming Networks.

This new Sprague Pulse-Forming Network was designed for laboratory use in radar research and development. With it, the five most needed pulse lengths—¼, ½, 1, 2, and 3 microseconds—may be obtained without distortion of the pulse shape.

Sprague's unique method of common switching *keeps the flat portion of the pulse flat* at all pulse lengths. Capacitor switching takes place in the common lead and hence at half network voltage—important at the higher voltages. The pulse lengths all correspond to the half-power point as measured by synchroscope at 70% voltage level under resistance load.

In addition, the rise time remains the same—approximately 0.1 microseconds from the 10 to 80% level. Network H-850 is designed to work into a 50 ohm impedance load. Its peak voltage rating is 13 Kilovolts for each pulse length, making it useful for normal low power ranges in radar equipment employing hydrogen thyratron tubes.

Universal Laboratory Network H-850 is typical of Sprague's advancements in pulse-forming networks. Sprague made the first commercially available radar network during World War II and has been the acknowledged leader in this field ever since!

For complete data on the Universal Laboratory Network H-850—or on other networks to meet your precise needs—write on your business letterhead to the Sprague Electric Co., 35 Marshall Street, North Adams, Massachusetts.

SPRAGUE

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

Want more information? Use post card on last page.

www.americanradiohistory.com

played sets in every picture-tube size ranging from 17 inches to 27 inches. Many companies featured the 24-inch set, RCA being a major exception, but the consensus of the industry seems to be that the 21-inch receiver will be the volume seller.

▶ **Prices**—Range of tv retail prices is fairly consistent. Majority of new lines introduced are priced from \$180–\$200 for 17-inch table models to \$600–\$800 for deluxe 21-inch combinations. Low for the industry was set by Emerson with a 17-inch vhf-only table model at \$149.95. Du Mont, with its 30-inch receiver at \$1,795 continues to maintain the high for the field.

▶ **UHF**—Practically all companies featured all-channel sets in their summer lines on an optional basis. A few continue to offer converters. Price of optional all-channel tuners have not changed much and continues to range between \$40 and \$50.

▶ **Radio**—Summer showings of new radio receivers have been numerous also. Emerson introduced a total of 60 new models including a pocket-size portable that uses subminiature tubes. But high-fidelity was the theme of a number of companies. So far, a dozen firms have introduced their version of hi-fi at summer showings.

▶ **Results**—Philco stated that it had taken orders for more radio sets at its convention than at any in the past five years and that tv orders were twice those of last year's mid-summer showing.

Zenith announced that its June sales convention was the most successful in the company's history with distributor radio and tv orders totalling approximately \$50 million, more than double the orders booked at its 1952 June showing.

CBS-Columbia revealed that its tv-radio orders approximated \$7.5 million which is almost 50 percent more volume than it signed up at its mid-summer model introduction meeting last year.

Electronic Plants Are Growing Fast

Growth in working area continues as manufacturers increase production

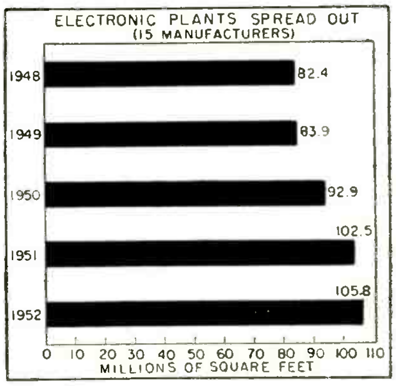
ONE index of the growth of the radio-tv-electronics industry in the past five years is the amount of plant space that representative manufacturers have added in that time.

For 15 firms in the field, working area rose from 82.4 million square feet in 1948 to 105.8 million at the end of 1952.

The big expansion years were 1950 and 1951. In 1950 plant area for these companies increased by 9 million square feet and in 1951, the top year for the period, square footage rose by 9.6 million.

▶ **Companies**—Most major radio-tv companies now have over 1 million square feet of working area in use. Giant of the industry is GE with 58.9 million square feet in its 131 plants in 99 cities. The company increased its square footage by 10.9 million since 1948 for the largest increase among the companies surveyed.

In terms of percent gain in plant space, Admiral stands near



the top. Plant increased 500 percent since 1948 to a total of over 1.5 million square feet in 1952.

▶ **Future**—Electronic manufacturers are continuing to expand plant facilities and 1953 is likely to show gains similar to those of 1952. However, some such growth may level off in 1954–55 because the government's fast tax amortization program will have run its course by then, barring unforeseen changes. Also, more efficient production methods are coming into use and existing plant areas are expected to be able to turn out more product per square foot of space so that the need for additional plant will not be as urgent in the future.

Consumer Installment Credit Zooms

Amount of credit extended by outlets selling radio-tv causes concern

INSTALLMENT credit made available to consumers by household appliance retail stores which include radio-tv dealers reached an all-time high of \$242 million at the end of May, according to the latest Federal Reserve figures. At no time since 1939 has such credit been extended so far, especially in the first half of the year.

As the chart on page 14 shows, the amount outstanding usually reaches its high point in the final months of each year. The previous high for the month of May was in 1951 when it reached \$207 million. The all-time high before the present record was set in December last year when the amount outstanding was \$239 million.

▶ **Concern**—As a result of the record increase in consumer installment credit used to buy radio-tv and appliances, some manufacturers fear that consumer indebtedness may be over-extended and may curtail sales of the high outputs planned for the remainder of this year. They point out that installment sales represent about 60 percent of total sales last year.

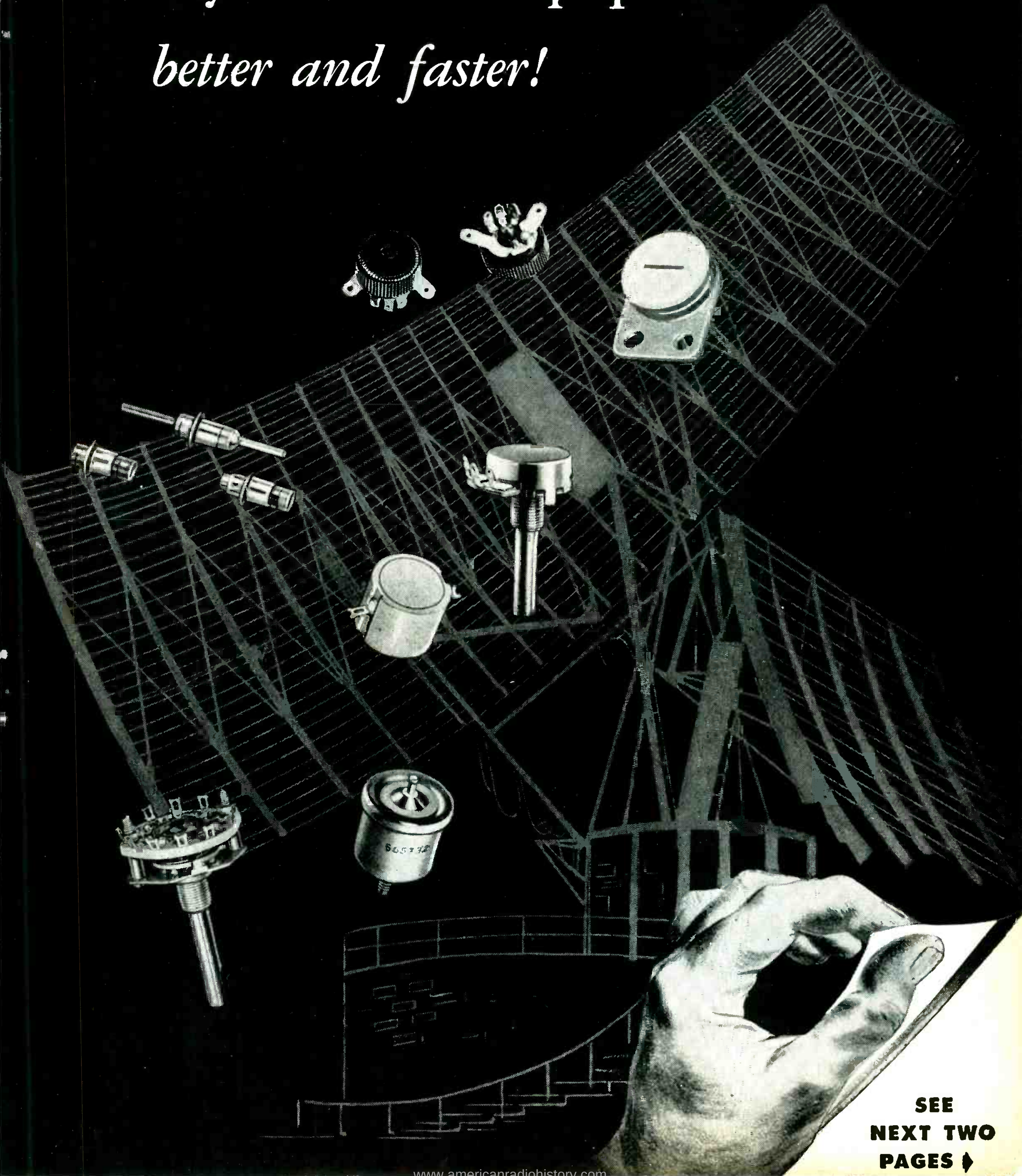
Not all manufacturers believe that consumer credit is overex-

(Continued on page 14)

www.americanradiohistory.com

how to handle orders for military electronic equipment...

better and faster!

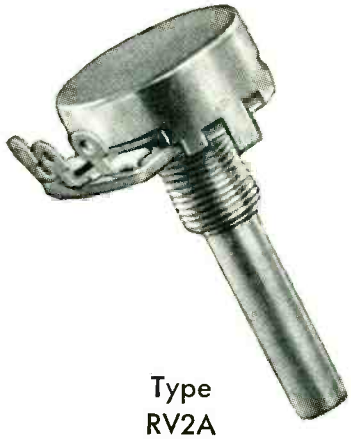


SEE NEXT TWO PAGES ▸

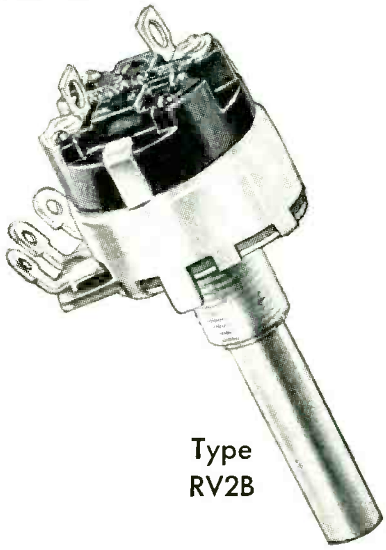
www.americanradiohistory.com

Choose CENTRALAB...

America's widest line of components that meet military specifications



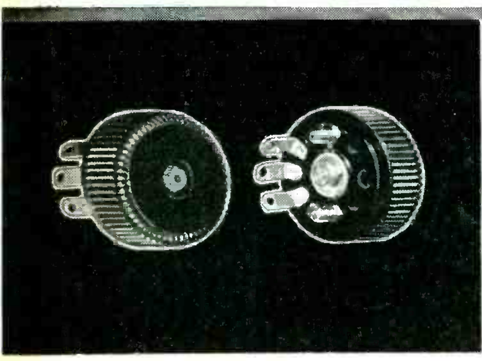
Type
RV2A



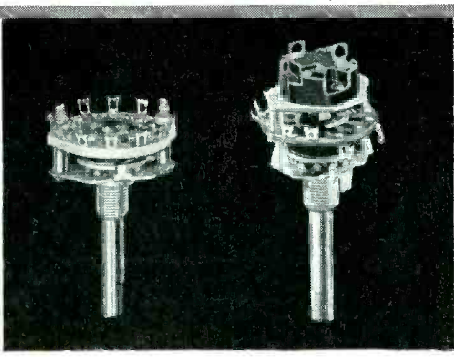
Type
RV2B

CENTRALAB MODEL 2 VARIABLE RESISTORS

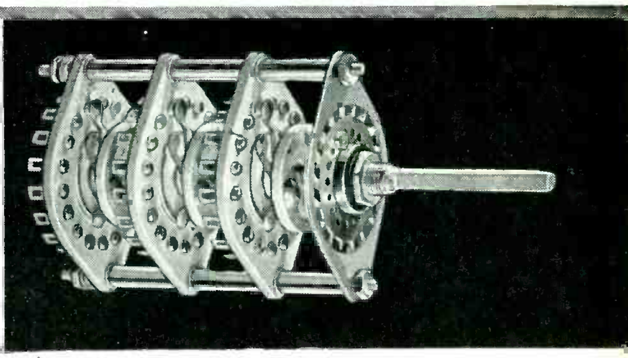
There's no prior contract approval or waivers required if you specify Centralab's Model 2 variable resistors on your next military order. They meet JAN R94, characteristic U requirements. Two types available — RV2A and RV2B — plain or with attached switches. Ratings from 2000 ohms to one megohm. For complete engineering data, check Bulletin No. 42-85 in coupon below.



Model 1, miniature variable resistors . . . no bigger than a dime . . . available in Standard or Hi-torque types. Either with or without on-off switch. Also available with slot — front or rear — for screw-driver adjustment. Hi-torque units hold settings under conditions of vibration or shock. For complete data check No. 42-158 in coupon below.

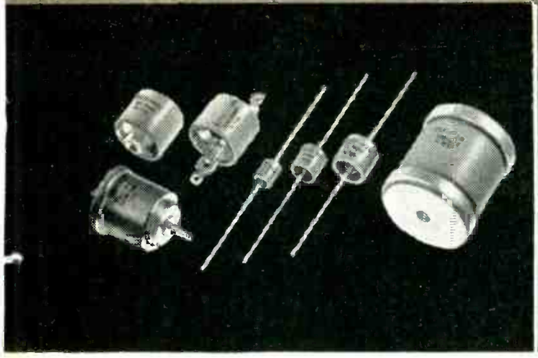


For miniature switches — specify Centralab's Series 20 with Steatite or Phenolic sections. Steatite is Grade L5. Meets JAN I-8 specs. Phenolic sections conform to JAN P-13 . . . Grade LTSE4. Available in 2 to 11 positions with stops, or 12 positions, continuous rotation—single or multiple sections—with or without attached on-off switch. Check No. 42-156.

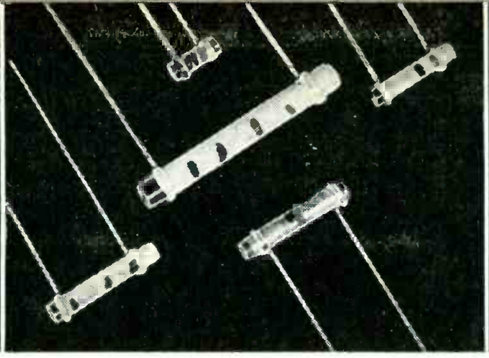


Centralab's Medium-Duty Power Switches. Use for R. F. or 110-115 V. application . . . 7½ amps. Voltage breakdown to ground — 3000 volts — RMS 60 cycles. Available with Grade L5 (JAN I-8) Steatite sections — shorting or non-shorting contacts. Models in 1, 2 or 3 poles, 18 contacts per section with adjustable stops, can be furnished up to 20 sections per shaft. Contacts and collector rings are coin silver. For complete data, check No. 42-136 in coupon.

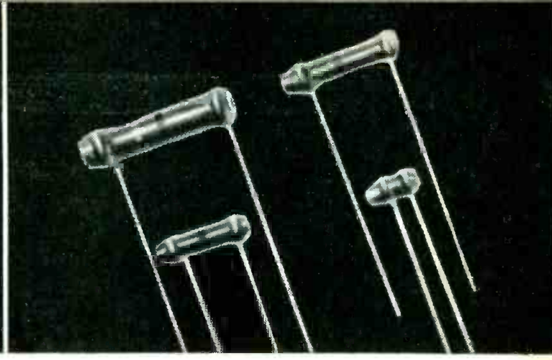
www.americanradiohistory.com



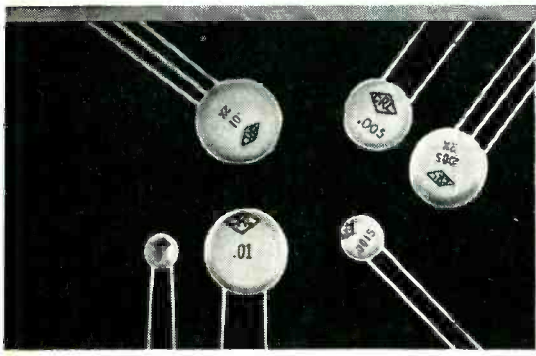
Centralab's Type 850 high voltage ceramic capacitors are especially designed for high voltage, high frequency circuits. Centralab's Type 950 high accuracy ceramic capacitors are especially developed for exacting electronic applications. Check bulletin No.'s 42-102 and 42-123.



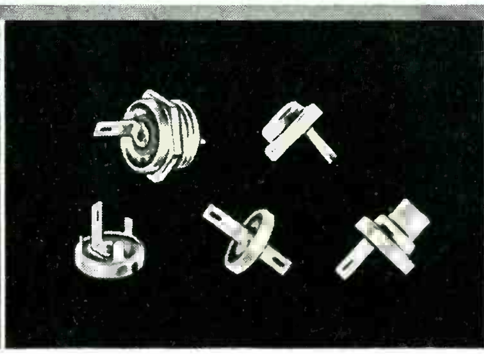
TC (Temperature Compensating) Tubulars — No prior contract approval or waiver necessary. Meet JAN-C-20A requirements. Type TCZ shows no capacitance change over wide range of temperature. Type TCN has special ceramic body to vary capacitance according to temperature. Bulletin No. 42-18.



BC (Bypass Coupling) Tubulars — Recommended for bypass coupling. Well suited to general circuit use. Centralab's own Ceramic X body provides imperviousness to moisture and low power factor. Easily withstands temperatures normally encountered in most electronic equipment. Bulletin No. 42-3.

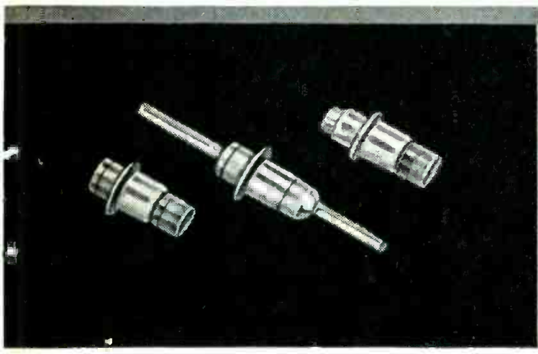


Ceramic Disc Hi-Kap Capacitors hold thickness to a minimum . . . have very high capacity in extremely small size. Use in h.f. circuits for bypass and coupling. Ceramic body assures low inductance. Other characteristics—humidity resistance, power factor, etc. — similar to BC Tubulars, Bulletin No. 42-4R.

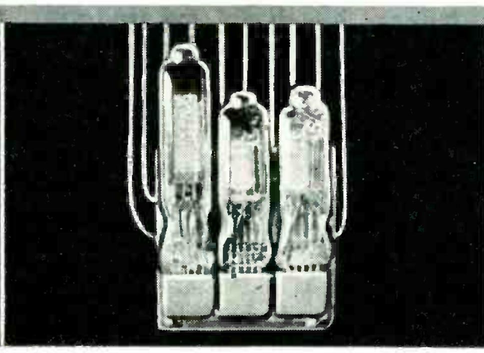


Something new in miniature ceramic capacitors! These "button types" are available in 5 different styles. Used for bypassing in low-power, high-frequency applications where small size, low inductance and light weight are essential. Check Bulletin No. 42-122 in coupon for more information.

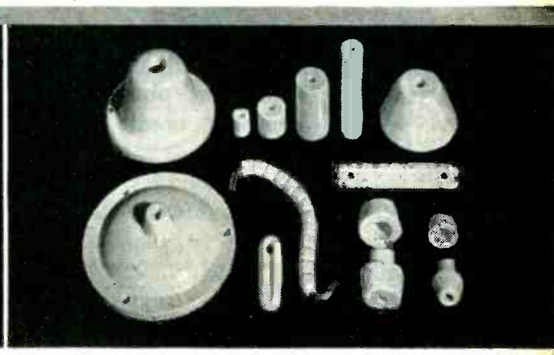
Centralab Ceramic Trimmers meet applicable portions of JAN-C-81. Very small size. Screw driver adjustment over full capacity range (180° rotation). Maintain stability in any position and under vibration. Spring pressure contact for rotor and stator. Bulletin No. 42-101.



Centralab's New Eyelet-Mounted Feed-Through Ceramic Capacitors are smallest available. They meet applicable portions of JAN-C-20A specifications. Capacities range from 10 to 3000 mmf...the widest range on the market. Voltage rating. 500 V.D.C.W. Check No. EP-15 in coupon.



New Sub-miniature Model III Ampec — a full three-stage speech amplifier of remarkably small dimensions — approximately $1\frac{1}{32}$" x $\frac{15}{16}$" x $\frac{11}{32}$" (barely larger than a postage stamp!). Excellent for microphone preamplifiers and similar applications. Check No. 42-130 on coupon for complete information.



Centralab standard and custom-molded Steatite ceramics plain or metallized . . . fully comply with JAN I-8. Steatite is Grade L5 for military use. Characteristics — high dielectric strength, low loss at high frequencies, high mechanical strength. For data on standard parts or custom molding, check No. 720.

Centralab

CRL

A Division of Globe-Union Inc.

914-H EAST KEEFE AVENUE • MILWAUKEE

E

Please send me Technical Bulletins as marked

☐ 42-85 ☐ 42-158 ☐ 42-156 ☐ 42-136 ☐ 42-102 ☐ 42-123 ☐ 42-18
☐ 42-3 ☐ 42-4R ☐ 42-122 ☐ 42-101 ☐ EP-15 ☐ 42-130 ☐ 720

Name..

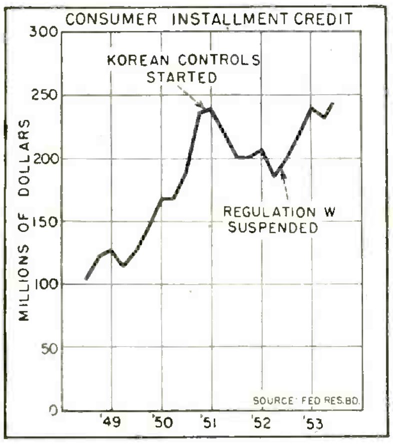
Title..

Company..

Address..

City..State..

www.americanradiohistory.com



tended. R. D. Siragusa, president of Admiral, asserted in a recent speech that the increase in consumer credit was not necessarily dangerous. The ratio of outstanding credit to the total of personal income available after spending for food, clothing, and housing still is sharply below the pre-World War II level, he explained. Income available for discretionary spending will be about $134 billion this year, compared with $26.5 billion in 1940.

"Before we reach the credit basis which was considered perfectly secure in 1940, present consumer credit could go almost $18 billion higher," he said.

▶ **Future**—It seems a good bet that installment credit will continue to rise in the months ahead. RCA Victor has relaxed credit requirements for its distributors and household appliance retail stores will benefit. DuMont has also liberalized credit requirements for dealers in the New York area. Other companies plan similar moves.

Defense Department Plans Research Cuts

Economies in basic research financed by the agency are proposed by Secretary Wilson

LARGE stake of some electronic companies in government financed research and development may be whittled down some if economies proposed by the Department of Defense are approved. In 1951 over 58 percent of the research and development done in electronics was financed by the Federal agencies and there are no indications that the percentage has dropped.

▶ **Budget**—Here is how total U. S. Research and Development was financed last year, in millions:

Total	$3,300
Privately Financed	1,400
Industry Financed	1,000
Other, including Foundations	400
Federally financed	1,900
Department of Defense	1,300
Agencies	600

The figures show that the Department of Defense has been the largest backer of research and development. Secretary of Defense Wilson wants to cut his department's share, is against the department paying for basic research. It is estimated that Defense Department's basic research obligations totaled $31.2 million in fiscal 1952 and $32.7 million in fiscal 1953. Since the research budget is "top secret", it is not known which basic projects may be cut.

▶ **Future**—Plans of the government for future research and development spending to be done by government agencies are as follows, according to the National Science Foundation and *Chemical Week* (figures in millions):

U. S. Research Budgets	1952 (Actual)	1953 (Est.)	1954 (Est.)
Department of Defense	$1,316	$1,400	$1,300
Atomic Energy Commission	250	260	266
Nat'l Adv. Comm. for Aero	67	79	88
Dept. of Agriculture	57	58	63
Dept. of Health, Educ. & Wel.	65	74	59
Dept. of Interior	33	37	34
Dept. of Commerce	28	24	26
Other Agencies	24	26	29
Total	$1,839	$2,059	$1,865

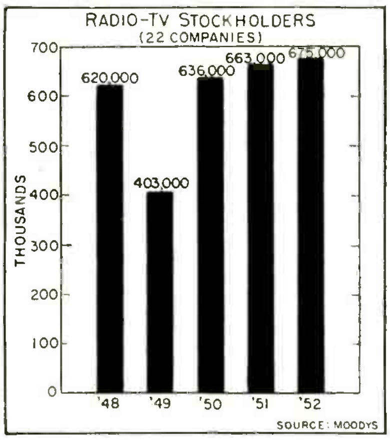
Electronic Stockholders Increased

Trend in number of shareholders has been upward and hit a new high last year

INDICATION of how investors feel about the prospects of the electronics business is seen in the growing number of stockholders in 22 companies in the field for the past five years. Although there is a substantial fluctuation in the number of shareholders from day to day, the overall trend has been upward.

Last year, the number of stockholders in 22 major radio-tv-electronics firms reached a total of 675,000, the highest number in the past five years. Low point in the period was in 1949 when the number of shareholders dropped to 403,000.

▶ **Gains**—Of the 22 firms surveyed, General Electric, RCA and Westinghouse, in that order had the largest number of shareholders. Company showing the largest increase in shareholders was



Westinghouse with an increase of over 36,000 in the five-year period.

In percent gain, Hoffman Radio was among the leaders with an increase of over 500 percent. The company's shareholders increased from 599 in 1948 to 3,200 in 1952.

▶ **Distribution**—Little is known about the number of shares held by individual investors but firms have expressed some interest in

(Continued on page 16)

www.americanradiohistory.com

SHOCK – VIBRATION – NOISE

ISOLATION NOTES

This **NEW** *Product Bulletin gives* **YOU**

COMPLETE ENGINEERING DATA on ALL-METL BARRYMOUNTS

Here's what's in it for **YOU:**

1. Transmissibility curves showing performance under test conditions of JAN-C-172A.
2. Curves showing reduction of transmitted acceleration and displacement.
3. Curves showing how changes in loading affect transmissibility at resonance and natural frequency for vertical motion.
4. Curves showing effect of high and low temperature on isolator performance.
5. Shock-characteristic data, including curves showing vibration isolation after 15g shock test.
6. Application data, including curves that show you how to choose isolators for unsymmetrical loads.
7. Dimensioned drawings of unit isolators, channel pairs, and mounting bases.
8. Detailed data on the construction, operating principle, and weights of mounts and bases.
9. A complete list of load ratings and catalog numbers for unit isolators, channel pairs, and bases.

We'll be glad to send you a FREE COPY of this, the first really comprehensive bulletin on knitted-wire vibration isolators. Ask for Barry Product Bulletin 534. And, if you have a special problem, count on getting the right answer from our Field Engineering Service.

THE **BARRY** CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

Atlanta Baltimore Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington

www.americanradiohistory.com

finding out more about their owners. As yet, such statistics are not complete enough to give any conclusive picture. One company's annual report shows that the average number of shares held by its stockowners had decreased from 300 to 100 shares in the past 14 years giving some indication that stock ownership is spreading out.

Tubes Take Over Elevator Operation

Electronic programming circuits assume job of starter and operators

HAVING already replaced elevator operators with electron tubes in many buildings throughout the country, the Otis Elevator Company recently announced another step toward eliminating completely the need for human supervision in "vertical transportation". The familar starter, with his Christmas tree of call lights and pushbuttons, has been electronically relieved of his duties except those of greeting incoming personnel and answering questions as to the location of various facilities within the building.

The new Otis system is completely automatic. Timed signals anticipate rush-hour crowds and prepare the elevator system for handling them. Some cars are retired during slack periods and returned to service in time to accommodate crowds.

Capacitance-operated doors diplomatically nudge a person standing in an open car door, and, after a polite interval, the doors close slowly and gently force him to go in or out.

▶ **Savings**—Installations of automatic operatorless equipment in a typical office building have proved to save $7,000 per elevator per year. During the current year, 80 percent of Otis installations will include the operatorless feature.

In a model setup, designed for demonstration purposes and for laboratory analysis of sample traffic problems, 325 tubes are used to operate four elevators.

RTMA Expands With The Industry

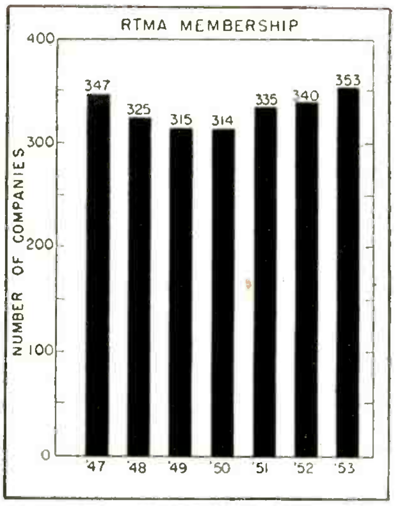
Membership hits all-time high as the association girds for further growth

COMPANY membership in the Radio-Television Manufacturers Association reached a total of 353 in mid-1953, the highest number since the association was founded 29 years ago. And the organization is preparing for even broader representation of the electronics industry, particularly in industrial and military fields.

A reorganization plan for this purpose has been approved by the board of directors and will be submitted to the full membership at a proxy meeting to be held in Washington on July 27. At the same time, the RTMA membership will be asked to vote on the board's recommendation to change the name of the association to the Radio-Electronics-Television Manufacturers Association.

▶ **New setup**—If the reorganization plan is approved, a radio-television industry committee and an electronics industry committee will be established. Among the immediate expansions approved by the board are the establishment of a regional office in Los Angeles, the expansion of the RTMA Engineering Office in New York, and the appointment of a manager of a newly created export department. The association's government relations activity is to be given greater recognition through the creation of a new department which will report directly to the electronics industry committee.

▶ **Why**—Need for broader representation in the association was made evident by president A. D. Plamondon's report at the recent annual meeting in Chicago. According to the report, more than $5.5 billion in electronic products for the armed forces have been delivered since the start of the Korean war and deliveries of electronic equipment and components



to the military in 1953 are expected to total $3 billion.

In the commercial field, the industry expects to produce approximately 7 million tv receivers in 1953. Set production during the first half of 1953 has been the highest of any first-half year since the tv boom began.

Radio production has also been booming. The increase in clock radios was nearly half again as great in the first half of 1953 as in 1952 and double that of 1951. Portable radio production has been at its highest rate this year and the number of auto radios manufactured so far in 1953 is rapidly approaching the 3-million mark, representing more than 80 percent of the automobiles produced in the same period.

Failures Blamed On Front Office

SIXTEEN manufacturers of electronic equipment and components and eight distributors of radio, tv and electronic apparatus failed during the year ended May 30, according to the annual report of the credit committee of RTMA.

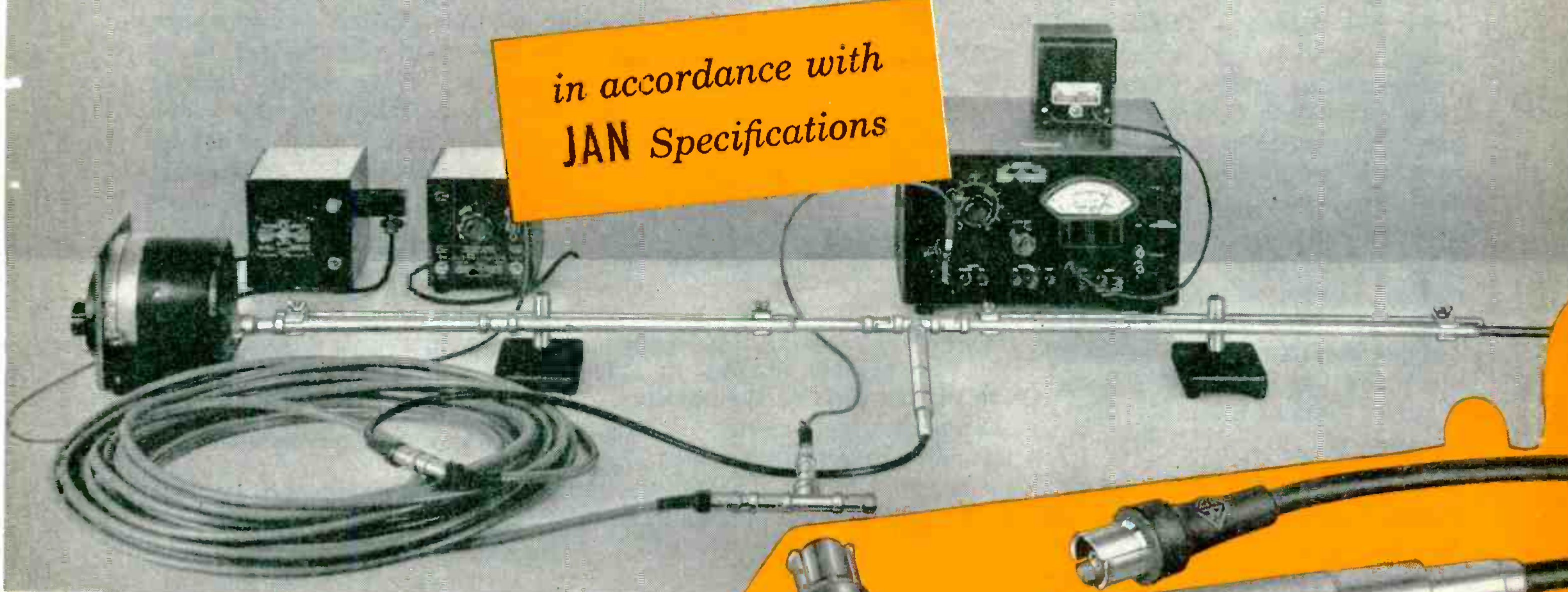
▶ **Cause**—"The most common cause of these failures," according to H. A. Pope, chairman of the committee, "may be summed up as inadequate management. . . . In several instances it was clear that management had not provided it-

(Continued on page 18)

R-F CABLE MEASUREMENTS

Reliable Accurate Low Cost

in accordance with JAN Specifications



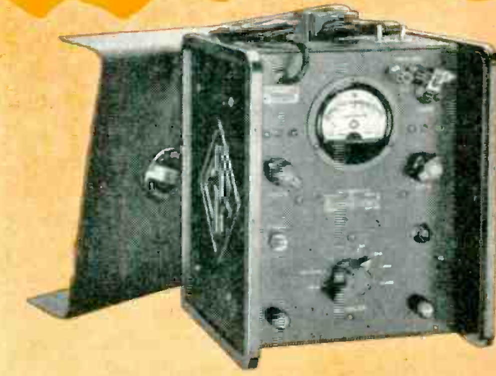
Complete Setup for attenuation measurements at the JAN specified frequency of 400 Mc. Equipment includes the G-R Type 1208-A Unit Oscillator, the 1231-B Amplifier and Null Detector and various coaxial components. With appropriate high-frequency oscillators, measurements may be made at any frequency from 200 Mc to 4000 Mc.

Key Element is the Type 874-GA Adjustable Attenuator operating on the wave-guide-below-cutoff principle. It is an accurate, continuously adjustable *primary* standard whose ultimate accuracy depends only on mechanical dimensions; specifically, the inside diameter of the attenuator tube and the accuracy of two screw threads. Price $55

For Designers, Manufacturers and Users of r-f cables . . .

GR offers a well integrated group of instruments and components for highly accurate measurements of . . .
Attenuation . . . Characteristic Impedance . . . Velocity of Propagation . . Capacitance . . . Insulation Resistance.

Manufacturers of coaxial and dual-coaxial cables, t-v twin-lead and shielded twin-lead are now using G-R equipment with highly satisfactory results. In the insertion-loss method illustrated above, attenuation measurements are made with an accuracy of better than 1% + 0.2 db. Accuracy is independent of crystal-detector calibration. Well-designed G-R Type 874 coaxial connectors eliminate troubles from leakage and bad contacts. The equipment is readily assembled and easy to operate.

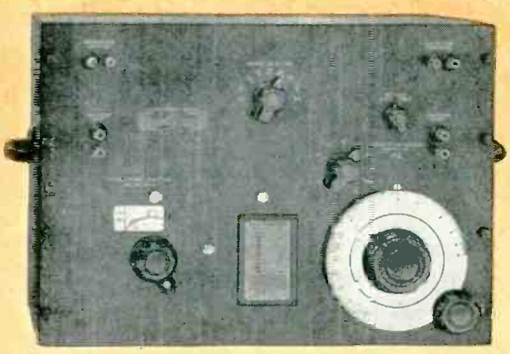


Insulation Resistance is measured directly by the Type 1862-A Megohmeter at the commonly accepted ASTM potential of 500 volts.

The instrument range is 0.5 to 2,000,000 megohms — accuracy is 3% to 50,000 megohms, decreasing at higher resistances. Guard and ground terminals are provided for measurements of three-terminal samples. A panel switch removes voltage from the unknown terminals permitting connections without danger of shock.

Type 1862-A Megohmeter $225

Velocity of propagation is measured, to an accuracy of within ±0.5%, with the same equipment in another configuration. Characteristic impedance is readily calculated from the values for velocity of propagation and capacitance per foot of cable.



Cable Capacitance and Capacitance Unbalance are measurable to a high degree of accuracy with the Type 716-C Capacitance Bridge — an instrument used the world over for capacitance standardization.

In substitution measurements, accuracies obtainable are ±0.1% or ±0.5 $\mu\mu$f, whichever is greater, for values up to 1000 $\mu\mu$f — frequency range is 30 cycles to 300 kc. With appropriate techniques, this bridge will also measure inductance and resistance as well as capacitance and conductance.

Type 716-C Capacitance Bridge (mounted in walnut cabinet) . . $545

Please send a copy of the NEW 14-page bulletin "MEASUREMENT OF CABLE CHARACTERISTICS."

Name ____________________

574

Company ____________________

Street ____________________

City ________ Zone ________ State ________

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts

90 West St. NEW YORK 6 920 S. Michigan Ave. CHICAGO 5

1000 N. Seward St. LOS ANGELES 38

www.americanradiohistory.com

self with satisfactory accounting tools and records. These businesses were losing money but were reporting profits. Others had accepted defense contracts at too low a price, or the contract called for work too difficult in terms of their production or engineering experience."

Of the 16 manufacturing companies, 4 were set assemblers; 1 made test equipment; 1 produced hearing aids; 2 made sound equipment and phonographs; 3 manufactured items primarily of a military nature and 5 produced components.

▶ **Distributors**—The report noted that electronic parts distributors increased their sales about 13 percent and that 50 new wholesalers were organized, reflecting the increasing number of sets in use that accentuates the demand for service parts, accessories and equipment. "So rapid an expansion in the experience of many wholesalers has demanded an increase in working capital that could not be met by reinvestment of earnings, in view of the continuing higher taxes."

Because of the higher unit price on so many tv items and the necessity for carrying larger stocks of merchandise, an investment of less than $20,000 for a new distributing company jeopardizes the possibility of successful operation, the report concluded.

No Special Channels For Theater TV

FCC rules that theater tv should be a common carrier operation in 5 to 1 decision

PROPONENTS of theater television received a setback when the Federal Communications Commission ruled that theater television transmission should be a common carrier operation on frequencies already allocated to the common carrier services.

The Commission reported that it heard no persuasive evidence that common carrier frequency allocations are not adequate for the service and that it finds no necessity for a separate allocation for theater tv. If there are not enough common carrier frequencies, FCC noted, theater tv proponents are free to take steps to establish a separate carrier or require reasonable service from existing carriers.

▶ **Merits**—In making the decision, the FCC pointed out that its ruling did not pass on the quality of interconnecting service or the adequacy of present common carrier service. These problems, it said, could be taken up if and when they arise on specific petition.

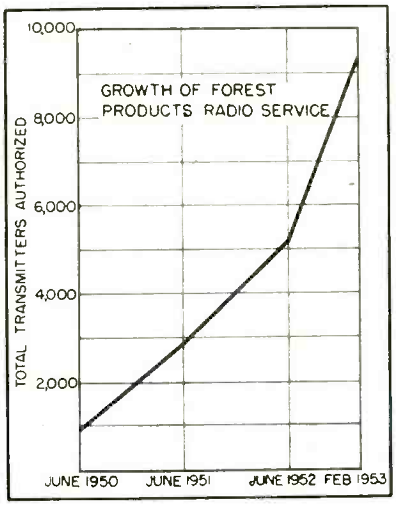
The FCC also pointed out that it was not passing on the merits or desirability of theater tv in general. "We recognize theater tv as an existing service which will continue to expand or not depending upon public acceptance and support thereof. Our concern is merely with the question of whether there should be a separate allocation of frequencies for the exclusive use of this service. Finding that there is no necessity for such an allocation, we have decided that this proceeding should now be terminated."

Commissioner Hennock issued a dissenting statement. Commissioner Doerfer did not participate.

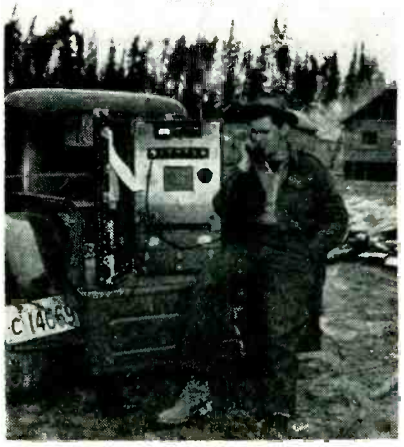
Lumberjack Radio Grows Rapidly

Forest products becomes fourth largest operator of industrial radio

SINCE its inception five years ago, the forest-products radio service has grown from two experimental installations to 9,310 transmitters used by more than a hundred logging and tree farming concerns. Of the total, 570 transmitters are fixed and 8,740 mobile.



Two-way radio serves to link remote lumber camps with lumber mills, pulp mills and company offices as well as to coordinate mobile crews engaged in logging, tree farming and harvesting. Lumbermen find that two-way radio speeds supply and repair orders, save lost motions in logging and decreases fire and accident hazards through closer communication with doctors and fire wardens. Radio networks of large logging firms also form important links in the aircraft-spotter service along our northern border.

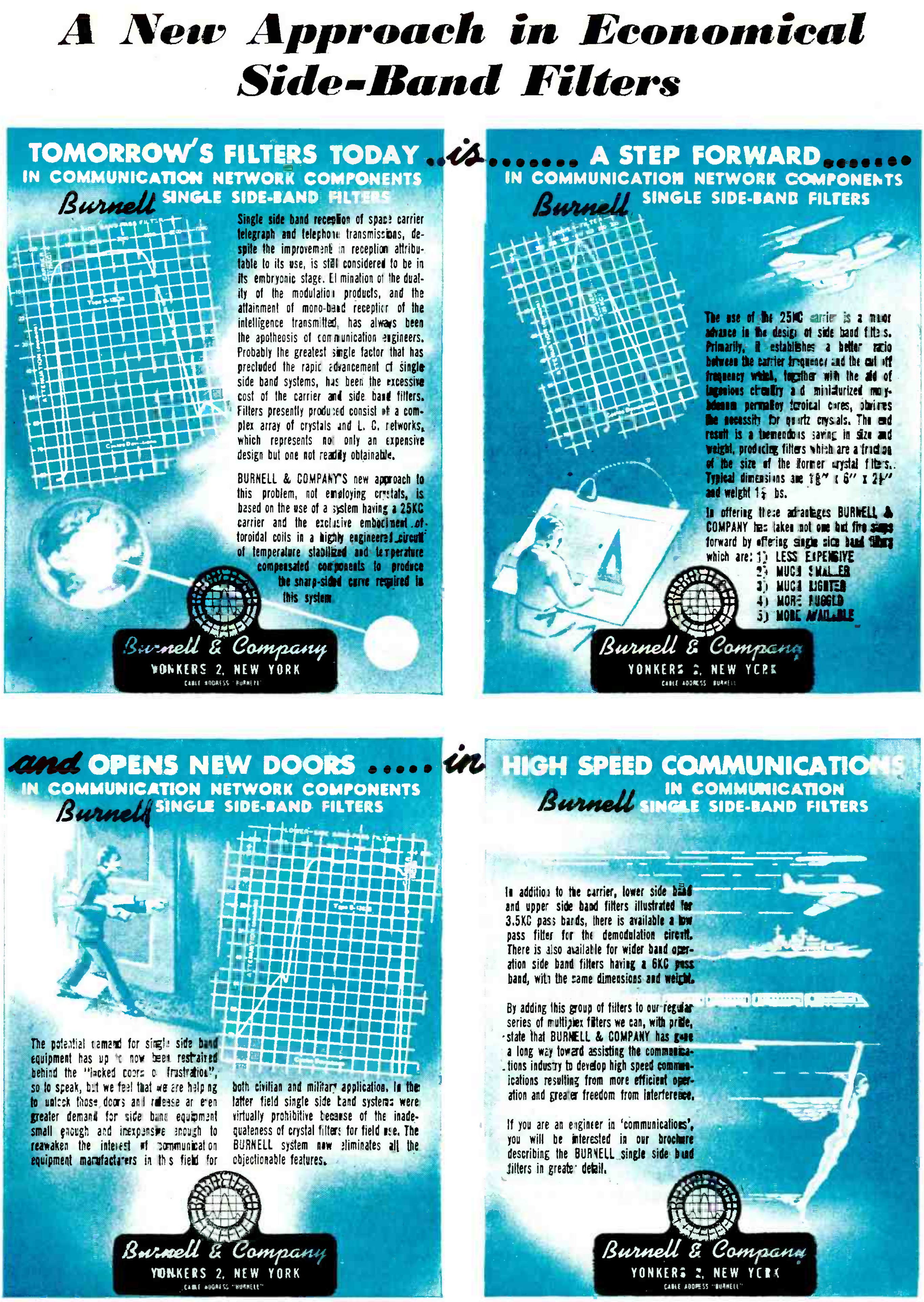


LOGGER uses two-way radio to contact office from mill.

▶ **Location**—Approximately 77 percent of all forest radio operations are in the Pacific northwest and

(Continued on page 20)

www.americanradiohistory.com



Want more information? Use post card on last page.

www.americanradiohistory.com

nearly 18 percent are located in southern states.

The forest-products radio service is primarily an industrial operation but in many cases it supplements forestry-conservation service operated by state governments. Concerned largely with fire protection, over 16,000 transmitters are operated by conservation authorities.

ARQ Equipment Rejects Garbled Messages

HAND-KEYED radiotelegraph signals are still used by amateurs, ship operators and others to get the message through. But most intercontinental circuits use faster radioteletypewriter equipment to handle volume traffic from point to point.

Corrections to Morse-code signals are fairly apparent to the operator. When he is in doubt, he asks for an RQ (request for correction). But fading and static often garble teleprinter signals without any operator being aware of a change in conditions. For this reason, a special seven-unit code was developed. Most static or missed impulses owing to fades are caught by special equipment that refuses to recognize signals outside the special code. The equipment alerts the receiving operator and prints an error-indicating symbol.

▶ **Leased Circuits**—Big customers of world-wide communications networks, like the press associations and airlines, can't be bothered asking for corrections. The new ARQ (automatic request for correction) device asks for corrections, receives a reply and only then passes the information along to the customer.

Each character transmitted is stored for a short time. When the automatic repeat signal is received, the transmitter stops, the last three transmitted characters are taken out of storage and re-sent. The customer gets only the perfect message, none of the garbled portion. RCA Communications, Inc. says that mutilation rates on their trans-Atlantic circuits should be reduced in a ratio better than 100 to 1.

Light Control Speeds Traffic Flow

TRAFFIC lights under the control of an electronic system have proven so successful in speeding traffic through a three-street intersection in White Plains, N. Y. that additional units are being ordered for other heavily-loaded intersections.

The $12,000 electronic unit keeps track of the number and spacing of cars approaching the intersection through roadway trippers placed 250 ft before each corner. Pedestrians use pushbuttons placed at the corners to inform the control that they are waiting to cross.

▶ **Operation**—In its normal position the control unit gives the green light to the main street of the intersection. The control is set so that a pre-determined number of cars waiting on one of the other streets will automatically take the green light away from the main street. Rates at which cars are approaching the intersection is also considered by the unit. If a series of closely spaced cars approaches the intersection from one of the streets, right-of-way is taken from the main street and given to the street carrying the group.

If the time between cars on the main street should drop below a preset level the light is switched to one of the other streets having cars waiting.

A cycle started by a pedestrian pushbutton will give the walk light to the waiting pedestrian at the end of a waiting period or sooner if the traffic drops below a preset level.

The system, installed by the Automatic Signal Division of Eastern Industries, handles 25,000 cars per day plus thousands of pedestrians. The equipment will pay for itself in the reduction of the number of officers at the intersection from three to one.

Financial Roundup

PROFIT statements by companies in the electronics field continue to show that business has been good in 1953. Security transactions during the past month were lighter than usual.

▶ **Profits**—Nine companies issued the following profit statements:

Company	Net—3 Months (in thousands) 1953	1952
AT&T (5 m.)	$99,894	$85,535
Arvin	906	615
Bendix Av.	4,721	3,638
CBS	2,404	1,522
DuMont (6 m.)	913	56
General Prec.	646	601
IT&T	4,832	4,735
Sentinel (12 m.)	404	263
Stewart-Warn.	1,076	956

▶ **Offerings**—Avco of Canada offered a $2 million issue of 15-year, 5½-percent sinking fund debentures, series A, at 98 and accrued interest to yield 5.7 percent. Proceeds will be used to purchase the assets of Crosley Radio and Television and Bendix Home Appliances, both of Canada, and for general corporate purposes.

Ampex registered with SEC covering 160,000 shares of common stock (50-cent par) to be offered for public sale. Proceeds will be used to retire bank loans, demand notes and for working capital.

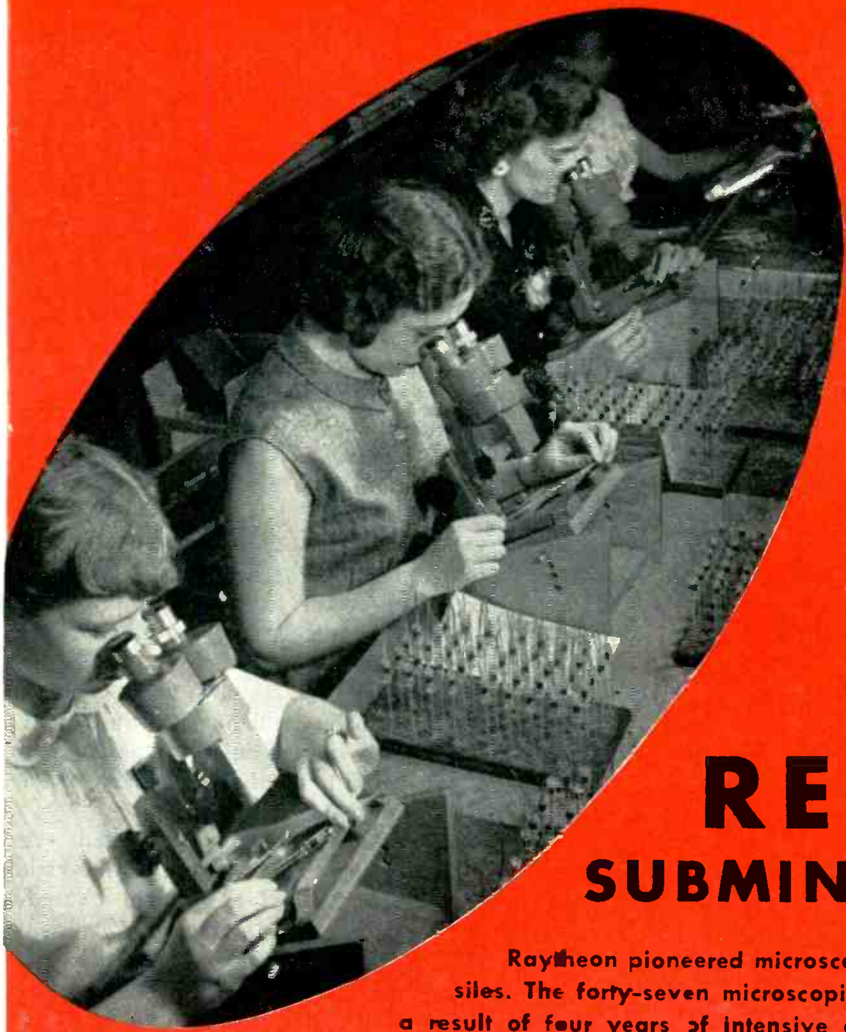
IT&T registered with SEC covering $35,883,300 in twenty-year convertible debentures to be offered to stockholders at the rate of $100 principal amount of debentures for each 20 shares of capital stock held. Proceeds will be used to repay bank loans in the U. S. Offering was later postponed.

▶ **Filings**—Technograph Printed Electronics filed with SEC covering 99,906 shares of common stock (par 40 cents) to be offered to stockholders of record July 13 at one new share for two now held. Subscription price is $3 per share. Proceeds will be used for licensing activities and for improving the company's patent position. Remainder will be used for working capital.

Soundscriber filed with SEC covering 15,588 shares of capital

(Continued on page 22)

www.americanradiohistory.com



47 MICROSCOPIC TESTS

on all

RAYTHEON

RELIABLE

SUBMINIATURE TUBES

Raytheon pioneered microscopic inspection of reliable tubes for missiles. The forty-seven microscopic tests were developed by Raytheon as a result of four years of intensive experience with visual inspection. This rigid multiple test procedure has been adopted as standard practice on every Raytheon Reliable Subminiature Tube. It assures utmost dependability of performance.

All these Raytheon Reliable Subminiature Tubes must pass microscopic inspection

Type	Description	Heater Volts	Heater Ma	Plate Volts	Plate Ma	Grid Volts	Screen Volts	Screen Ma	Amp. Factor	Mut. Cond.
CK5702WA	RF Amplifier Pentode	6.3	200	120	7.5	R_k = 200 ohms	120	2.5	—	5000
CK5703WA	High Frequency Triode	6.3	200	120	9.4	R_k = 220 ohms	—	—	25.5	5000
CK5744WA	High Mu Triode	6.3	200	250	4.2	R_k = 500 ohms	—	—	70	4000
CK5783WA	Voltage Reference		Operating voltage approximately 86 volts between 1.5 and 3.5 ma.							
CK5784WA	RF Mixer Pentode	6.3	200	120	5.2	−2	120	3.5	—	3200
CK5787WA	Voltage Regulator		Operating voltage approximately 100 volts between 1 and 25 ma.							
CK5829WA	Dual Diode	6.3	150		Max. Peak Inverse 360 volts. I_o = 5.5 ma. per plate					
CK6021	Medium Mu Dual Triode	6.3	300	100	6.5	R_k = 150 ohms	—	—	35	5400
CK6111	Medium Mu Dual Triode	6.3	300	100	8.5	R_k = 220 ohms	—	—	20	5000
CK6112	High Mu Dual Triode	6.3	300	100	0.8	R_k = 1500 ohms	—	—	70	1800
CK6152	Low Mu Triode	6.3	200	200	12.5	R_k = 680 ohms	—	—	15.8	4000

Note: All dual section tube ratings (except heater) are for each section.

Write for new edition of Raytheon Reliable Subminiature Tube Booklet.

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

Newton, Mass. Bigelow 4-7500 • Chicago, Ill. NAtional 2-2770 • New York, N. Y. WHitehall 3-4980 • Los Angeles, Calif. Richmond 7-5524

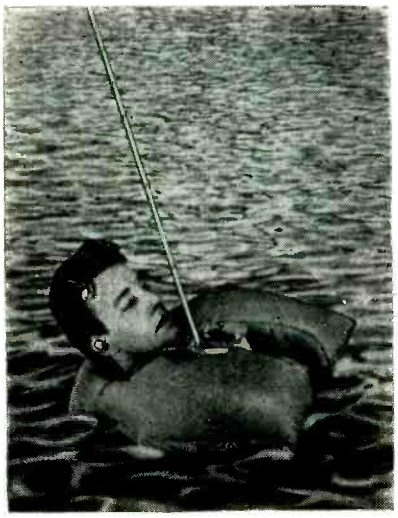
RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

www.americanradiohistory.com

stock (no par) to be offered at $6.25 per share. Proceeds will be used to pay debts and for working capital.

Muntz TV filed with SEC covering 12,000 shares of common (par $1) to be offered at market (about $3.25 per share) for the account of E. W. Muntz, president.



New British air-sea rescue device transmits coded pulses to searchers

SARAH Helps Locate Downed Flyers at Sea

Self-powered beacon transmitter gives accurate fixes up to 66 miles away

CHANCES of a downed pilot's being rescued are greatly enhanced if he has SARAH with him. Following the trend to assign feminine names to air-sea rescue devices, Ultra Electronics, Ltd., of London, named the equipment after the three functions it facilitates, Search And Rescue And Homing.

The equipment weighs 31 pounds and fits inside an ordinary Mae West. Signals sent out by a downed pilot can be picked up by another aircraft flying at 10,000 feet and a distance of 66 miles away. Usable range to surface vessels is about 6 miles. Peak power is 16 watts and self-contained batteries provide 20 hours of continuous operation.

▶ **Works in Water**—A downed pilot simply releases the hood on a case containing a collapsed 31-inch antenna. The antenna springs out, and the transmitter begins sending out precoded pulses which, in addition to giving an accurate fix, provide positive identification of the pilot in trouble. Fixes may be made to within 100 feet.

A version of the equipment, modified to meet American specs, will be made and sold by Simmonds Aerocessories of Tarrytown, New York.

FCC Reviews First Post-Freeze Year

TOTAL of 398 new tv stations were authorized by the Federal Communications Commission in its first post-freeze year ending June 30, 1953. Some 300 cities in 47 states, Hawaii and Puerto Rico now have one or more tv authorizations. Vermont, where the only two applicants are in competition, is the only state without a grant.

Of the 398 new tv stations authorized, 256 are for uhf operation and 142 are for vhf operation. A total of 89 stations have received special temporary authorizations to start operation.

▶ **Noncommercial**—Educational tv grants total 17; 13 uhf and 4 vhf. KUHT-TV in Houston with a vhf grant is the only noncommercial educational station on the air. Channels reserved for noncommercial educational use have been allocated to 245 municipalities.

During the year, 6 construction permits were dropped by their holders; 2 on vhf and 4 on uhf.

At present, about 600 applications for additional tv stations are pending before the commission, including 31 noncommercial educational ones. Most of the applicants for commercial stations are in hearing or face hearing because they are competitive. About 250 channel assignments in some 175 cities are in contest.

Electronics Business Increases Overseas

ELECTRONICS is big business in foreign countries too. Last month these developments made news:

▶ **British Television**—A ten-year development plan presented by the BBC aims at a 95-percent coverage of Great Britain and Northern Ireland and a second program service. At present only one tv channel is available to viewers in any locality.

First stage of the $84-million plan will be erection of five medium-power and eight low-power transmitters to supplement the five high-power units now in use. Color television is under consideration but will have to wait until a color system fully compatible with present British receivers is developed.

An expansion of program service may force British television into the uhf band; vhf channels are occupied largely by military and emergency services. Price estimates on uhf converters range from $14 to $100.

▶ **Machine Tools**—Ultrasonic equipment for industry on display at the British Instrument Industries Exhibition at Olympia July 11–30 included: a device for determining the elastic modulus of concrete, soldering irons and deep-tinning baths and machine tools using carborundum abrasive. The ultrasonic machine tools are said to be useful particularly in machining hard, brittle materials such as tungsten carbide, magnetic ferrites, ceramics and quartz.

▶ **Eagle Eye**—Used to televise the races at Ascot, Marconi's 80-inch tv camera lens is said to be able to spot a fly on the nose of a man half a mile away.

▶ **German Electronics**—Radio production in West Germany last year was 2,600,000 sets valued at $114-million, of these, 400,000 sets valued at $14-million were exported. Sales of television sets

(Continued on page 24)

www.americanradiohistory.com

NEW...

GOOD-ALL

Capacitors

● GOOD-ALL production techniques make it possible for MIFILM capacitors to be available in sizes smaller than other miniaturized brands. Metal enclosed and hermetically sealed, MIFILM capacitors normally operate between −65°C and +150°C. Insulation resistance 10^{15} ohms. Power factor less than .5%. Sizes from .173" dia. x 21/32" long (.001 mfd, 600 VDC) to .750" dia. x 1⅞" long (1 mfd, 600 VDC). Slightly larger sizes to 1000 VDC.

Your inquiries regarding this revolutionary advance in miniature capacitors are invited. We invite sample orders for your evaluation.

*DUPONT'S TRADEMARK FOR ITS POLYESTER FILM.

★

MIFILM subminiature capacitors

★

With MYLAR* plastic dielectric. Metal enclosed, Hermetically sealed.

★

Write for complete catalog covering GOOD-ALL MIFILM, MARBELITE and MIRACLE X long life capacitors.

GOOD-ALL **ELECTRIC MFG. CO.**

114 W. FIRST ST. Phone 112-113 OGALLALA, NEBR.

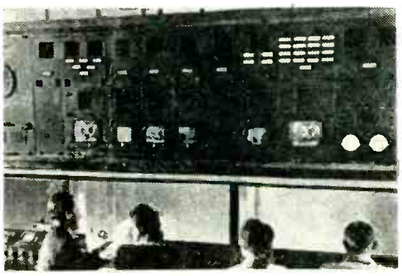
ROBERT A. GOODALL, President   Cable Address, "GOODALLA"

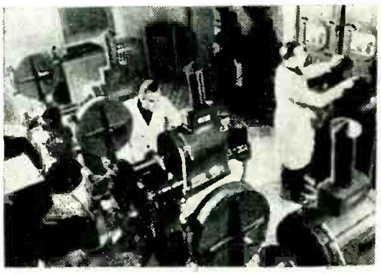
www.americanradiohistory.com

in Germany are expected to reach 80,000 this coming fall and winter.

▶ **Italian Television**—Italy's first regular service is promised for Jan. 1, 1954. At that time four stations will be on the air: two in Milan, one in Rome and one in Turin. Major problem is making a home receiver within the means of the average worker who earns $359 annually.

Sales possibilities for cathode-ray tubes to the Italian television industry seem good, however. Domestic production has not yet reached a commercial scale. At present the 17-inch tube is most in demand.





RADIO MOSCOW'S tv master control and film-scanners are proof that . . .

Television Lags In Soviet Russia

Three stations are on air with less than 100,000 receiving sets in operation

NEWS THAT an additional three-camera studio has been opened in the Ukranian capital of Kiev recalls that only three Soviet television transmitters are known to be on the air. These are located at Moscow, Leningrad and Kiev. A few years ago, a transmitter was reported on the air in Kharkov but this station has not been mentioned lately.

Location	*Frequency in MC*	
Kharkov	unknown	
Kiev	visual—	77.25
	aural—	83.75
Leningrad	visual—	59.25
	aural—	65.75
Moscow	visual—	49.75
	aural—	56.25

Standards—625 lines, 25 frames, 8-mc channel width, f-m sound

Hours of Operation—8-11 p-m local time, six nights a week

▶ **Home Receivers**—Standard Russian tv set is a 7-inch model selling for $300. A luxury model with a 9-inch screen sells for $600; it includes a 10-inch loudspeaker and all-band radio. A 19-inch model is reported to be in production. The tv screens are said to have a distinct greenish cast.

Sets in use number between 50,000 and 100,000. Sales of tv receivers in the Moscow area last year totaled 6,000 with 40,000 radios sold. The Russians have recently announced experiments in the fields of color tv and 3-D.

▶ **Radio**—A recent report from Riga, Latvia, announces a new a-m broadcast transmitter designed to serve rural areas.

Signals from a central transmitter are picked up by five intermediate receivers and retransmitted over telephone lines to amplifiers in the homes of subscribers. This gives complete control over the listener's program choice.

▶ **Communications**—A teleprinter enabling two-way traffic at speeds up to 20,000 words per hour was shown at a recent radio show in Moscow. Also shown was a high-speed transmitter capable of transmitting up to 1,000 wpm. Development of high-quality portable transmitting equipment is said to occupy the energies of many radio engineers.

▶ **Siberia**—Workers and students of the Kirov Polytechnical Institute at Tomsk built an experimental television transmitter which has an effective range of about 6 miles.

▶ **Confession**—Even Pravda, the official Communist newspaper, admits that electronics lags in Russia and has demanded prompt correction of serious defects in its radio and television industries. It complains that the speed with which radio facilities are being extended in all sections of the U.S.S.R. "cannot be considered satisfactory." It added that the Ministry of Communications, fundamentally responsible for this work, failed to fulfill the plan assigned to it during the past year.

Turning to tv, Pravda admits that the problems of color tv have not been solved. It calls for accelerated scientific research both in this field and in three-dimensional tv. Pravda also reports its readers complained repeatedly about the defects of their tv sets and the monotony and inadequate preparation of programs.

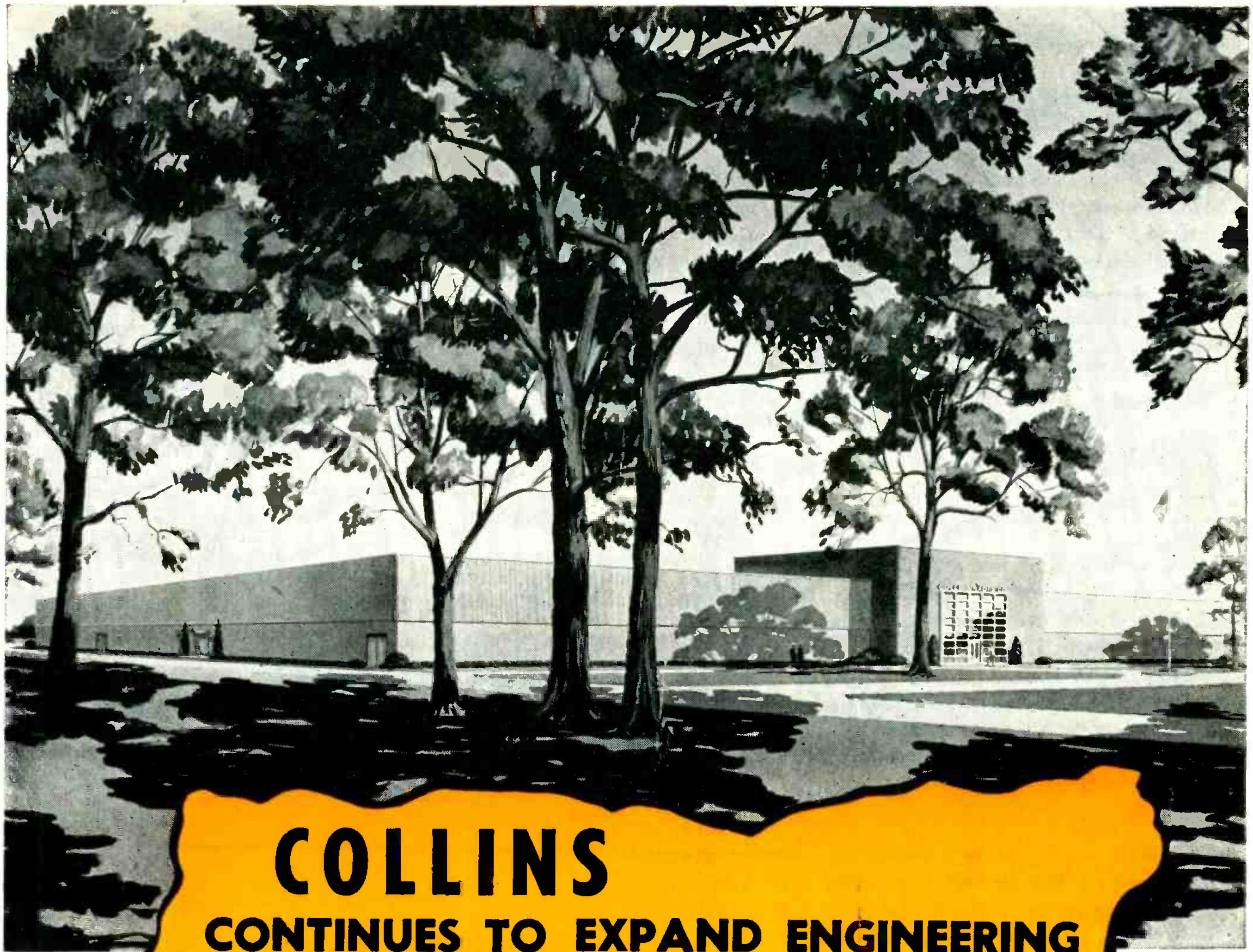
Microwaves Aid Atomic Research

FOUR MICROWAVE radio-relay systems, valued at over one-quarter million dollars, are helping speed research efforts at two installations operated by the Atomic Energy Commission. The equipment is used for transmission of voice intelligence, remote control of equipment and transmission of scientific data by telemetering. All equipment has a capacity of 24 voice channels, each of which can be subchanneled to as many as 18 telemetering channels.

▶ **Nevada, California**—One link, operating at the Nevada Proving Grounds, consists of two terminals with 100-percent standby equipment. Single-hop path length is 50 miles. One terminal is on the test site itself, at an elevation of 4,300 feet. The other is at Spring Mountain, 9,000 feet above sea level;

(Continued on page 26)

www.americanradiohistory.com



COLLINS
CONTINUES TO EXPAND ENGINEERING AND RESEARCH FACILITIES

A new Collins Engineering and Research building, containing more than 100,000 square feet of floor space, is now under construction. This modern structure is being built on a 52 acre wooded tract in Cedar Rapids. It will contain the latest architectural refinements and be one of the finest, most completely equipped engineering-research laboratories in the country.

This new Engineering and Research building will supplement Collins Main Plant and Aeronautical Research Laboratories in Cedar Rapids. Its facilities will also be available to the Research and Manufacturing Divisions of Collins' Burbank and Dallas plants.

Learn more about the possibilities of joining the excellent staff of engineers working in these modern surroundings. If you are a graduate engineer or physicist with several years experience in the design and development of electronic communications and navigation equipment, write Glenn Johnson, Collins Radio Company, Cedar Rapids, Iowa. A copy of Collins' booklet "Electronic Engineering" will be sent to you.

For the best in engineering opportunity, it's . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36 | 1930 Hi-Line Drive, DALLAS 2 | 2700 W. Olive Ave., BURBANK

Want more information? Use post card on last page.

www.americanradiohistory.com

RCA equipment with frequency-division channeling is used.

Other systems are at Salton Sea Test Base in California. The three separate single-hop systems link outlying test facilities with the central control building. Each link is about 15 miles long. The equipment operates 200 feet above sea level. Six terminals with pulse-type channeling are used. This equipment is Motorola.

Metallic Rectifiers Gain In Volume

DOLLAR volume of domestic orders received for selenium and copper-oxide rectifier cells and stacks in 1952 reached $11.3 million compared to $10.7 million in 1951.

Further evidence of the growth of the field is that there are now more than 50 manufacturers of metallic rectifiers, compared to 35 in 1951.

▶**Growth** — Selenium rectifiers have shown the greatest growth of the metallic rectifiers in the past few years. One company that estimates that its production last year accounted for one-third of industry's total volume, sets its present production rate at 1.5 million a month.

Belgian Electronics Gains Momentum

SHOT IN THE ARM was given to electronics production in Belgium when the country's leading manufacturer, Ateliers de Constructions Electriques de Charleroi, signed a Belgium government contract to supply mobile radar units SCR584 for the Belgian Army. The equipment was not specified for delivery until July, 1953. The company, however, was ahead of schedule, the first unit having been delivered in April of this year. By August it is hoped the units will be coming off the production line at ten a month. An electronics industry has only been in existence in Belgium since the end of the war. Before that, little electronic equipment outside of radio was manufactured.

MEETINGS

AUG. 3–5: Argonne National Laboratory Symposium On Digital Computers, Argonne National Laboratory, Lemont, Ill.
AUG. 17–22: Third International Congress of Electroencephalography And Clinical Neurophysiology, Boston, Mass.
AUG. 19–21: WESCON (Western Electronic Show & Convention), IRE (7th Region) and WCEMA (West Coast Electronic Manufacturers' Association cosponsors, Municipal Auditorium, San Francisco, Calif.
AUG. 21–22: Fourteenth Annual Summer Seminar, Emporium Section of IRE, Emporium, Pa.
AUG. 29–SEPT. 6: West German Radio and Television Exhibition, Duesseldorf, Germany.
SEPT. 1–3: International Sight and Sound Exposition, Palmer House, Chicago, Ill.
SEPT. 1–12: British 20th National Radio & Television Exhibition 1953, Earlscourt, London, England.
SEPT. 14–16: Fourth Annual Convention and Manufacturer's Conference, NEDA, St. Louis, Mo.
SEPT. 21–25: Second Analytical Instrument Clinic, Chicago, Ill.
SEPT. 21–25: Eighth National Instrument Exhibit, Sherman Hotel, Chicago, Ill.
SEPT. 28–30: Ninth annual National Electronics Conference, Sherman Hotel, Chicago, Ill.
OCT. 5–8: Fall Technical Meeting sponsored by Canadian National Committee, URSI and IRE Antenna Group, Ottawa, Canada.
OCT. 20–22: Thirteenth Annual Session Of A.A.R. Communications Section, Hotel Plaza, San Antonio, Texas.
NOV. 9–12: Conference on Radio Meteorology, Austin, Texas.
NOV. 13, 14: Annual Electronics Conference, Hotel President, Kansas City, Missouri.

Industry Shorts

▶**Tape** recorder sales of $200 million a year by 1956 are predicted by A. J. Palmer, president of Ampro.

▶**Radios** in working order in the U. S. totalled 110 million on Jan. 1, 1953, according to the four major networks, an increase of 5 million over last year's estimate.

▶**First** assembly-line production of transformers has been achieved in Bulgaria, according to Pravda.

▶**Two tons** of Marconi radio goes air freight to Bermuda to increase communications facilities for the forthcoming Three-Power Conference.

▶**India** plans to establish a factory for making wireless and radar equipment. Production is expected to begin in 1956.

▶**Electronic** manufacturers can no longer prematurely grab engineers from military service. Defense Department's new directive prohibits employment interviewing at separation centers.

▶**Some** 40,000 crystal sets and more than a million old-fashioned loudspeaker receivers are still operated in Poland. Radio licenses there totaled over 2.2 million at the end of March, 1953.

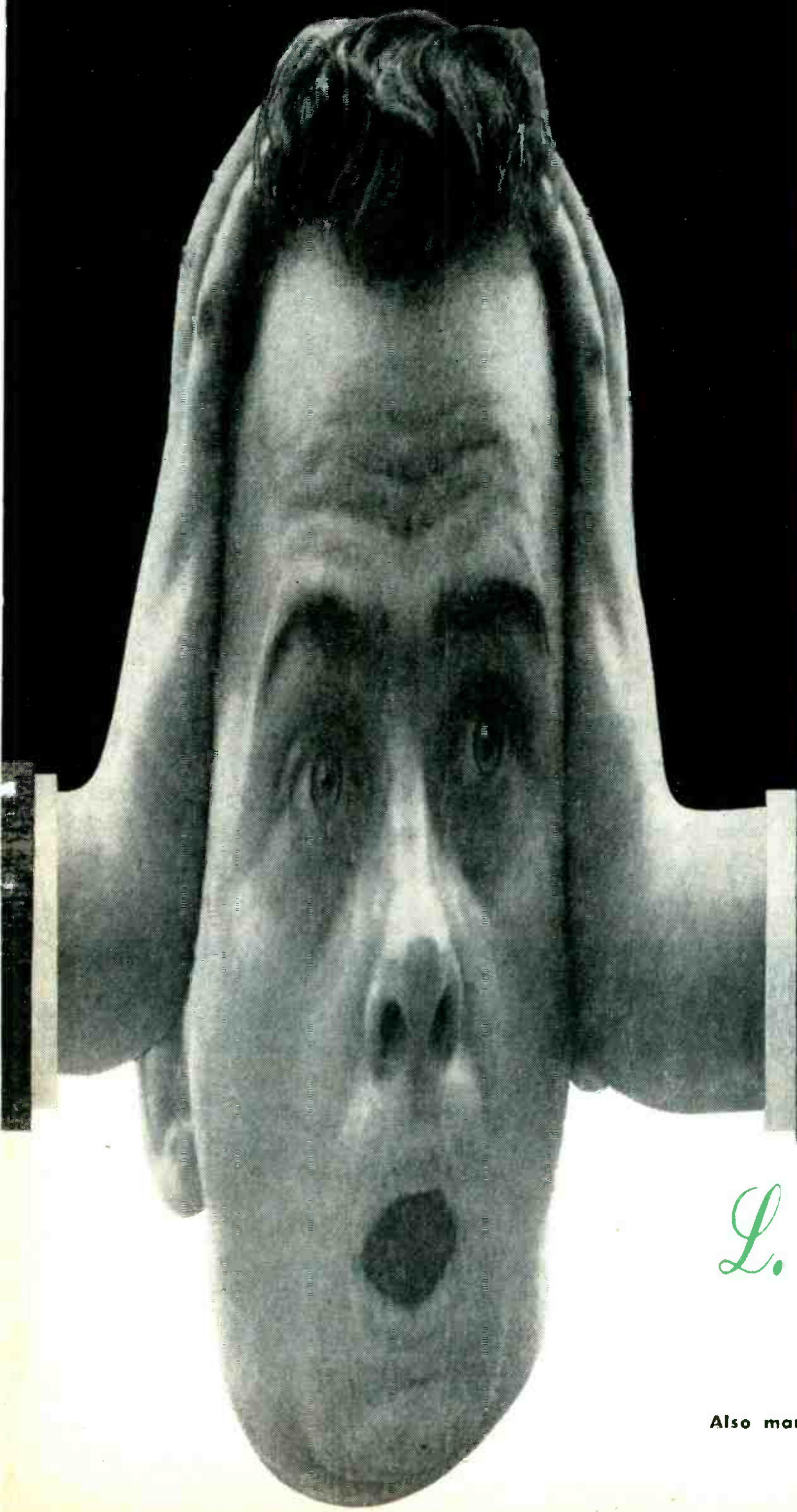
▶**Czechoslovakia's** first tv transmitter began operating in June. Hungary plans to start tv broadcasting next year.

▶**Pentagon** keeps cool with the aid of rooftop electronic sensing elements that measure the sun's heat and regulate the building's air conditioning system.

▶**SEAC** (Standards Eastern Automatic Computer) is expected to reduce from 240 to 20 the machine-hours needed to complete Loran tables at the National Bureau of Standards.

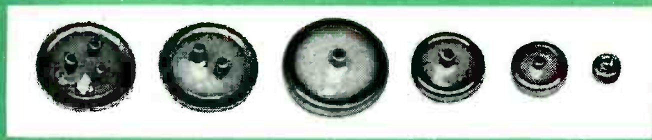
www.americanradiohistory.com

BOY, HAVE WE GOT HIGH COMPRESSION GLASS-TO-METAL VACUUM SEALS!



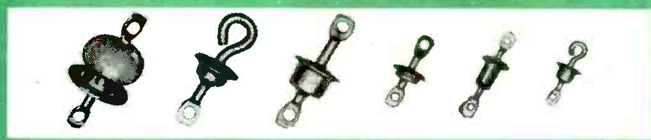
MULTI-PIN HEADERS

The new vacuum tight, HIGH COMPRESSION glass-to-metal seal makes CONSTANTIN HEADERS ideal for use in the manufacture of sealed relays, transformers, inductances and practically any product which demands a stabilized atmosphere and protection from moisture. All seals are hot tin dipped at 530°F. to facilitate soldering and eliminate rejections due to thermal shock. Ingenious seal engineering and flexible manufacturing methods permit numerous additional configurations, and solve the problems of adapting CONSTANTIN HEADERS to any requirement.



CONDENSER END SEALS

Constantin offers a complete line of special END SEALS that assures a stabilized atmosphere, thus making them especially adaptable to capacitors, filters, delay lines and precision resistors. The normal finish is achieved by hot tin dipping at 530°F. Special finishes can be supplied upon request.

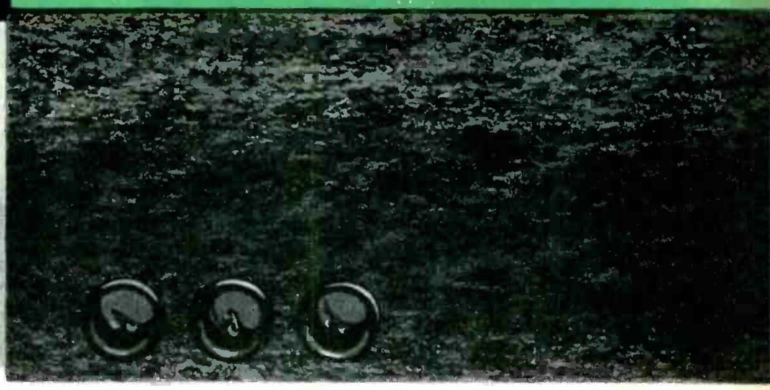


TERMINALS

Constantin's extensive line of HIGH COMPRESSION TERMINALS are available in all combinations of hooks, eyes, tubes and pierced flats. Hot tin dipping at 530°F. allows easy soldering and prevents rejections occuring from thermal shock.

Engineering know-how and controlled manufacturing procedures go into producing these fine examples of glass-to-metal sealing. Standard units of the complete line have test ratings from 1,000 to 15,000 volts R.M.S. and 5 to 25 amperes.

Consult our engineering department for further information about standard or special items.



L. L. Constantin & Co.

MANUFACTURING ENGINEERS

Rt. 46 and Franklin Ave., Lodi, N. J.

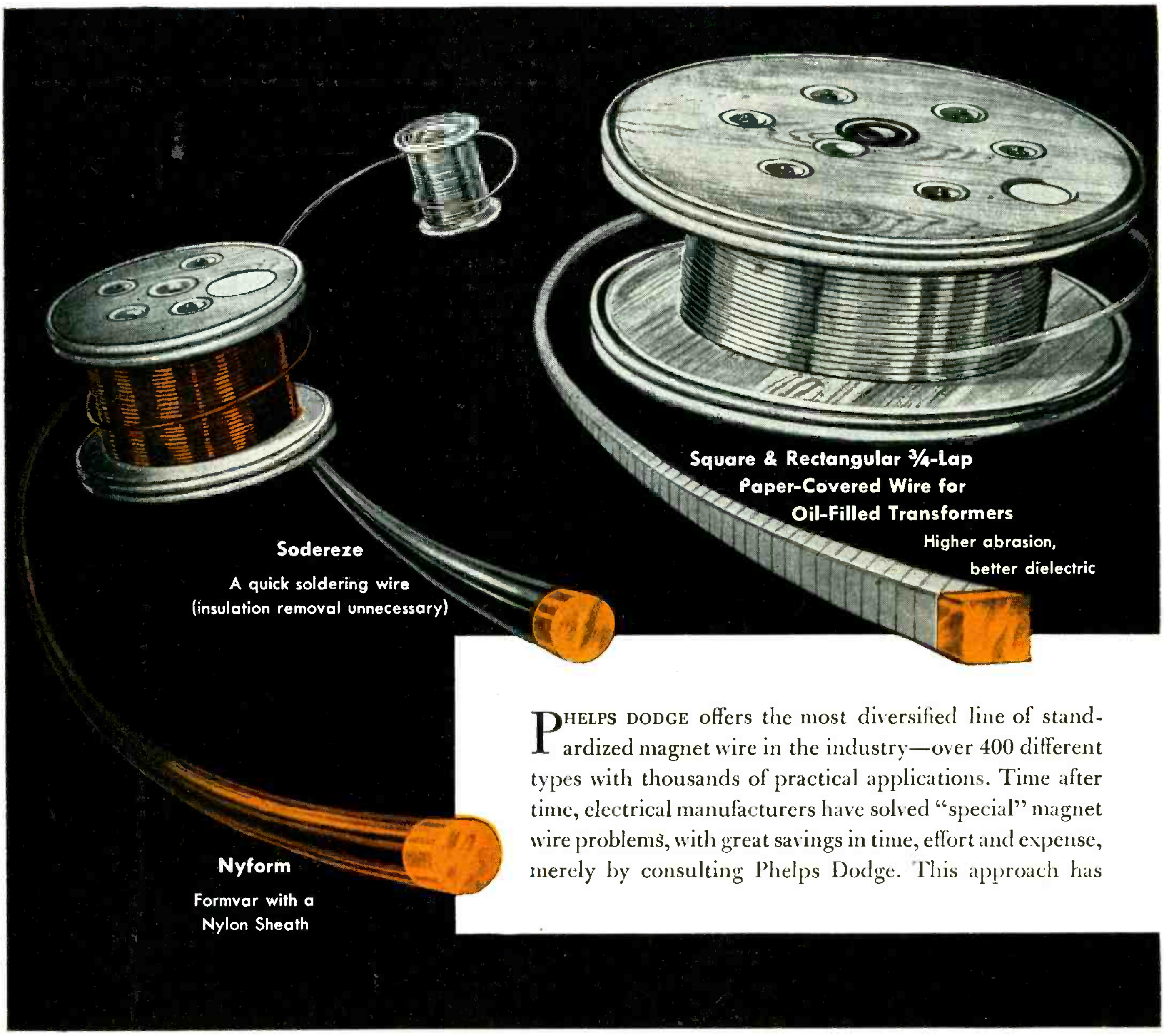
Also manufacturers of — TRANSISTOR MOUNTS
CRYSTAL HOLDERS
MULTI-PIN CON PLUGS
VACUUM COATING EQUIPMENT

These compression seals are in addition to our regular and complete line of Kovar to hard glass seals.

www.americanradiohistory.com

Before you specify that

CHECK THE WIDE RANGE OF



PHELPS DODGE offers the most diversified line of standardized magnet wire in the industry—over 400 different types with thousands of practical applications. Time after time, electrical manufacturers have solved "special" magnet wire problems, with great savings in time, effort and expense, merely by consulting Phelps Dodge. This approach has

First for Lasting Quality

PHELPS DODGE COPPER PRODUCTS

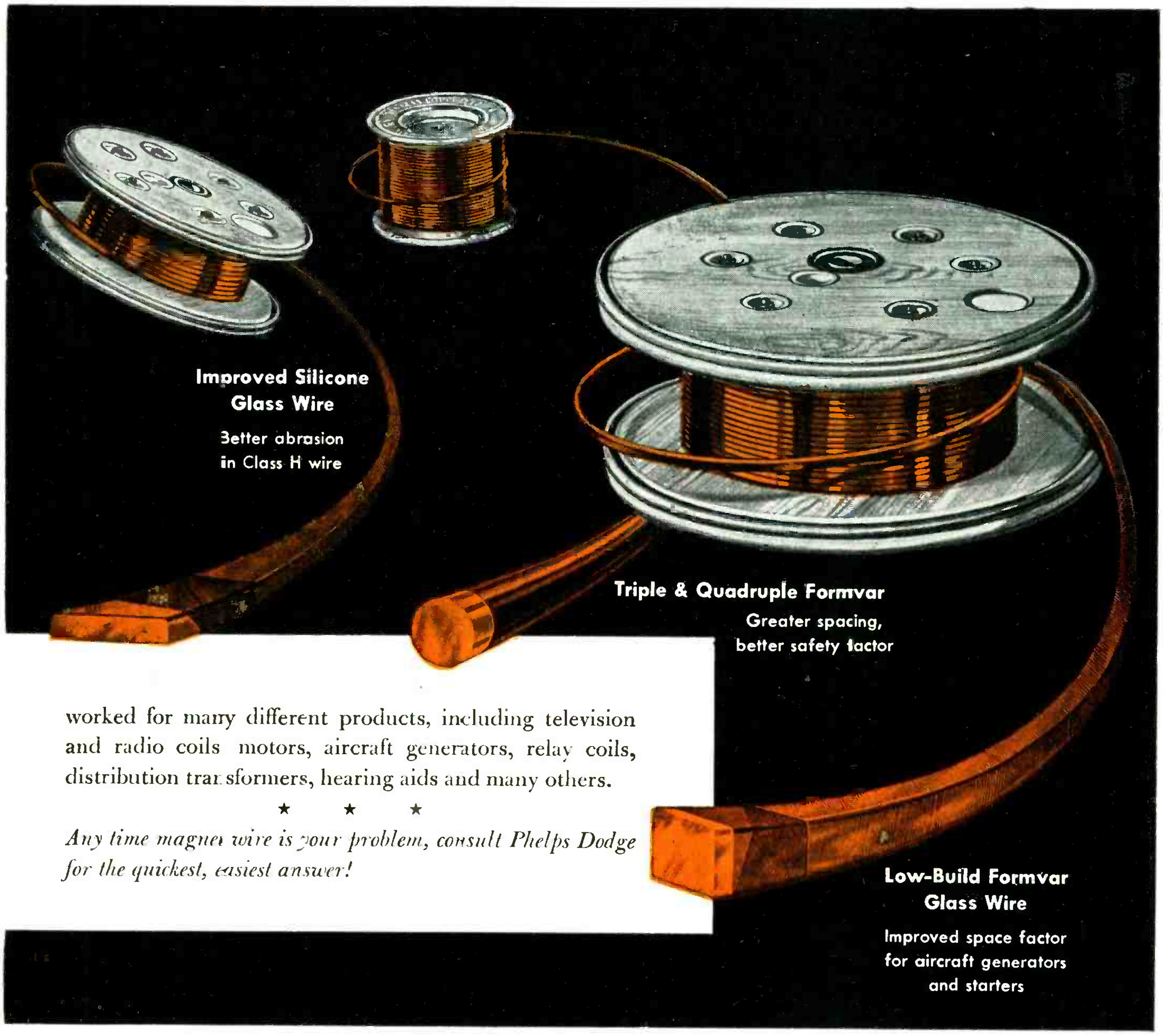
CORPORATION

Want more information? Use post card on last page.

www.americanradiohistory.com

"Special" Magnet Wire . . .

PHELPS DODGE "STANDARDS"



worked for many different products, including television and radio coils motors, aircraft generators, relay coils, distribution transformers, hearing aids and many others.

★ ★ ★

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, easiest answer!

—from Mine to Market!

PHELPS DODGE COPPER PRODUCTS CORPORATION — MINE TO MARKET — REG. U. S. PAT. OFF.

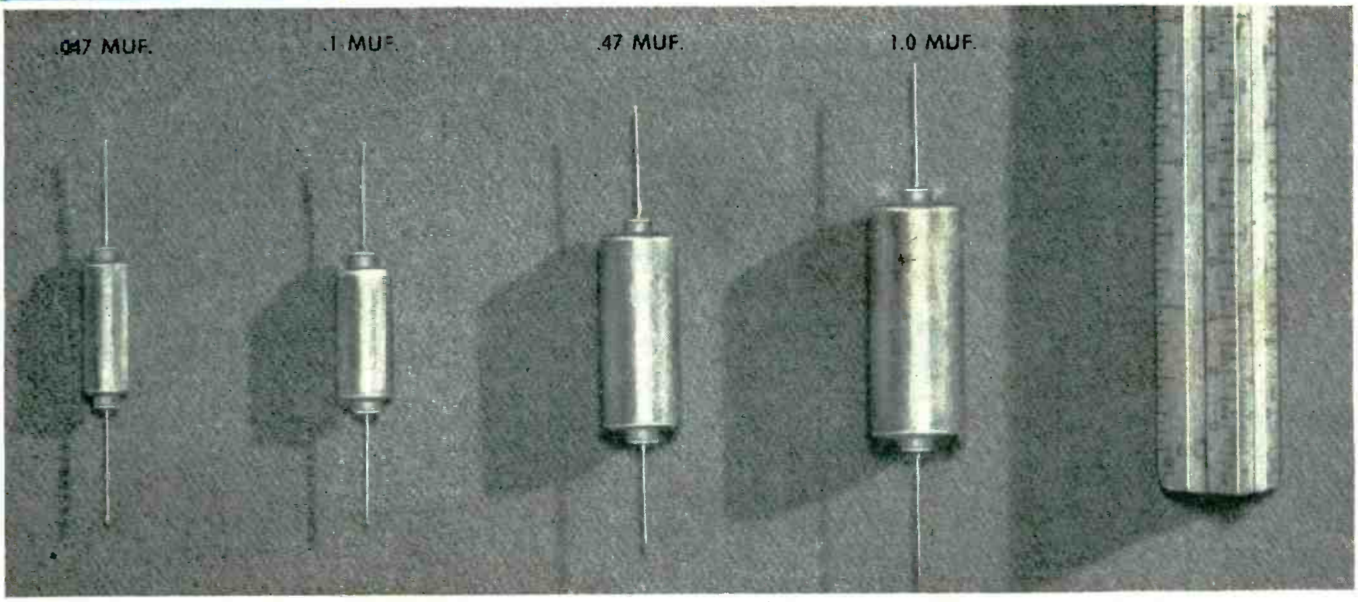
INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

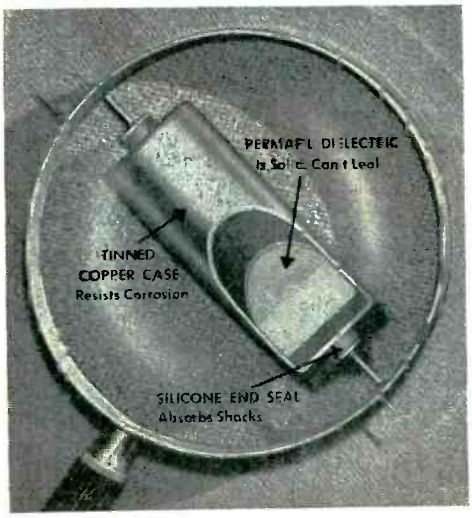
Want more information? Use post card on last page.

www.americanradiohistory.com

DESIGNER'S



New metal-clad subminiature capacitors withstand extreme temperatures



RUGGEDLY CONSTRUCTED G-E subminiature metal-clad capacitors meet all requirements of JAN-C-25 and the proposed MIL-C-25.

Permafil solid dielectric permits operation up to 125C without derating

Here's a complete new line of General Electric metal-clad subminiature capacitors designed to meet difficult operating conditions. Now you need no increase in capacitor size for applications with high working temperatures.

G. E.'s exclusive permafil solid dielectric eliminates the possibility of leakage without derating from −55C to +125C—and up to +150C with proper derating. Silicone bushings give high shock resistance—both thermal and physical—and leads can be soldered right up to the bushing.

Muf ratings range from .001 to 1.0 muf in 100, 200, 400 and 600 volts d-c working. They can be operated at full voltage up to altitudes of 50,000 feet.

If you need even smaller capacitors, G. E. has introduced another line of new Pyranol* (liquid-filled) metal-clad capacitors. These are designed for operation from −55C to +85C without derating and offer the same electrical advantages as their permafil cousins. For further information on permafil capacitors, send for new Bulletin GEC-5934.

GENERAL ELECTRIC

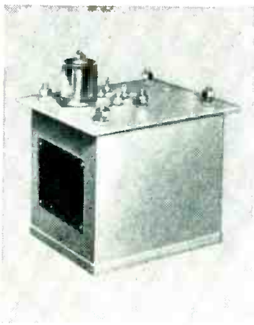
www.americanradiohistory.com

DIGEST

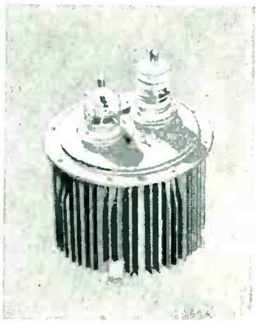
TIMELY HIGHLIGHTS ON G-E COMPONENTS

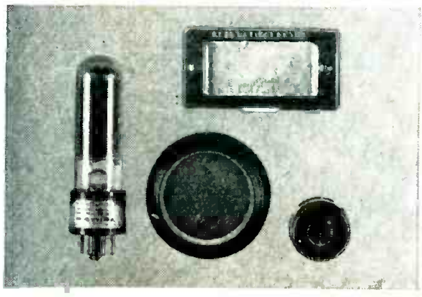
Compact high-voltage components built for extra long service life

These G-E high-voltage components offer a continuous-service life for long periods under extreme temperatures and mechanical shocks. All are oil-filled and hermetically sealed to resist moisture, dirt and dust. For applications 5000 volts and higher, where corona must be held to a minimum, a wide range of ratings can be tailored to meet your needs. In your inquiry, please include all functional requirements, any physical limitations, and expected quantities. Contact your G-E Apparatus Sales representative for more information.


Rectifiers


Reactors


Transformers

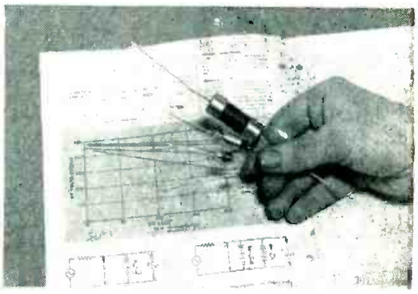


Detects, measures light accurately

G-E photovoltaic cells—for applications where electronic amplifiers are not practical—provide extra-high output with stability and long life in capturing light energy and converting it into electrical energy. This self-generating power plant can detect, measure, and control light—and can measure variations in colors. These G-E cells are available in a hermetically sealed series with standard mountings, and in a wide variety of mounted and unmounted sizes. See Bulletin GEC-690.

Speeds solution to field problems

The G-E analog field plotter offers a valuable aid to electronics equipment engineers in simplifying complex field studies. Problems in electrostatics, electromagnetics, and many other fields are rapidly solved with this sensitive, versatile plotting board and associated equipment. It needs only a low-voltage d-c supply, and is not affected by line-voltage variations. Explanation and instructions are covered in a 50-page manual accompanying plotter. For details, see Bulletin GEC-851.



Cover wide temperature range

From −55C through +100C—that's the wide range covered by these new G-E miniature selenium rectifiers. Stacks—available for either lead or bracket mounting—have the same outstanding features as larger G-E selenium cells: long life, good regulation, high reverse resistance, and low heat rise. For protection, they are enclosed in either Textolite* tubes, or hermetically sealed in metal-clad casings. For more data, contact your G-E Apparatus Sales representative.

EQUIPMENT FOR ELECTRONICS MANUFACTURERS

Components

Meters, Instruments
Dynamotors
Capacitors
Transformers
Pulse-forming networks
Delay lines
Reactors
Thyrite*
Motor-generator sets
Inductrols
Resistors
Voltage stabilizers
Fractional-hp motors
Rectifiers
Timers
Indicating lights
Control switches
Generators
Selsyns
Relays
Amplidynes
Amplistats
Terminal boards
Push buttons
Photovoltaic cells
Glass bushings

Development and Production Equipment

Soldering irons
Resistance-welding control
Current-limited high-potential tester
Insulation testers
Vacuum-tube voltmeter
Photoelectric recorder
Demagnetizers

*Reg. Trade-mark of General Electric Co.

General Electric Company,
Apparatus Sales Division, Section 667-26
Schenectady 5, New York

Please send me the following bulletins:
√ for reference
X for immediate project

☐ GEC-690 Photovoltaic Cells
☐ GEC-851 Analog Field Plotter
☐ GEC-5934 Permafil Capacitors

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

Name ______________________

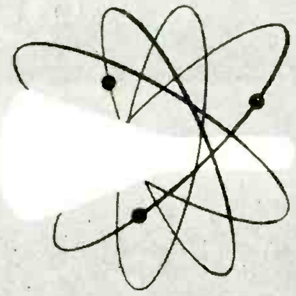
Company ______________________

City ______________________ State ______

Want more information? Use post card on last page.

www.americanradiohistory.com

FOR TOP ENGINEERING COUNSEL ON PERMANENT MAGNETS CONSULT INDIANA



design summary

Equipment—

Electronic Data Processing Machines, designed and manufactured by International Business Machines Corporation.

Application and Solution

1) A Cunife magnet . . . used to build up the magnetic surface on the drum used in the IBM Magnetic Drum Reader and Recorder Unit of the Electronic Data Processing Machines.

INDIANA Cunife has been selected to do this specific phase of the work because of its high coercivity and remanence . . . properties which enable it to produce proper signals.

2) Alnico magnets . . . perform a very important function in determining the tape control movement in the Magnetic Tape Reader and Recorder Unit of the Electronic Data Processing Machines.

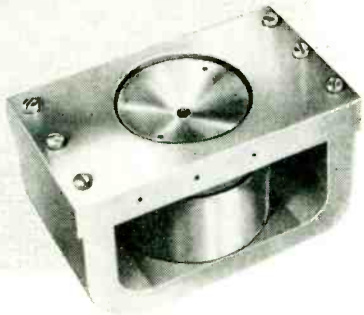
INDIANA Alnico magnets were selected because of their high efficiency which permits an immediate pick-up of signals and a high degree of sensitivity in the unit.

For a complete selection of experimental permanent magnets, write for:
Cast Catalog No. 11-A8
or
Sintered Catalog No. 12-A8.

IBM

electronic data processing machines

Magnetic Drum Reader and Recorder Unit of the IBM Electronic Data Processing Machines which uses an INDIANA Cunife magnet.



INDIANA Alnico magnet in housing used in the Magnetic Tape Reader and Recorder Unit of the computer.

HIGH-SPEED COMPUTER USES INDIANA PERMANENT MAGNETS

This versatile IBM computer is a remarkable addition to America's productive effort and a valuable tool in furthering its economic growth. INDIANA feels honored in being selected to contribute to the progress of high-speed electronic calculation by providing the Cunife and Alnico permanent magnets for this machine.

Just as IBM did, so you, too, can rely on INDIANA for quality permanent magnets . . . for top engineering assistance on your problems. Rigid quality control during all phases of production is your assurance of magnets with exact magnetic and physical characteristics. Consult INDIANA, today.

THE INDIANA STEEL PRODUCTS COMPANY
VALPARAISO, INDIANA
WORLD'S LARGEST MANUFACTURER OF PERMANENT MAGNETS

INDIANA PERMANENT MAGNETS

PERMANENT MAGNETS MAY DO IT BETTER

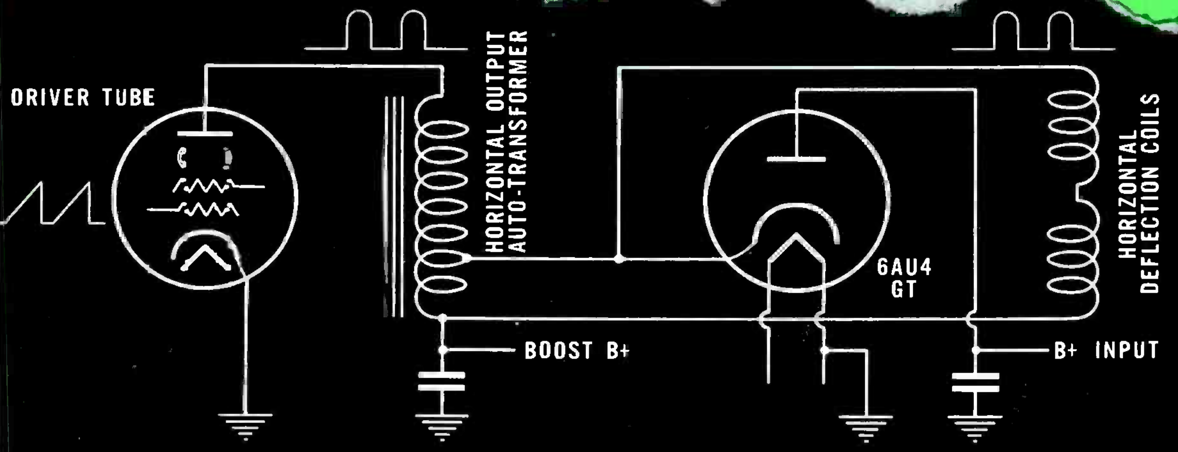
www.americanradiohistory.com

TUNG-SOL®

DAMPER DIODE

6AU4 GT

for TV use with picture tubes having 90° deflection



see other side for additional information →

www.americanradiohistory.com

6AU4 GT

DAMPER DIODE

A Tung-Sol Designed and Developed Tube

HERE is an entirely new Damper Diode designed to keep pace with the development of the large screen 90° deflection picture tubes. Wider deflection angles and the increased second anode voltage so necessary to maintain picture brightness require higher deflection power and increased circuit efficiency. The 175 ma. rating of type 6AU4GT is more than adequate—with ample safety factor—for these new designs. "Stretching" the ratings of tubes designed for 70° deflection service is not sound engineering and invariably leads to production troubles and jeopardizes the service life in the field. This new tube is the answer.

The 6AU4GT retains the many features which have established the 6AX4GT as a favorite for the 70° deflection designs. Insulation between heater and cathode designed to withstand the full pulse plate-to-cathode voltage eliminates the need for separate power transformer windings insulated for high voltage. Improvements in the heater—cathode insulation have decreased the warm-up time and resulted in improved reliability. The 6AU4GT is produced under the same careful manufacturing techniques and the thorough quality control which the industry has come to expect from the Tung-Sol organization.

DIRECT INTERELECTRODE CAPACITANCES

Heater to Cathode: (H to K)	4.0	μμf
Plate to cathode and heater: P to (H+K)	8.5	μμf
Cathode to plate and heater: K to (P+H)	11.5	μμf

RATINGS [A]

Interpreted according to RTMA Standard M8-210

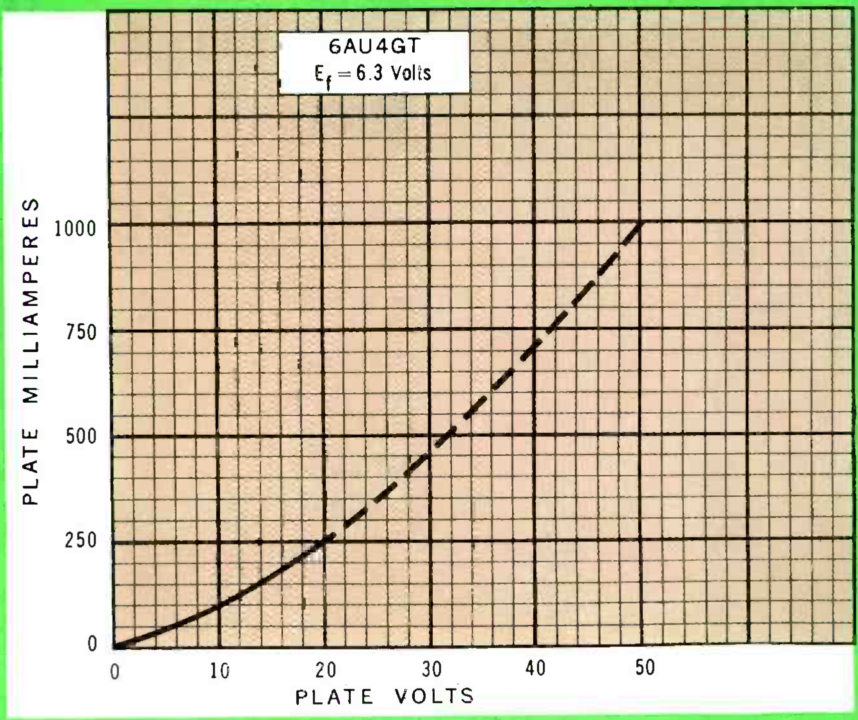
DAMPER DIODE [B]

Heater voltage	6.3	VOLTS
Maximum heater cathode voltage:		
Heater negative with respect to cathode		
DC	900	VOLTS
Total DC and peak (absolute maximum)	4 500	VOLTS
Heater positive with respect to cathode		
DC	100	VOLTS
Total DC and peak	300	VOLTS
Maximum peak inverse plate voltage (absolute maximum)	4 500	VOLTS
Maximum DC plate current	175	MA.
Maximum steady state peak plate current	1 050	MA.
Maximum plate dissipation	6.0	WATTS
Average tube voltage drop (with tube conducting 350 MA.)	25	VOLTS

[A] All values are evaluated on the design center system except where absolute maximum is stated.

[B] For installation in a 525-line, 30-frame system as described in "STANDARDS OF GOOD ENGINEERING PRACTICE FOR TELEVISION BROADCASTING STATIONS: FEDERAL COMMUNICATIONS COMMISSION." The duty cycle of the horizontal voltage pulse, not to exceed 15% of scanning cycle.

The TUNG-SOL engineering which has produced the 6AU4GT is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types is available on request to TUNG-SOL Commercial Engineering Department.



TUNG-SOL
ELECTRON TUBES

TUNG-SOL ELECTRIC INC., Newark 4, New Jersey

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle

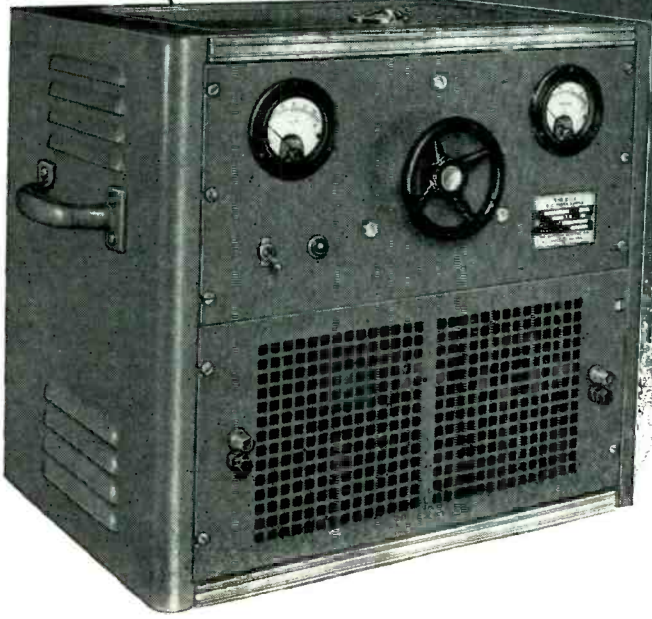
TUNG-SOL makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

AUGUST, 1953

www.americanradiohistory.com

THE IDEAL SOURCE OF D-C VOLTAGE FROM A-C LINES

VARICELL



STABILIZED and REGULATED

Output voltage is unaffected by changes in the magnitude of a-c line voltage or output load current. Stabilization and regulation is ± 0.25 volts. R.M.S. ripple voltage is less than 0.1 volts.

ADJUSTABLE OUTPUT SETTINGS

Any desired output of d-c voltage from 0 to 30 volts is achieved by simply rotating the handwheel on the front panel.

CONVENIENT, EASY TO USE

The VARICELL is operated by simply plugging into any handy a-c voltage source supplying a nominal 115 volts, 60 cycles, 1 phase. The load is connected to either of the two pairs of SUPERIOR 5-WAY Binding Posts. The assembly is energized by an "On-Off" switch. A voltmeter visually identifies the output voltage at the binding posts. An ammeter shows the output load current.

ENGINEERS, LABORATORY TECHNICIANS, PRODUCTION TEST MEN and ALL OTHERS WORKING WITH LOW D-C VOLTAGES . . . get complete information now on the VARICELL. Use coupon below to get your copy of Bulletin V1051.

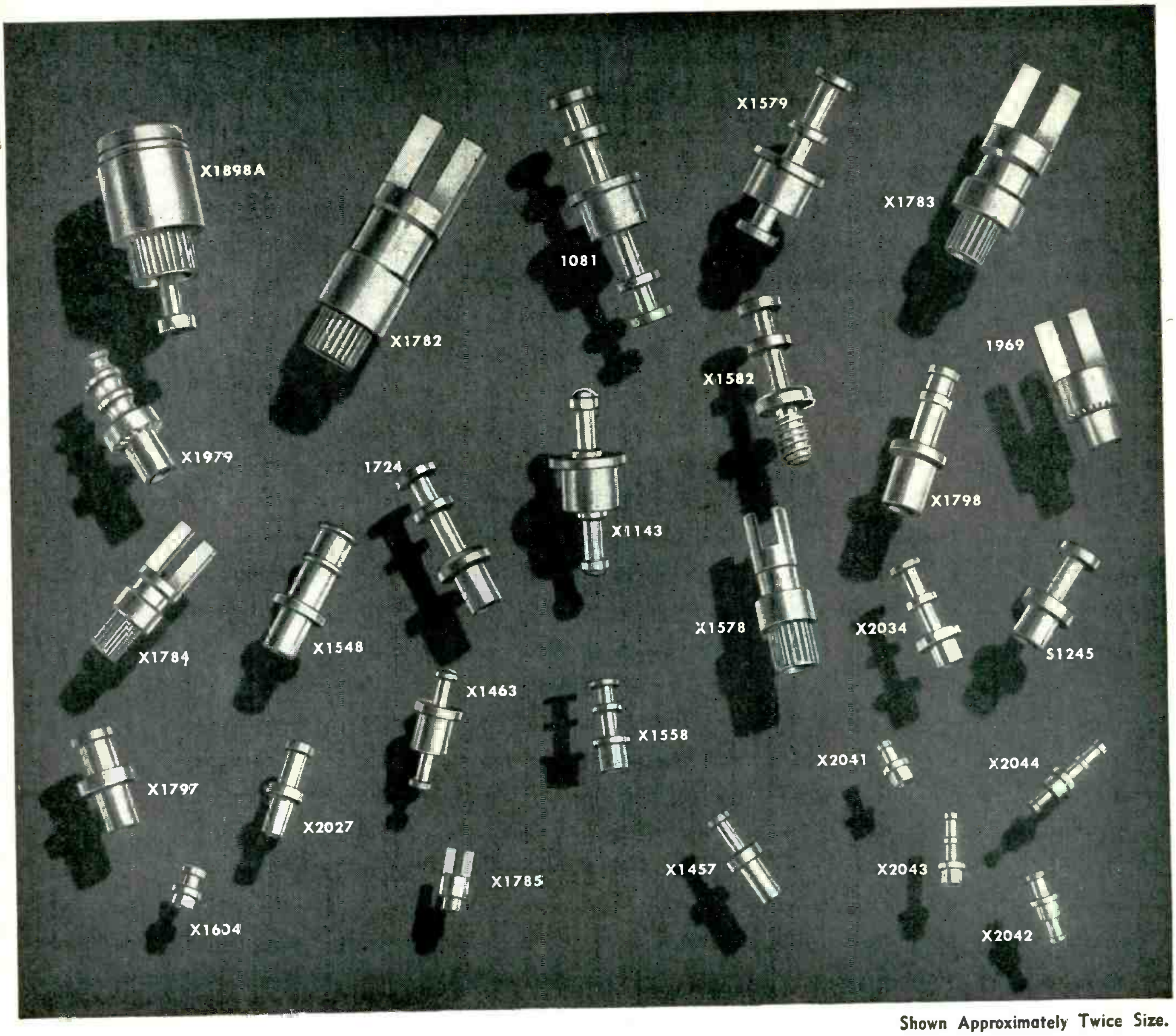
THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC COMPANY
208 Mae Avenue, Bristol, Connecticut

Please send my free copy of Bulletin V1051 describing the VARICELL.

NAME________________________
POSITION________________________
COMPANY________________________
CO. ADDRESS________________________
CITY____________ ZONE_____ STATE________

www.americanradiohistory.com



Shown Approximately Twice Size.

Everything you need in standard terminal lugs
. . . or made to your own specifications!

C.T.C. has exactly the types and sizes of terminal lugs you want . . . or will quickly make them to your specifications in any production quantity. Very likely you'll find what you're looking for in the broad C.T.C. line of standard terminals. There are 28 different types, each available in varied shank lengths.

C.T.C. standard terminals are of silver plated brass, coated with water dip lacquer to keep them chemically clean for soldering.

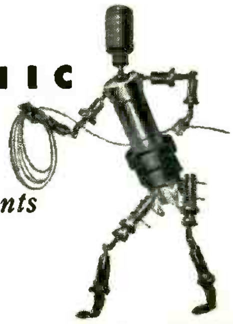
In addition, combination screw and solder terminals are available in 3 sizes, and a complete line of phenolic or ceramic terminals can be furnished.

All materials, processes and finishes meet applicable government specifications. Finishes include hot tinned, electro-tin, cadmium plate or gold plate on special order. In the event standard terminals don't meet your needs, C.T.C. offers a special consulting service to solve your solder terminal problems without extra cost or obligation.

For all specifications and prices, write to Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast Manufacturers contact: E. V. Roberts, 5068 West Washington Blvd., Los Angeles 16 and 988 Market Street, San Francisco, California.

CAMBRIDGE THERMIONIC CORPORATION

custom or standard . . . the guaranteed components



See our listing in Electronics Buyers' Guide

Want more information? Use post card on last page.

www.americanradiohistory.com

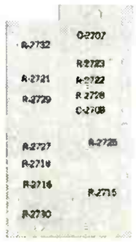
PANELYTE®
THE STRUCTURAL PLASTIC

(For Years a Standard for Radio and TV)

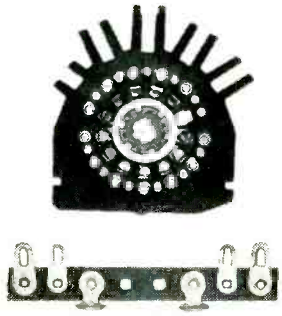
Offers You FULL RANGE of Finest Quality Laminates

This range of Industrial Laminates, with phenolic, melamine and silicone resins, includes insulation for radio, TV and other electronic purposes. Available in sheets, rods, tubes, molded specialties and fabricated parts.

Paper Base Insulation



Silicone Fiberglas Insulation



High Insulation Resistance Laminate

Paper Base Tubing

STANDARD GRADES TO GOVERNMENT and INDUSTRY SPECIFICATIONS

SHEET STOCK

Panelyte Grade	Nema Grade	DESCRIPTION	GOVERNMENT SPEC.
750	X	Paper Base, Phenolic Resin, Mechanical	...... (PBM)
550	XX	Paper Base, Phenolic Resin, Mechanical & Electrical	MIL-P-3115B (PBG)
520	XXX	Paper Base, Phenolic Resin, Electrical	MIL-P-3115B (PBE)
770	P(XP)	Paper Base, Phenolic Resin, Cold Punching, General Electrical	......
772	PC	Paper Base, Phenolic Resin, Cold Punching, Secondary Electrical	......
774	XXP	Paper Base, Phenolic Resin, Hot Punching, Good Electrical	......
776	XXXP	Paper Base, Phenolic Resin, Hot Punching, High Frequency	MIL-P-3115B (PBE-P)
900	C	Fabric Base, Phenolic Resin, Mechanical	MIL-P-15035B (FBM)
910	CE	Fabric Base, Phenolic Resin, Good Electrical, Fair Mechanical	MIL-P-15035B (FBG)
940	L	Fabric Base (Fine Weave), Phenolic Resin, Fine Machinability	MIL-P-15035B (FBI)
950	LE	Fabric Base (Fine Weave), Phenolic, Good Electrical, Fair Mechanical	MIL-P-15035B (FBE)
580	A	Asbestos Paper, Phenolic Resin, Heat Resistance, Low Voltage	......(PBH)
980	AA	Asbestos Cloth, Phenolic Resin, Very High Impact	...... (FBH)
115	G8	Glass Mat, Melamine Resin, Fire & Arc Resistant	......
120	G1, G2	Staple Glass Cloth, Phenolic Resin, Heat Resistance	......
130	G7	Continuous Glass Cloth, Silicone Resin, High Heat Resistance	MIL-P-997B (GSG)
135	G6	Staple Glass Cloth, Silicone Resin, High Heat Resistance	......
140	G5	Continuous Glass Cloth, Melamine Resin, Arc Resistance, High Strength	MIL-P-15037B (GMG)
170	G3	Continuous Glass Cloth, Phenolic Resin, Highest Strength	......
190	N1	Nylon Cloth, Phenolic Resin, Lowest dielectric & loss factor	MIL-P-15047B (NPG)
780	....	Paper Base, Phenolic Resin, Good Insulation Resistance	MIL-P-3115B (PBE-P)
9101	....	Fabric Base, Phenolic Resin, Low Water Absorption	Navy Spec 33B4
920	....	Fabric Base (Medium Weave), Phenolic, Good Impact, Good Machinability	MIL-P-15035B (FBM)

ALL ROD AND TUBE TO SPECIFICATION MIL-P-79B.

PANELYTE can be of service anywhere you have use for Industrial Laminates. Would you like a free sample of Panelyte? Or a free copy of the Panelyte Industrial Catalog? Or a visit from a Panelyte engineer? Or all three? No obligation, of course.

Just let us know by sending in the coupon below, now.

OTHER PANELYTE PRODUCTS

1. **DECORATIVE**, for table-tops, all horizontal work surfaces, wall-covering, etc. in sizes up to 4' x 10'.
2. **MOLDED LAMINATED PARTS** — refrigerator inner-door panels, breaker strips, specialty molded items, breaker frames.
3. **INJECTION MOLDINGS**—32, 48, 60, 200 oz. capacity. Television masks, refrigerator parts, industrial items, etc.
4. **REINFORCED PLASTICS**—sheets, fabricated parts.

PANELYTE THE STRUCTURAL PLASTIC DIVISION

ST. REGIS PAPER COMPANY

230 PARK AVENUE • NEW YORK 17, NEW YORK

Offices in Principal Cities

PANELYTE DIVISION E-8
ST. REGIS PAPER COMPANY
230 Park Avenue, New York 17, New York

- ☐ Please send me sample of Grade ______ Panelyte.
- ☐ Please send Panelyte Industrial Catalog.
- ☐ Please have a Panelyte engineer contact me.

Name ______

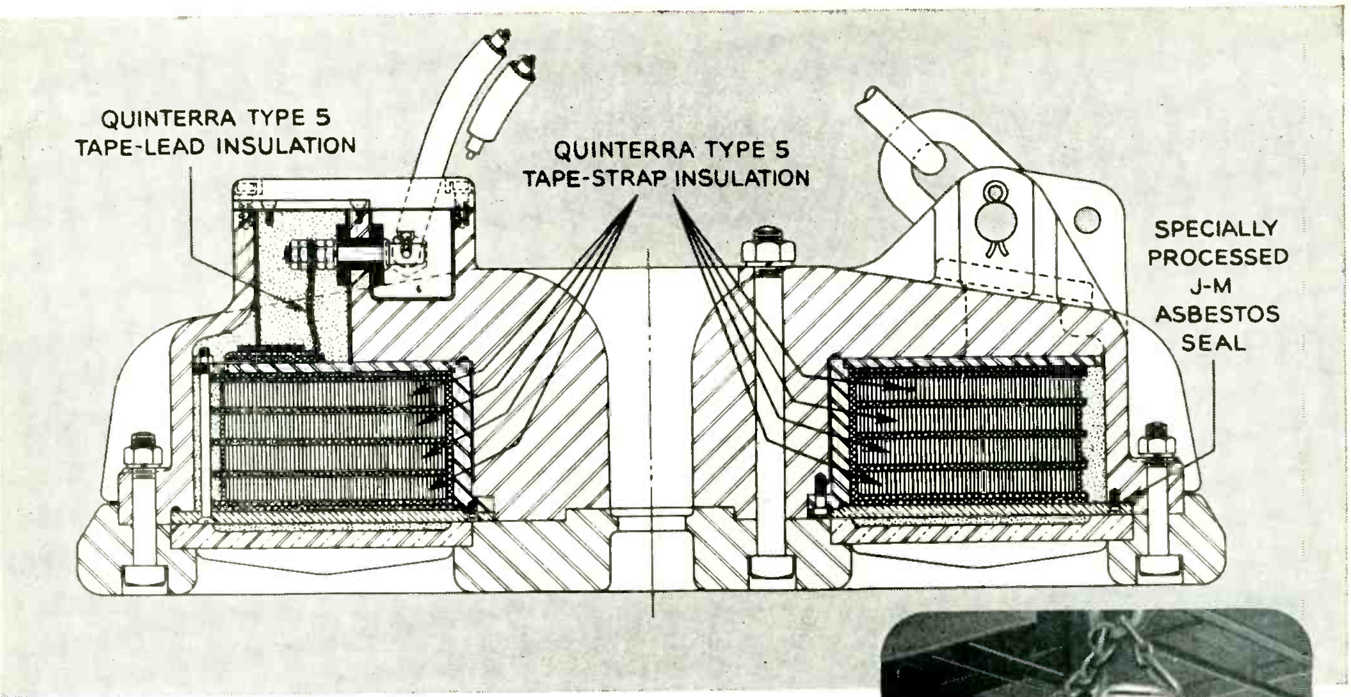
Firm Name ______

Address ______

City ______ Zone ______ State ______

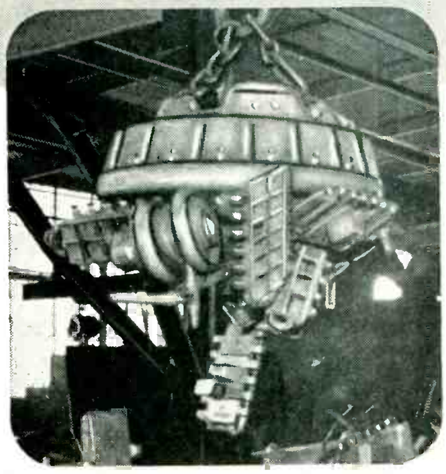
Want more information? Use post card on last page.

www.americanradiohistory.com



How Stearns Magnetic Inc.

Builds greater loads per lift into magnets



Stearns lifting magnet, wound with Quinterra Type 5 Electrical Insulation, carries heavier loads for longer periods, has greater protection against short-circuited windings.

with Quinterra® asbestos electrical insulation

• Stearns Magnetic Inc. — a pioneer in its field — wanted improved performance for lifting magnets. So they turned to Quinterra Electrical Insulations to insulate the turns of copper strap in the pancake coils and to protect lead wires. The thinness, flexibility and uniform caliper of Quinterra permit a higher number of turns of copper ribbon per given area. Quinterra thereby improves the space factor and increases efficiency. Its lasting dielectric strength, high thermal stability and good heat dissipation permit heavier current loads with less danger of shorting the coils.

This application is typical of the many ways in which Quinterra Electrical Insulations help improve product performance. With these insulations, manufacturers can also reduce equipment size, save weight and materials. Quinterra permits equipment to operate at higher temperatures because it remains a dielectric despite heat and time . . . the bulk of its dielectric strength is in the highly purified asbestos base sheet. Moreover, it has ample mechanical strength for normal handling and resists corrosion. Available both in treated and untreated forms.

Quinterra Electrical Insulations may lower your production costs and improve product performance. For more information, send for free booklet EL-40A, "Pyrolysis Protection Pays Well."

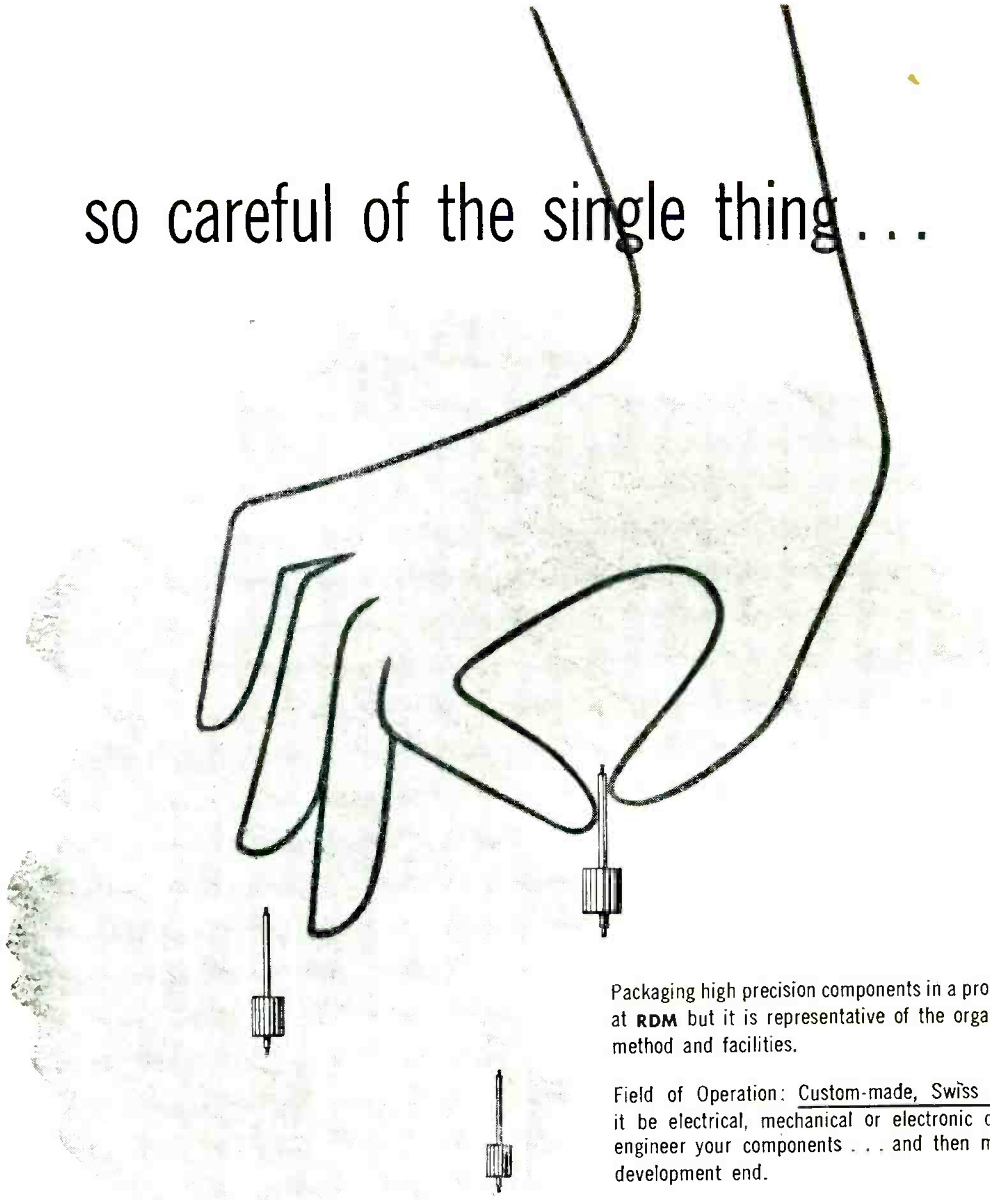
Simply write to Johns-Manville, Box 60, New York 16, New York. In Canada, the address is 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS Johns-Manville ELECTRICAL INSULATIONS

www.americanradiohistory.com

www.americanradiohistory.com

so careful of the single thing . . .



Packaging high precision components in a protective capsule is an end-activity at **RDM** but it is representative of the organization—the field of operation, method and facilities.

Field of Operation: Custom-made, Swiss precision components. Whether it be electrical, mechanical or electronic devices, **RDM** is ever ready to engineer your components . . . and then manufacture where research and development end.

Method: Emphasis on the particular. Component reliability is vital to fine devices and can only be assured by undivided attention to the single part. Quality control at **RDM** is maintained by a continuous inspection of all processes . . . with the final result safely encapsuled.

Facilities: A complete one-stop service to the manufacturer of precision devices. All precision primary and secondary processes are accomplished under one roof. **RDM** alone assumes full responsibility for the dependable reproduction of your most exacting specifications . . . and for delivery on time. Costly and time-consuming bottlenecks are eliminated when you make **RDM** part of your production line.

That's the story of **RDM** in a capsule . . . quality, reliability, economy on crucially precise components.

Our brochure is more detailed. Write.

THE AMERICAN NAME
RDM
IN SWISS PRECISION

RESEARCH DEVELOPMENT MANUFACTURE, INC.

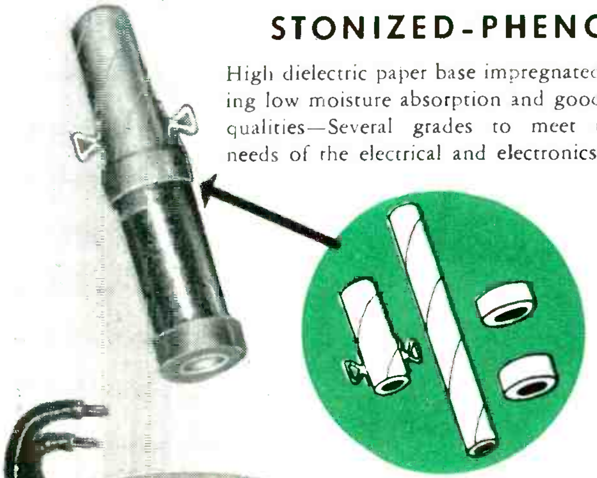
431 E. COLLOM STREET, PHILADELPHIA 44, PENNSYLVANIA

PINIONS • GEARS • SHAFTS • PIVOTS • BEARINGS • SPECIAL SCREWS

www.americanradiohistory.com

COIL FORMS

by STONE

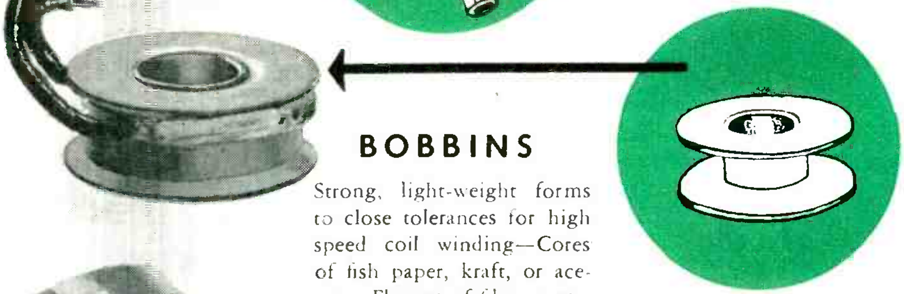


STONIZED-PHENOLIC

High dielectric paper base impregnated forms having low moisture absorption and good fabricating qualities—Several grades to meet the specific needs of the electrical and electronics industry

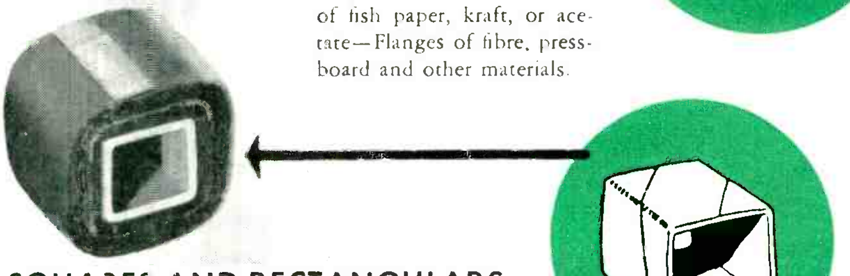
Stone's coil forms are used by a variety of America's leading manufacturers. These firms have found that Stone's unequalled service means dependable supply during the peak requirement season; consistently close tolerances in meeting rigid specifications; the experienced background necessary to sound construction recommendations; and a quality of product unsurpassed in the industry.

See your nearest Stone representative—or write directly—for more detailed information on how we can serve you promptly and efficiently.



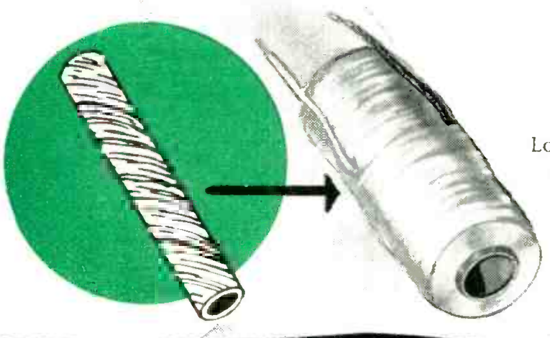
BOBBINS

Strong, light-weight forms to close tolerances for high speed coil winding—Cores of fish paper, kraft, or acetate—Flanges of fibre, pressboard and other materials.



SQUARES AND RECTANGULARS

Spiral wound tubes of neutral kraft and fish paper designed to meet the exacting requirements of irregular shaped forms.



ROUND-PAPER

Low cost forms in wide range of constructions, diameters, and wall thicknesses—Can be furnished notched, punched, and printed to your specifications.

SALES OFFICES

CLEVELAND . . . . . *Main 1-8410*
C. E. White & Company,
Bulkley Building

NEWARK . . . . *Humboldt 5-9000*
L. K. Detwiler, 443 Broad St.,
Room 205

CHICAGO . . . . . *Tuxedo 9-6920*
Joseph L. Pits,
1643 N. Nagle Avenue

BRIDGEPORT *3-2575*
O. E. Pfannkuch & Co.,
952 Main Street

PHILA. . . . . *Chestnut Hill 7-1575*
I. R. Blair,
18 Hilltop Road

ST. LOUIS . . . . . . *Parkview 3274*
E. B. Henderson Co.,
8147 Delmar Blvd.

LOS ANGELES *Pleasant 2-0791*
E. H. Southwell Co.,
5957 So. Western Avenue

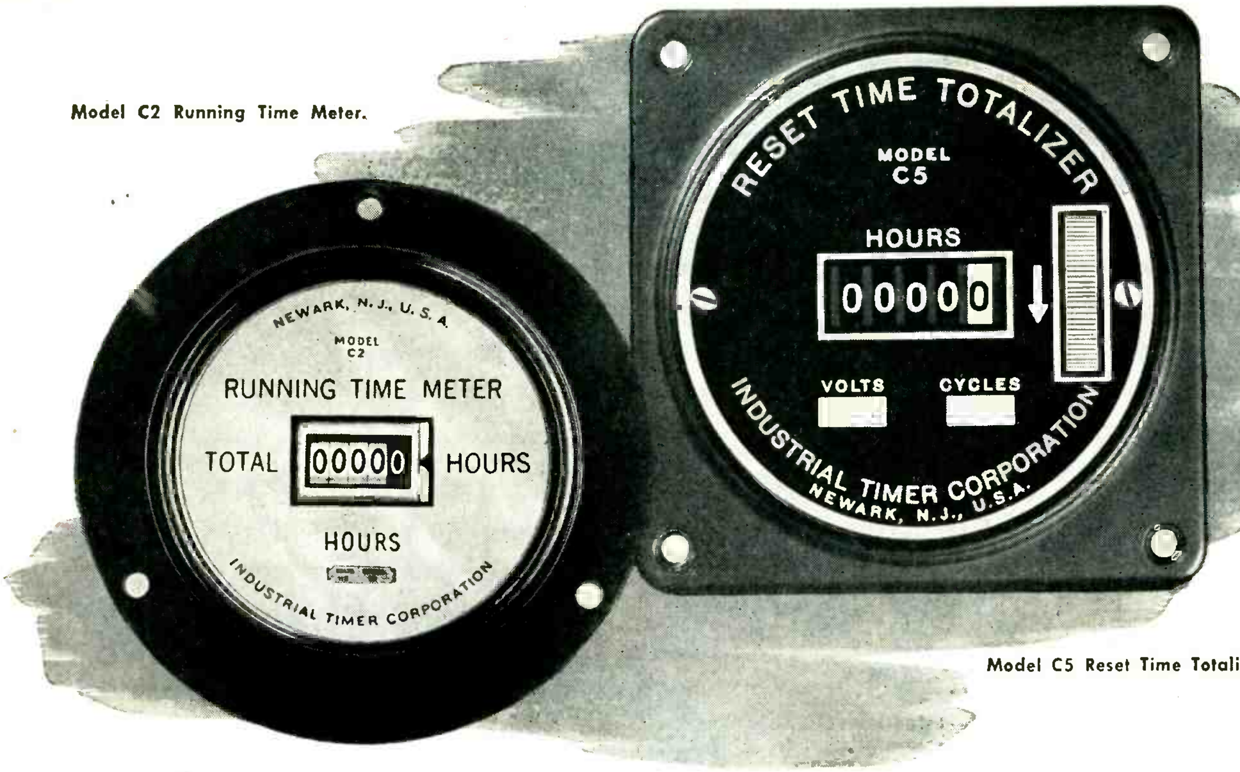
TORONTO . . . . *Murry 1106*
Electric Insulation & Fibre Co.,
Ltd., Mendota Road, Etobicoke

• STONE PAPER TUBE COMPANY
Incorporated
• STONIZED PRODUCTS COMPANY, INC.
900-922 Franklin St. N.E. Washington 17, D.C.

Want more information? Use post card on last page.

www.americanradiohistory.com

Model C2 Running Time Meter.



Model C5 Reset Time Totalizer.

NOW BOTH! Reset and Non-Reset Elapsed Time Meters

For applications where it may be desirable to reset to zero at any time, Industrial Timer now offers Reset Time Totalizers, in addition to its Running Time Meters.

SYNCHRONOUS MOTOR DRIVEN. Both types of elapsed time meters provide you with an exact record of machine hours on A.C. operated machines... up to 100,000 hours with "electric clock" running accuracy. Both utilize heavy duty synchronous motors that are self lubricating for long life. And both are available in enclosed and open type models. Running Time Meters are enclosed in black bakelite cases. Reset Time Totalizers in steel housings with baked black finish.

WIDE VARIETY OF APPLICATIONS. These Industrial Elapsed Time Meters permit you to compute readily production costs on A.C. operated machines — predict replacements for equipment of predetermined life expectancy. They can be used in a wide variety of applications such as: radio transmitters, vacuum tube devices, refrigerators, oil burners, molding machines, life test equipment, diesel generators, conveyors and many other types of machinery and equipment. For technical data, request Bulletin 88-53.

Reset Time Totalizer — Model Designations

CASED	OPEN	COUNT	RANGE	VOLTAGES	CYCLES
C 5		1/10 hr.	10,000 hrs.	115,220	60,50,25
	C 7	1/10 hr.	10,000 hrs.	115	60,50,25
C 5A		1 hr.	100,000 hrs.	115,220	60,50,25
	C 7A	1 hr.	100,000 hrs.	115	60,50,25

Running Time Meters — Model Designations

CASED	OPEN	COUNT	RANGE	VOLTAGES	CYCLES
C 2		1/10 hr.	10,000 hrs.	115,220,440	60,50,25
	C 4	1/10 hr.	10,000 hrs.	115	60,50,25
C 2A		1 hr.	100,000 hrs.	115,220,440	60,50,25
	C 4A	1 hr.	100,000 hrs.	115	60,50,25
C 2D		1/10 min.	10,000 min.	115,220,440	60,50,25
	C 4D	1/10 min.	10,000 min.	115	60,50,25
C 2F		1 min.	100,000 min.	115,220,440	60,50,25
	C 4F	1 min.	100,000 min.	115	60,50,25

MANUFACTURERS OF THESE AND OTHER TIMERS AND CONTROLS FOR INDUSTRY —
CAM TIMERS • TIME DELAY TIMERS • AUTOMATIC RECYCLING TIMERS
MANUAL SET TIMERS • INSTANTANEOUS RESET TIMERS.

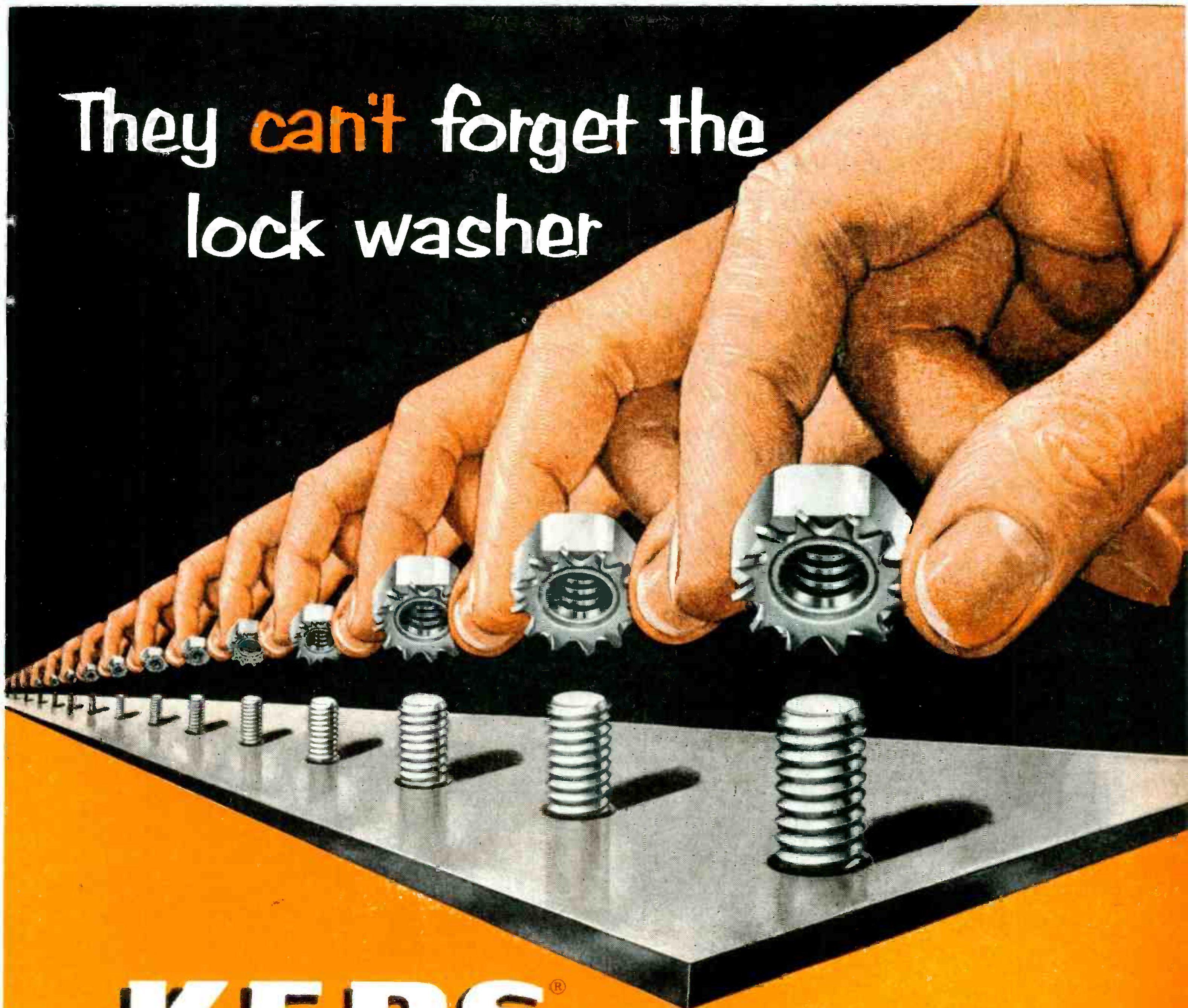
Timers that Control the Pulse Beat of Industry

INDUSTRIAL TIMER CORPORATION

INDUSTRIAL TIMER CORPORATION
115 EDISON PLACE, NEWARK 5, N. J.

Want more information? Use post card on last page.

www.americanradiohistory.com



KEPS®...

THE PRE-ASSEMBLED NUT AND WASHER

Stop worrying about loose connections . . . use KEPS! And be sure to specify KEPS with SHAKEPROOF® Lock Washers for maximum locking efficiency! Tapered-twisted teeth bite deep to assure positive vibration protection against loosening. Try KEPS now!

FREE... TESTING SAMPLE KIT

. . .make your own tests on your own products . . . see how KEPS hold tighter, improve product quality and save time. Send for your kit now!

SHAKEPROOF

"Fastening Headquarters"®

DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois • Offices in principal cities
In Canada: Canada Illinois Tools Limited, Toronto, Ontario

America's great resources plus a free economy made this business possible!

www.americanradiohistory.com

MEPCO'S NEW SEALED Precision Resistors STOP Humidity Failures

Over 2 years of laboratory development and testing were required to achieve a sealed resistor design up to Mepco's standard of quality. No sacrifice of our standard time-proven features have been made in order to perfect this sealed resistor.

SPECIFICATIONS: Meets all requirements of MIL-R-93A and JAN-R-93.

SEALING: Completely encapsulated and bonded.

OPERATING TEMPERATURE: −65°C. to +125°C.

WINDINGS: Reversed and balanced PI-windings for low inductance with use of only the finest "certified" resistance alloys.

EXCLUSIVE INTERNAL FEATURES: Internal section's cross-over wire insulated from winding by 2000 v. insulation (patented). Special metal molded connecting feature, which bonds end of winding and terminal in a non-corrosive and mechanically secure manner — no solder or flux used.

TERMINALS: Rigid hot solder coated brass terminals for easier and more secure soldering.

TYPE	NOMINAL WATTAGE RATING	RESISTANCE		NO. SECTIONS	SUPERSEDES JAN-R-93 TYPE
		MIN.	MAX.		
RB15 (M15)	.25 .50	0.1 ohm 0.1 ohm	.185 meg. .6 meg.	2	RB10
RB16 (M16)	.35 1.00	0.1 ohm 0.1 ohm	.3 meg. 1.5 meg.	2	RB11
RB17 (M17)	.50 1.00	0.1 ohm 0.1 ohm	.3 meg. 2.0 meg.	4	RB12
RB18 (M18)	.50 1.00	0.1 ohm 0.1 ohm	.75 meg. 4.0 meg.	4	RB13
RB19 (M19)	1.00 2.00	0.1 ohm 0.1 ohm	4.0 meg. 15.0 meg.	8	RB14
RB52 (M52)	.25 .50	0.1 ohm 0.1 ohm	.1 meg. .5 meg.	2	RB51

MIL - R - 93A
WATTAGE & RESISTANCE TOLERANCE

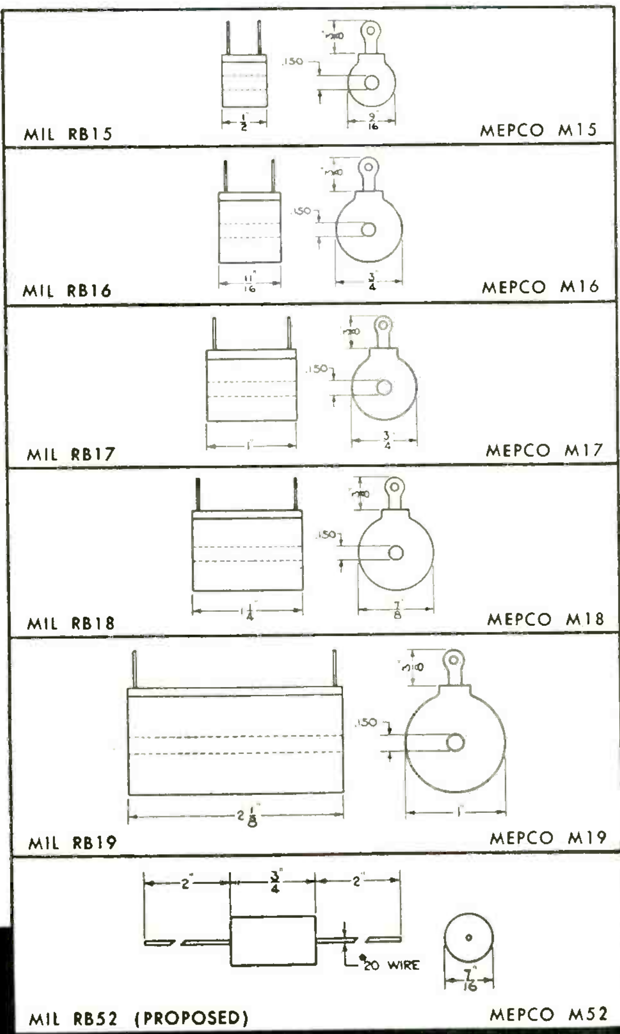
TOLERANCE SYMBOL	RESISTANCE TOLERANCE	PERCENT OF NOMINAL WATTAGE
B	0.10 %	50 %
C	0.25 %	50 %
D	0.50 %	75 %
F	1.00 %	100 %

MIL - R - 93A
TEMPERATURE COEFFICIENT
(REFERRED TO 25°C)

SYMBOL	EXPRESSED IN PERCENT PER DEGREE C.	
	NEGATIVE, MAX.	POSITIVE, MAX.
E	0.0022	0.0022
J	0.0040	0.0155
K	0.0050	0.0255

SPECIAL REQUIREMENTS

Variations of the above ratings, tolerances, temperature coefficient, etc. can be supplied to special order.



MEPCO, INC. MORRISTOWN, NEW JERSEY

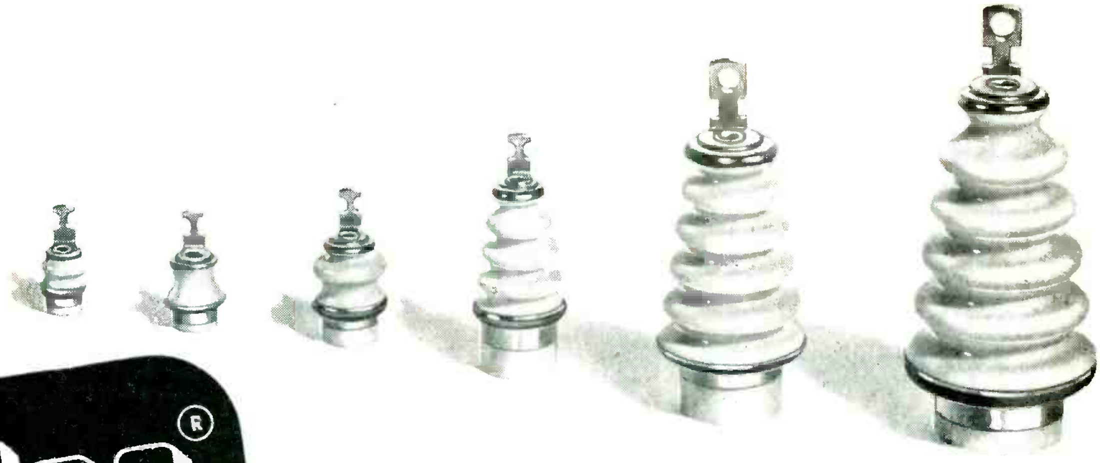
www.americanradiohistory.com

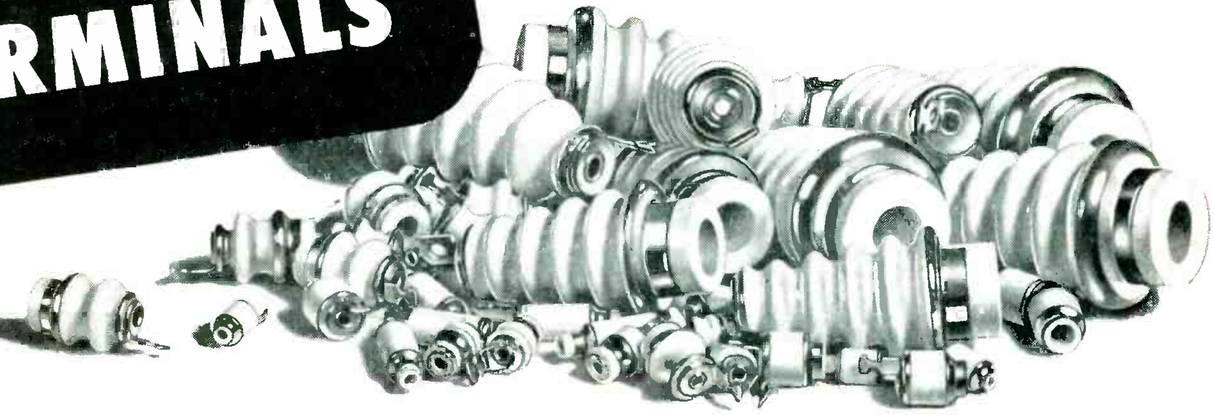
for hermetically sealed electrical components

ALSIMAG®

standard

METALLIZED HERMETIC TERMINALS

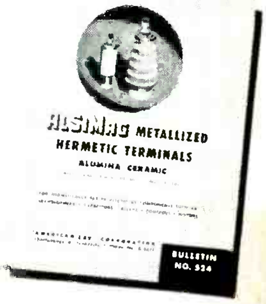




VITRIFIED ALUMINA MATERIAL . . . SUPERIOR METAL-CERAMIC BONDING

Reasonable quantities of all Standard Designs in stock for immediate shipment. Special Designs made to your specifications.

COMPLIES WITH L5A REQUIREMENTS OF JAN-I-10 SPECIFICATIONS



Bulletin No. 524
Sent on Request

52ND YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

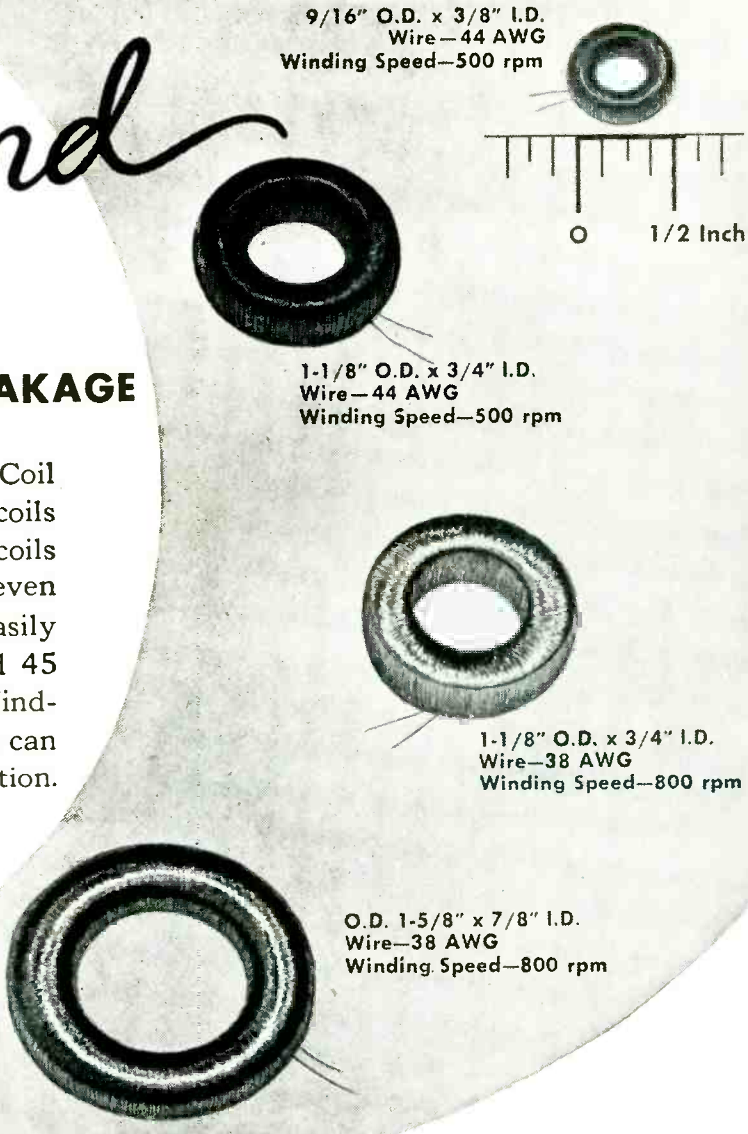
A SUBSIDIARY OF MINNESOTA MINING AND MANUFACTURING COMPANY

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N.J., Mitchell 2-8159 • SYRACUSE, N.Y.: 330 Arlington Ave., Phone 76-5068 • CLEVELAND: 5012 Euclid Ave., Room 2007, Express 1-6685 NEW ENGLAND: 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • PHILADELPHIA: 1649 N. Broad St., Stevenson 4-2823 • ST. LOUIS: 1123 Washington Ave., Garfield 4959 CHICAGO: 228 N. LaSalle St., Central 6-1721 • SOUTHWEST: John A. Green Co., 6815 Oriole Dr., Dallas 9, Dixon 9918 • LOS ANGELES: 5603 N. Huntington Dr., Capitol 1-9114

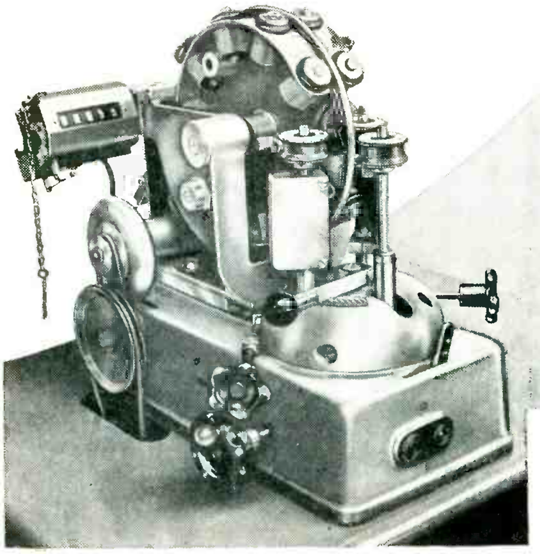
www.americanradiohistory.com

EVENLY *Wind*



SMALL TOROIDAL COILS AT HIGH SPEEDS WITH MINIMUM WIRE BREAKAGE

The MICAFIL Model RW-0 Toroidal Coil Winder automatically winds toroidal coils continuously around 360° and sector coils from 30° to 180°. To produce smooth, even layers of wire, the winder is adjusted easily to wind any wire size between 26 and 45 AWG and to obtain the proper pitch. Winding direction can be changed and feeds can be adjusted while machine is in operation.



CAPACITY

Coil Sizes
- Minimum finished I.D. . . . . ¼"
- Maximum finished O.D. . . . . 2"
- Minimum finished O.D. . . . . ½"

Wire Sizes . . . . 26 to 45 AWG

Winding Speed—
- according to wire size . . up to 800 rpm

Shuttle Capacity—
- according to wire size . . . . 48 to 500 ft.

MICAFIL Toroidal Coil Winders are made in three larger sizes for winding coils up to 8" O.D. and with 11 AWG Wire.

SPIRALING DEVICE—Device winds spirals for shuttle loads—in advance . . . Newly developed to permit continuous operation of Coil Winder . . . Winds to predetermined lengths.

SHUTTLES—Made in four different ring diameters to accommodate range of spiraled wire sizes . . . Larger wire capacities . . . *More than one coil can be wound with single loading* . . . Changed within 2 minutes . . . Loaded in less than a minute.

ACCURATE MECHANICAL TURNS COUNTER—Preset for required number of turns . . . Automatically stops winder when turn count is reached.

Let Cosa Engineers study and recommend the winder for your needs. Or, write for Literature.

COSA CORPORATION
405 Lexington Ave., New York 17

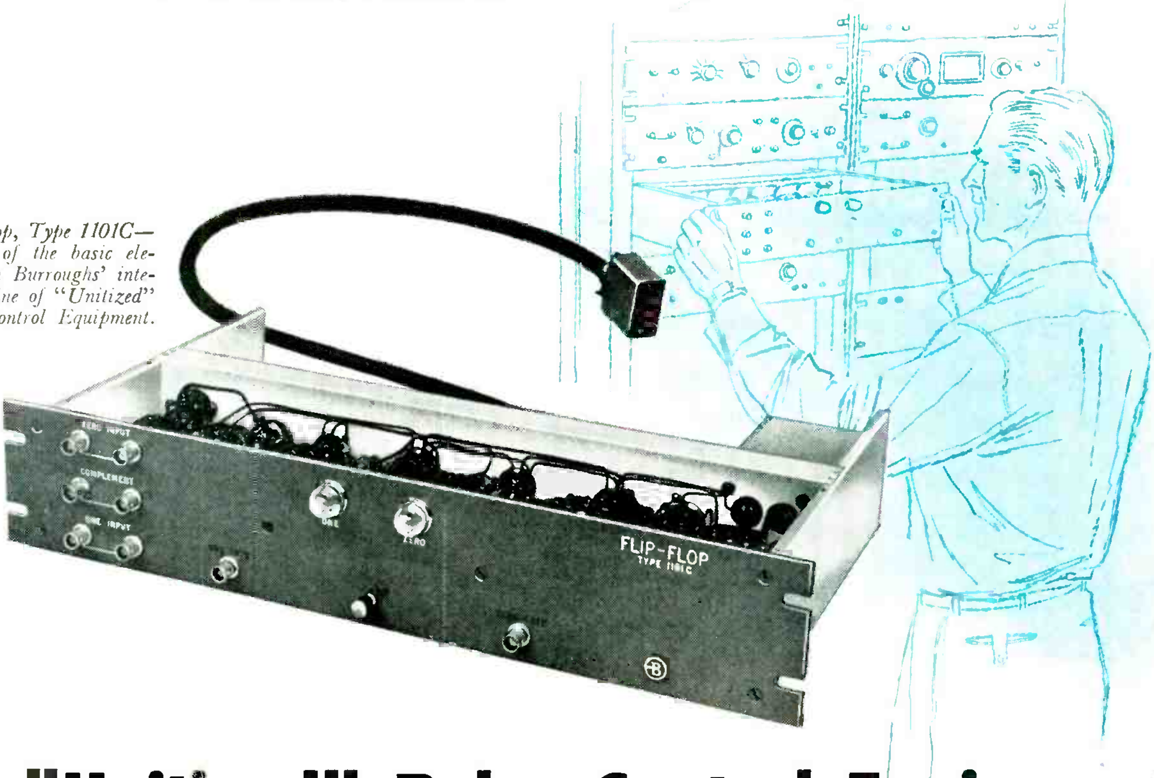
Your source for all Precision Machine Tools—from Small Bench Lathes to Large Boring Mills

IN DETROIT AREA contact COSA CORPORATION of Detroit, 16923 James Couzens Highway, Detroit 35, Mich.

www.americanradiohistory.com

FOR APPLICATIONS IN RADAR, TELEMETERING, DIGITAL COMPUTING, TELEVISION, NUCLEAR PHYSICS

Flip-Flop, Type 1101C—another of the basic elements in Burroughs' integrated line of "Unitized" Pulse Control Equipment.



"Unitized" Pulse Control Equipment

saves time and money in electronic engineering

There's no longer any need to tie up engineering personnel with the time-consuming work of developing and "breadboarding" electronic test circuits. Burroughs, a leader in the office machine industry, now offers an integrated line of "Unitized" Pulse Control equipment covering all the basic functions in pulse circuit engineering. These one-basic-function units are designed with a maximum of flexibility to be used as building blocks for test systems ranging from the very simple to the most complex. Engineers need only make a block diagram of the apparatus needed, assemble the necessary Burroughs units in the plug-in rack, and interconnect them with the various standard coaxial cables and accessories. It's really that easy! It's equally easy to reassemble your units for a different project when your present tests are completed.

YOU SIMPLY "PLUG IN" BURROUGHS FLIP-FLOPS

Burroughs Flip-Flop, Type 1101C, demonstrates the one-basic-function principle that makes Burroughs "Unitized" Equipment so suitable for your needs.

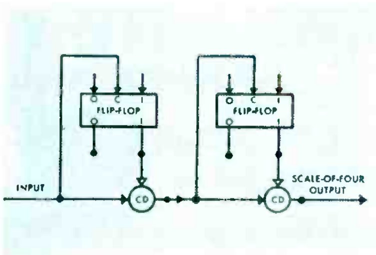
This flip-flop is a bistable circuit designed specifically to provide an output gating voltage to be used in coincidence circuits. The unit contains a pentode Eccles-Jordan circuit capable of being switched at rates up to 2.5 megacycles per second, with 0.1 microsecond pulses.

There are three inputs—Zero, One and Complement—operating from pulse amplitudes of 12 volts or more. Coaxial output jacks marked "Zero Gate" and "One Gate" supply either 0 volts or -23 volts at an impedence level of approximately 680 ohms.

Two neon lights on the front of the panel indicate the position of the flip-flop. A terminal block on the rear of the unit can be used to operate indicator lights installed at a remote point for visual monitoring.

Proved by more than two years of constant use, Burroughs "Unitized" Pulse Control equipment has been purchased by many leading electronic research organizations. Some of the users are: Massachusetts Institute of Technology, University of Michigan, Stanford Research Institute and National Union Radio Corporation.

Scale-of-Four Binary Counter Using Burroughs "Unitized" Equipment



The left flip-flop, Type 1101C, changes state with each input pulse, so that the left coincidence detector (CD) or gate, Type 1201B, is alternately opened and closed with succeeding input pulses, with the result that every other input pulse passes through the left coincidence detector, giving a count of 2. A similar flip-flop and gate combination cascaded to the first combination gives a total scale of 2 x 2 = 4. The number of flip-flop and coincidence detector combinations that can be cascaded is unlimited.

For full information on Burroughs "Unitized" Pulse Control Equipment, write or call Department 12B, Electronic Instruments Division, Burroughs Corporation, 511 N. Broad St., Philadelphia 23, Pa.

PULSE GENERATORS
COINCIDENCE DETECTORS
PULSE DELAYS
FLIP-FLOPS
PULSE GATERS
CHANNEL SELECTORS
MIXERS

ELECTRONIC INSTRUMENTS DIVISION

Burroughs

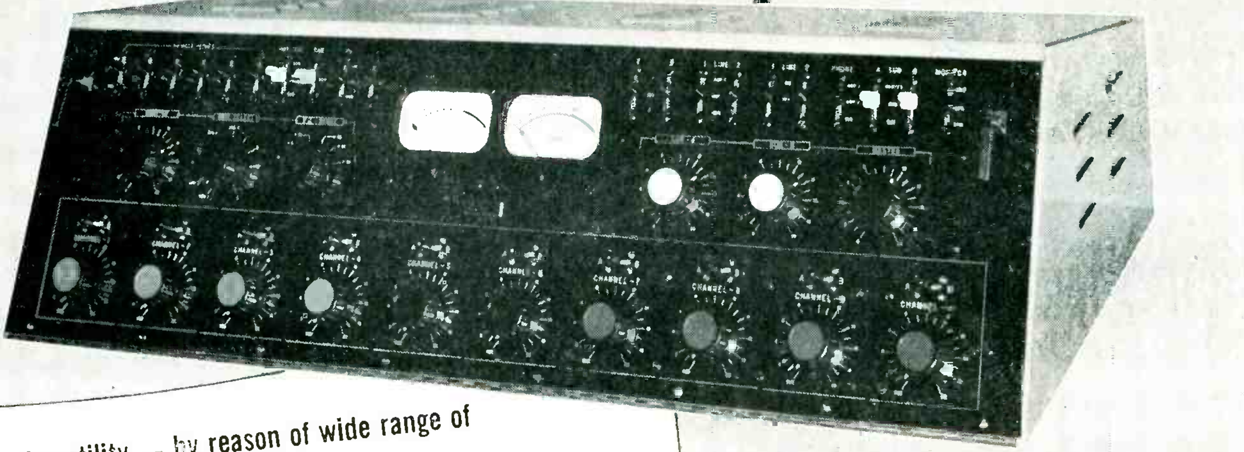
THE BEST KNOWN NAME IN OFFICE MACHINES

Want more information? Use post card on last page.

www.americanradiohistory.com

BEST LONG-TERM INVESTMENT IN TV STUDIO SPEECH CONSOLES

the New GATES CC-1 "Program Master"



- Versatility — by reason of wide range of plug-in amplifiers
- Accommodates 14 plug-in units, 10 pre-amplifiers, 2 line amplifiers, 1 monitoring amplifier, 1 power supply
- Buy this GATES Console with the number of amplifiers needed — add later for expansion

Outstanding Features

- Ten mixing channels
- Provision for ten or lesser number of pre-amplifiers
- Provision for single or duplicate line amplifiers
- Choice of 8 or 16 watt monitoring amplifier
- Complete remote line, cueing, over-ride and auxiliary switching facilities
- Provision for patch panel termination of all major circuits
- Duplicate VU meters
- Group control of any number of mixing positions provided by two SUB and one MASTER gain controls
- Color coded control facilities

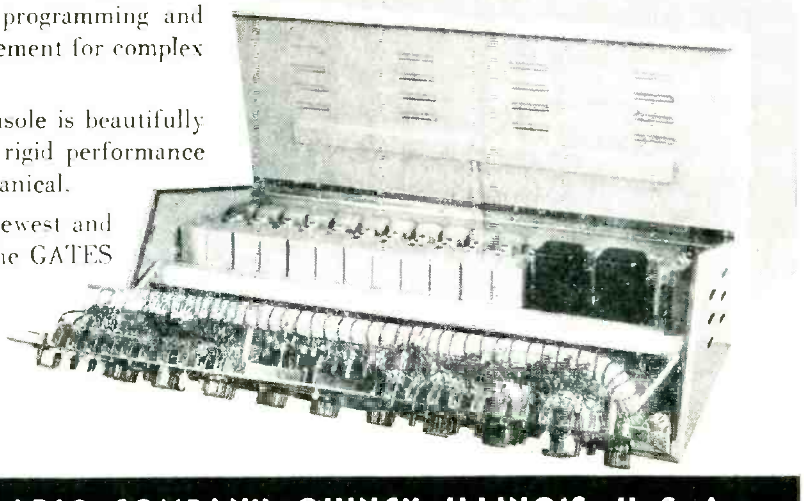
Here is a TV speech console that can grow with your station. Meets ALL large studio demands for TV (and AM too) yet is flexible enough for any station requirement.

It features NEW GATES PLUG-IN amplifiers throughout. There's room for 14 — but you buy only what you need and add later as you need them.

The NEW GATES CC-1 was designed following months of study covering all phases of TV programming and production. It fully meets every requirement for complex or simplified production techniques.

The NEW GATES CC-1 Speech Console is beautifully constructed, providing a new high in rigid performance standards — both electrical and mechanical.

Before you invest, investigate the newest and latest in speech input equipment — the GATES CC-1 "PROGRAM MASTER".



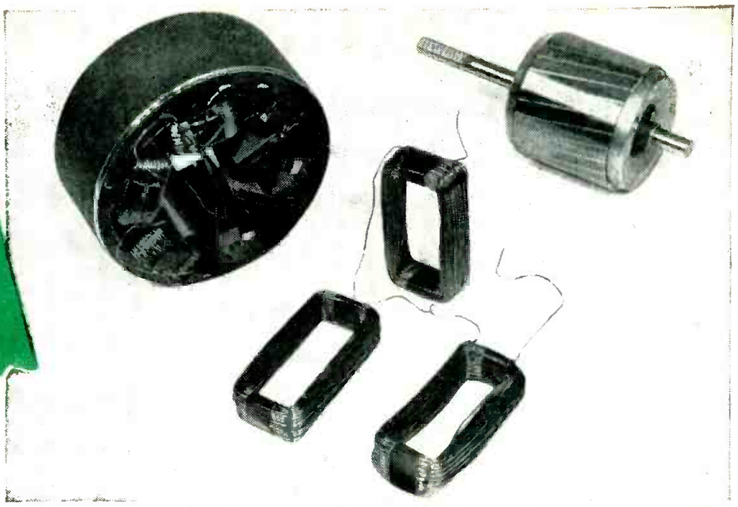
GATES

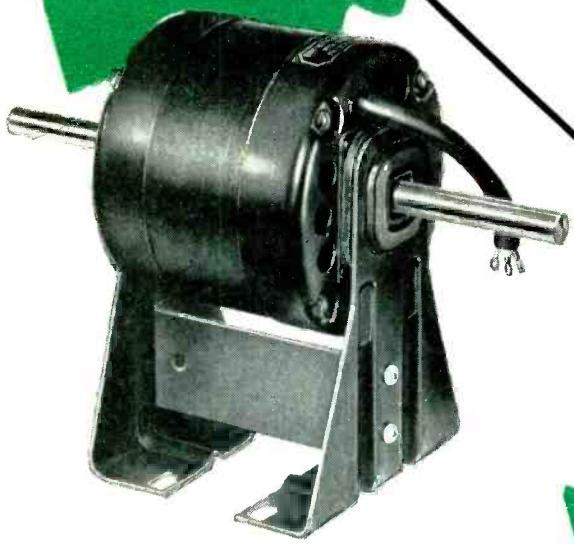
GATES RADIO COMPANY, QUINCY, ILLINOIS, U. S. A.

MANUFACTURING ENGINEERS SINCE 1922

2700 Polk Avenue, Houston, Texas • Warner Building, Washington, D. C. • International Division, 13 E. 40th St., New York City
Canadian Marconi Company, Montreal, Quebec

MARCO SHADED POLE TRI-MOTORS





For Quietness, Efficiency, and Long Life — stators are made from special silicon steel laminations, heat-treated, aligned under hydraulic pressure and solidly riveted. Slot cell insulation is tough Natvar 100% rag paper-varnished cambric, cuffed to fit. Coils are wound from a single length of polyvinyl formal coated magnet wire, eliminating soldered connections. The assembled unit is impregnated with oil and moisture proof varnish and baked in infra red ovens for a permanently sound insulation job.

Are Insulated with NATVAR SLOT CELL INSULATION

Marco Industries, Inc., Depew, N. Y. manufactures "quality motors tailored to your product at readymade prices". They are available in 1/100 — 1/8 H.P. range; 4 and 6 pole; 1, 2 and 3 speed; and in open, enclosed, or fan cooled types.

Their quiet, efficient performance in air moving equipment, office machines, pumps, and many other applications is the result of excellent basic design, modern production and test methods, and careful selection of materials. Natvar Slot cell insulation is used because of its uniformly high dielectric strength and resistance to abrasion, oil, and moisture.

If you need insulating materials with good physical and electrical properties, you can depend on Natvar flexible insulation. It will pay you to get in touch with your distributor or with us direct.

Natvar

Natvar Products

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Varnished-lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 22

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE RAHWAY 7-8800 — CABLE ADDRESS NATVAR: RAHWAY, N. J.

201 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

Want more information? Use post card on last page.

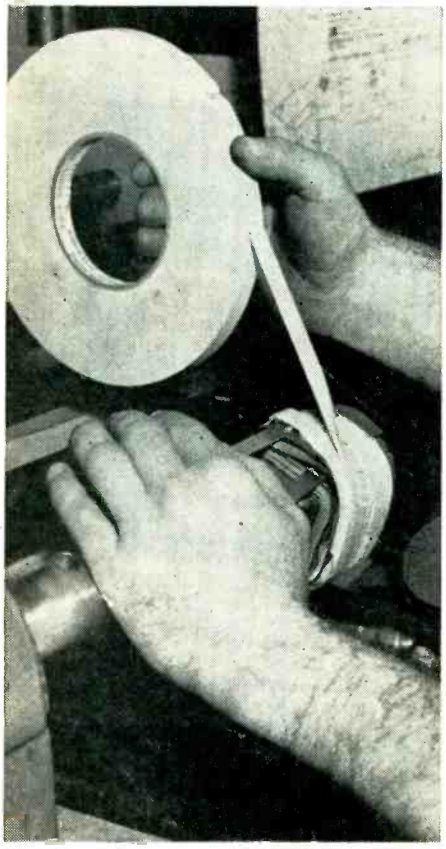
www.americanradiohistory.com

JOB-TAILORED TAPES NEATLY FILL THE BILL AT PECO!

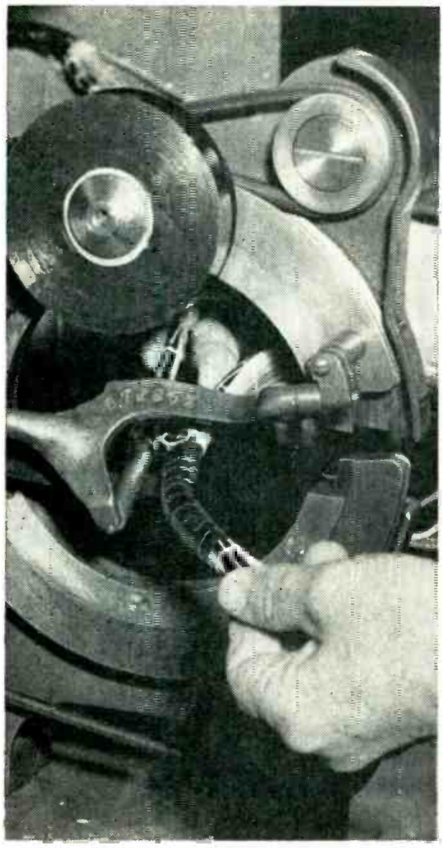
Harnessing and insulating jobs are no headaches at Power Equipment Co., Detroit, Mich. These specialists in controlled rectifiers use the tapes that are tailored to do each job *right*—"Scotch" Electrical Tapes.

Dozens of different "Scotch" Pressure-Sensitive Electrical Tapes are available to help *you* meet your rigid specifications, too. There are tapes with thermosetting adhesives, tapes with special backings of vinyl plastic, treated paper, glass cloth, acetate and neoprene. They're all clean to handle, easily and quickly applied. They all stick at a touch—right off the roll.

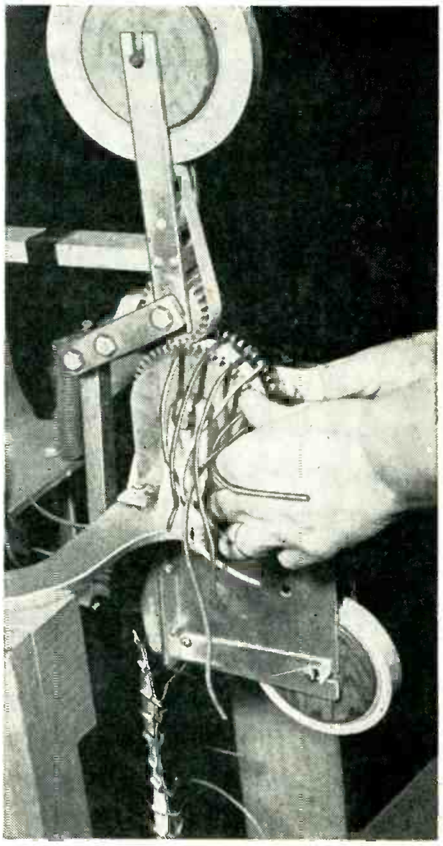
You name it—"Scotch" Brand has it! For complete information write Minnesota Mining & Mfg. Co., Dept. E-83, St. Paul, Minn.



ANCHORING sheet leads on this PECO transformer coil requires a strong but not bulky tape. The job is done to order with "Scotch" Electrical Tape No. 45. Sheet leads can be punched, then wired directly to the transformer. No terminal bond is needed.



INSULATING a PECO rectifier harness calls for a compact tape with high dielectric. Here, *super-thin* "Scotch" Plastic Electrical Tape No. 33 neatly meets specifications. Has dielectric strength of 10,000 volts, yet is only 7 mils thick! Carries UL seal.



SADDLING terminal lead-outs for PECO coils is correctly done with "Scotch" Electrical Tape No. 38. Thermosetting adhesive is heat-cured to form a permanent bond, highly resistant to solvents. Caliper: 10 mils. Dielectric strength: 1500 volts. Treated paper backing.

3M COMPANY

The term "Scotch" and the plaid design are registered trademarks for the more than 200 pressure-sensitive adhesive tapes made in U. S. A. by **Minnesota Mining & Mfg. Co., St. Paul 6, Minn.**—also makers of "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N. Y. In Canada: London, Ont., Can.

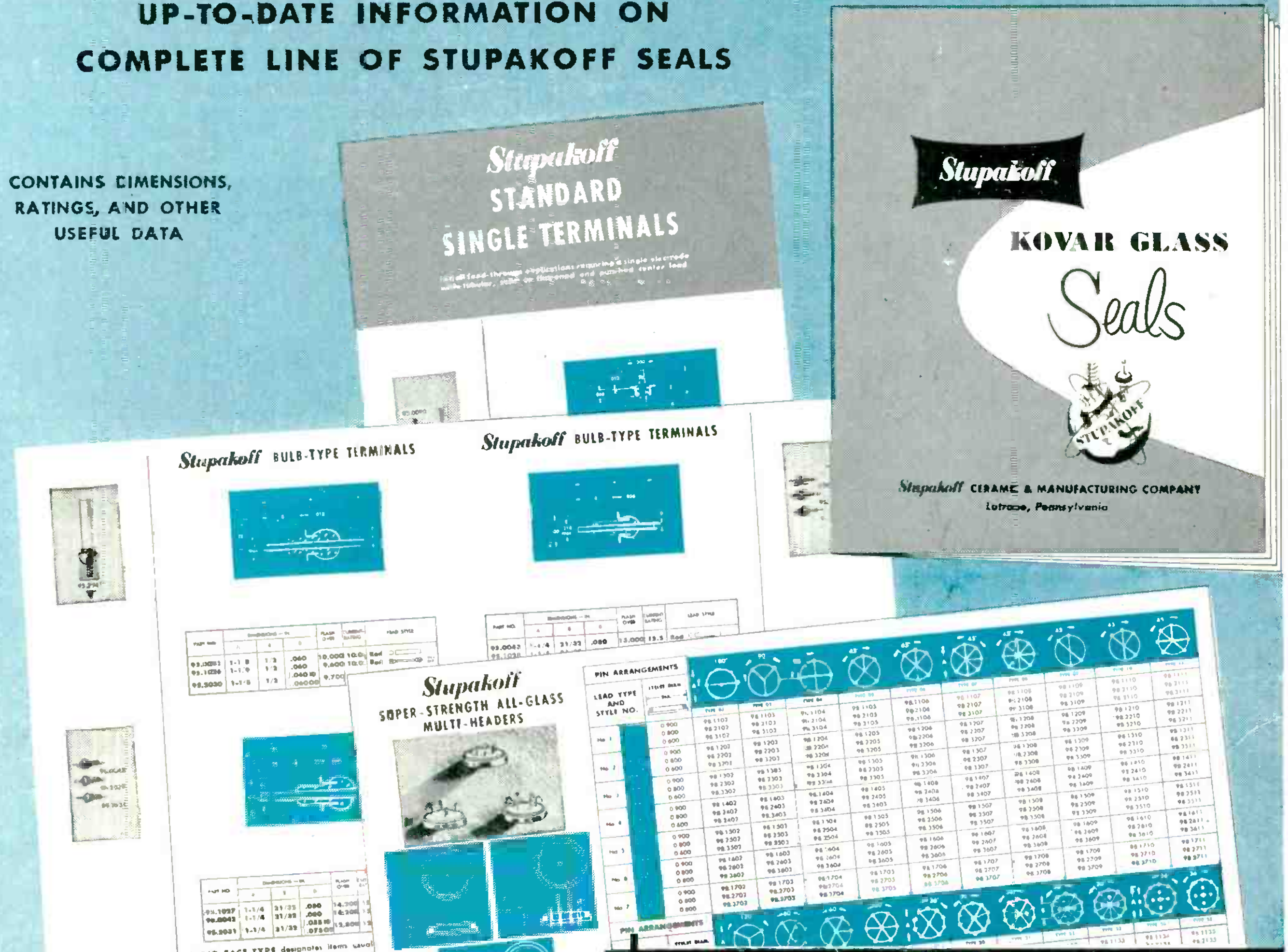
REG. U. S. PAT. OFF.
SCOTCH
BRAND
ELECTRICAL TAPES

www.americanradiohistory.com

new catalog now available!

UP-TO-DATE INFORMATION ON COMPLETE LINE OF STUPAKOFF SEALS

CONTAINS DIMENSIONS, RATINGS, AND OTHER USEFUL DATA



In addition to information on standard and special types of seals, this 32-page catalog has an engineering section with suggestions for manufacturers who wish to develop their own designs.

STUPAKOFF
CERAMIC & MANUFACTURING CO.
LATROBE, PENNSYLVANIA

Send for FREE copy Today!

STUPAKOFF CERAMIC & MANUFACTURING CO.
Latrobe, Pennsylvania

Please send me a copy of the new Stupakoff Kovar-Glass Seals Catalog, No. 453.

Name ____________________

Company ____________________

Address ____________________

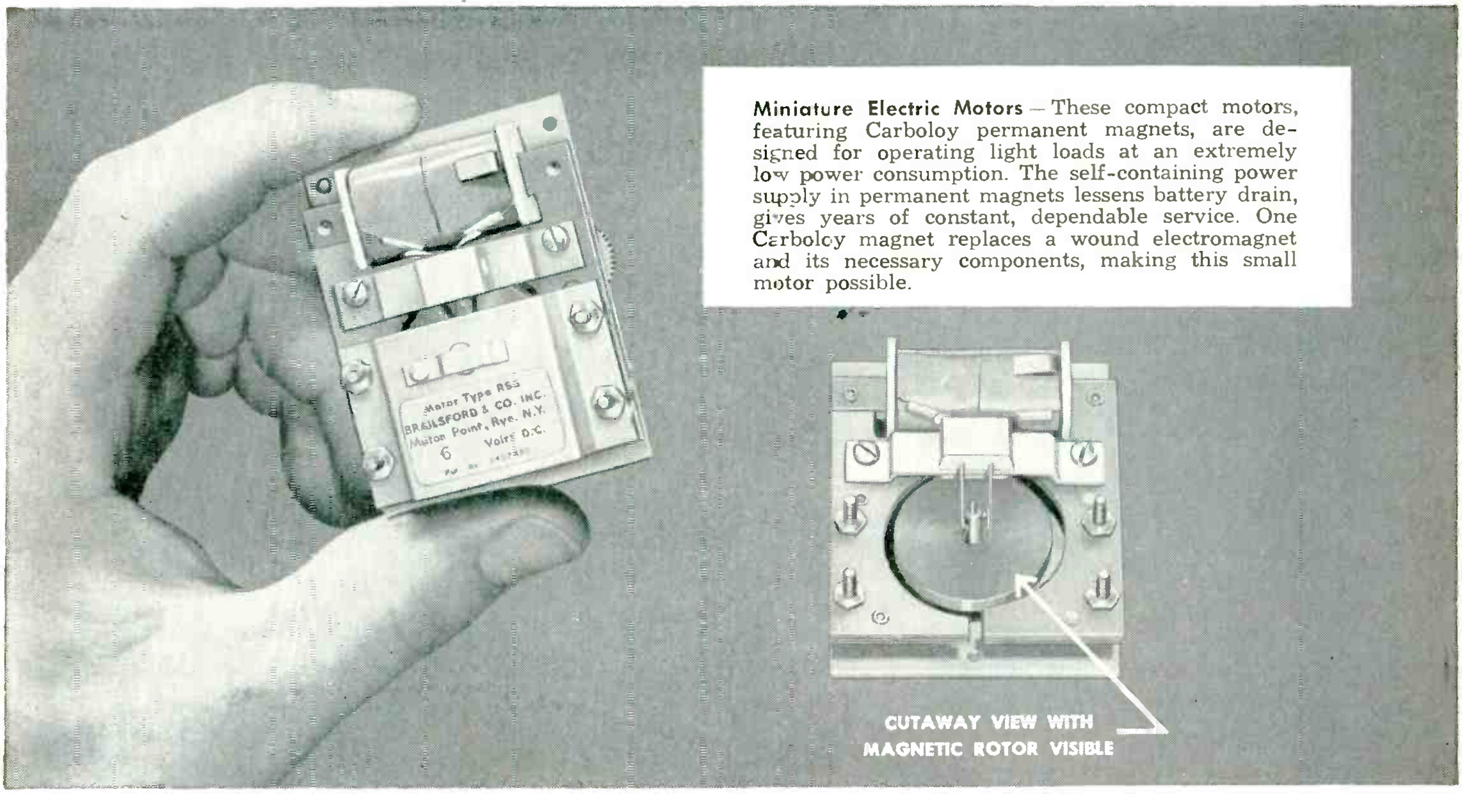
City ____________________ State ____________________

(E)

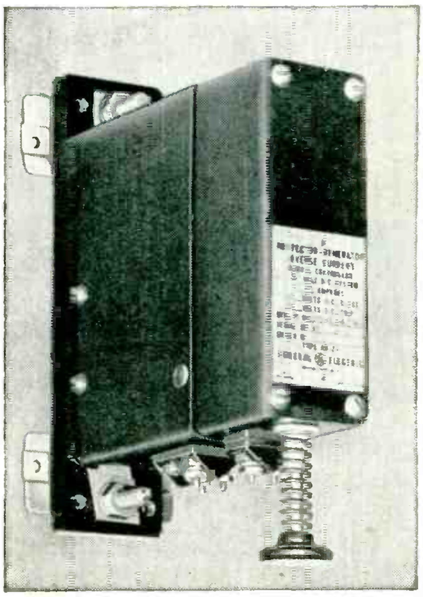
Want more information? Use post card on last page.

www.americanradiohistory.com

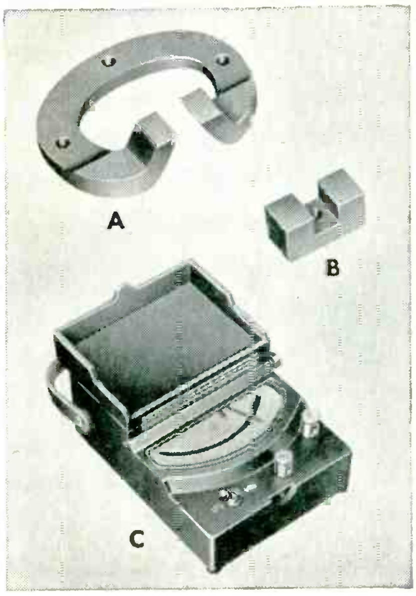
Why electrical products using weigh less, cost less,



Miniature Electric Motors — These compact motors, featuring Carboloy permanent magnets, are designed for operating light loads at an extremely low power consumption. The self-containing power supply in permanent magnets lessens battery drain, gives years of constant, dependable service. One Carboloy magnet replaces a wound electromagnet and its necessary components, making this small motor possible.



Circuit Breakers — Here, a Carboloy magnet assembly simplifies trip element. It eliminates a coil and polarizing connection . . . makes possible reverse-current tripping independent of system voltage. Breaker weighs less, costs less to build.



Instruments — Figure A is damping magnet once used in GE indicators. Figure B is tiny Carboloy magnet now used. It permits smaller indicator design (Fig. C), cuts materials and assembling costs . . . speeds up calibrations.

YOU GET ALL THESE BENEFITS IN CARBOLOY PERMANENT MAGNETS

- Cool—generate no heat
- Require no electrical energy
- Cost nothing to operate
- Eliminate coils, windings, wiring, etc.
- Need no maintenance—no coils to burn out, no slip rings to clean or replace, etc.
- Simplify mechanical assemblies—exert strong tractive force for holding, lifting and separating devices that eliminates component parts, makes product design and fabrication simple.
- Save space—great magnetic strength in small sizes
- Powerful—and power is constant
- Combine electrical and mechanical features—transform electrical energy into mechanical motion; mechanical motion into electrical energy
- No power failures ever
- Resist moisture—no coils to collect dampness
- Give uninterrupted operation
- Create savings—often eliminate costly, power-supplying parts
- Simple—no operating parts
- Reduce weight, product size
- Supply a permanent source of energy

www.americanradiohistory.com

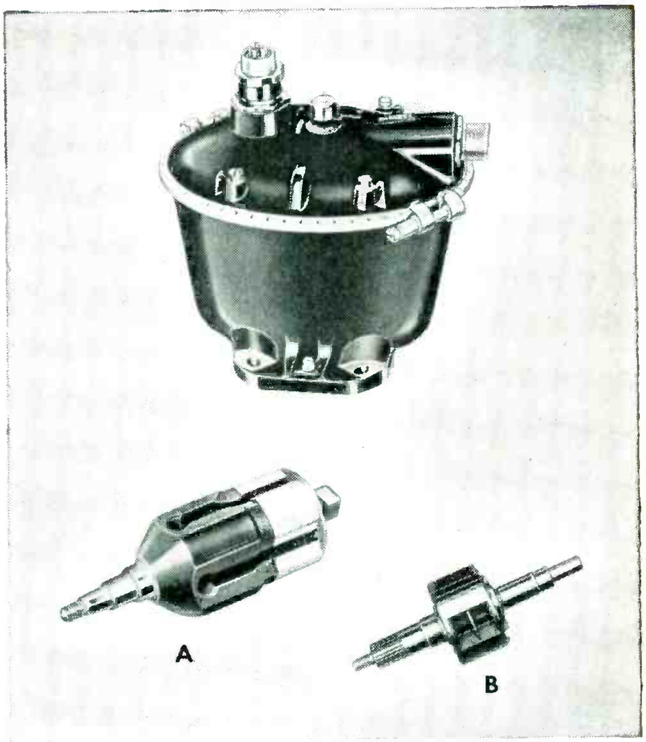
Carboloy permanent magnets work better

If you manufacture any electrical device using an electromagnet, you will probably save money by substituting, instead, a Carboloy permanent magnet.

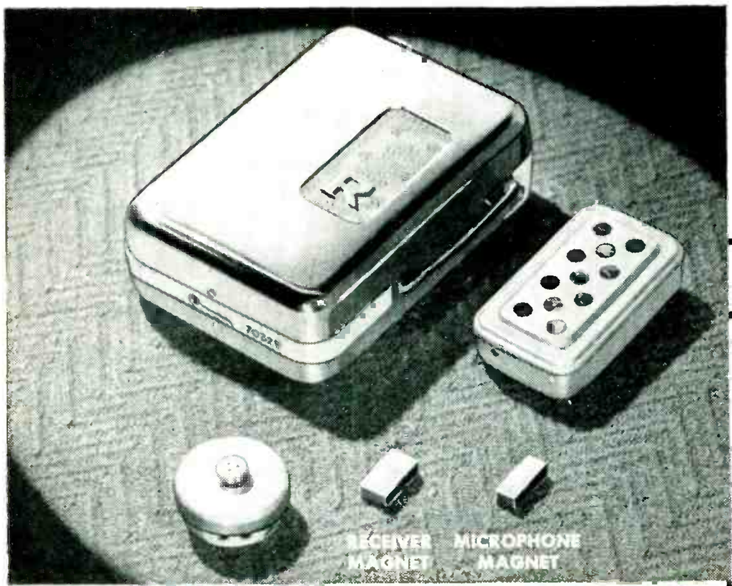
For these magnets are permanent *sources* of energy that need no wires, coils or operating parts. Their power and small size let you simplify design, build more compact, finer-performing products, and save on material and assembly costs.

Check the magnet applications on these pages. Perhaps they'll suggest similar uses in your product. If so, contact a Carboloy magnet engineer. He'll welcome the chance to work with you on your design and application idea . . . at no charge, of course.

And the Carboloy name assures you of high-quality, uniform, high-energy permanent magnets in any size, shape; cast or sintered to your specifications. Send coupon for free Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.



Magnetos — To save space and weight, Scintilla Magneto Division, Bendix Aviation Corporation, now makes aircraft magneto rotors from Carboloy permanent magnets. Figure A shows old-style rotor that weighs 4 lbs. 9 ozs. Figure B shows new rotating Carboloy permanent magnet weighing only 2 lbs. 4 ozs. — less than half as much as old-style rotor.



Hearing Aids — New all-magnetic, all-transistor "Radioear" hearing aid (made by E. A. Myers & Sons, Inc., Pittsburgh) uses Carboloy permanent magnets in *both* microphone and receiver. These magnets have eliminated hearing aid failure caused by severe heat and humidity encountered in normal use.

CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

Plants at Detroit and Edmore, Michigan

"Carboloy" is the registered trademark for the products of the Carboloy Department of General Electric Company

MAIL COUPON TODAY

Carboloy Department of General Electric Company
11139 E. 8 Mile Street, Detroit 32, Michigan

Sirs:

Rush me, without cost or obligation, copies of Permanent Magnet Design Manual PM-101 and Standard Stock Catalog PM-100.

Name ____________ Position ____________

Company ____________

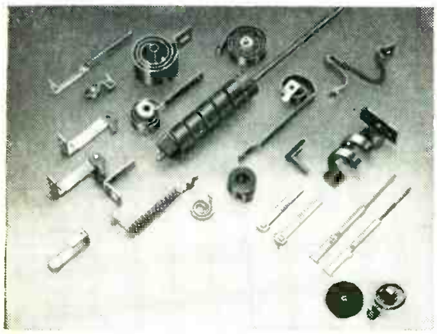
Address ____________

City ____________ Zone ______ State ______

Want more information? Use post card on last page.

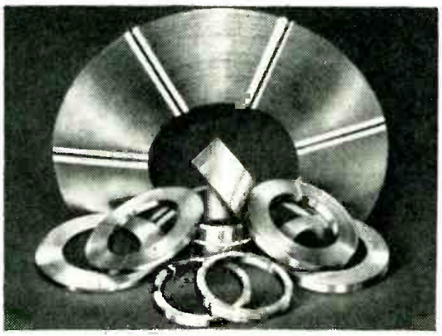
www.americanradiohistory.com

General Plate Products
that solve your Electronic Problems



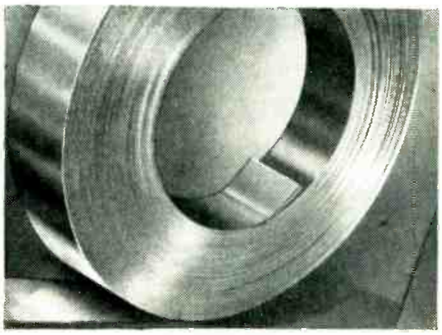
TRUFLEX THERMOSTAT METALS

TRUFLEX thermostat metals are manufactured in a wide variety of types, each with a different reaction to temperature. Uniformity of metal insures accurate and consistent performance. Precision parts fabricated to exact specifications.



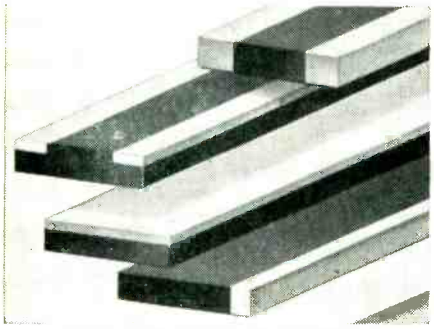
COMPOSITE METALS

Available in practically any combination of precious to precious, precious to base or base to base metals. Combinations for electronics include aluminum-clad iron, nickel-clad iron for anode materials.



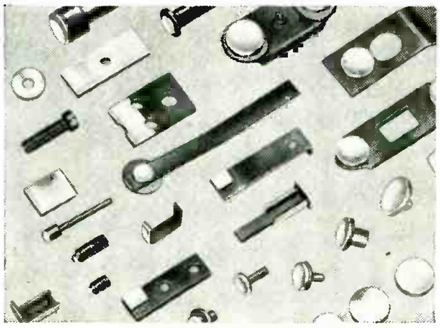
ALCUPLATE

Copper-clad aluminum for component cases or cans, chassis, cooling fins, etc., light weight, excellent conductivity. Copper surface is ideal for soft soldering and electroplating.



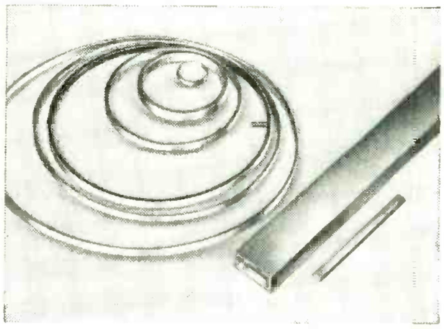
COMPOSITE CONTACT MATERIAL

Precious metals and alloys bonded to base metals available in following types — overlay, single and double edgelay, single and double inlay, Top-Lay, ready for you to fabricate into contacts.



COMPOSITE CONTACTS

General Plate can supply all types of fabricated composite contacts, buttons, rivets, contact assemblies made to customer's specifications. These contacts give electrical conductivity and long life at reduced costs.



WAVE GUIDE and COLLECTOR RINGS

RECTANGULAR WAVE GUIDES. Solid silver, silver lined brass or aluminum. Sizes to government specifications. COLLECTOR RINGS. Solid silver or precious metal on base metal. All sizes.

GENERAL PLATE PRODUCTS

- **Alfer, Alnifer, Nifer** — Aluminum and Nickel-clad steel for anode plates.
- **Alcuplate®** — Copper-clad aluminum for component cases, chassis, cooling fins, condenser blades, etc.
- **Alsiplate®** — Silver-clad aluminum for lightweight condensers, etc.
- **Composite Contacts and Contact Materials**—Increased strength and longer life at reduced cost.
- **Collector Rings** — Fabricated from solid precious metals or precious-clad base metals. Sizes ranging from fraction of an inch to few feet in diameter.
- **Truflex® Thermostat Metal** — Sheet, strip, formed elements and assemblies produced to specification.
- **Thin Gauge Metals** — Beryllium copper, nickel, pure beryllium, Haynes Stellite alloys, etc.
- **Platinum-Group Metals** — Sheet, wire, tubing, parts of all types. Complete assay and refining facilities for platinum-group metals.
- **Silver and Gold Brazing Alloys** — Available as sheet, wire, powder and fabricated parts.
- **Bondwich** — Solder-clad brazing shim for carbide-tipped tools.
- **Bronco** — Phosphor Bronze-clad copper for high conductive springs.
- **Conflex** — Copper-clad spring steel for electrical and thermal conductive springs at low cost.
- **#720 Manganese Age-Hardening Alloy** — Corrosion resistant spring material for diaphragms, springs, finger stock, etc.
- **Rectangular Wave Guide Tubing** — Wide range of sizes to government specifications.

Write for catalog PR700

General Plate Composite Metals, made by metallurgically bonding one metal to another, are available in sheet, strip, tubing or wire in various widths, thicknesses and diameters.

Silver, gold and platinum-group metals bonded on base metals give solid precious metal performance at a fraction of the cost of solid precious metal. The precious metal provides specific performance requirements such as electrical conductivity and corrosion resistance while the base metal provides workability, strength, and solderability.

Composite base metals provide a new group of engineering metals with properties not available in solid metals. Their use frequently results in lower material costs as compared to solid metals.

In many electronic applications further economy results when General Plate supplies fabricated parts ready for assembly into your product. General Plate makes an infinite variety of fabricated parts, such as electrical contacts, collector rings and TRUFLEX thermostat metal parts to customer's exact specifications.

General Plate Engineers will gladly help you with your problems.

You can profit by using General Plate Composite Metals!

METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
38 FOREST STREET, ATTLEBORO, MASSACHUSETTS

www.americanradiohistory.com

ELECTRONIC TEST INSTRUMENTS

Read the

HEWLETT·PACKARD
JOURNAL
TECHNICAL INFORMATION FROM THE -hp- LABORATORIES

...for up-to-the-minute news of electronic developments, techniques and instrumentation, sent regularly without charge

The *-hp-* Journal is an engineering periodical sent to you as another service of the Hewlett-Packard Company. It is written for engineers, by engineers. Typical papers discuss such subjects as:

"Design notes on the RC Oscillator Circuit"
"Direct-Reading UHF Power Measurements"
"Good Practice in Slotted Line Measurements"
"New 100 kc Counter for Electronics and Industry"

Articles also contain technical data, performance information and operating suggestions for *-hp-* test instruments. All issues are fully illustrated.

WEST COAST ELECTRONIC MANUFACTURERS ASSOCIATION · MEMBER

See us at WESCON
San Francisco
Booths 1111,1112

Write today for your free subscription
(Please give your title or position; or state if engineering student)

HEWLETT-PACKARD COMPANY
2784A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
SALES REPRESENTATIVES IN ALL PRINCIPAL AREAS

WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF ELECTRONIC TEST INSTRUMENTS
Vacuum Tube Voltmeters - Audio Oscillators - Frequency Counters, Monitors and Standards - Audio, VHF, UHF and SHF Signal Generators - Square Wave Generators - FM and TV Broadcast Monitors - Wave and Distortion Analyzers - Slotted Lines - Tunable Bolometer Mounts - VHF Bridges - VHF Detectors - Microwave Test Equipment and Power Meters - Standing Wave Indicators - Low Pass Filters - Electronic Frequency Meters - Attenuators - Wide Band Amplifiers - Regulated Power Supplies - Electronic Tachometers Voltage Dividers, Multipliers, Shunts - Accessories

Instruments for Complete Coverage

Want more information? Use post card on last page.

www.americanradiohistory.com

ALLIED CONTROL'S NE

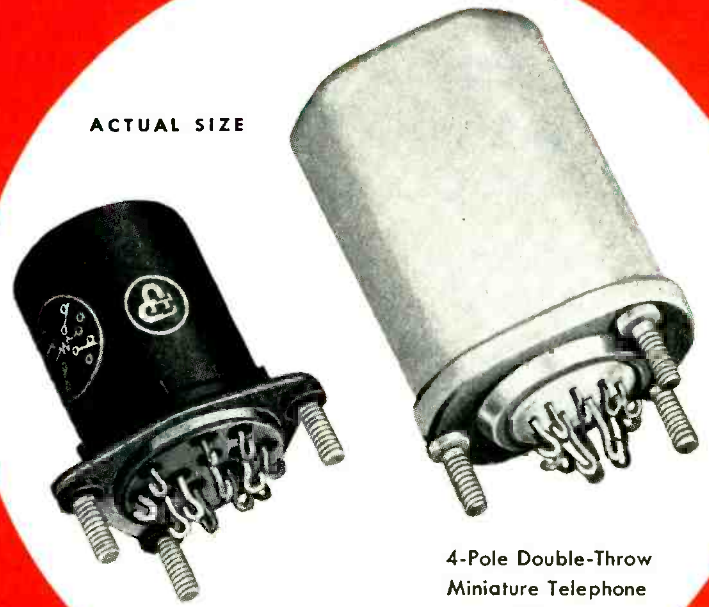
✓ SIZE CUT 66%

✓ WEIGHT CUT 48%

✓ RELIABILITY DOUBLED

✓ WRIGHT FIELD APPROVED

ACTUAL SIZE



New MH-12 with Interchangeable Mounting

4-Pole Double-Throw Miniature Telephone Relay

Designed to withstand a shock of 50G, these new Allied Control double-throw miniature relays were developed to meet the rigid requirements of U.S.A.F. Specifications MIL-R-5757A.

Known as the Allied MH series, this new line of relays consists of the 6-pole MH-18, the 4-pole MH-12, and the 2-pole MH-6. Contacts are rated at 2 amps resistive or 1 amp inductive at 28 volts D. C.

The high performance of these relays has been achieved in an extremely compact, unitized construction and parallels the most recent advances in airborne equipment design. The "actual size" photographs shown above highlight the 66% savings in overall size, the 48% savings in weight and the 30% reduction in chassis area.

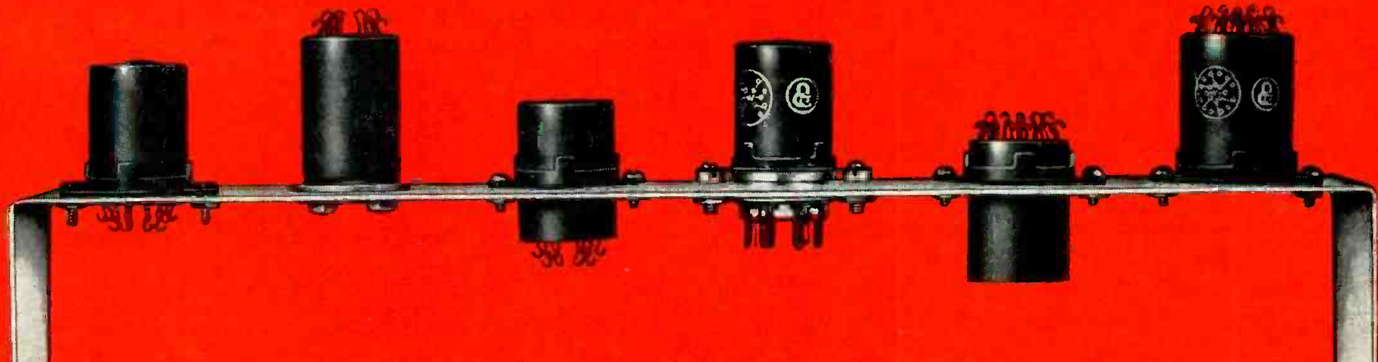
For detailed specifications and drawings of these new relays, contact your local Allied Control Representative or write us for Bulletin 1002.

www.americanradiohistory.com

W 50 G MINIATURE RELAY

APPROVED MIL-R-5757A

SIX DIFFERENT MOUNTINGS



1. Standard Mounting
2. Flush Mounting—2 Studs at 5/8" Centers
3. Thru-Chassis Mounting—Terminals Down
4. Plug-In Mounting With Socket
5. Thru-Chassis Mounting—Terminal Up
6. Flush Ring Mounting

6-POLE
MH-18

4-POLE
MH-12

2-POLE
MH-6

FEATURES

Wide Ambient Temperature Range: *55°C to 85°C standard—65°C to 125°C MHB-type*

Vibration Resistant: *15G's vibration to 500 cycles* • **Operating Shock:** *no contact chatter to over 50G's*

High Altitude: *seal-tested to 70,000 feet*

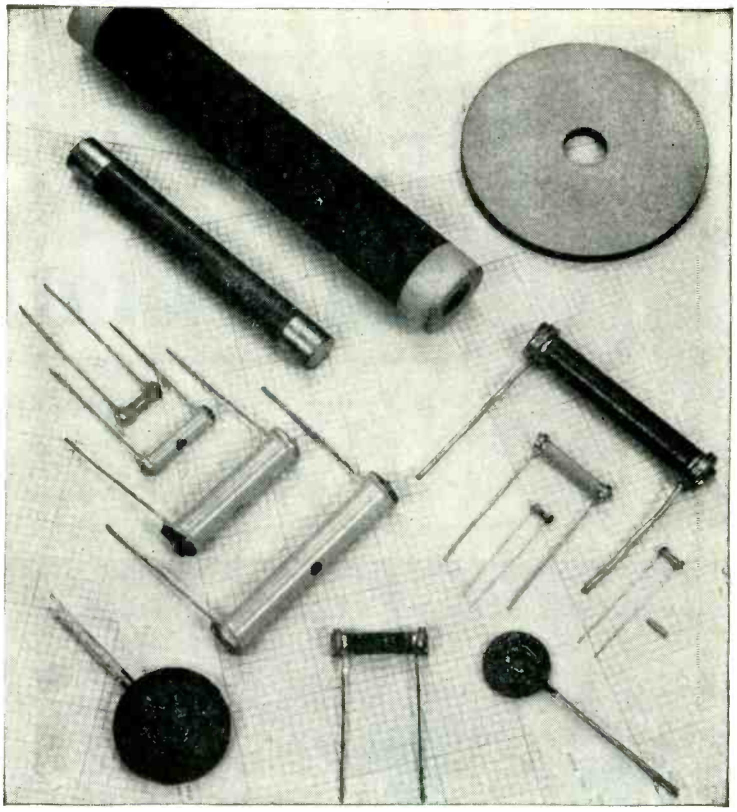
Dependable Operation: *life expectancy of over 1 million operations at rated load*

High Speed: *operate-to-make time under 8 ms.*
release-to-make time under 4 ms.
release-to-break time under 2 ms.

ALLIED CONTROL COMPANY, INC.
2 EAST END AVENUE, NEW YORK 21, N. Y.

www.americanradiohistory.com

Wanted! Tough circuit problems for GLOBAR Ceramic Resistors



To help you solve those tough problems, five types of GLOBAR Brand Ceramic Resistors, with distinctly different characteristics, are available in a wide range of shapes and sizes. Whenever you have difficult temperature or voltage compensation problems in your electrical or electronic circuits, you can count on GLOBAR Ceramic Resistors to help you out. In ordinary circuits, too—wherever maximum resistor life and dependability are required—try GLOBAR Ceramic Resistors.

GLOBAR Ceramic Resistors are engineered to meet your *exact* requirements. They are electrically fired in one piece, and will withstand the severest service. They are always uniform, because they are strictly controlled from design and manufacture to final inspection.

GLOBAR Brand Ceramic Resistors

TYPE	TEMPERATURE COEFFICIENT	VOLTAGE COEFFICIENT	DISSIPATION CAPABILITY
"A"	LOW	LOW	NORMAL
"CX"	LOW (POSITIVE)	PRACTICALLY ZERO	EXCEPTIONAL
"B"	MODERATE (NEGATIVE)	MODERATE	NORMAL
"F"	HIGH (NEGATIVE)	PRACTICALLY ZERO	ABOVE NORMAL
"BNR"	MODERATE (NEGATIVE)	EXTREMELY HIGH	NORMAL

If you have a resistor problem, let our engineers help you—without obligation, of course. Just send complete circuit information.

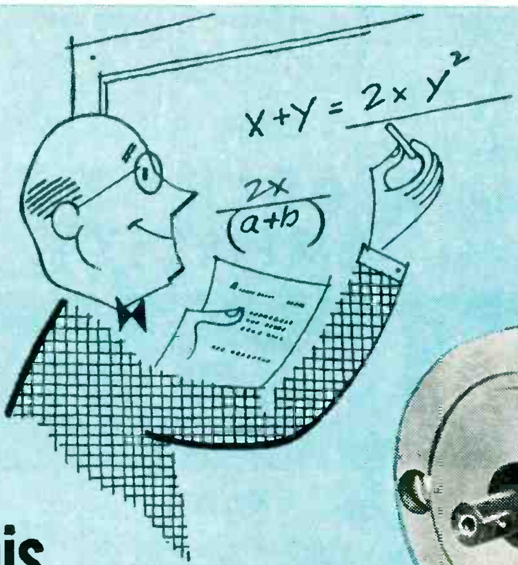
For useful engineering data on GLOBAR Ceramic Resistors, write for your copy of Bulletin R to Dept. E 87-124.

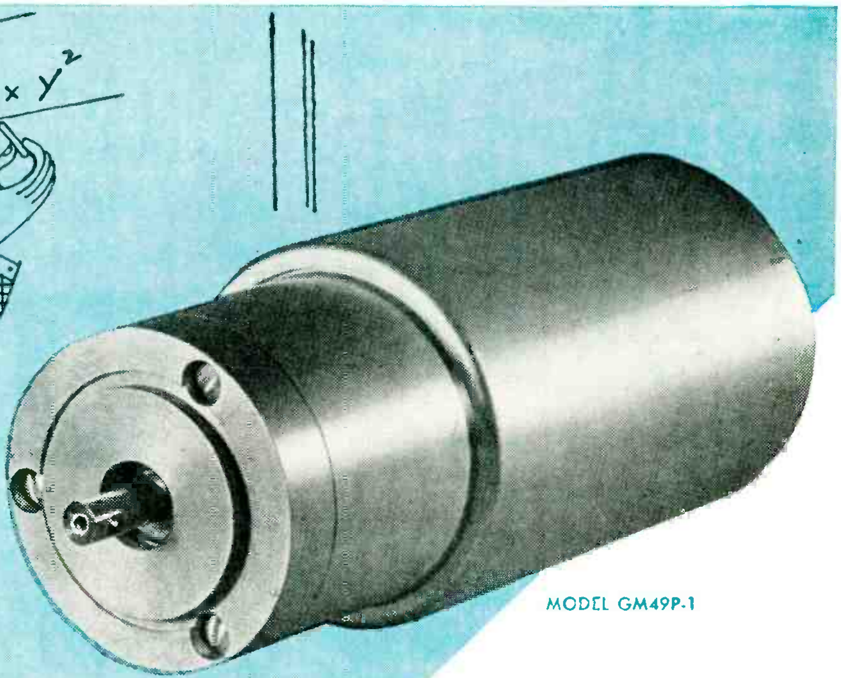
GLOBAR
TRADE MARK
Ceramic Resistors
by CARBORUNDUM

"Carborundum" and "Globar" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, New York

87-124

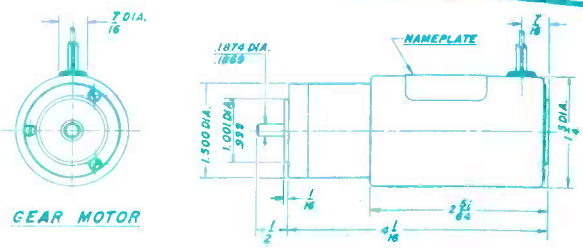
www.americanradiohistory.com





MODEL GM49P-1

this EAD motor has a "head" for torque problems



SPECIFICATIONS FOR MODEL GM49P-1

400 Cycle Capacitor Run Induction Gear Motor

115 Volts • 400 Cycles • 1 Phase • 0.5 Amps.
Full Load Torque: 100 Oz.-In.
Starting Torque: Over 100 Oz.-In.
Gear Head Lubricated per Mil-G-3278
22 R.P.M. • 314 to 1 Gear Ratio • Reversible Rotation
Intermittent Duty: 15 Minutes on, 15 Minutes off

Ambient Temperature: −55° to +74° C

Altitude: to 50,000 Ft.

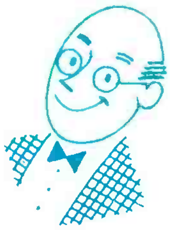
TYPICAL APPLICATIONS

- Military and Aircraft
- Follow Up Devices
- Instrument Controls
- Automatic Controls
- Automatic Pilot
- Radar Equipment
- Electronic Control
- Actuators
- Timers

A precision gear head combined with a miniature motor gives you the answer to high torque at low speed. The motor can be 60 cycle, 400 cycle or variable frequency—in single, two or three phase—with non-cooled or self-cooled frame types. The gear head is arranged to provide the output speed you require, with standard timing ratios of 60, 3600 or 8000 to 1 possible. High output torques, to drive, actuate or control, in confined areas, make this line of tiny gear motors ideal for a wide variety of applications on the ground and in the air.

SOLVING SPECIAL PROBLEMS IS ROUTINE AT EAD

If your problem involves rotating electrical equipment, bring it to EAD. Our completely staffed organization will modify one of our standard units or design and produce a special unit to meet your most exacting requirements.



EAD

EASTERN AIR DEVICES, INC.

585 DEAN ST., BROOKLYN 17, NEW YORK

Want more information? Use post card on last page.

www.americanradiohistory.com

ANOTHER **RMC** FIRST!

STABLE CAPACITY DISCAPS®

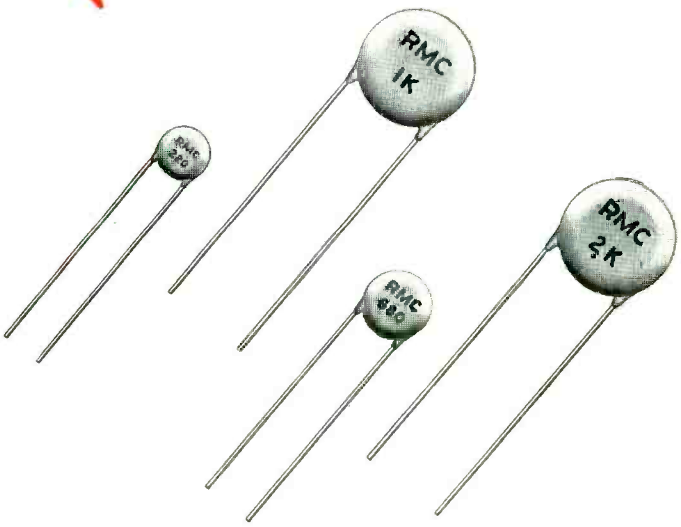
Type J

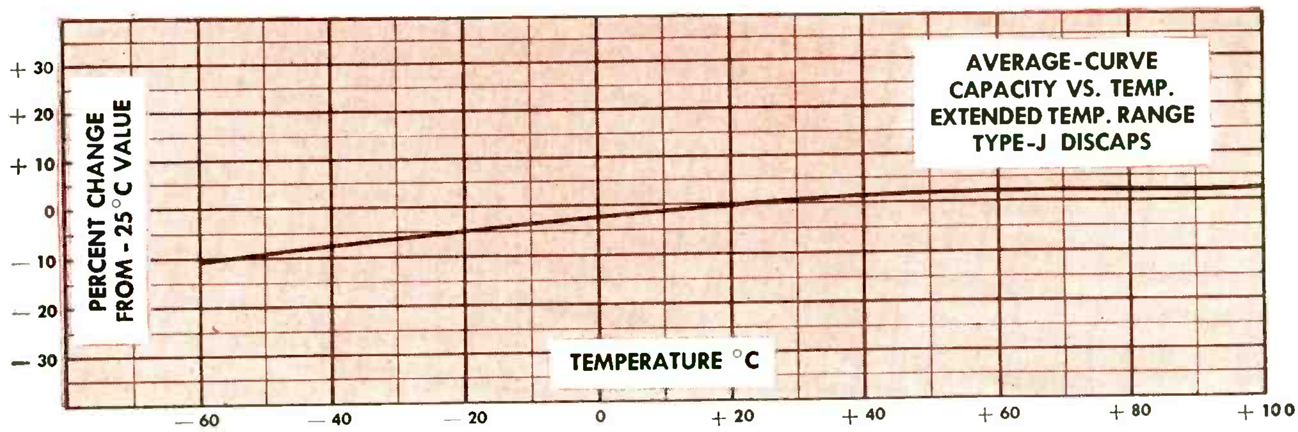
When you have an application requiring a capacitor with maximum stability over an extreme temperature range specify RMC's new Type J DISCAPS.

Because of RMC's exclusive dielectric element design the actual capacity change of Type J DISCAPS between —60°C and +100°C is only ±15% of the capacity at 25°C. Between +25°C and +85°C the change is only ±5% of the capacity at 25°C. Type J DISCAPS are rated at 1000 working volts.

Now available in capacities between 220 MMF and 2000 MMF, Type J DISCAPS combine exceptional mechanical and dielectric strength with a moderate price for trouble free performance and lower production costs.

If you have a design problem requiring a standard or special type of ceramic capacitor we invite your inquiry.





A New Development from the RMC Technical Ceramic Laboratories

SEND FOR SAMPLES AND TECHNICAL DATA

DISCAP CERAMIC CONDENSERS

RMC

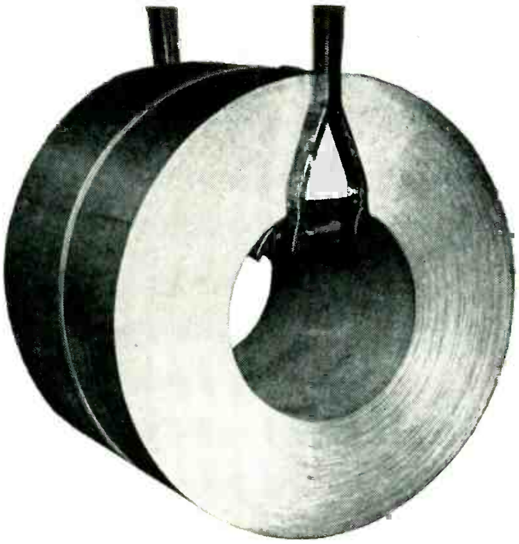
RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

DISTRIBUTORS: *Contact* Jobber Sales Co., 146 Broadway, Paterson 1, N. J.

www.americanradiohistory.com



Long coils of DI-MAX Quality permit continuous press operation, eliminate end-of-sheet scrap losses.

COLD FINISHING gives you This Improved Electrical Steel

Armco DI-MAX, a hot-rolled electrical steel with a **cold-reduced finish,** offers you these advantages:

1. **Flatter laminations with excellent stacking factor**
2. **Increased die life**
3. **High permeability at all inductions**
4. **Magnetic properties fully developed at mill**
5. **Supplied in long butt-welded coils, with ductile welds having the same thickness tolerance as the sheets**

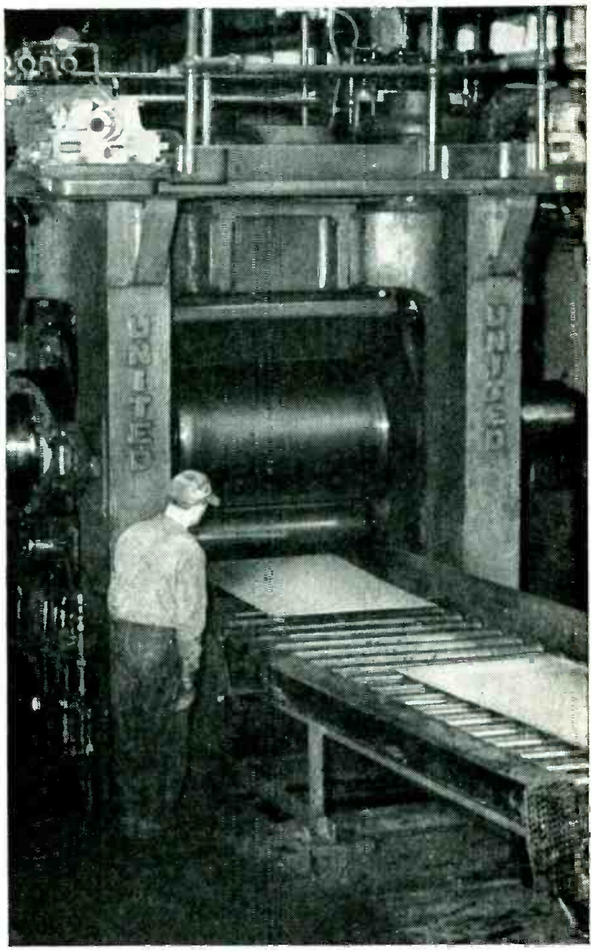
ADEQUATE INSULATION

DI-MAX Quality electrical steels as supplied have insulation adequate for many applications. Where extra interlamination resistance is required, the steel is supplied with Armco No. 4 insulation.

GRADES IN DI-MAX

DI-MAX Quality is available in coils in the following hot-rolled electrical grades: Armco TRAN-COR 72, 82, 101, Electric and Armature.

Write us for more information on DI-MAX QUALITY.



High pressures developed by four-high cold-finishing mills improve lamination factor in stacked cores.

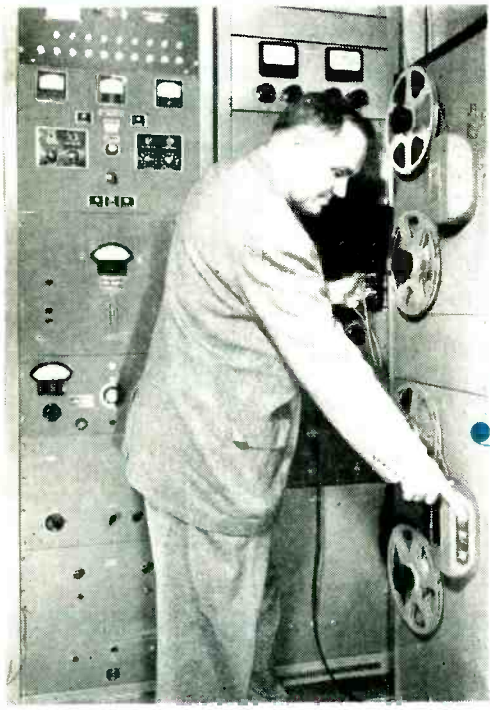
ARMCO

ARMCO STEEL CORPORATION

3693 CURTIS STREET, MIDDLETOWN, OHIO

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

www.americanradiohistory.com



An Ampex Automatic Station now in operation at KEAR in San Mateo, California. It sustains the evening programs on tapes prepared by the daytime staff.

Announcing

THE AMPEX AUTOMATIC STATION

a new concept in radio programming and operation

Now a 16 hour broadcast day can be handled by an 8 hour staff. Commercials and announcements for the full broadcast day can be pre-taped in fast succession and will be automatically cued to prepared program material.

AUTOMATIC CUEING

Your broadcast time can be sustained automatically by alternate operation of two Ampex 450 Continuous Tape Reproducers. One carries a program tape—the other has a tape with commercials and announcements. One stops—the other starts. It's "cued automatically" with sub-audible "trigger signals" recorded on the tapes themselves. And when desired both machines can be stopped and live programs, separate tapes or discs can still be broadcast in the conventional manner.

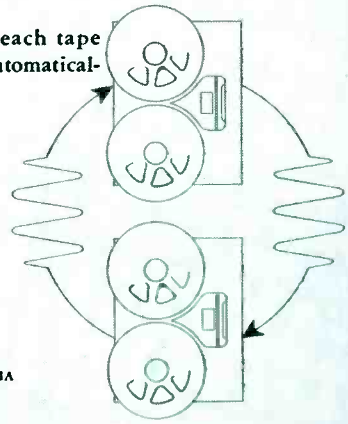
ELECTRONIC SPLICING

The announcer pre-records his announcements, pressing a button between each one to place the "trigger signal" on the tape. In effect he is putting the announcement in its proper place with a fast "electronic splice."

PRE-PLANNED PROGRAMS

Program tapes for use in your Ampex Automatic Station will contain the cueing signals. Selections and exact performance times are available to your program director for accurate integration with commercials and local announcements.

Sub-audible tones on each tape stop one machine and automatically start the other.



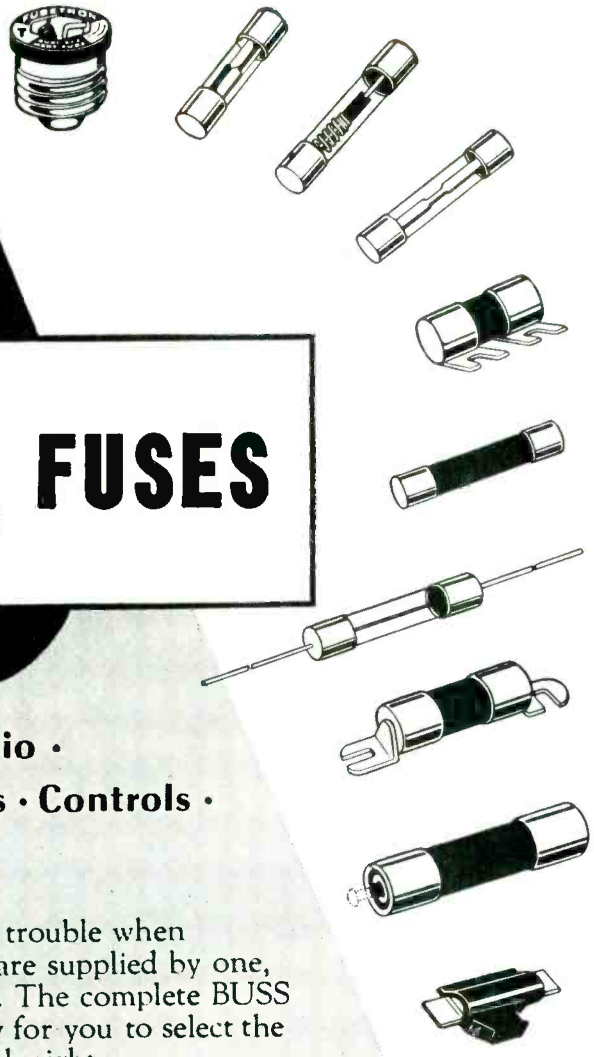
Write today for further information to Dept. E-1217A

AMPEX
MAGNETIC RECORDERS

AMPEX CORPORATION
934 Charter Street, Redwood City, California
Distributors in principal cities
In Canada: Canadian General Electric Company

www.americanradiohistory.com

YOU'LL FIND THE RIGHT FUSE, FASTER in the Complete Line of Electronically Tested ....BUSS FUSES



for Television · Radio · Radar · Instruments · Controls · Avionics . . . .

You'll save time and trouble when all your fuse needs are supplied by one, dependable source. The complete BUSS line makes it easy for you to select the fuse to do the job right.

The makers of BUSS fuses insist on perfection. Every fuse is electronically tested in a sensitive device that rejects any fuse not properly calibrated, properly constructed and right in all physical dimensions.

Take advantage of the profit-saving efficiency that you can gain by standardizing on the complete line of BUSS fuses.

Plus A COMPLETE LINE OF FUSE CLIPS, BLOCKS AND HOLDERS

MAIL THIS COUPON *TODAY*...

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me bulletin SFB containing facts on BUSS small dimension fuses and fuse holders.

Name ____________________

Title ____________________

Company ____________________

Address ____________________

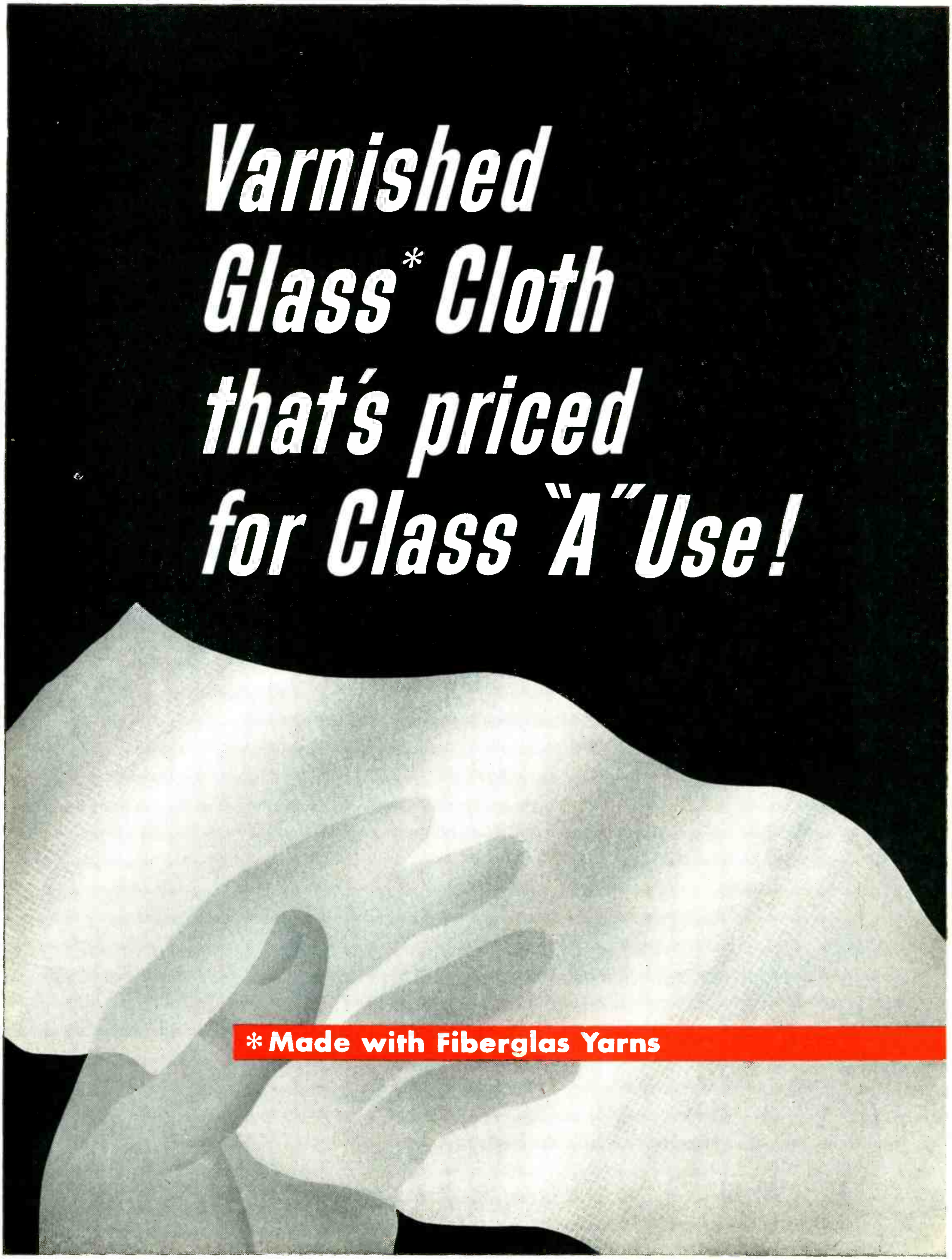
City & Zone ____________ *State* ________ ELRC-853

IF YOU WOULD LIKE ASSISTANCE on your protection problems, BUSS fuse engineers are always at your service. They will be glad to help you select the fuse that will do the job best... if possible, a fuse that is available from local wholesalers' stocks.

BUSSMANN Mfg. CO., Division of McGraw Electric Co.
University at Jefferson, St. Louis 7, Missouri

Want more information? Use post card on last page.

www.americanradiohistory.com



Want more information? Use post card on last page.

www.americanradiohistory.com

Want extra performance in Class A equipment at no premium cost?

. . . in transformer layer or phase insulation? If you do, you'll want to know more about this stronger, safer, longer-lasting varnished glass cloth. For this is cloth in sheet or tape form that's priced for general Class A use . . . wherever straight-cut organic textile fabrics were formerly used!

STRONGER

A stronger, more permanent support for insulating varnish is provided because Fiberglas* yarns have greater tensile strength than organic textile-based yarns of equal thickness.

SAFER

Equipment withstands higher temperatures, breaks down less readily, because Fiberglas glass-based varnished cloths provide higher thermal heat dissipation and higher heat resistance.

LONGER LASTING

Class A equipment lasts longer, gives better performance when suitable varnished glass cloths are used. Glass cloths are inorganic—will not rot . . . resist moisture, oil and severe weathering.

AVAILABLE NOW

If you haven't already checked into the possibilities of this cloth, be sure to call your supplier today—or write direct to Owens-Corning Fiberglas Corp., Dept. 860, 16 East 56th Street, New York 22, N. Y.

*Fiberglas is the trade mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with fibers of glass.

OWENS-CORNING
FIBERGLAS
TM REG. U.S. PAT. OFF.

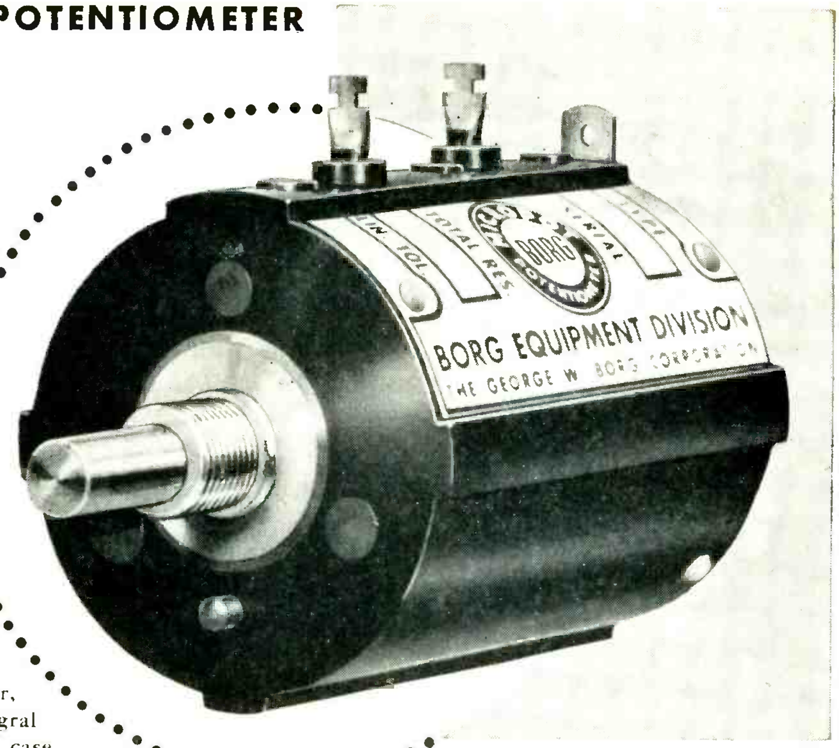
"if it's Fiberglas, it's Owens-Corning!"

Want more information? Use post card on last page.

www.americanradiohistory.com

PRECISION TEN-TURN POTENTIOMETER

BORG MICROPOT

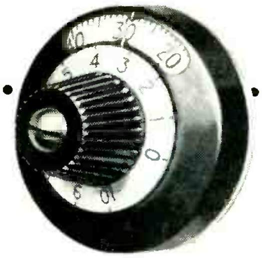


- **PERMANENT "MICRO" ACCURACY**

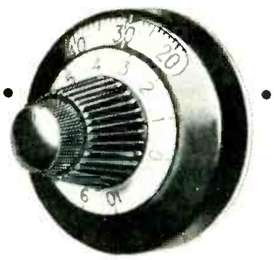
- **ZERO-BASED LINEARITY OF ±.25%, ±0.1% AND ±0.05%**

For applications requiring maximum, permanent accuracy of settings, specify the Borg Micropot Ten-Turn Potentiometer. Superior, consistent accuracy is assured through integral moulding of the resistance wire within the case, plus operation of the moving contact by a precision ground lead screw. All Borg Micropots are automatically machine-tested for a *zero-based* linearity of ±.25% or ±0.1%, with overall resistance ±5%. Available on special request with ±0.05% linearity.

Other important features of the Borg Micropot are accuracy in setting and resetting (due to Borg anti-backlash device) . . . very fine resolution . . . rigid terminals, moulded integrally with the housing. Micropots are available for immediate shipment in 1.15 to 3 ohm and 30 to 250,000 ohm ranges.



BORG MICRODIAL 746-A
Friction Screw



BORG MICRODIAL 746-B
Friction Knob

BORG ten-turn MICRODIAL

Borg Microdials indicate contact position to an indexed accuracy of one part in one thousand. For use on Borg Micropots or similar multi-turn applications. It is composed of two concentric dials . . . one for counting increments of each turn in 1/100ths, the other for counting turns. Borg Microdials can be friction-held in any position against accidental turning.

FOR IMMEDIATE SERVICE CALL YOUR NEAREST BORG REPRESENTATIVE

ARIZONA AND CALIFORNIA
W. S. Harmon Company
1638 South LaCienga Blvd.
Los Angeles 35
Phones: Bradshaw 2-3321
Crestview 6-3027

NEW ENGLAND STATES
Gerber Sales Company
42 Church St., New Haven
Phone: University 5-2147
739 Boylston St., Boston 16
Phone: COpley 7-0061-0062

DEL., EASTERN PA., SOUTHERN N.J.
L. Parker Naudain
Broad St. Station Bldg.
Philadelphia 3
Phone: Rittenhouse 6-3185

ILLINOIS
Jerome Kleker Company
177 Sunset Ave., Glen Ellyn
Phone: 2297

INDIANA
Hoemig Sales Company
1730 Clover Lane, Fort Wayne
Phone: Anthony 2083

KAN., MO., NEB., OKLA., TEXAS
The George E. Harris Co.
1734 N. Hillside, Wichita
Phones: 62-2731 and 63-9226

John Pilkington
6315 Brookside, Kansas City
Phone: Delmar 9600

Lee Thayer
6635 Delmar St., St. Louis
Phone: Volunteer 3-6550

Richard O'Barr
304 Sinclair Bldg., Fort Worth
Phone: Edison 7148

MD., VA., DISTRICT OF COLUMBIA
J. J. Maguire
742 Investment Bldg., Washington
Phone: National 4247

UPPER NEW YORK
Martin P. Andrews
Fayetteville
Phone: 65-8405

GREATER NEW YORK
David Sonkin
Lucas Building
10 Fiske Place, Mt. Vernon
Phone: 8-9809-10-11

OHIO, KY., WESTERN PA.
John O. Olsen Co.
16201 Shaker Blvd., Cleveland
Phone: WYoming 1-2624

William F. Needles
4016 Diehl Ave., Cincinnati
Phone: SYcamore 1297

Paul M. Lawman
1262 Shadycrest, Pittsburgh
Phone: LOcust 1-3273

Micropots with Standard resistance values may be obtained from:
Allied Radio Corp., Chicago, Ill. Radio Shack Corp., Boston, Mass. Herbach and Rademan, Philadelphia, Pa.

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
Janesville, Wisconsin

www.americanradiohistory.com

DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

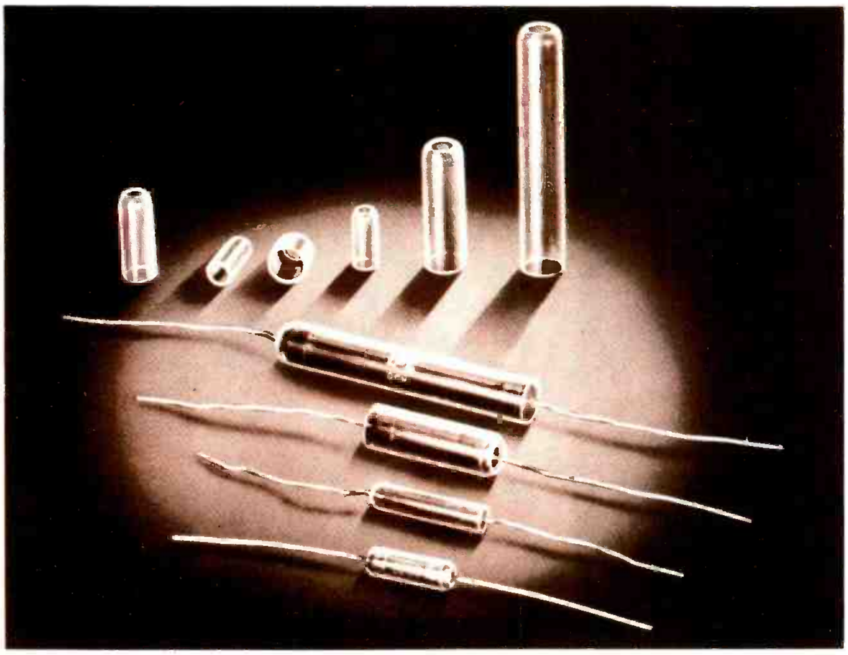
Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company AUGUST 1953

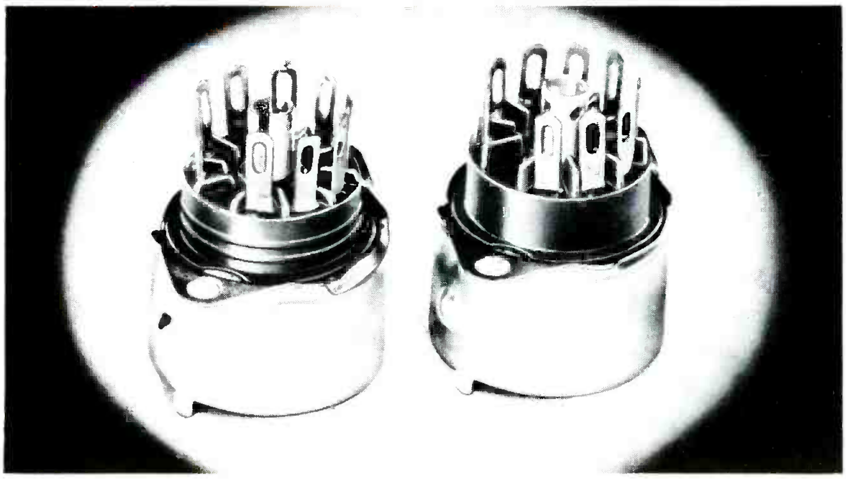
Novel Use of Kel-F in Tube Socket Boosts "Ceiling" on Tube Performance... Cuts Altitude Leaks

The simple expedient of lengthening the base connector barriers, formerly employed (see comparison photo—old style, left; new style, right) prevents arc-over or ionization in rarefied atmospheres, or under high humidity, and enables the tube to perform perfectly at high altitudes... 15% above the tube's rated "ceiling." This improvement is the result of using Kel-F polymer® as the insulation for the new socket—a unique plastic tough enough to stand up under thermal cycling, operational shock and vibration, without cracking or deforming even in the thin sections required for the longer barriers.

The Elco Corporation, custom molders and electronic manufacturers of Philadelphia, Pa., injection-molded this miniature tube socket for a major producer of electronic gear. Molded on standard equipment, tolerances required for the "floating" contact slits and the barriers were provided for in the mold and no machining was required. The high mechanical strength and non-stick properties of Kel-F also assured a low production reject rate caused by mold breakage.

Refer to Report E-112





Transparent, Heat-Proof "Armor" of Kel-F® for Carbon Resistors Cuts Damage... Boosts Efficiency... Simplifies Maintenance

Compact electrical installations, where heat and physical damage to resistors has been a "bug," are now relying on tubular "armor" of Kel-F trifluorochloroethylene polymer plastic. Because of its non-flammability, unusual heat resistance and high impact and compressive strength, this versatile plastic prevents damage due to fire or elevated temperatures, a careless slip of a tool (or severe operational vibration, shock), and chemicals or lubricants. Protecting both the barrel and caps of each resistor, the sleeves last indefinitely without cracking or deforming. And, these "armor" sleeves of Kel-F polymer remain transparent even after extended use, making quick identification of resistor ratings or markings possible without removal.

The resistor sleeves shown are but a few of the many types and sizes produced by The Garrison Company, Fanwood, N. J., for major producers and users of resistors. The Garrison Company extrudes lengths of the required diameter tubing from Kel-F polymer molding powder using standard techniques. A specially-designed attachment automatically cuts the extruded tubing to required size and forms one end. On installation, the other end may be formed to a similar shape. At present, the protective sleeves are produced in .178″ to .302″ I.D. sizes and in lengths from ½″ to 3¼″. Sizes are kept to strict tolerances to fit standard carbon resistors snugly.

Refer to Report E-111

(SEE REVERSE SIDE)

® *Registered trademark for The M. W. Kellogg Company's trifluorochloroethylene polymers.*

www.americanradiohistory.com

KEL-F

TRIFLUORO CHLORO ETHYLENE POLYMERS

KEL-F

MOLDING POWDERS

KEL-F

FLUORO CHLORO CARBON PLASTIC

KEL-F

DISPERSION COATINGS

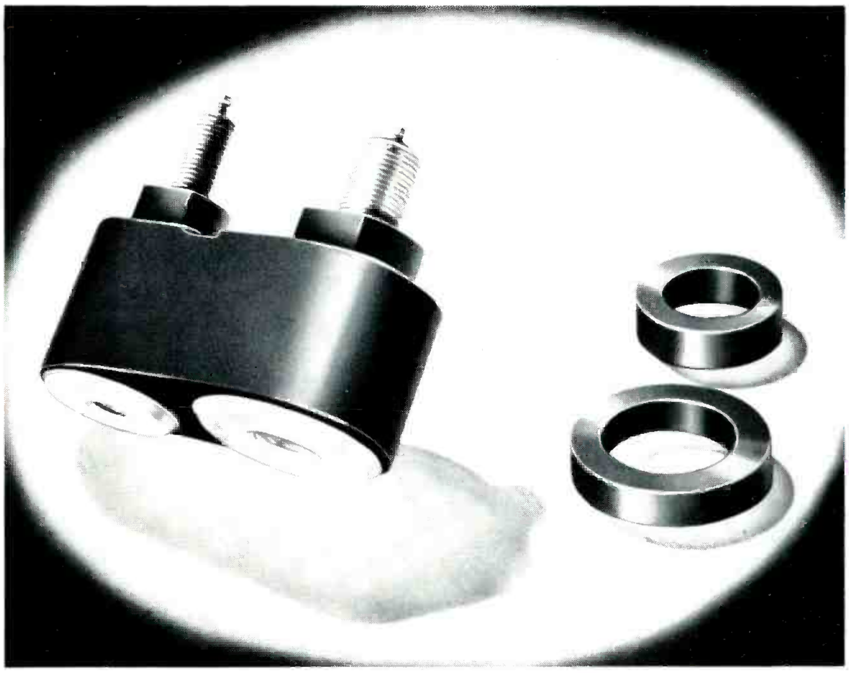
KEL-F

TRIFLUORO CHLORO ETHYLENE POLYMERS

KEL-F

OILS WAXES GREASES

CONTINUED FROM PRECEDING PAGE



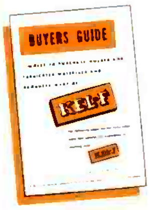
Antennae Insulator-Mount of Kel-F® Blocks RF Leakage . . . Takes High Wind Loads . . . Eliminates Fungus Losses

Found to be the material with the lowest RF loss, Kel-F trifluorochloroethylene polymer, with its toughness and dimensional stability, enables the antennae insulator mount shown above to stand up under high wind and shock loads and other physical abuse that caused other mounts to fail after a short time.

The dual insulator-mount and two insulating washers, designed to hold a "short" and "long" antenna, are injection-molded and used by the JFD Electronics Corporation of Brooklyn, N. Y. in portable military radio receivers. The complex antennae insulator, together with insulating washers, are produced by standard procedures in a single "shot," using multiple-cavity molds.

Kel-F trifluorochloroethylene polymer was specified for this critical application on the basis of its unique combination of desirable properties. The high electrical insulation resistance of Kel-F at high and low temperatures is further enhanced by the plastic's zero water absorption and non-wettability. Since Kel-F remains unaffected by sustained exposure to moisture, surface electrical losses are eliminated. The non-wetting and non-stick properties of this fluorocarbon plastic prevent the formation or adhesion of conductive fungus growths. Kel-F polymer also extends trouble-free operation of the part by eliminating corrosion and loosening of metal inserts due to release of plasticizers.

Refer to Report E-106



Be Sure to Get This Handy Reference . . .

Whether you're looking for a source of supply of a particular basic form of Kel-F, a finished product, or a reputable firm to do custom molding or fabricating, you'll find it easily in the "Buyers Guide," just off the press. Write to Technical Service for your copy.

Molders of the Month

Leading molders and extruders specialize in fabrication of materials and parts made of Kel-F . . . each month this column will spotlight several of these companies with their principal services and products.

General American Transportation Corporation
Chicago, Ill.
Injection Molding
Compression & Transfer Molding
Electrical, Electronic Components

A. Gusmer, Inc. (Stalpic Division)
Woodbridge, N. J.
Dispersion Coating

Nichols Engineering Company
Stratford, Conn.
Machining
Liquid Level Gages & Glasses

Santay Corporation
Chicago, Ill.
Injection Molding
Electrical, Electronic Components

Severna Metals Company
E. Orange, N. J.
Machining

Sinko Manufacturing & Tool Company
Chicago, Ill.
Injection Molding
Electrical and Electronic Components

Standard Plastics Company, Inc.
Attleboro, Mass.
Injection Molding
Electrical, Electronic Components

For complete information regarding any item mentioned in DESIGN AND PRODUCTION NEWS, ask for detailed APPLICATION REPORTS, write

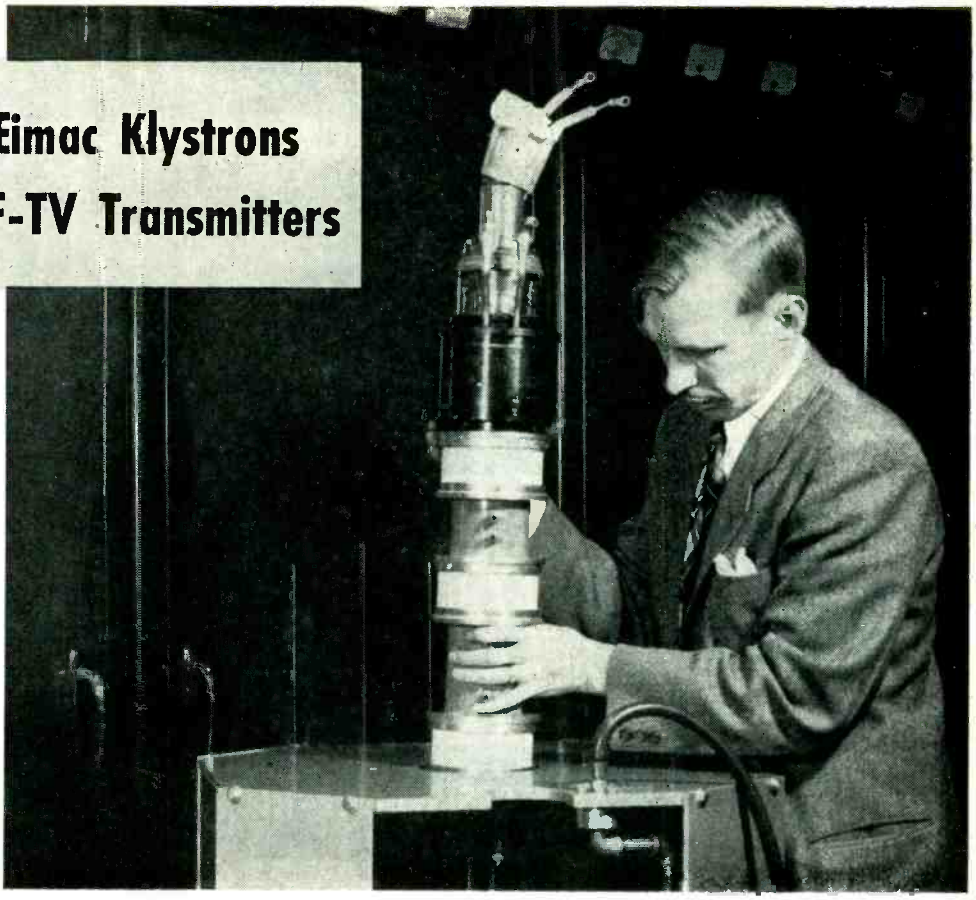
Technical Service
CHEMICAL MANUFACTURING DIVISION
THE M. W. KELLOGG COMPANY
P. O. Box 469, Jersey City 3, N. J.
or offices in Boston, Chicago, Dayton, Los Angeles and New York

KELLOGG
SUBSIDIARY OF PULLMAN INCORPORATED

® *Registered trademark for The M. W. Kellogg Company's trifluorochloroethylene polymers*

www.americanradiohistory.com

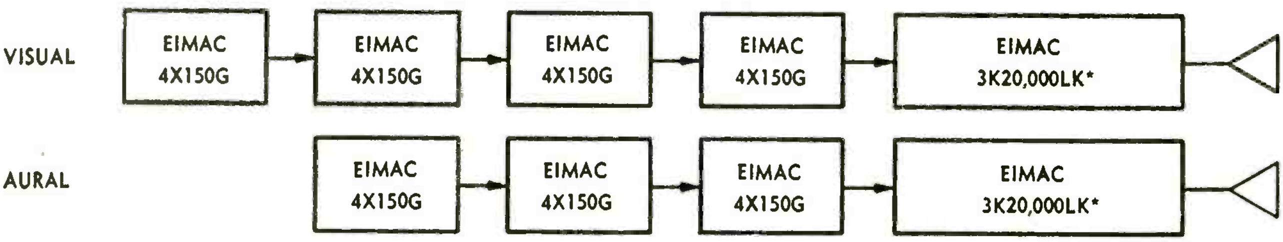
DuMont features Eimac Klystrons In 5 kilowatt UHF-TV Transmitters



W. H. Sayer, DuMont research engineer, places Eimac klystron in RF section of DuMont 5kw transmitter.

DuMont combines the latest in electronic design and engineering techniques in its new, up-to-the-minute five kilowatt UHF-TV transmitters. With Eimac klystrons as final amplifiers, DuMont utilizes the only tubes that offer all these features for high-power UHF-TV—1) Low initial cost and operating economy 2) Light weight 3) Reserve power for long life in typical operation 4) High power gain of 20 db. or more 5) Three tubes to cover the spectrum 6) Convenient external tuning makes efficient and accurate circuit alignment possible.

EIMAC TUBES IN DRIVER AND FINAL STAGES



For further information about Eimac klystrons write our Application Engineering department.

***3K20,000LA channels 14-32**
***3K20,000LF channels 33-55**
***3K20,000LK channels 56-83**

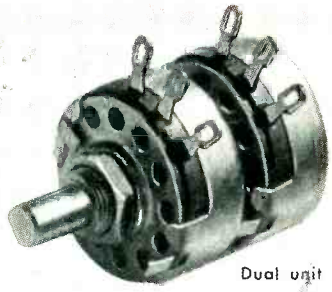
Eimac TUBES

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

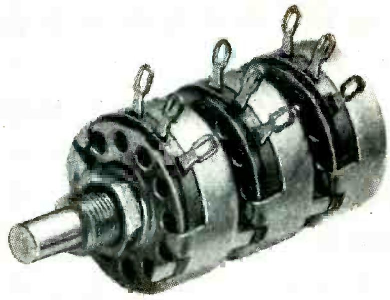
Want more information? Use post card on last page.

www.americanradiohistory.com

Type J Bradleyometer in single unit construction, without line switch



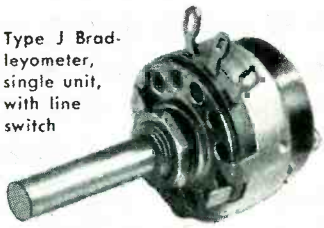
Dual unit



Type J Bradleyometer in triple unit construction

ADJUSTABLE RESISTORS and POTENTIOMETERS

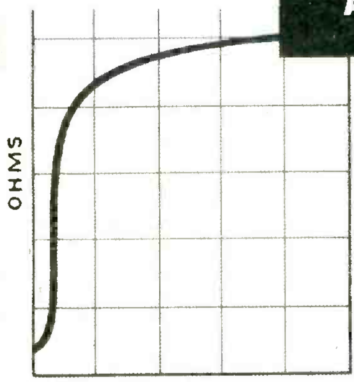
Type J Bradleyometer for screw driver adjustment with bushing shaft lock

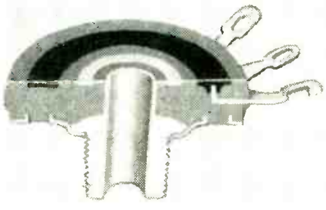


Type J Bradleyometer, single unit, with line switch

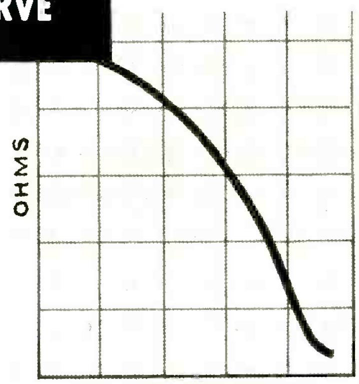
Type J Bradleyometer, of the dual type construction, with line switch

ANY RESISTANCE-ROTATION CURVE





During manufacture, the molded resistor can be varied in resistance throughout its circumference. After molding, it is unaffected by temperature or moisture.



QUALITY CONTROLS for CRITICAL CIRCUITS

If you need a potentiometer or adjustable resistor that is not affected by moisture, cold, or age, specify the Allen-Bradley Type J Bradleyometer. It is not a film or paint type resistor. The resistor can be built up to produce any form of resistance-rotation curve.

After molding, the resistor is no longer affected by heat, cold, moisture, or age. There are no rivets, nor welded or soldered connections. The shaft, cover, faceplates, and other metal parts are made of corrosion resistant metal. Let us send you the latest Bradleyometer data.

Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.

A-B Quality

ALLEN-BRADLEY

FIXED & ADJUSTABLE RADIO RESISTORS

Sold exclusively to manufacturers QUALITY of radio and electronic equipment

www.americanradiohistory.com

A NEW IRVINGTON CLASS "B" INSULATION...

IRV-O-BESTOS®

By bonding a range of thicknesses of Quinterra asbestos to various thicknesses of Mylar—a tough, strong polyester film with the highest dielectric strength known—Irvington now brings you a line of Class "B" insulation that balances cost and properties to meet your needs. The Mylar gives IRV-O-BESTOS its high tensile, tear and dielectric strength. The Quinterra makes for ease of gripping—gives added heat stability and added thickness at moderate cost.

Since Quinterra is available in thicknesses from .003" to .015", and Mylar from .0005" to .007", a very large number of combinations are available—in duplex constructions or in triplex, with either the Quinterra or the Mylar on the outside. Whether your requirements are for high dielectric strength, or for added thickness at low cost, IRV-O-BESTOS will fill your needs.

Look to
IRVINGTON
for Insulation Leadership

- INSULATING VARNISHES
- VARNISHED CAMBRIC
- VARNISHED PAPER
- VARNISHED FIBERGLAS
- INSULATING TUBING
- CLASS "H" INSULATION

Mail the coupon for technical data and samples of this outstanding new Class "B" insulation.

*Johns-Manville Corp. trademark **du Pont trademark

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

11 Argyle Terrace, Irvington 11, New Jersey

Plants: Irvington, N. J.; Monrovia, Calif.; Hamilton, Ontario, Canada

Irvington Varnish & Insulator Company
11 Argyle Terrace, Irvington 11, N. J. EL 8/53

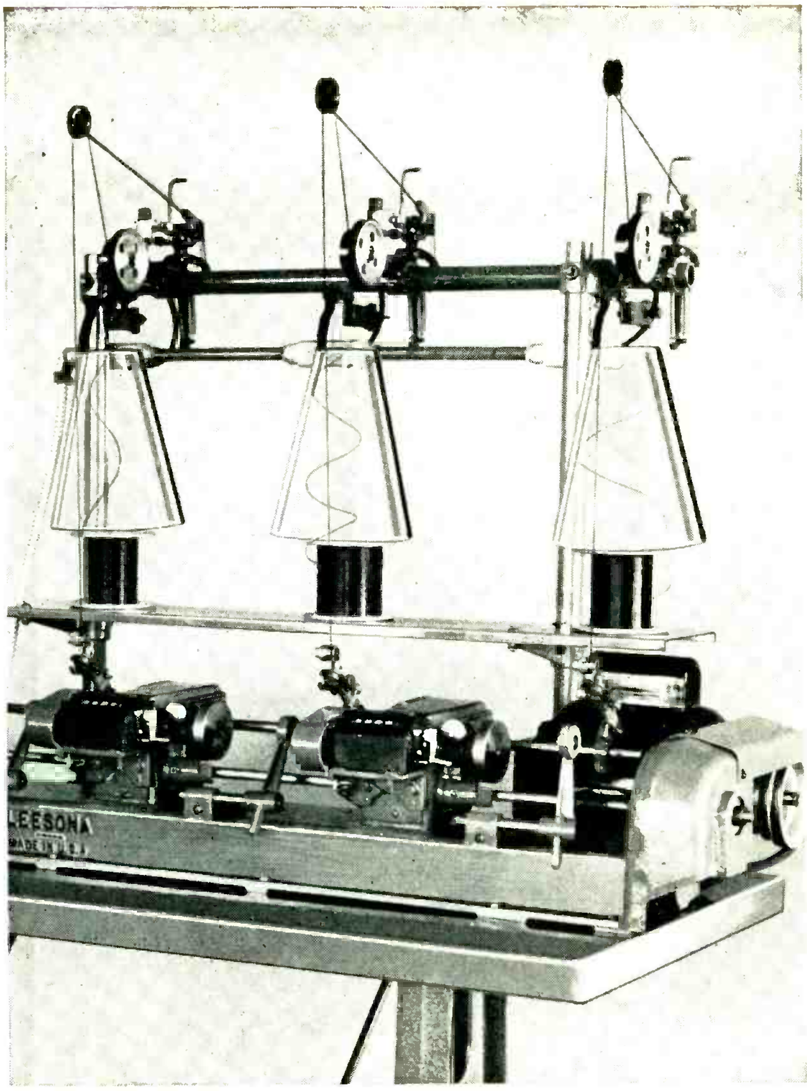
Gentlemen:
Please send me technical data sheet and samples of your new IRV-O-BESTOS Class "B" insulation.

Name........................Title..........
Company..........................
Street..........................
City....................Zone.........State..........

Want more information? Use post card on last page.

www.americanradiohistory.com

HIGH SPEED • TOP PRODUCTION • LOW COST



UNIVERSAL NO. 102 HI-SPEED COIL WINDER specifically designed for spool-wound coils. Has these desirable characteristics: instant starting over-end tension . . . will accommodate wire size from No. 24 to No. 42 (B&S) . . . can wind two coils per head simultaneously . . . winds up to 4700 rpm, but can be operated at 650 rpm when required.

in Coil Winding with this fast machine

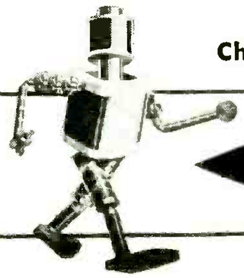
This is the coil winder that does it fast and does it right.

It increases the operator output of spool-wound coils particularly those having a high number of wire turns. It is well suited for winding timing motor coils, telephone relays, small motor fields and other coils not requiring insulation between layers.

Wherever it has been put to work the result has been greater operator and machine efficiency. The operator can supervise several heads simultaneously. Winding and handling time can be synchronized so that there is no unproductive waiting time.

DETAILS YOURS FOR THE ASKING. You'll want to know more about the Universal No. 102 Coil Winder because everything you learn will lead to greater winding efficiency. Your copy of Bulletin 102-H will go in the mail the day we get your request.

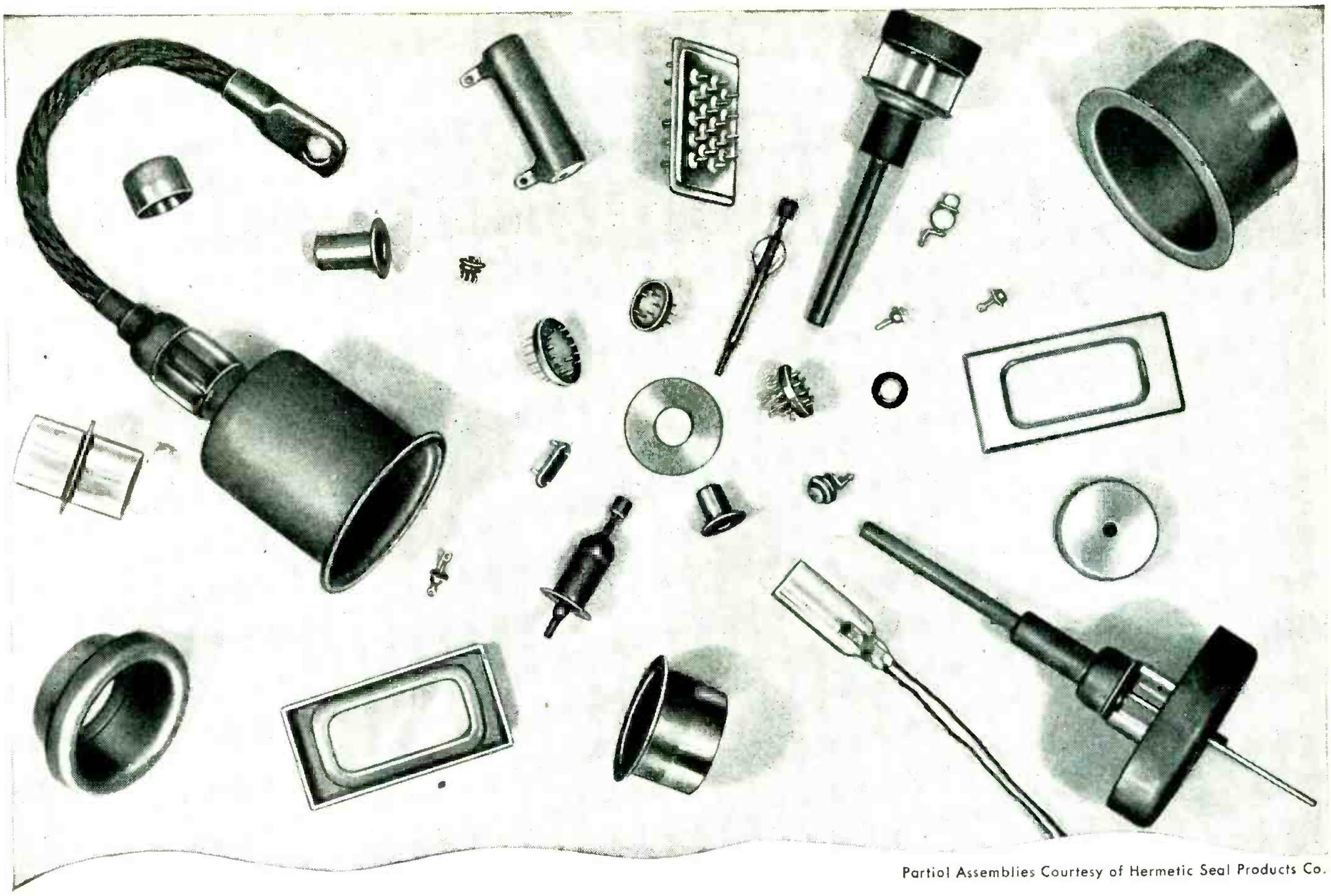
UNIVERSAL WINDING COMPANY
P. O. Box 1605, Providence 1, R. I.
Chicago office and Demonstration Room, 9 So. Clinton St., Chicago 6, Ill. 23B-2-6



LEESONA ®

For winding coils in quantity accurately . . . automatically use Universal Winding Machines

www.americanradiohistory.com



Partial Assemblies Courtesy of Hermetic Seal Products Co.

Now 4 D-H Special Alloys Cover Most Glass-to-Metal Sealing Needs

From a single source, the Driver-Harris Company, you can now obtain metal alloys to meet your glass-to-metal sealing needs for both *hard* and *soft* glass.

NEW ALLOY THERLO* This cobalt, nickel iron alloy, possesses ideal properties for sealing hard or thermal shock resistant glass. It matches such commercial hard glasses as Corning 7052 and 7040 in expansivity from 80°C to the annealing point. It produces a permanent vacuum-tight seal with simple oxidation procedure and resists attack by mercury. Readily machined and fabricated, it can be welded, soldered or brazed.

DRIVER-HARRIS 142 ALLOY contains 42% nickel. This is the standard alloy for sealing into sealed beam auto lamps using Corning 776 glass. Used with a borated copper coating, it is the accepted seal for incandescent lamps and radio tubes and matches 8160 glass.

DRIVER-HARRIS 52 ALLOY contains 50% nickel. It provides a slightly higher coefficient of expansion than the D-H 142 alloy and seals successfully with 0120 glass.

DRIVER-HARRIS 146 ALLOY contains 46% nickel. It offers special expansion properties, which permit seals with ceramic coated materials as shown above.

Manufactured to the same high standards that have made Driver-Harris the leader in special purpose alloys for more than 40 years, these alloys are available as rod, wire, strip, sheet foil—and in special shapes. They enable you to meet your specific sealing needs from a single source—so why not consult us today.

*T.M. Reg. U. S. Pat. Off.

SPECIAL PURPOSE ALLOYS SINCE 1899 D H TRADE MARK REG. U. S. PAT. OFF.

Also sole producers of Nichrome, Advance* and Karma**

Driver-Harris Company

HARRISON, NEW JERSEY

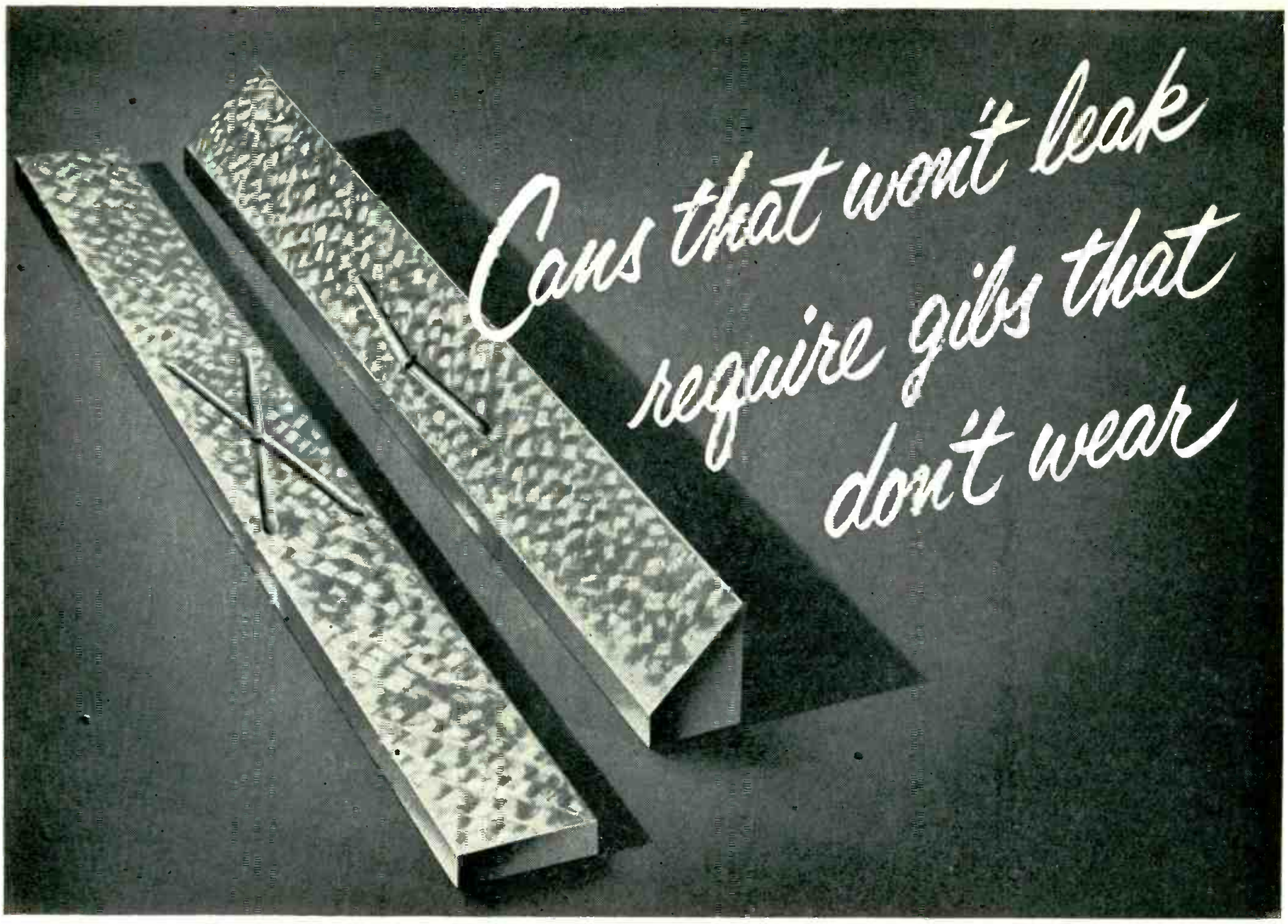
BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

Want more information? Use post card on last page.

www.americanradiohistory.com



THEY'RE MADE OF BERYLCO BERYLLIUM COPPER

When you discard a tin can, you may not think you're throwing away a precision device, but you are. All parts of a can must be accurately formed to within one ten-thousandth inch, otherwise leakage and spoilage will result.

The flat and bevel gibs shown here are used on a bodymaker producing 12 and 6 oz. spray cans. Twenty-six dies, each guided by similar Berylco gibs, turn out 100 can bodies per minute. Tolerances are so critical that gib wear of less than .001'' can cause trouble. Production stoppages pile up headaches, and thousands of cans can be ruined through corrosion.

Gibs machined from Berylco #25 bar stock have now been employed for the "SPRA-TAINER" bodymaker twice as long as any previously used material, and there have been no shutdowns. The superior wear resistance of Berylco is due not so much to its heat-treatable feature—work-hardening alone is sufficient—as to its dense, less porous structure, which reduces friction and makes lubrication less critical.*

Wear resistance is only one of the many desirable engineering qualities of Berylco beryllium copper. Its unique combination of such properties as strength, conductivity, elasticity and fatigue resistance has enabled designers to convert difficult or "impossible" jobs into standard production items.

As the world's largest producers, we will be glad to help you include beryllium copper in your plans for the future. For sample material or engineering assistance, call or write any of the offices below.

VALUABLE ENGINEERING INFORMATION

on Berylco beryllium copper is contained in a series of technical bulletins, published monthly. To receive your copy regularly, write on your business letterhead.

TOMORROW'S PRODUCTS ARE PLANNED TODAY—WITH BERYLCO BERYLLIUM COPPER

** Data supplied by Crown Can Co. (Div. C. C. & S. Co.), Phila., Pa.*

BERYLCO THE BERYLLIUM CORPORATION

DEPT. 3H, Reading 21, PENNSYLVANIA

New York • Springfield, Mass. • Rochester, N. Y. • Philadelphia • Cleveland • Dayton • Detroit • Chicago • Minneapolis • Seattle • San Francisco • Los Angeles

Representatives in principal world-trade centers

www.americanradiohistory.com

ERIE

Complete line of

DISC CERAMICONS®

HIGH VOLTAGE

HIGH VOLTAGE DISC CERAMICONS employ the same basic diameters that have been standardized in 500 volt Ceramic capacitors. Careful and detailed life testing has been accomplished over a long period of time to establish required dielectric thicknesses to assure conservative ratings in the high voltage line. Standard voltage ratings range from 1,000 through 6,000 Volts, D.C., Working.

TEMPERATURE COMPENSATING

TEMPERATURE COMPENSATING DISC CERAMICONS, in four sizes, offer all standard combinations of temperature coefficient and capacitance value. They are tested for conformance to Erie specifications for Tubular Ceramicons and meet all requirements for RTMA REC-107A Class 1 ceramic capacitors. They are available in capacity ranges up to 725 mmf.

GENERAL PURPOSE

GENERAL PURPOSE DISC CERAMICONS have low series inductance which assures efficient high frequency operation. They are made in sizes from 5/16" to 3/4" diameter, and in capacitance values ranging from 10 mmf to .02 mfd.

ERIE DISC CERAMICONS are available in three styles, each having a wide range of capacitance values for the basic applications. These capacitors consist of flat ceramic dielectrics with fired silver electrodes. Lead wires are firmly soldered to the electrodes, and completed units are given a protective coating of wax impregnated phenolic. For complete description and specifications, write for catalogs and samples.

ERIE components are stocked by leading electronic distributors everywhere.

25th Anniversary
ERIE
TRADE MARK
RESISTOR CORP

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

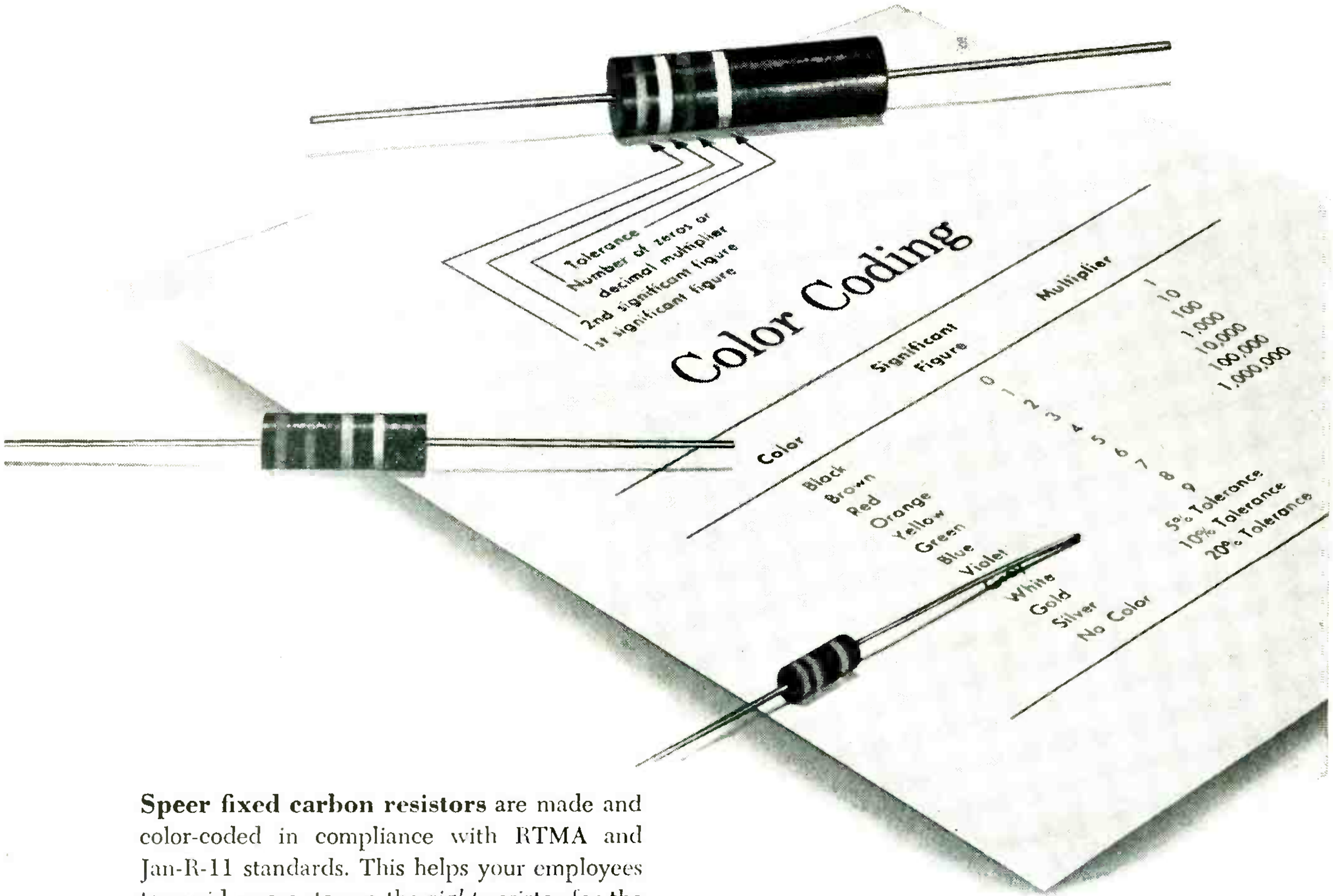
Main Offices: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill. Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.

Factories: **ERIE, PA. • LONDON, ENGLAND • TORONTO, CANADA**

www.americanradiohistory.com

Speer makes it easy for you to choose the right Carbon resistor!



Speer fixed carbon resistors are made and color-coded in compliance with RTMA and Jan-R-11 standards. This helps your employees to avoid errors—to use the *right* resistor for the circuit every time.

Speer resistors are made better – are the right resistors for *every* circuit. By using very high pressure to create an inseparable bond between the protective phenolic shell and the carbon core, Speer gives its resistors these important advantages:

1. More efficient heat transfer.
2. Greater ability to sustain overloads for long periods of time.
3. Uniform diameter resistive element for the entire length of the resistor, which eliminates weak points and potential burn-outs.
4. Uniformly thick protective covering over the entire length, which eliminates low-voltage breakdown between resistive element and adjacent conductor – makes for minimum change in resistance when subjected to adverse humidity conditions.

All shipments of Speer resistors are given numerous tests for resistance rating, and are backed by a minimum resistance change when exposed to an accelerated ten-day humidity test. Speer manufactures a complete line of ½, 1 and 2 watt resistors in all standard values from 10 ohms to 20 megohms. Nonstandard values are available for special applications.

Write today for your free copy of Speer Resistor's new complete catalog

SPEER RESISTOR

SPEER RESISTOR DIVISION

SPEER CARBON COMPANY

St. Marys, Pennsylvania

Other Divisions: Jeffers Electronics
International Graphite & Electrode

www.americanradiohistory.com

Want to punch something?

THEN LOOK at these parts . . . all punched from Taylor Vulcanized Fibre or Laminated Plastics. They are typical of the wide variety of shapes and sizes that can be economically produced to close tolerances.

When you use Taylor Vulcanized Fibre and Laminates for your punched parts, you have a wide range of physical, electrical and mechanical properties to choose from. Vulcanized fibre can be furnished in sheets, rolls and rods . . . laminated plastics in sheets, tubes and rods. A variety of colors and finishes is available.

For switch insulation, brush holders, arc barriers, refrigerator latch gaskets, shielding, relay covers, armature slot insulation, luggage reinforcing strips, and washers . . . just to name a few applications . . . be sure and investigate the advantages of Taylor materials for making punched parts.

A Taylor Engineer will be glad to help you pick the grade of Vulcanized Fibre or Phenol, Melamine or Silicone Laminated Plastics that are best suited to your particular requirements.

Taylor Fibre Co., Norristown, Pennsylvania—La Verne, California.

TAYLOR
Laminated Plastics
Vulcanized Fibre

Want more information? Use post card on last page.

www.americanradiohistory.com

"Know-How" at Your Service!

IF YOUR PROBLEM CONCERNS ELECTRICAL INSULATING MATERIALS...Here's Your Solution...

Ask Your Representative From INSULATION AND WIRES INCORPORATED

A COMPLETE LINE OF ALL THESE PRODUCTS IS IN STOCK —READY FOR SHIPMENT

Varnished Cambric Products
Insulating Paper
Varnished Tubing
Saturated Sleeving
Insulating Varnish
Vulcanized Fibre
Phenolite
Fibre Wedges
Wood Wedges
Built-up Mica Products
Asbestos Insulation
Woven Glass Insulation
Pressure Sensitive Tape
Cotton Tape
Cotton Sleeving
Commutators Built To Specifications
Teflon
Silicone Resins
Silicone Insulations

Helping manufacturers in the selection and application of all types of electrical insulating materials for many years has given your IWI Representative a store of practical experience that would be difficult to match in the industry. Also at his command, and yours, are the research and engineering departments of the leading insulation manufacturers which IWI represents. All of this "know-how" is at your disposal—to help you choose exactly the right product for the job, no matter how special. Your inquiries are solicited—any time, without obligation.

IF IT'S ELECTRICAL INSULATION YOU CAN GET IT FAST FROM IWI

IMMEDIATE SERVICE from a warehouse near you. Get your small production lots and seldom-used items from IWI.

TOP QUALITY PRODUCTS only are sold by IWI—nationally advertised and used by leading electrical manufacturers everywhere.

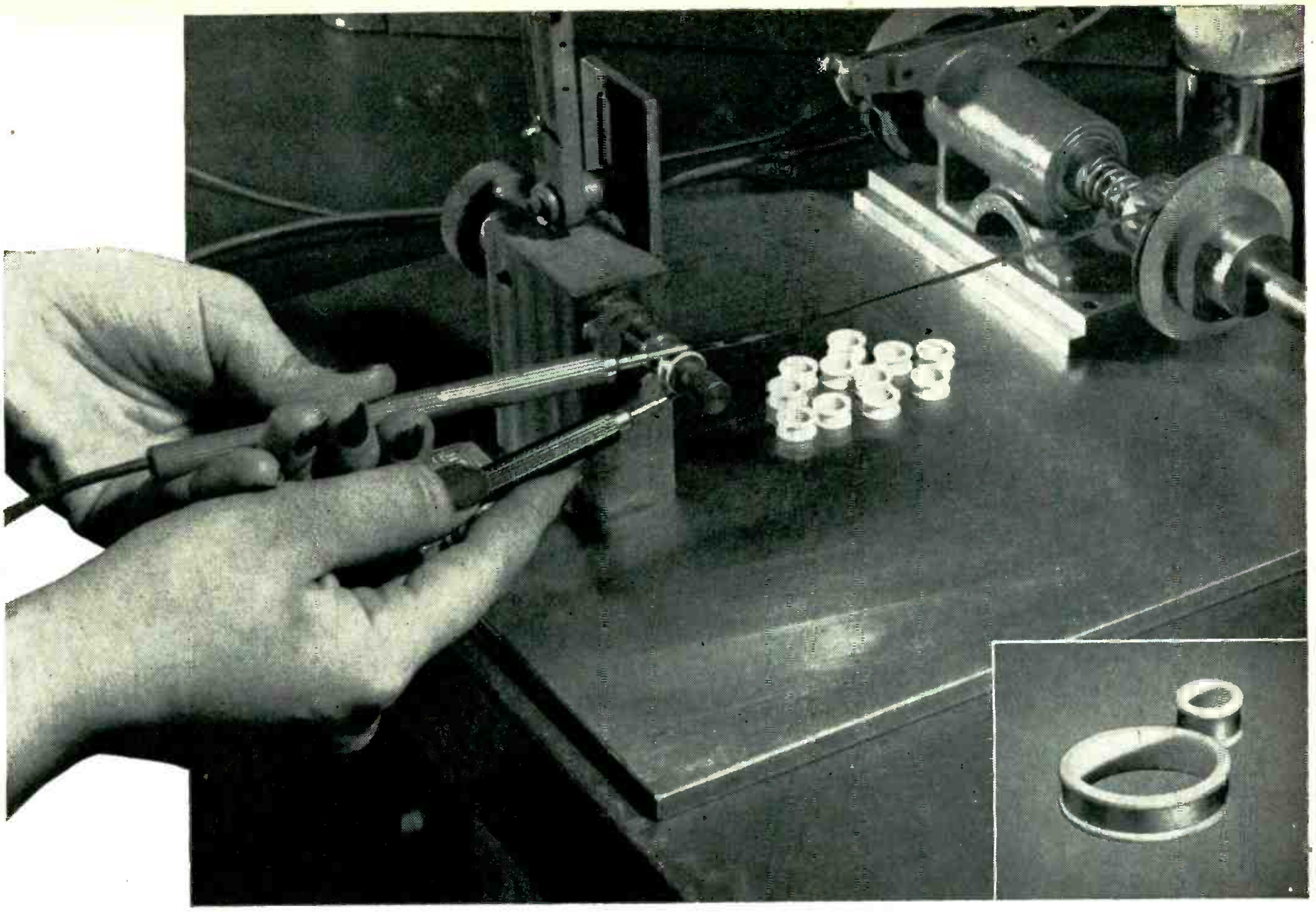
Your Most Complete and Dependable Source

A NATIONAL NETWORK OF WAREHOUSES SERVING ELECTRICAL MANUFACTURERS

INSULATION AND WIRES INCORPORATED
3435 Chouteau Avenue • St. Louis 3, Missouri

Write For The Address Of The Warehouse Nearest Your Plant

www.americanradiohistory.com



Hiperthin* Cores . . .
newest approach to electronic circuit designs

New circuit designs, often making it possible to replace tubes in amplifiers, computers, modulators and similar electronic equipment, are being developed through the use of Westinghouse Hiperthin Cores.

An entirely new, thin magnetic material, capable of retaining its desirable qualities even when rolled as thin as ⅛ mil, is the reason.

Compounded of grain-oriented silicon or nickel-iron alloys, it combines the fast response, high permeability and low coercive force needed in vhf circuits. Non-deteriorating, it eliminates the periodic replacement problem encountered with tubes, assuring sustained and accurate performance.

To manufacture the new core economically, Westinghouse engineers devised new production methods. The illustration above shows a core being subjected to an electronically controlled spot weld, after being wound. New techniques have also been developed for effectively insulating the turns, and for annealing the metal on a ceramic form as a unit to insure permanent stability.

All your core requirements . . . whether they're for electrical or special electronic applications . . . can be met best by engineers who know and understand your problems. For further information write for reprint No. 4866, *Progress in Core Material for Small Transformers.* Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70676

*Trade Mark

YOU CAN BE **SURE**...IF IT'S
Westinghouse

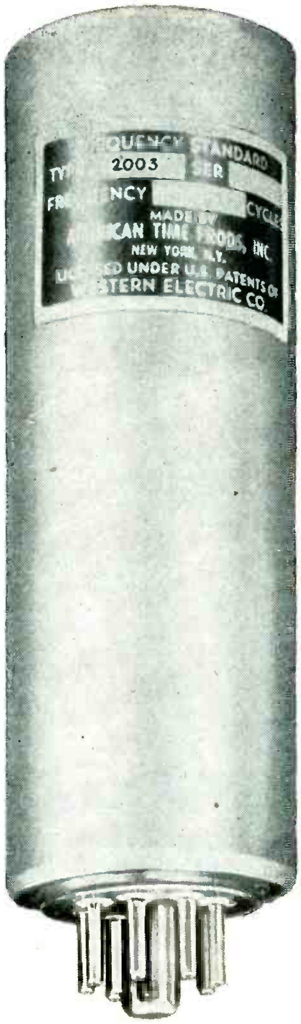
Want more information? Use post card on last page.

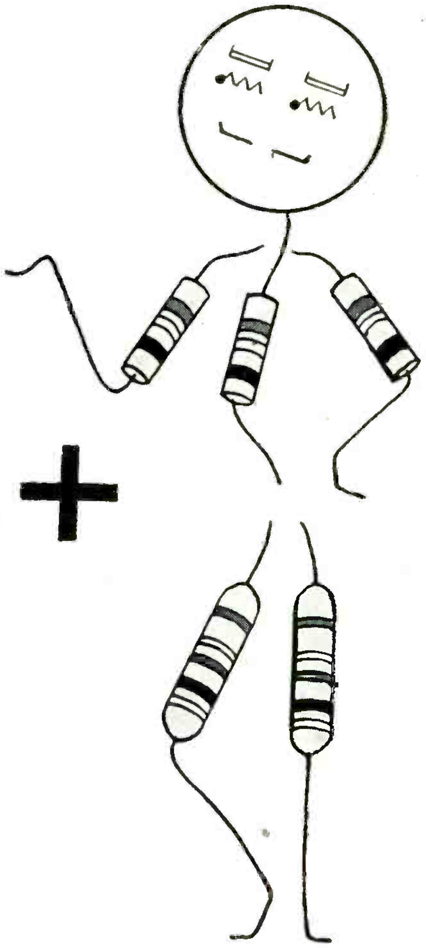
www.americanradiohistory.com

The

PERFECT

Wedding





TYPE 2003 FREQUENCY STANDARD

The Type 2003 contains, in addition to the tuning fork, all circuit components which are selected or critical.—The tube and remaining components — three resistors and two .01 capacitors — are external and can be laid out and integrated with your equipment.

TUNING FORK STANDARD, hermetically sealed.

SIZE — 4½ inches long. 1½ inches diameter.

SIMPLE EXTERNAL CIRCUIT, 1 tube, 3 resistors, 2 capacitors.

TUBE — Choice of 12AT7, 6201, 5751, 6BF7, 6BG7 or 6021.

POWER REQUIRED, 75 to 300 V at 1 to 5 m.a. — 6.3 V at 300 or 350 m.a.

AVAILABLE — in 400 or 500 cycles

ACCURACY guaranteed to .002%, 15° to 35° C.

Write for descriptive literature, specifying Type 2003.

Also TYPE 2007

(4½" x 1½")

COMPLETELY SELF-CONTAINED INCLUDING VACUUM TUBE

Manufacturer of high precision frequency and timing instruments controlled by tuning fork oscillators.

American Time Products, Inc.

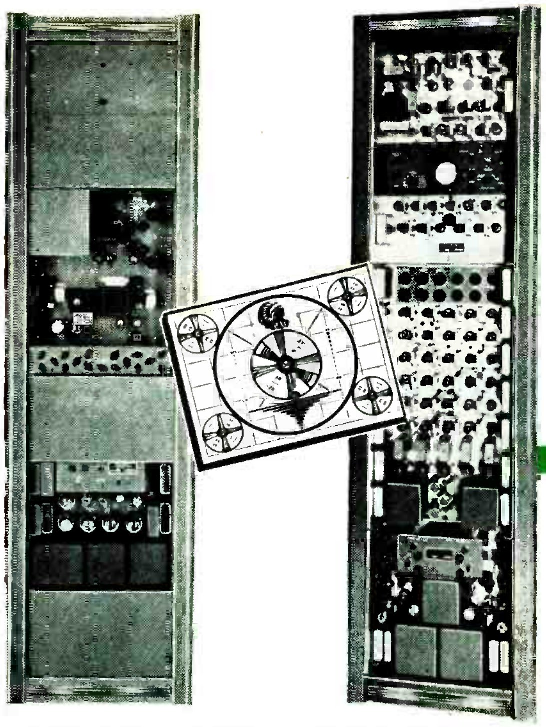
580 Fifth Avenue **New York 36, N. Y.**

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY

www.americanradiohistory.com

Look To *Polarad* For...

TELEVISION EQUIPMENT



MONOSCOPE SIGNAL SOURCE
Model PT-102

SYNCHRONIZING GENERATOR
Model PT-101

Monoscope Signal Source and Synchronizing Generator are used for the generation of composite Video Signals (test pattern) for testing of Video Systems.

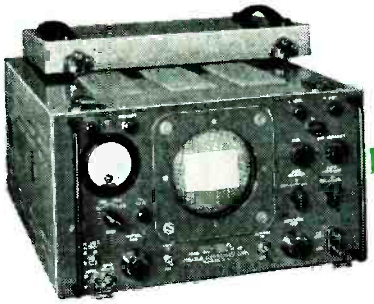
Features:

PT-101

- Standard RTMA signals for driving camera
- Built in 3" oscilloscope for monitoring output signals and for general maintenance
- Simple adjustment controls for all output pulses on front panel

PT-102

- Standard RTMA composite Video Signals—3 outputs 2 volts across 75 ohms.
- Overall resolution 500 lines
- Linear high definition test pattern for laboratory and industrial use
- Self contained regulated and high voltage supply



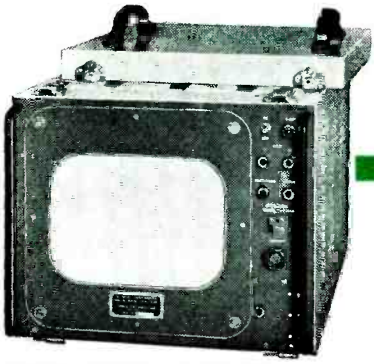
PORTABLE TELEVISION WAVE FORM MONITOR
Model TO-1

Features:

- Special Sync separator for TV signals
- 5" cathode ray tube
- Signal calibration accuracy 2%
- Large horizontal expansion amplification—24 tube diameters
- Frequency response 4 mc ± 3 db, 60 cps sq. wave less than 2% tilt
- Portable instrument that may be rack mounted

Uses:

- General purpose oscilloscope, especially designed for Video Wave form analysis



STUDIO PICTURE MONITOR
Model M-105

Features:

- Monochrome and/or color signals per FCC and NTSC standards
- Resolution, 450 lines or better
- 12" Kinescope
- Portable instrument that may be rack mounted
- Horizontal and vertical linearity excellent

Uses:

- High Fidelity Picture Monitor-Studio or Laboratory
- Use with storage and traveling wave tubes

REGULATED POWER UNITS

Model:	*Output voltage*	*Output current*
PT-110	400-450 V.	250-300 Ma
PT-111	250-300 V.	100-400 Ma
PT-111D	250-300 V.	100-400 Ma
PT-112	250-300 V.	150-800 Ma

Features:

- Electronically regulated power supplies
- Ripple less than 30 mv. peak to peak
- Rack mounting—dishpan construction—all parts readily accessible
- Centering current for T.V. application

We Manufacture a Complete Line—Write for Catalog

POLARAD ELECTRONICS CORP.
100 Metropolitan Avenue, Brooklyn 11, N. Y.

Export Dept. 13 E. 40th St., New York, N. Y.
Sales Representatives: Albuquerque • Boston • Bridgeport • Chicago • Cleveland
Dayton • Kansas City • Los Angeles • New York • Seattle • Ottawa, Canada

Polarad
Electronics Corporation

www.americanradiohistory.com

VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

by **KEPCO**

Kepco Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions within the range of the instrument.

Write for complete specifications.

VOLTS	CURRENT	REGU-LATION	RIPPLE	6.3 V.† AC. CT.	MODEL
0-1500	0-200 Ma.	0.5%	20 Mv.		1520
0-1200	0-20 Ma.	0.1%	10 Mv.	10 Amp.	1220
0-1000	0-500 Ma.	0.5%	20 Mv.		1350
200-1000	0-500 Ma.	0.5%	20 Mv.		1250
0-1000	0-50 Ma.	0.1%	10 Mv.	10 Amp.	1020
0-600	0-3 Amp.	0.5%	10 Mv.		780
0-600	0-2.25 Amp.	0.5%	10 Mv.		770
0-600	0-1.5 Amp.	0.5%	10 Mv.		760
0-600	0-750 Ma.	0.5%	10 Mv.		750
0-600 0-150 Bias	0-300 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	615
0-600	0-300 Ma.	0.5%	5 Mv.	10 Amp.	500R
#1 0-600 #2 0-600	0-200 Ma. 0-200 Ma.	0.5% 0.5%	5 Mv. 5 Mv.	10 Amp. 10 Amp.	800
0-600 0-150 Bias	0-200 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	815
#1 200-500 #2 200-500	0-200 Ma. 0-200 Ma.	0.5% 0.5%	5 Mv. 5 Mv.	6 Amp. 6 Amp.	510
200-500	0-200 Ma.	0.5%	5 Mv.	6 Amp.	245
0-400 0-150	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	400
100-400	0-150 Ma.	0.5%	5 Mv.	10 Amp.	141
100-400	0-150 Ma.	0.01%	1 Mv.	10 Amp.	2000
0-350	0-3 Amp.	0.5%	10 Mv.		730
0-350	0-2.25 Amp.	0.5%	10 Mv.		720
0-350	0-1.5 Amp.	0.5%	10 Mv.		710
0-350	0-750 Ma.	0.5%	10 Mv.		700
100-325 0-150 Bias	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	10 Amp.	131
0-300 0-150 Bias	0-150 Ma. 0-5 Ma.	0.5% *	5 Mv. 5 Mv.	5 Amp.	315
0-150	0-50 Ma.	0.5%	5 Mv.		150
3-30	0-30 Amp.	0.5%	0.1%		3030
1-13	0-10 Amp.	0.5%	10 Mv.		3200
0.3-3	0-100 Ma.	5 Mv.	1 Mv.		3100

DC POWER SUPPLY SPECIFICATIONS

REGULATION: As shown in table for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

*Regulation Bias Supplies: 10 millivolts for line 105-125 volts. ½% for load at 150 volts.

†All AC Voltages are unregulated.

All units are metered except Models 131, 315 and 3100.

All units are designed for relay rack mounting or bench use.

WORKMANSHIP

Workmanship is of a quality with the highest existing production standards and best instrument electronic practices consistent with the intended use of the item as a continuous duty voltage regulated power supply. Oil filled paper condensers and resistor-board construction are included in the design.

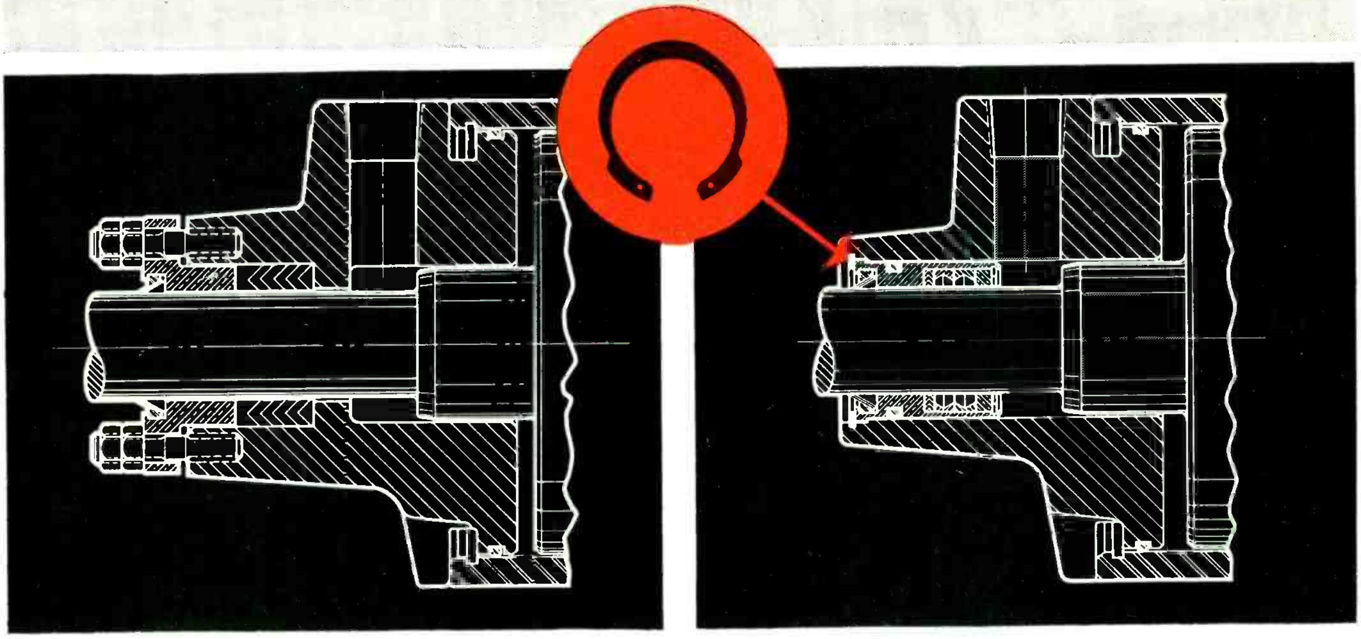
MANUFACTURERS OF ELECTRONIC EQUIPMENT • RESEARCH • DEVELOPMENT

KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, NEW YORK

www.americanradiohistory.com

Waldes Truarc Ring Saves $2.84 Per Unit, Cuts Labor-Time and Materials in Hydraulic Packing Unit



OLD STYLE stuffing box required skilled worker to install packing rings one at a time, then adjust packing glands by trial and error. Disassembly was equally difficult, time-consuming and costly.

NEW Monopak Cartridge is smaller, lighter, streamlined and installed with one Truarc Retaining Ring. Disassembly and reassembly with new cartridge takes unskilled worker just 1 minute.

Hydraulic Accessories Company of Van Dyke, Michigan, uses a single Waldes Truarc Inverted Ring (internal series 5008) to hold Monopak Cartridge in cylinder head.

New design eliminates costly machining and saves 2⅛ lbs. of material. Re-design with Waldes Truarc Retaining Ring reduces stuffing box diameter from 3½" to 2⅞", and reduces length from 5⅞" to 4⅜". Allows savings in assembly, adjusting and testing.

NEW DESIGN USING WALDES TRUARC RING PERMITTED THESE SAVINGS PER UNIT

MACHINE TIME SAVED:	
Chucking, facing and boring	$ .72
Drilling and tapping 3 holes	.18
Drilling and counterboring 3 holes	.12
Assembling, adjusting, testing	.90
MATERIAL SAVED:	
1½ lbs. cast iron	.30
½ lb. bronze	.23
3 studs	.36
3 nuts	.03
TOTAL	**$2.84**

Waldes Truarc Retaining Rings are precision-engineered . . . quick and easy to assemble and disassemble. Always circular to give a never-failing grip. They can be used over and over again. There's a Waldes Truarc Ring to answer every fastening problem.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

For precision internal grooving and undercutting . . . Waldes Truarc Grooving Tool.

SEND FOR NEW CATALOG

WALDES TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947, 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print) E-085

Name..............................

Title..............................

Company..............................

Business Address..............................

City.................... Zone.......... State..........

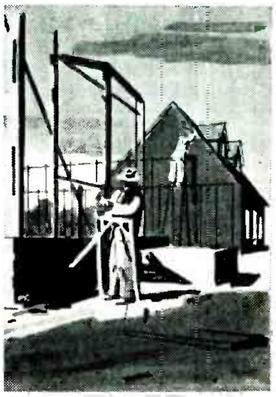
www.americanradiohistory.com

For every Electrical need

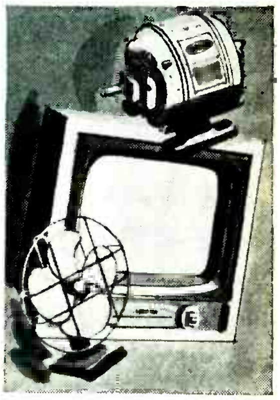
CHECK General for ELECTRICAL

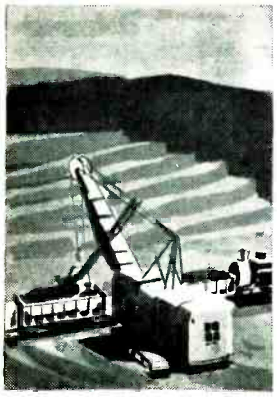

AUTOMOTIVE - AIRCRAFT

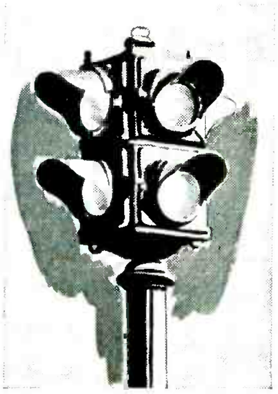

COMMUNICATIONS


CONSTRUCTION


GENERAL INDUSTRY

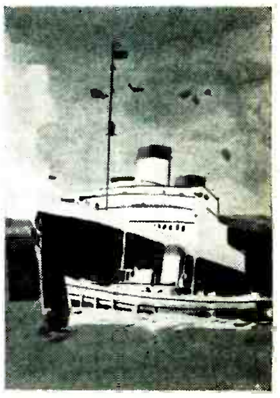

MFRS. ELECTRICAL APPARATUS


MINING-EARTH MOVING


MUNICIPAL

POWER


RAILROADS


SHIPBUILDING - SHIPYARDS

GENERAL CABLE
GENERAL CABLE

GENERAL CABLE

C O R P O R A T I O N

"More Power to You"®

Executive Offices: 420 Lexington Avenue, New York 17, N. Y.
Sales Offices in Principal Cities of the United States

www.americanradiohistory.com

Cable *FIRST*

WIRE and CABLE

Copper, bronze and aluminum conductors in thousands of different sizes and types of product. Constructions and insulations of every modern variety.

This is General Cable, a *prime source of supply* for everyone who generates electricity, distributes electricity or utilizes electricity.

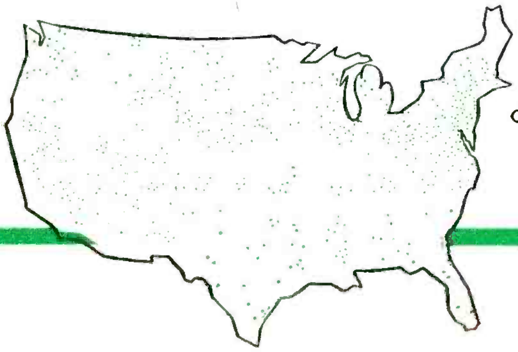
Whatever your electrical wire and cable need, whenever you need it—say "General Cable" to your purchasing agent, your distributor—or call on the nearest General Cable office.

ONE Source of Complete Supply

ONE Completeness of Service

ONE Standard of Quality

For Quicker Service Anywhere in the United States...General Cable maintains



22 Sales Offices

14 Resident Sales Representative Locations

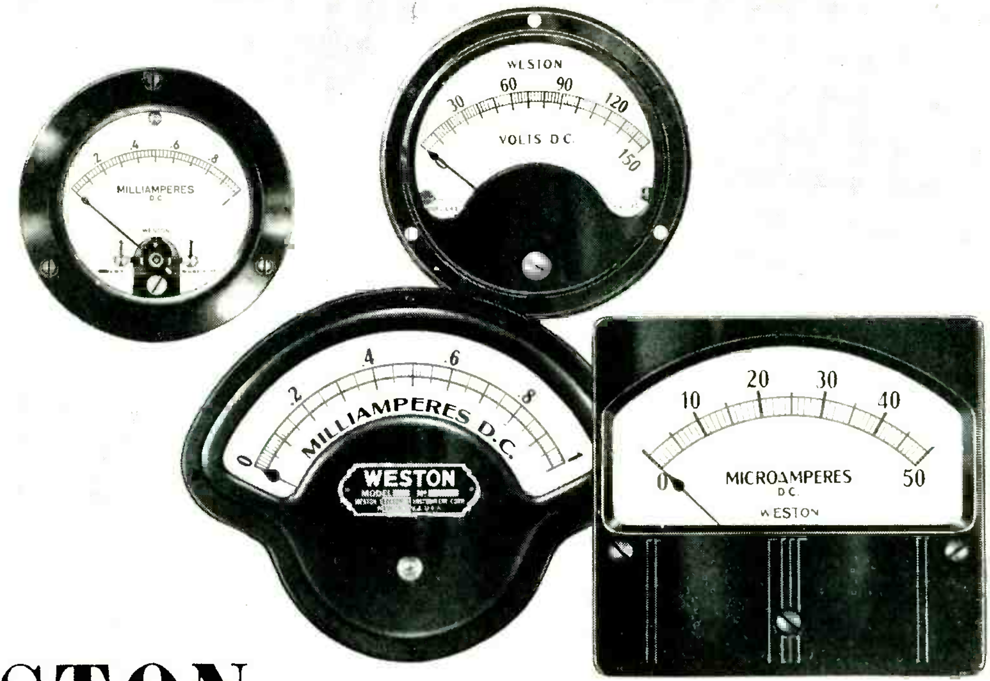
Over **600** Distributor Sales Locations

6 Regional Stock Distribution Points

6 Manufacturing Plants and Stocks

Want more information? Use post card on last page.

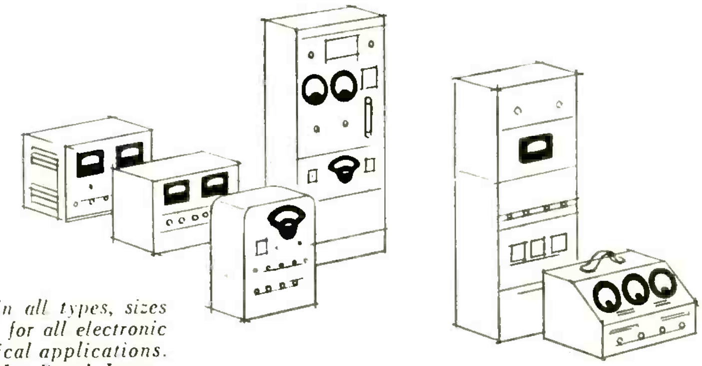
www.americanradiohistory.com



WESTON

PANEL INSTRUMENTS...

...outward evidence of the high quality built within fine electronic equipment



Available in all types, sizes and ranges for all electronic and electrical applications. Send for the Panel Instrument bulletin.

WESTON ELECTRICAL INSTRUMENT CORPORATION, 614 Frelinghuysen Avenue, Newark 5, N. J.

www.americanradiohistory.com

HOW

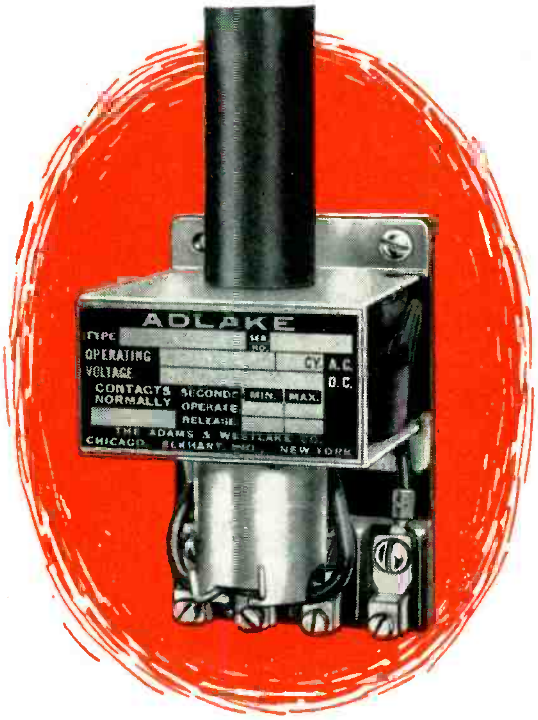
are Adlake Mercury Relays saving money for American Industry?

Today, ADLAKE Relays are increasing efficiency and assuring dependable operation in timing and control circuits in many of the most exacting installations in industry! They are saving money by doing—year in and year out—the jobs that conventional relays can do in an uncertain manner at best!

For instance, ADLAKE Relays have proved their ability to stand up under the most adverse conditions of temperature and moisture. Their time delay characteristics are fixed and non-adjustable . . . normal line voltage fluctuations or ambient temperatures from −38.8° to 200° F. have no material effect on these characteristics.

Yes, in chick incubators or diesel locomotives . . . wherever sensitivity and dependability are required . . . ADLAKE Relays can be counted on. Send for complete Relay catalog today . . . The Adams & Westlake Company, 1171 N. Michigan, Elkhart, Indiana. In Canada, write Powerlite Devices, Ltd., of Toronto.

EVERY ADLAKE RELAY IS TESTED—
AND *GUARANTEED*—TO MEET SPECIFICATIONS!



Type 1040-44 ADLAKE Relay . . . available with time delay or load features and either normally open or normally closed

Adlake 96th year of serving the transportation and building industries

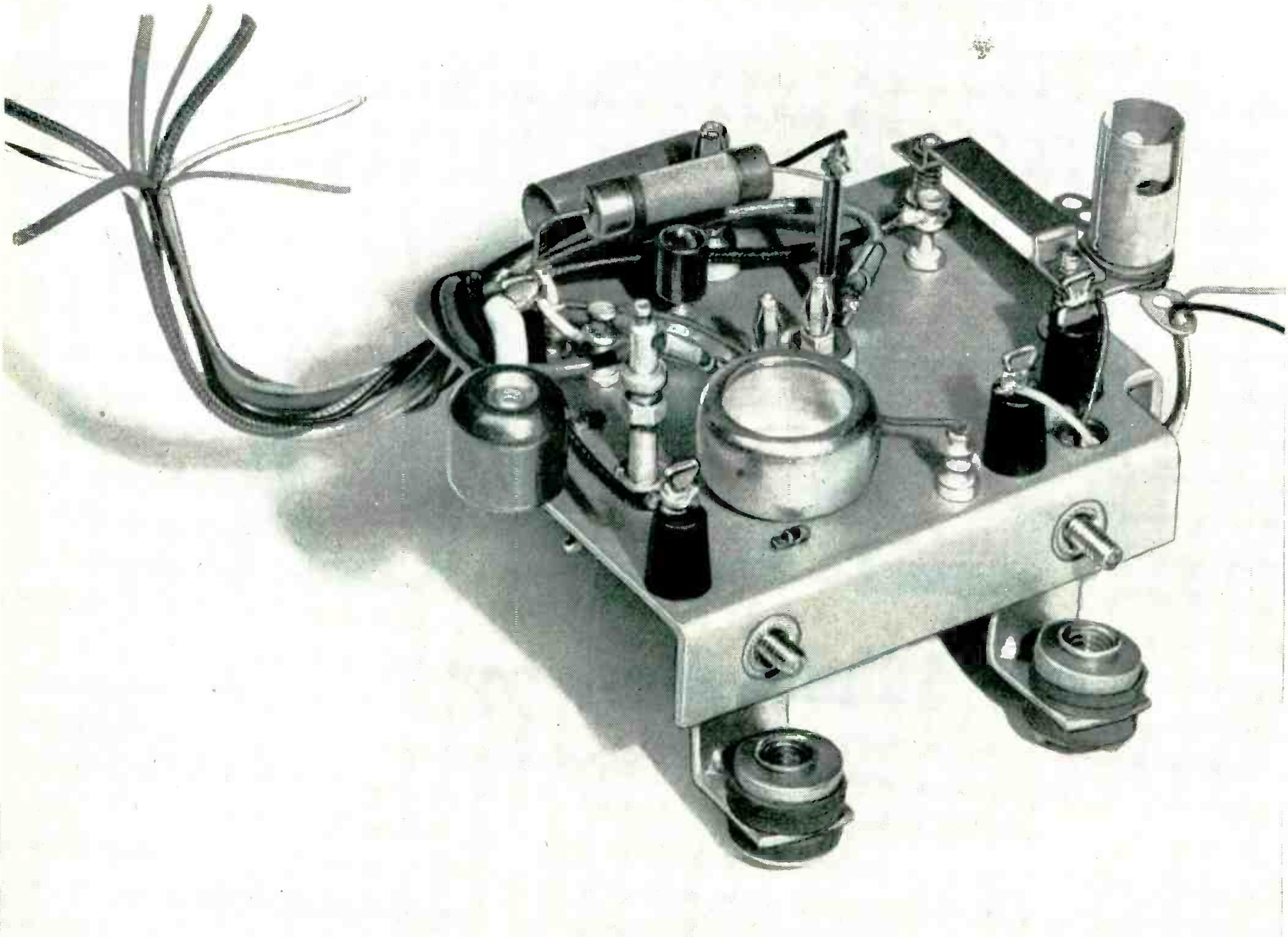
THE Adams & Westlake COMPANY

Established 1857 • ELKHART, INDIANA • New York • Chicago

Manufacturers of ADLAKE Hermetically Sealed Mercury Relays

Want more information? Use post card on last page.

www.americanradiohistory.com



Ever See Our 50,000 Watt Conglomerator?

It doesn't put out quite 50,000 watts and it's only the seventh cousin, twice removed, of an electronic brain. But every one of its precision-made parts fulfills a vital function in military or civilian electronic apparatus of one type or another.

As the Conglomerator clearly demonstrates, too, Ucinite is equipped to manufacture, assemble and wire to your specifications a wide variety of connectors, sockets, mountings and other electrical parts for use in electronic apparatus of all types.

With our own molding facilities for thermoplastic materials as well as volume production equipment for metal stamping and fabricating, Ucinite is ready to supply any need for metal or metal-and-plastics assemblies.

The specialized abilities and experience of the Company's own staff of design engineers are available for work on special problems.

ELECTRICAL ASSEMBLIES
Ucinite
RADIO AND AUTOMOTIVE

The
UCINITE CO.
Newtonville 60, Mass.
Division of United-Carr Fastener Corp.

Specialists in
ELECTRICAL ASSEMBLIES,
RADIO AND AUTOMOTIVE

www.americanradiohistory.com

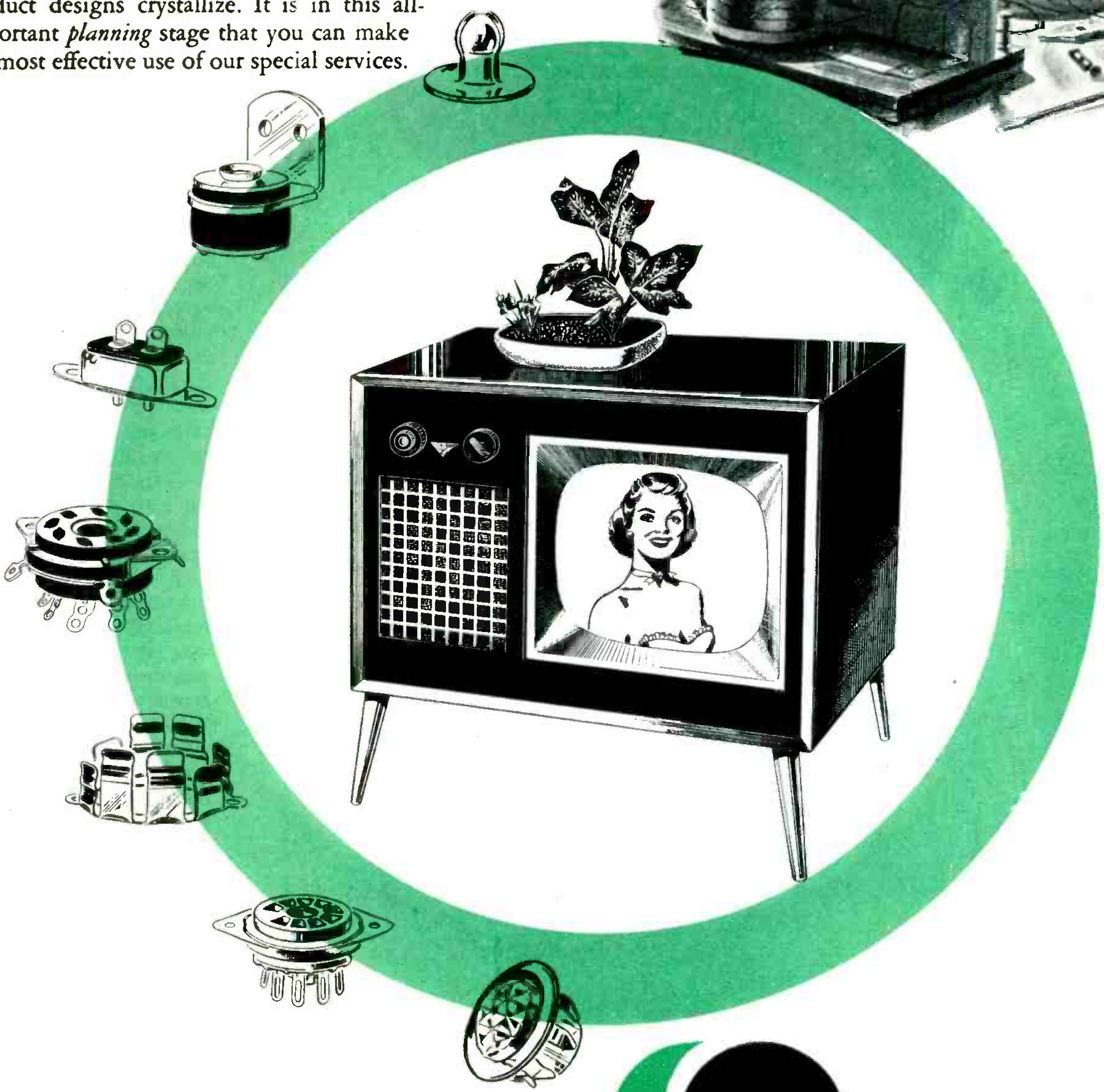
HAVE YOUR FASTENING METHODS

kept pace?

It's a long way from crystal and cat whisker to UHF and TV . . . and design changes never stop. That's why it pays to have your fastening methods checked by trained specialists . . . constantly.

United-Carr offers you ★ Complete engineering and design service ★ Complete facilities for volume production of specialized fasteners and allied devices. ★ Wide experience with the top manufacturers of electronic equipment, automobiles, aircraft, appliances, furniture. ★ The varied technical knowledge of all our divisions and subsidiary companies combined . . . to help you cut costs, speed assembly, improve product performance.

Call your nearest United-Carr field engineer *before* your new product designs crystallize. It is in this all-important *planning* stage that you can make the most effective use of our special services.



UNITED-CARR DOT FASTENERS

UNITED-CARR FASTENER CORP., CAMBRIDGE 42, MASS.

TAILOR-MADE IN VOLUME QUANTITIES

Want more information? Use post card on last page.

www.americanradiohistory.com

eliminate doubt...

place the responsibility for your electrical insulation

with...

MITCHELL-RAND

★ SINCE 1889 ★

Mr

Electrical Insulation Headquarters

and obtain the electrical insulation best suited for the job.

MIRAGLAS VARNISHED TAPES, CLOTHS AND SLEEVINGS • MIRAGLAS TAPES, BRAIDED SLEEVINGS AND TYING CORDS • MIRAGLAS SILICONE TREATED CLOTHS, TAPES AND TUBINGS • MICA TAPES, CLOTHS AND MICA-FIBERGLAS COMBINATIONS • FIBRE, PHENOL FIBRE AND MIRALITE POLYESTER RESIN SHEET INSULATING PAPERS—DURO, FISH, PRESSBOARD, ETC. • VARNISHED CAMBRIC TAPES, CLOTH AND SLOT INSULATIONS • COTTON TAPES AND SLEEVINGS • TWINES AND TIE TAPES • ASBESTOS TAPES, SLEEVINGS AND CLOTH, TRANSITE AND ASBESTOS EBONY • ARMATURE WEDGES AND BANDING WIRE • VARNISHED TUBINGS, HYGRADE, MIRAGLAS, HYGRADE VF, MIRAGLAS SILICONE • THERMOFLEX AND FLEXITE EXTRUDED PLASTIC TUBING • PERMACEL MASKING TAPES AND ELECTRICAL TAPES • BI-SEAL, BI-PRENE; FRICTION TAPES AND RUBBER SPLICE • COMPOUNDS—TRANSFORMER, CABLE FILLING, POTHEAD, ETC. • INSULATING VARNISHES OF ALL TYPES.

mitchell-rand

INSULATION COMPANY, INCORPORATED

51 MURRAY ST. • COrtlandt 7-9264 • NEW YORK 7, N.Y.

Want more information? Use post card on last page.

www.americanradiohistory.com

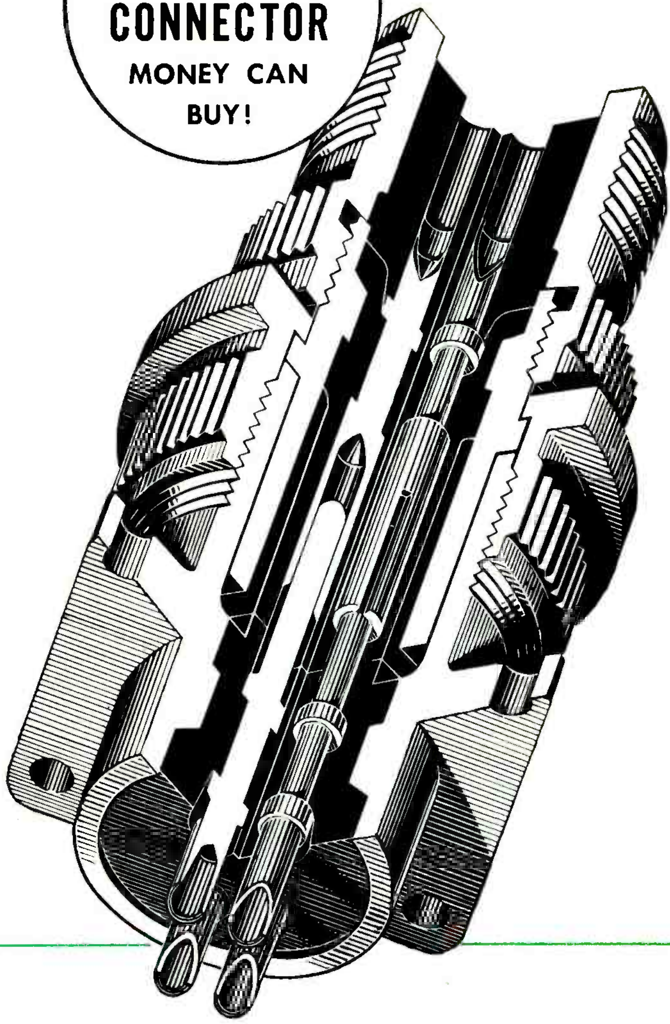
www.americanradiohistory.com

SCINFLEX ASSURES YOU PEAK PROTECTION AGAINST CIRCUIT FAILURE

When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength remains well above requirements within the temperature range of −67°F to +275°F. It makes possible a design increasing resistance to flashover and creepage. It withstands maximum conditions of current and voltage without breakdown. But that is only part of the story. It's also the reason why they are vibration-proof and moisture-proof. So, naturally, it pays to specify Bendix Scinflex Connectors and get this extra protection. Our sales department will be glad to furnish complete information on request.

• Moisture-Proof • Radio Quiet • Single Piece Inserts • Vibration-Proof • Light Weight • High Insulation Resistance • High Resistance to Fuels and Oils • Fungus Resistant • Easy Assembly and Disassembly • Fewer Parts than any other Connector • No additional solder required.

The Finest
ELECTRICAL CONNECTOR
MONEY CAN BUY!



BENDIX SCINFLEX

ELECTRICAL CONNECTORS

Bendix

SCINTILLA MAGNETO DIVISION of *Bendix* AVIATION CORPORATION
SIDNEY, NEW YORK

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FACTORY BRANCH OFFICES: 118 E. Providencia Ave., Burbank, Calif. • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Michigan • Brouwer Bldg., 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

www.americanradiohistory.com

Booth from Brooklyn Important Spot at Western Electronic Show—

SEE —low cost, custom-built sheet metal cabinets, chassis, housings and enclosures that convinced leading West Coast electronics manufacturers to choose Karp.

SEE —enclosures that were produced without a cent of new tooling.

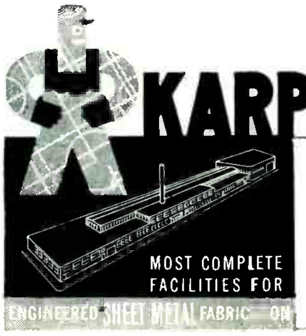
SEE —intricate heliarc welding of aluminum sheet to aluminum casting.

SEE —simple design revisions on enclosures that cut costs up to 60%.

SEE —how Karp enclosures cut your assembly-line costs to the bone.

VISIT **KARP** *Booths 1006-1007, Civic Auditorium, San Francisco, August 19-21*

KARP METAL PRODUCTS CO.
Division of H & B American Machine Company
215 63RD STREET, BROOKLYN 20, N. Y.



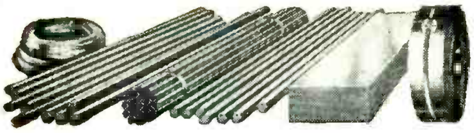
FACILITIES

FOR ENGINEERED SHEET METAL FABRICATIONS: in aluminum or steel
long run or short • spot, arc, gas or heliarc welding • any type finish.

- Modern plant—3 city blocks long
- Thousands of dies available
- Most modern of sheet metal fabricating equipment
- U. S. Air Force Certified Welding Facilities
- Air-conditioned spray room ... complete baking facilities
- Complete sub-assembly facilities

Want more information? Use post card on last page.

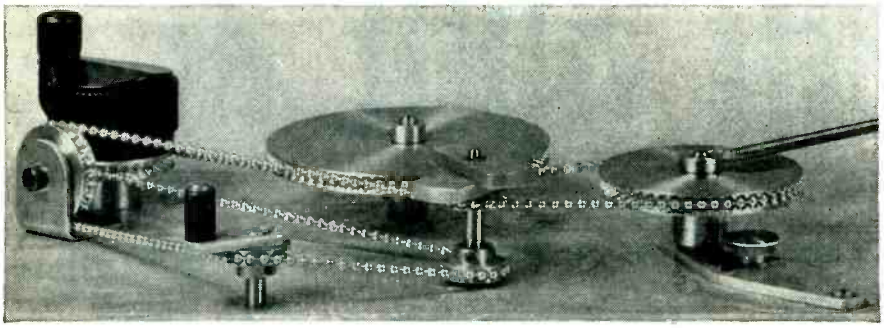
www.americanradiohistory.com



BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

Bridgeport MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

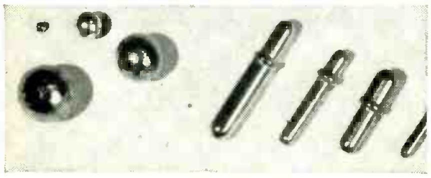


New low-cost Bead Belt — a sprocket drive for TV tuners, machines, etc. Timing and movement accurately controlled because slippage and backlash are avoided. Courtesy The Bead Chain Manufacturing Co., Bridgeport, Conn.

Uses of Multi-Swaging Products Challenge Imagination

Do you know that multi-swage products are among the most familiar items of everyday use? Examples are bead chain of a thousand uses; radio tube pins, terminals, jacks, contact pins and friction fasteners for electronic, electrical, and mechanical devices; stop pins, dowel pins, rest pins for appliances and novelties; spacers; shaft bearings for toys and other light duty applications.

Just how and where multi-swage products can be used advantageously for new applications in modern design is up to the imagination of designers and engineers.



Multi-swage products — hollow tubular parts with tightly swaged seams — are widely used for contact pins, terminals, jacks, and sleeves. Friction fasteners made by this process retain their spring properties remarkably well. Courtesy The Bead Chain Manufacturing Co., Bridgeport, Conn.

Efficient and Economical

The multi-swage products illustrated are made by The Bead Chain Manufacturing Company, Bridgeport, Conn. They are mainly produced from annealed narrow width strip brass (70-30) of uniformly close tolerances for composition, temper, gauge and flatness. Strip is fed into an extremely ingenious but very complicated high-speed automatic machine. It operates similar in principle to the eyelet machine except that some of the stages are designed for multiple swaging. This operation causes the metal to flow into the proper form of the product design and results in an article which is extremely work hardened with accompanying great strength and stiffness.

Multi-swage products are hollow and have a longitudinal seam which remains tightly closed because of the stresses imparted from the swaging operation. When forced apart by a tapered pin, a strong spring pressure is developed. When the pin is removed, the seam closes tightly even after the above operation is repeated thousands of times. Sizes range up to a maximum of ¼″ diameter and 1½″ long.

Because of the minimum waste involved, and high speed of manufacture, the multi-swage method is more economical than other methods of manufacture for producing small tubular parts in large volume. Other advantages are dimensional accuracy and a variety of shapes. Fitting up charges for tooling, etc., for new items are surprisingly modest.

The New Bead Belt

Outstanding features of bead chains are nonkinking, low friction, and unusually great strength in proportion to its weight, especially in the small sizes. Tensile strength ranges from 15 pounds to 200 pounds depending upon size and metal used.

A new development in the accurate spacing of the beads and an ingenious method of closing the ends has led to the manufacture of a belt drive from bead chain. Specially designed sprockets fit the individual beads and eliminate slippage and backlash. Timing and movement of various parts are accurately controlled.

It is being applied in TV tuners, eliminating costly gearing mechanisms. Other applications are for timing devices, recorders, air conditioners, etc.

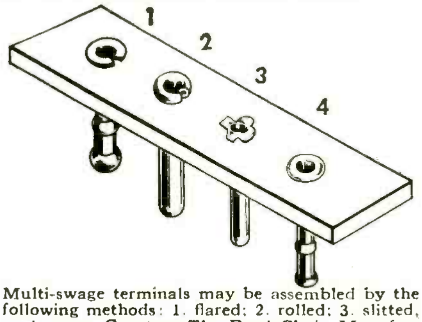
Many Alloys Used

Aside from brass, other alloys are used. Nickel Silver (copper 65%, nickel 18%, zinc remainder) is excellent as a white base for silver plated goods or for higher strength.

For decorative jewelry, Red Brass (85% copper, 15% zinc), and Commercial Bronze (90% copper, 10% zinc) are used because of their rich, golden colors.

For high strength and resistance to corrosion and wear, Silicon Bronze 609 (98% copper and 2% silicon) and Phosphor Bronze 35 (95% copper, 5% tin and 0.15% phosphorus) are recommended.

Bridgeport Brass Company is always glad to work with customers who have special metal requirements, as exemplified by multi-swage process which calls for careful control of uniformity and accuracy in gauge and temper. Fabricators desiring to improve their products through the selection of superior alloys, or who wish to reduce operating costs and spoilage by using metal designed for their particular requirements, should contact the nearest Bridgeport district office.



Multi-swage terminals may be assembled by the following methods: 1. flared; 2. rolled; 3. slitted, or 4. spun. Courtesy The Bead Chain Manufacturing Co., Bridgeport, Conn. (336)

www.americanradiohistory.com

New Ultra-Stable Microwave Oscillator

MODEL 803

Also Available: LFE Model 802 for ultra-stable microwave frequencies in the X-Band

The LFE Model 803 Stable Microwave Oscillator provides a source of highly stabilized microwave frequencies suitable for use as a local oscillator for microwave measurements, or in many other applications where a high degree of stability is required, such as Q measurements, SWR measurements and general narrow band design work. A dial accurately calibrated directly in frequency is an important feature. The main elements of the unit are a kylstron oscillator, a stabilizing monitor loop which consists of a calibrated dual-mode reference cavity, a feedback amplifier and a self-contained power supply. Means are provided for modulating the oscillator.

Specifications

- ***Frequency Coverage***
  2700–2950 Mc.—S-Band
- ***Dial Calibration***
  Calibrated directly in frequency—1 Mc. per division.
- ***Frequency Stability***
  Short Term Deviation—less than one part in 10^8.
  Long Term Drift—less than 100 Kc/sec from original setting.
- ***Modulation***
  Can be modulated 25% when stabilized; 100% modulation possible when stabilization is removed.
- ***Attenuation***
  Attenuator provides 100 db. range of control.
- ***Power Output***
  15 milliwatts.
  Output Connector—Type N.
- ***Power Consumption***
  150 watts.
- ***Size***
  10½" x 19" front panel, 14⅛" deep, cabinet with rack mounting panel.
- ***Weight***
  100 lbs.

For complete information, see your LFE engineering representative or write—

L/E

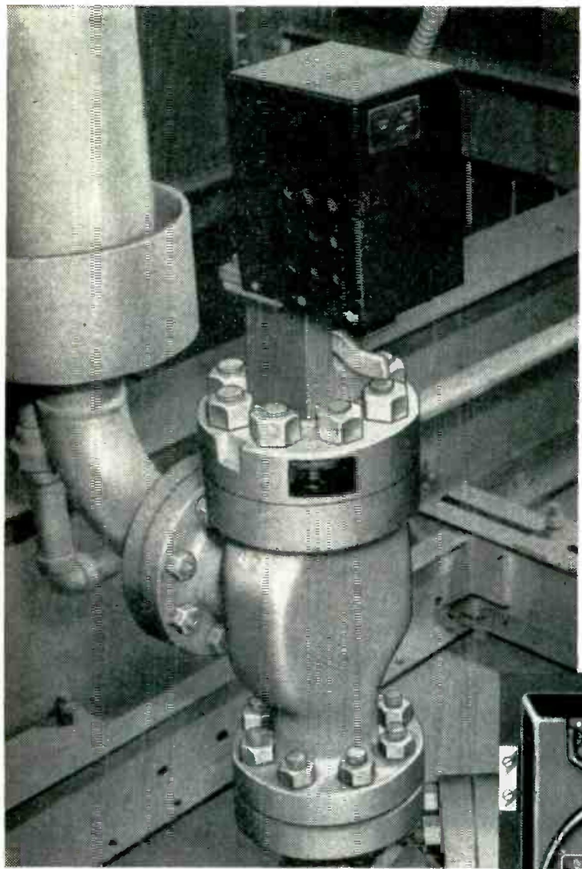
LABORATORY for ELECTRONICS, INC.
75-3 PITTS STREET • BOSTON 14, MASS.

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • SOLID DELAY LINES

Want more information? Use post card on last page.

www.americanradiohistory.com

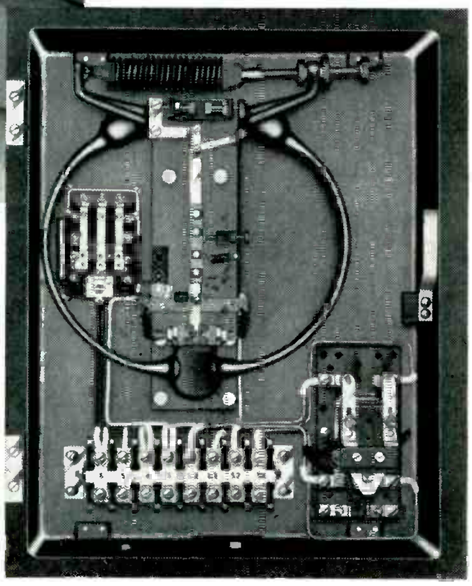
ELECTROMATIC relief valve depends on WARD LEONARD RELAYS



CONSOLIDATED ELECTROMATIC RELIEF VALVE ACTUATED BY WARD LEONARD RELAYS, keeps boiler pressures balanced within one percent of a predetermined level. This conserves power, maintains uniform line pressure and decreases maintenance of spring-loaded safety valves.

This relief valve, made by Manning, Maxwell & Moore, Stratford, Conn., is designed to increase the efficiency of steam generating systems by automatically keeping boiler pressures balanced within one percent of a predetermined value.

The relays used in the control unit which actuates this relief valve must give trouble-free performance with practically no attention. While they may be called into action frequently or only once or twice a year, it is extremely important that they function perfectly when needed. Such trigger-sharp sensitivity after long inoperative periods is a very exacting and unusual requirement for any relay. Ward Leonard relays handle this assignment dependably and accurately.



PERFECT PERFORMANCE, even after months of inoperation, is required of the electrical control unit. To meet this very severe and unusual operating condition, Ward Leonard 110 and 130 relays shown here give trouble-free performance with little or no maintenance. The midget 110 relay will open or close circuits up to ten amperes. The two-pole 130 relay can be economically adapted to a variety of applications by varying interchangeable parts in its assembly.

WARD LEONARD

WARD LEONARD ELECTRIC COMPANY

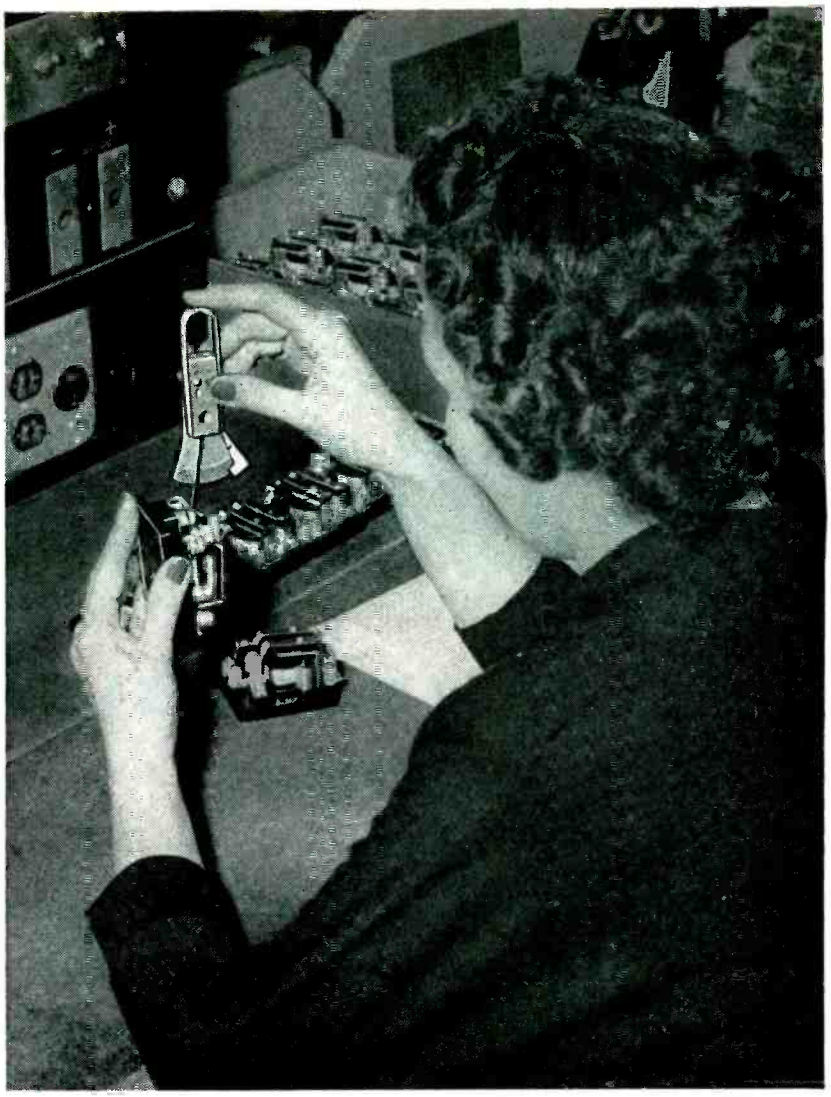
MOUNT VERNON, NEW YORK

Result-Engineered Controls Since 1892

Want more information? Use post card on last page.

www.americanradiohistory.com

WARD LEONARD'S attention to every detail in the construction of relay components gives you accurate, dependable performance



CONTACT PRESSURE OF EVERY RELAY is measured on a gram gauge in Ward Leonard's Mount Vernon plant.

Take the Ward Leonard relay coils, for example. All magnetic relays have coils, but there can be a world of difference between them. Here's how Ward Leonard insures perfect performance in every relay coil as a routine production procedure:

Coils are layer wound using insulated magnet wire with insulating paper between each layer. They are vacuum impregnated with heat reactive varnish. Their ends are sealed with an end seal compound. Insulated tape used for anchoring provides auxiliary insulation. The outside wrap provides excellent mechanical protection. The final finish dip in insulating varnish provides a virtual hermetic seal for the coil.

These features of the relay coil are indicative of the detailed attention given to every component of Ward Leonard relays. And after the components are assembled, all finished relays are measured for resistance, close dimensional tolerances, pick-up, drop-out, dielectric strength and contact continuity.

Whether you make heavy industrial equipment like the Electromatic Relief Valve, or highly sensitive electronic apparatus, there's a Ward Leonard electrical control that will meet your needs.

For complete information, write for our Relay Catalog. Ward Leonard Electric Co., 31 South St., Mount Vernon, New York. 3.15

Want more information? Use post card on last page.

www.americanradiohistory.com

A GOOD NAME TO REMEMBER WHEN YOU NEED DEPENDABLE COMPONENTS... *faster!*

STACKPOLE

Electronic Components Division

Stackpole Carbon Company, St. Marys, Pa.

Also • LINE AND SLIDE SWITCHES • CERAMAG® (ferrite) CORES • IRON CORES • MOLDED COIL FORMS • GA "GIMMICK" CAPACITORS, etc.

Want more information? Use post card on last page.

www.americanradiohistory.com

One Sure Way to Get MORE DEFENSE FOR LESS MONEY

How can we get more national defense for less money? The best answer yet given to this question appears in a little-noticed section of the new defense budget. That answer, with which this editorial is concerned, is to provide more equipment with which to step up munitions production in an emergency. Thus we can eliminate much of the need to stockpile finished munitions in advance.

The new defense budget provides an appropriation of $500 million, to be invested by the Secretary of Defense in specialized facilities required to produce munitions on a wartime scale, but not adapted to profitable operation by private industry in normal times. Facilities of this type are known as "stand-by capacity."

There is no strictly political controversy over the "stand-by capacity" program. It was originally suggested by Clay Bedford, Special Assistant to the Secretary of Defense during the Truman administration. It has since been reviewed and endorsed by the Eisenhower administration. Moreover, it involves little or no technical controversy. Civilian and military experts are well agreed that the only alternative to enormous expenditures for stockpiling military equipment is to provide enough facilities for producing it quickly in an emergency.

Here is the Key Idea

In his speech of May 19, introducing his defense budget to Congress and the nation, President Eisenhower stressed the value of such reserve capacity in these terms, ***"The more swiftly and smoothly we can mobilize, the less our dependence upon costly standing armies and navies."***

In accord with this idea, the $500 million requested for the present reserve capacity program would be invested in tools that require a long time to produce, and so present grave complications in an emergency unless they are ready in advance. Some such tools would be installed in new plants that are needed to eliminate potential bottlenecks in the defense production program. Others would be ordered to replace that part of the government's present machine-tool inventory which is made obsolete by changes in the design of defense products. By completely "tooling up" with the most modern equipment, the admin-

www.americanradiohistory.com

istration hopes to realize a production potential many times greater than could be achieved by spending the same amount of money on military end-products.

Examples of Savings

In the specialized field of defense production, adequate modern capacity is the key to both economy and speedy delivery in a pinch. Here are some striking examples from the recent report of the Advisory Committee on Production Equipment (Vance Committee) to the Director of Defense Mobilization:*

— In the case of certain ammunition components, the cost of new capacity can be recovered in only six weeks of full production.

— If $500 million worth of special tools needed to make aircraft are purchased in advance, aircraft production during the first two years of war will be increased about $18 billion. In other words, it costs 1/36 as much to acquire the tools in advance as to acquire the aircraft.

— In the case of a certain ordnance item, an expenditure equal to the cost of only 150 units of the item will provide the capacity to produce thousands and save three years' time in meeting mobilization requirements.

Moreover, reserve plants and equipment can be kept up-to-date at only a small fraction of the cost required to maintain an up-to-date reserve of military end-products. The cost of replacing 5,000 obsolete tanks is at least $1 billion. The cost of new tools for a tank plant would be less than 10% of that amount.

*This Committee, headed by Mr. Harold Vance, President of the Studebaker Corporation, included Clay Bedford, then President of Chase Aircraft, Manly Fleischman, former Defense Production Administrator, and several retired military leaders with wide experience in procurement.

Savings Will Multiply

On the basis of facts like these, the Vance Committee recommended that the Defense Department spend $500 million to $800 million per year on specialized defense production facilities in order to provide substantial reserve capacity as soon as possible. It also recommended that expenditures for military end-products which get obsolete rapidly be held to a minimum. The Eisenhower administration has adopted this approach to the problem of munitions production in asking that $500 million be invested in reserve capacity.

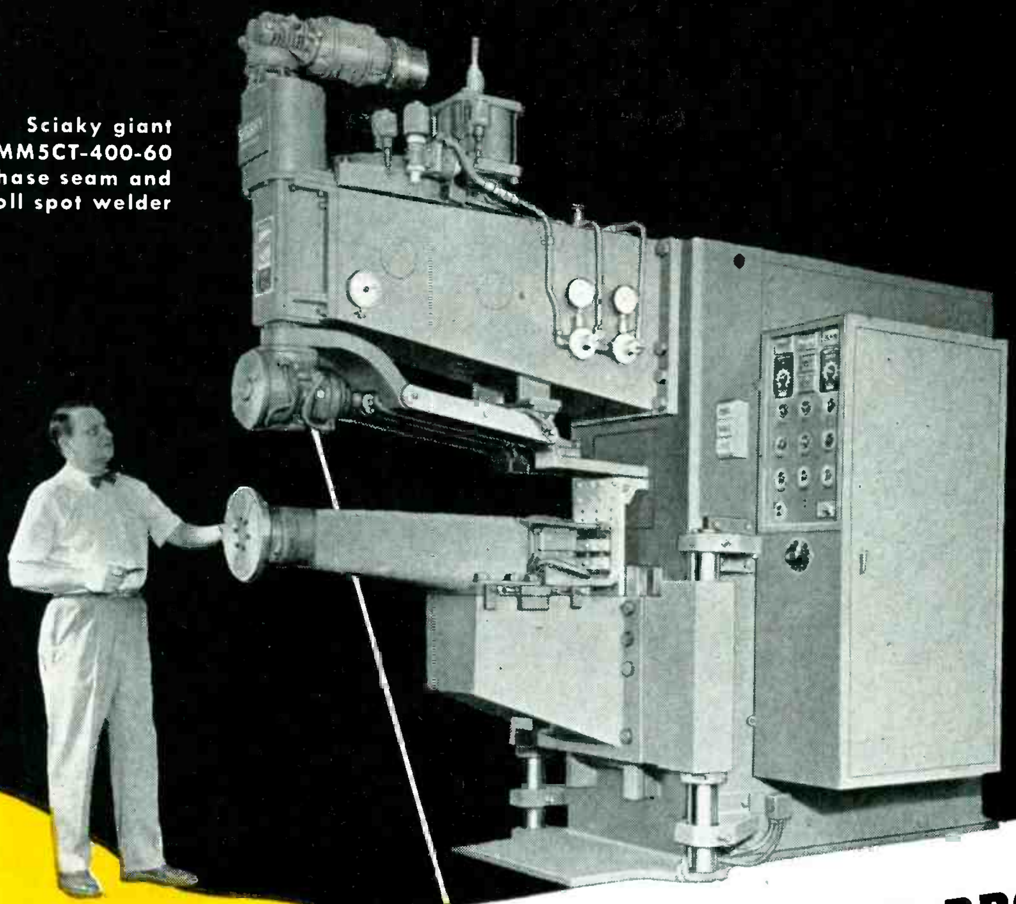
The importance of this approach is much greater than is indicated by the amount of money to be spent on new tools, although this amount will go far toward assuring a healthy machine tool industry, adequate to meet emergency demands. ***What is really important is the great saving that can eventually be made in the cost of our defense program by a modern tooling program.*** If we are to maintain this program for a long period, and if we are to pay as we go, we must have a low-cost program. No other plan to reduce and control the cost of a garrison economy can compare with the new approach suggested in the Vance Report and now embodied in the new defense budget.

Congressmen will do well to scrutinize all military appropriations carefully. They have a chronic tendency to be too big. But there should be no penny-pinching on investments in capital equipment that will pay out in as short a time as six weeks in a war emergency. It would be tragic if this opportunity for real economy were lost in the controversy over other aspects of the defense program. ***The tooling program is a key part of the Eisenhower effort to cut defense costs. It should be promptly approved.***

McGraw-Hill Publishing Company, Inc.

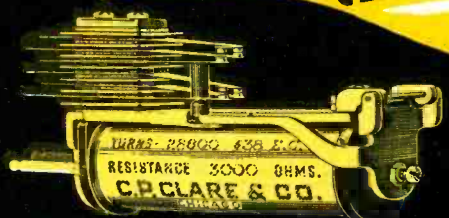
www.americanradiohistory.com

Sciaky giant
PMM5CT-400-60
three phase seam and
roll spot welder



Where ordinary relays won't do...
...that's where you find
CLARE RELAYS

IN SCIAKY BROS. GIANT SEAM WELDERS, *for instance*



CLARE
Type C Relay

CLARE
Type J Relay

Clare Relays which perform precise functions in control of Sciaky welders are of plug-in type with dust covers

There is nothing small . . . or ordinary . . about this giant SCIAKY SEAM WELDER. It has a 54" throat depth for longitudinal seam welding . . . a 60" throat depth for circular seam welding . . . and will deliver a maximum of 150,000 amperes of welding current between the electrodes.

Engineers of Sciaky Bros., internationally famous pioneers and inventors of electric resistance welding equipment, found CLARE RELAYS a natural selection for their controls which demand the utmost in precise operation. Among the requirements were:

★ **Extremely fast operation . . . Within half a cycle, two relays — one operating another — have to be energized and operate their contacts.**

★ **Complete structural uniformity . . . Two relays with coils in series must operate their contacts simultaneously and maintain this performance consistently.**

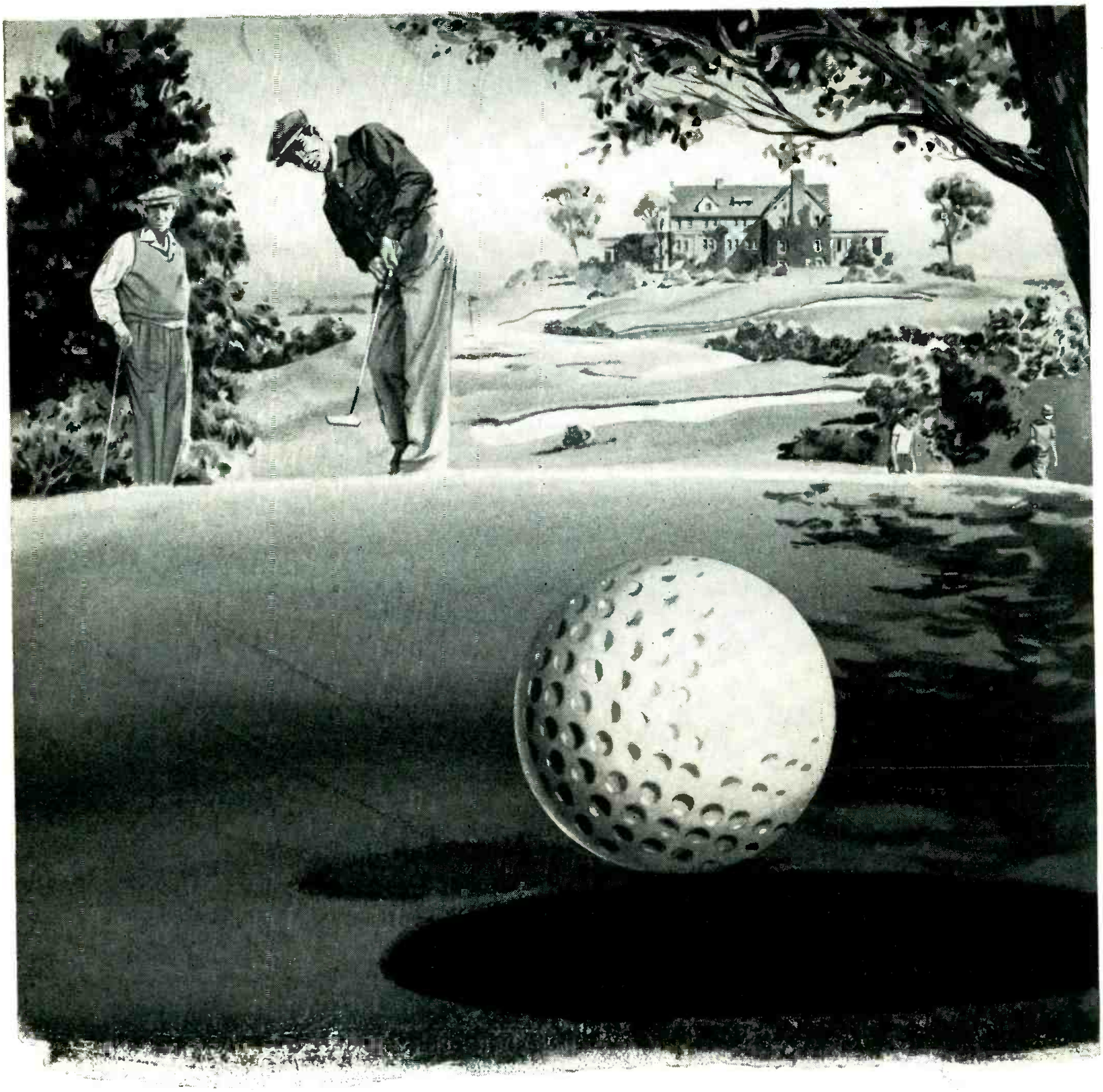
No, this was no job for ordinary relays. Clare Relays were selected and are used for important precision controls in all Sciaky control panels

If your product, like the Sciaky welder, is a quality product . . . if you must have only the highest quality components . . . a consultation with the engineers of C. P. Clare & Co. can save you time and money. Experienced sales engineers are located in principal cities. Call them direct or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable address: CLARELAY.

***FIRST* IN THE INDUSTRIAL FIELD**

CLARE RELAYS

www.americanradiohistory.com



PAR is just another habit!

When you keep your eye on the ball—and keep playing the game for all you're worth, day after day—you're pretty sure to be a better-than-average performer.

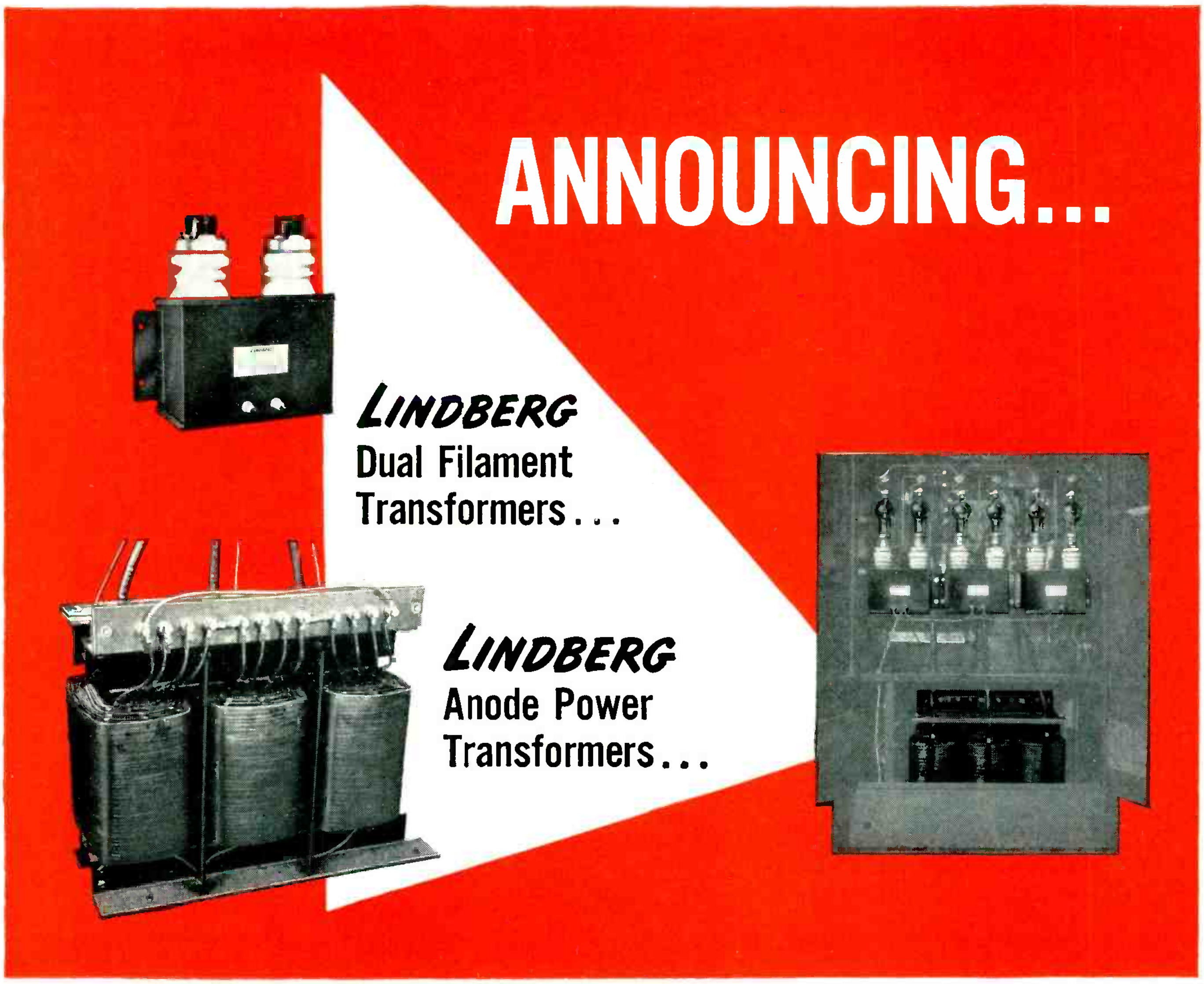
That's the way it goes in the brass mill business, too. And here at Bristol we are able to score consistently enough—both in production and service—so that quite a few of the country's top users of sheet, rod and wire have taken us on as their partner.

Care to shoot a "Practice round" with us some time?

THE
BRISTOL BRASS
CORPORATION

Makers of Brass since 1850 in Bristol, Connecticut.
Offices or warehouses in Boston, Chicago, Cleveland, Dayton, Detroit, Los Angeles, Milwaukee, New York, Philadelphia, Pittsburgh, Providence, Rochester.

www.americanradiohistory.com



Lindberg Dual Filament Transformers have been developed specifically for industrial electronic applications. Each transformer supplies filament power for *two* rectifier tubes simultaneously. Furnished complete with sockets . . . contained in one enclosure . . . conserves space . . . simplifies mounting and handling. Available in two sizes . . . 100 VA and 200 VA, 115 volt primary, dual 5 volt filament supply, each secondary circuit center tapped at 2.5 volts. These transformers are available from stock.

Lindberg Anode Power Transformers are engineered to exacting specifications with particular attention paid to rugged construction, long life and ability to take momentary high voltage stresses and overloads. They are available in sizes 5 KVA to 100 KVA in both single and three phase construction. Long experience in the design and manufacture of specialized transformer equipment enables us to give proper attention to your application. Delivery can be made to meet your requirements.

Lindberg filament and anode power transformers have been used exclusively in all Lindberg High Frequency Induction Heating Units and have proven to meet the exacting requirements demanded of them in this highly specialized field.

We invite your inquiries giving details of your special applications.

LINDBERG TRANSFORMERS

Transformer Division, Lindberg Engineering Company, 2489 West Hubbard Street, Chicago 12, Illinois

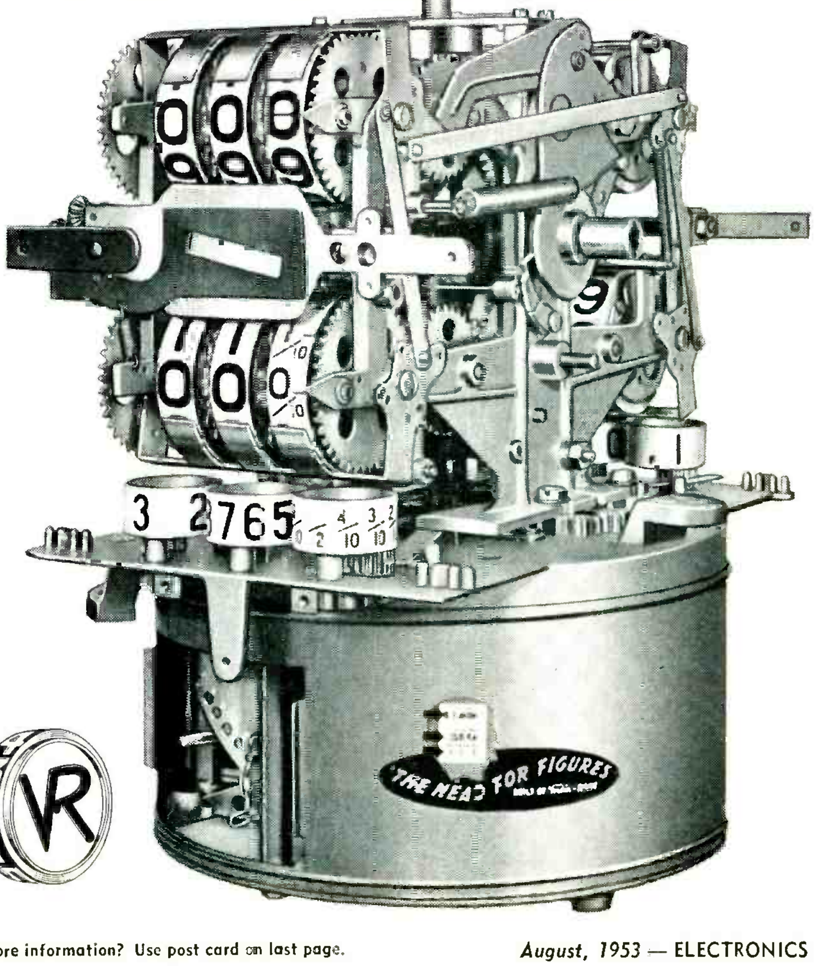
Want more information? Use post card on last page.

www.americanradiohistory.com

It Computes the Cost of Gasoline Pumped... in All of the World's Currencies

Everyone Can Count on

VEEDER-ROOT



Yes, this Veeder-Root Gasoline Pump Computer speaks the languages of 144 countries! A rugged, accurate mechanism of 800-plus parts, it's the modern protection given you by gasoline pump manufacturers, gasoline refiners and their service-station outlets . . . *to make sure you get full measure in your tank, and the right change in your pocket* (or you can buy in "even money"). And what's more, it underscores the fact that "Veeder-Root Counts Everything on Earth" . . . electrically, mechanically or manually . . . with standard and special devices of every conceivable type. Do *you* have a counting problem, in any of your defense work or any of your regular production? If so, you can count on V-R to help you in every possible way.

VEEDER-ROOT INCORPORATED
"The Name That Counts"
HARTFORD 2, CONNECTICUT
Chicago 6, Ill. • New York 19, N. Y. • Greenville, S. C.
Montreal 2, Canada • Dundee, Scotland
Offices and Agents in Principal Cities

"Counts Everything on Earth"

Here's the tube that gives **WMCA**

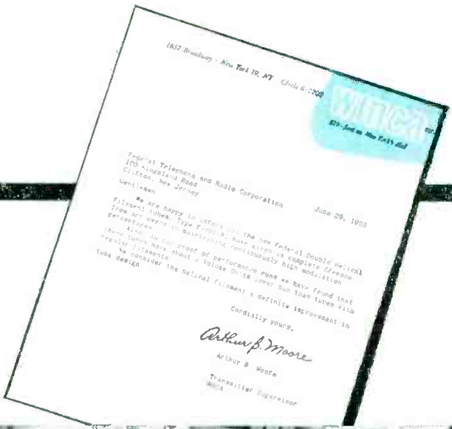
FREEDOM FROM ARC-OVERS—LOWER HUM!

Federal's F-892-R

with the Federal-developed

DOUBLE HELICAL FILAMENT

- *Does away with bowing*
- *Greatly increases tube performance and life*



"... a definite improvement in tube design," says WMCA

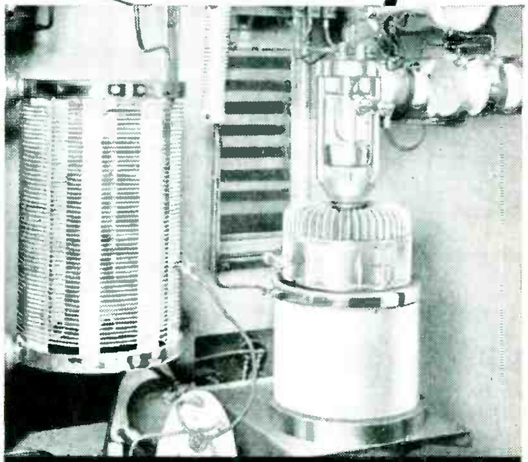
Federal's Double Helical Filament—in Federal's F-892-R—has achieved an outstanding record of dependability at WMCA—America's Leading Independent Station, and First on New York's Dial.

WMCA reports that these tubes "have given us complete freedom from arc-overs in maintaining continuously high modulation percentages. Also, in our proof of performance runs we have found that these tubes have about 2 Volume Units lower hum than tubes with regular filaments."

Federal's F-892-R—wound through 360° for mechanical stability and carrying opposing electrical fields which provide improved electrical stability—definitely eliminate *bowing*—one of the primary causes of filament-to-grid shorts!

Sturdier, longer lasting and more economical, Federal's double helical filament tubes are the key to a new era of *performance quality* and *operating dependability* for 5 and 10 KW transmitters. Write for full information today, address Dept. K-313.

"Federal always has made better tubes"



Federal's F-892-R installed in Power Amplifier Section of WMCA's 5000-watt Transmitter

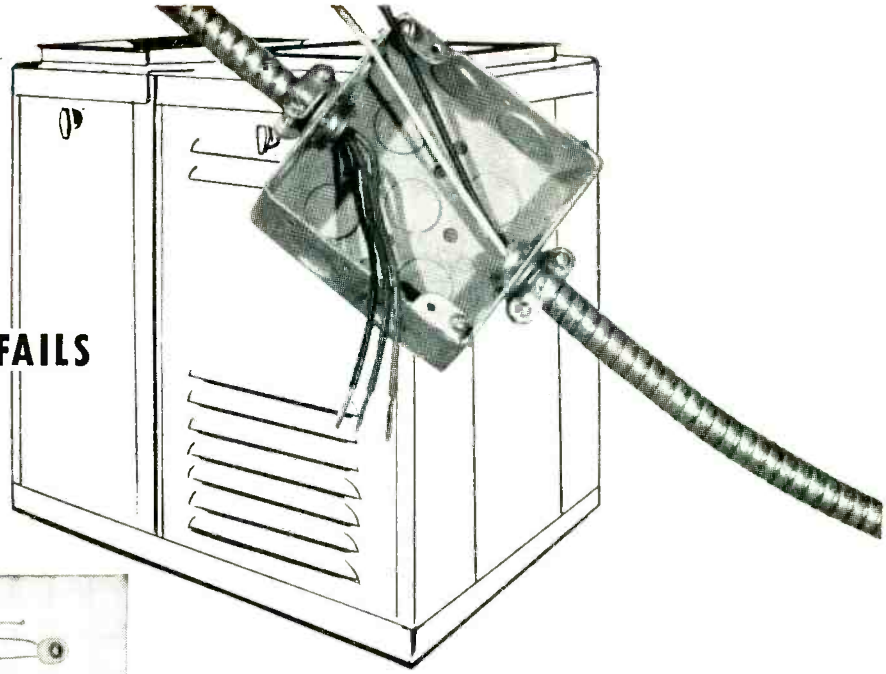
Federal Telephone and Radio Corporation

FEDERAL TELEPHONE & RADIO — AN IT&T ASSOCIATE

VACUUM TUBE DIVISION • 100 KINGSLAND ROAD, CLIFTON, N. J.

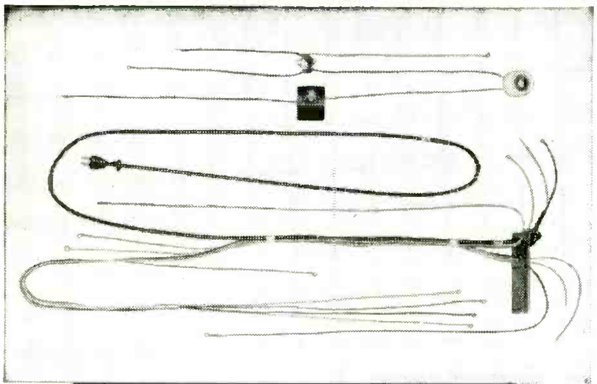
In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

www.americanradiohistory.com

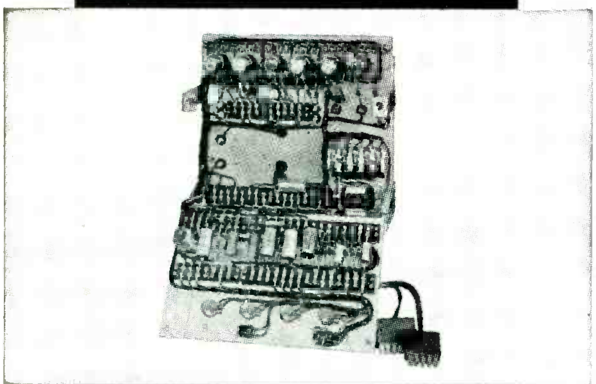


IF THE WIRING FAILS

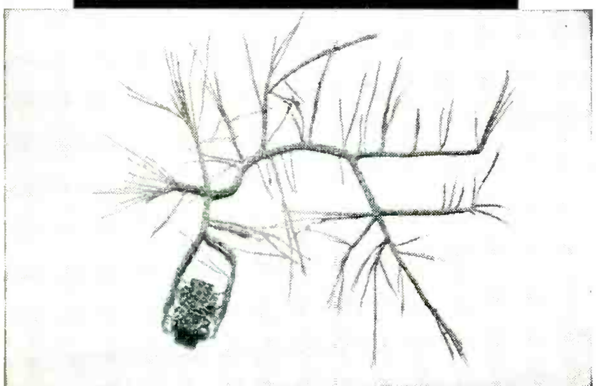
SO DOES YOUR
PRODUCT'S REPUTATION



Home Appliances. Unilectric serves over 80 leading appliance manufacturers like Hamilton Mfg. Co. of Two Rivers, Wisconsin.



Electronic Products. Unilectric Wiring Systems are standard on many electronic products like this Square D Co. electronic welder.



Military Products. Unilectric's war and defense production experience includes products like this radar cable assembly for Wells Gardner Co., Chicago.

FOR DEPENDABLE PRODUCT WIRING USE

UNILECTRIC
TRADE-MARK
WIRING SYSTEMS

For over 10 years, Unilectric has been wiring headquarters for the nation's electrical and electronic manufacturers.

Investigate This Proven Cost Saving Service!

UNILECTRIC WIRING SYSTEMS
TRADE-MARK

MANUFACTURED BY

UNITED MANUFACTURING & SERVICE CO.
409 SOUTH SIXTH STREET
MILWAUKEE 4, WISCONSIN

Want more information? Use post card on last page.

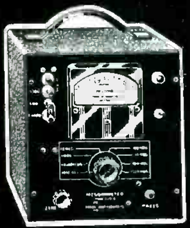
www.americanradiohistory.com

FREED *Instruments & Transformers*

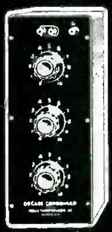
Famous For

QUALITY • DEPENDABILITY • ACCURACY

No. 1030
Low Frequency
"Q" Indicator



No. 1020B
Megohmmeter



Decade
Inductors

No. 1040
Vacuum Tube Voltmeter

FREED

HIGH FIDELITY-HIGH LEVEL OUTPUT TRANSFORMERS

The Freed "Quality Grade" audio transformers are wide band, high fidelity components featuring astatic construction, longitudinal balance, low harmonic distortion, uniform response, high efficiency, and constant impedance match throughout the audio frequency spectrum. Maximum neutralization of stray fields is accomplished by use of humbalanced coil structures and multiple alloy shielding. High fidelity is achieved on every tap of the universal impedance winding without line reflection or transverse coupling.

All Quality Grade Components are thoroughly impregnated in a special non-hygroscopic varnish, and fully encapsulated in a moisture proof, high melting point compound.

TUBES TO LINE, TUBES TO VOICE COIL, LINE TO LINE, LINE TO VOICE COIL

CATALOG	APPLICATION	IMPEDANCE LEVEL OHMS PRIMARY	SECONDARY	MAXIMUM POWER LEVEL V.U.*	RATIO	MAX PRI DC PER SIDE Ma.	D.C. UNBAL. Ma.	FREQ. RESPONSE C. P. S.	CASE NUMBER
QGA 25	PP 2A3, 6B4, 6L6 300A, 275A to Univ. 500 ohm line	5,000 SPLIT	U-500	+42 (15 WATTS)	3.16:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 26	As above to Universal Voice Coil	5,000 SPLIT	U-16	+42	17.7:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 27	Push-pull 6V6, 6AQ5, 7C5, 6N7 to Univ. 500 ohm line	8,000 SPLIT	U-500	+42	4:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 28	As above to Univ. Voice Coil	8,000 SPLIT	U-16	+42	22.4:1	50	5	±0.5 DB 20-30000	DC-5BT
QGA 29	P.P. 6F6, 6V6, 6AQ5, 7C5, 7B5, 6AR5, 6K6, 6L6 to Universal 500 ohm line	10,000 SPLIT	U-500	+42	4.47:1	40	4	±0.5 DB 20-30000	DC-5BT
QGA 30	As above to Universal Voice Coil	10,000 SPLIT	U-16	+42	25:1	40	4	±0.5 DB 20-30000	DC-5BT
QGA 31	P.P. 807, 1614, KT-66, (Williamson Amplifier) to Univ. 500 ohm line	10,000 SPLIT	U-500	+45.5 (36 WATTS)	4.47:1	50	5	±0.5 DB 20-30000	DC-6AT
QGA 32	As above to Universal Voice Coil	10,000 SPLIT	U-16	+45.5	25:1	50	5	±0.5 DB 20-30000	DC-6AT
QGA 33	P.P. Parallel 2A3, 6A5G, 300A to Univ. 500 ohm line	2,500 SPLIT	U-500	+45.5	2.24:1	100	10	±0.5 DB 20-30000	DC-6AT
QGA 34	As above to Universal Voice Coil	2,500 SPLIT	U-16	+45.5	12.5:1	100	10	±0.5 DB 20-30000	DC-6AT
QGA 35	P.P. 6L6 or P.P. Parallel 6L6 to Univ. 500 ohm line	3,800 SPLIT	U-500	+47 (50 WATTS)	2.75:1	130	13	±0.5 DB 20-30000	DC-7BT
QGA 36	As above to Universal Voice Coil	3,800 SPLIT	U-16	+47	15.4:1	130	13	±0.5 DB 20-30000	DC-7BT
QGA 37	High level multiple line to Universal Voice Coil	U-500	U-16	+42	5.6:1	0	0	±0.5 DB 20-30000	DC-5BT
QGA 38	High level multiple line to Universal Voice Coil	U-500	U-16	+47	5.6:1	0	0	±0.5 DB 20-30000	DC-7BT

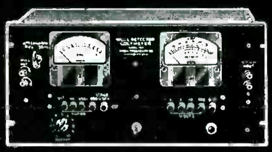
U-16 IMPEDANCES IN OHMS

2, 4, 8, 12, 16

U-500 IMPEDANCES IN OHMS

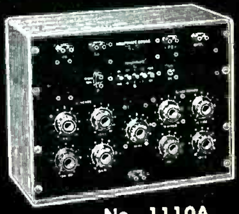
50, 125, 200CT, 250, 330, 500CT
125 and 500 ohms can be used for 150 and 600 ohms

SEND FOR COMPLETE CATALOG OF FREED INSTRUMENTS AND TRANSFORMERS



No. 1210
Null Detector &
Vacuum Tube Voltmeter

No. 1010
Comparison Bridge



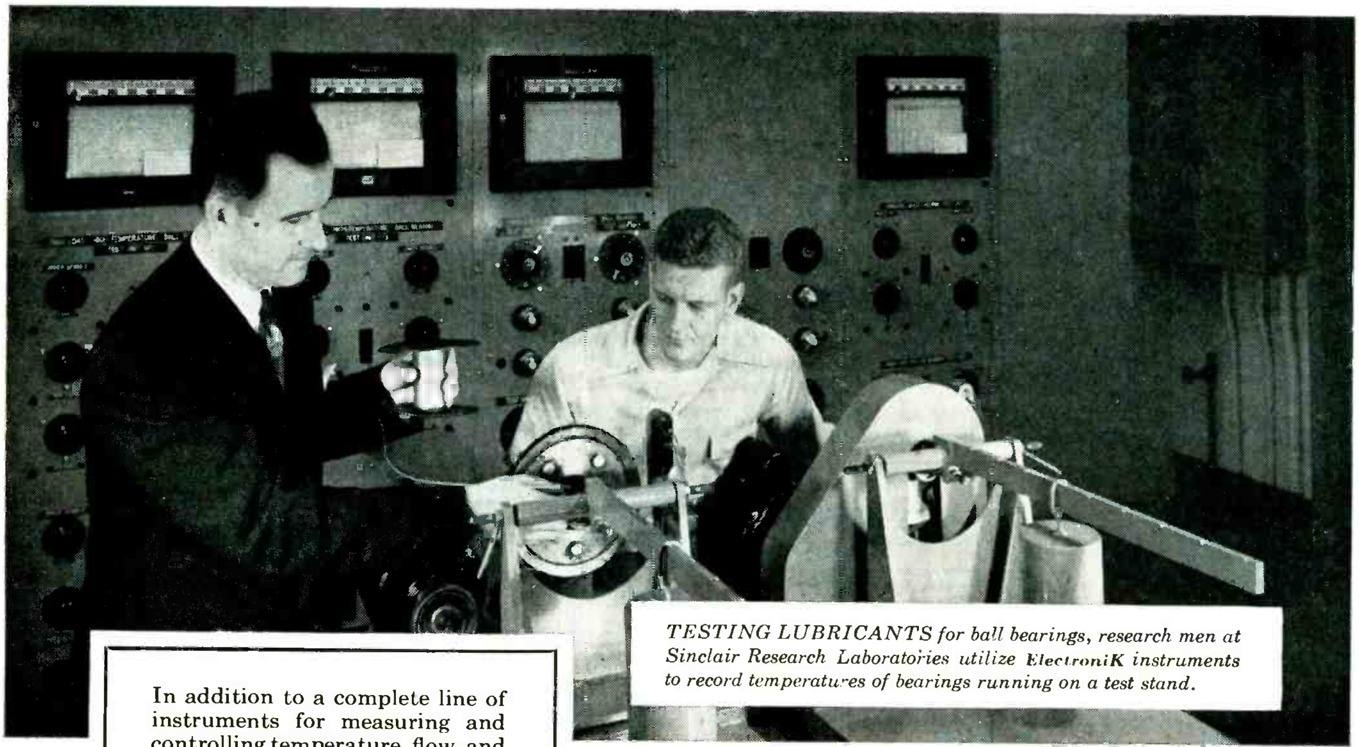
No. 1110A
Incremental Inductance
Bridge

FREED TRANSFORMER CO., INC.

1722 WEIRFIELD ST. (RIDGEWOOD) BROOKLYN 27, N.Y.

www.americanradiohistory.com

How many research hours in a day?



TESTING LUBRICANTS for ball bearings, research men at Sinclair Research Laboratories utilize ElectroniK instruments to record temperatures of bearings running on a test stand.

In addition to a complete line of instruments for measuring and controlling temperature, flow, and dozens of other variables, Honeywell offers these special *ElectroniK* instruments of interest to research men:

Function Plotter: automatically plots the relation of two independent variables.

Two-Pen Recorder: simultaneously measures two variables on a single chart.

Extended Range Indicator: featuring automatic range-changing, readable to one part in 5000.

Narrow Span Recorder: measures spans as narrow as 100 microvolts, without external pre-amplifier.

Brown Electrometer: measures currents as low as 10^{-15} ampere.

High Speed Recorder: features pen speed of only one second for full scale travel.

OBSERVING tests, measuring critical conditions, collecting data, plotting curves . . . the routine labor of research takes a lot of time out of each day . . . each week . . . each month.

You'll find that *ElectroniK* instruments can save countless scientific man-hours by doing all these laborious but essential jobs for you. They free highly trained scientists for more important work . . . giving them an opportunity to use their brainpower most effectively. And these instruments do the routine work faster, more accurately than could be done by human hands.

ElectroniK potentiometers are accelerating the pace of research in academic and industrial laboratories, atomic energy projects, pilot plants, and test centers throughout the world. For a discussion of how they can help your own research programs, call our nearest engineering representative . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4428 Wayne Ave., Philadelphia 44, Pa.

REFERENCE DATA: *Write for Research Bulletin 15-14, "Instruments Accelerate Research" . . . and for Data Sheets on specific instruments.*

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

H HONEYWELL

www.americanradiohistory.com

SLANT your requirements to

INSTRUMENT CORP. OF AMERICA

for miniature

SLIP RING AND COMMUTATOR ASSEMBLIES

This Instrument Corporation of America plant contains the most modern and complete facilities available anywhere in the world for the exclusive production of Miniature Slip-Ring and Commutator Assemblies to precision standards. It is now in full scale production to meet your requirements in the fastest possible time at the lowest possible cost.

COMPLETE ENGINEERING AND PRODUCTION FACILITIES AVAILABLE

Our assemblies can be supplied at low cost. Quality is the highest in the industry. Dimensional accuracy and other characteristics are excellent and these units are highly recommended for instruments such as synchros, etc.

ONE PIECE ELECTRO-PLATED TYPES FOR EXTREME ACCURACY

Wherever extreme dimensional precision, accurate concentricity and high dielectric qualities are required, the electro-deposition method is recommended . . . the production of which is licensed under an exclusive arrangement with the Electro Tec Corporation.

TYPICAL SPECIFICATIONS:

Sizes: .035" to 24" Cylindrical or Flat

Cross-sections: .005 to .060" or more

Finish: Polish to 4 Micro-Inches or Better

Breakdown: 1000 V or More Hi-Pot Inter-Circuit

Ring Hardness: 75 to 90 Brinell

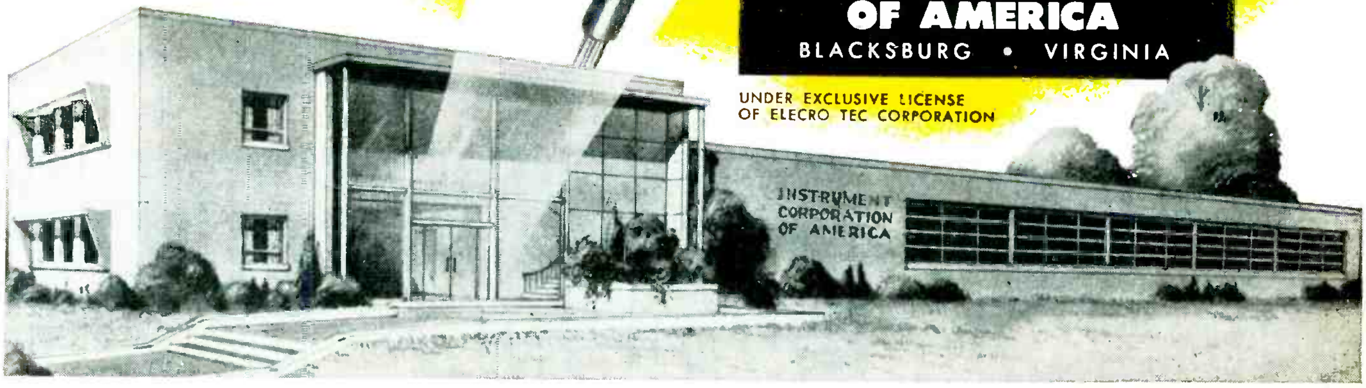
Rotation Speeds: To Over 12000 RPM

Surface Protection: Palladium and Rhodium or Gold Prevent Tarnish, Minimize Wear

Our engineering staff is at your service at all times for consultation

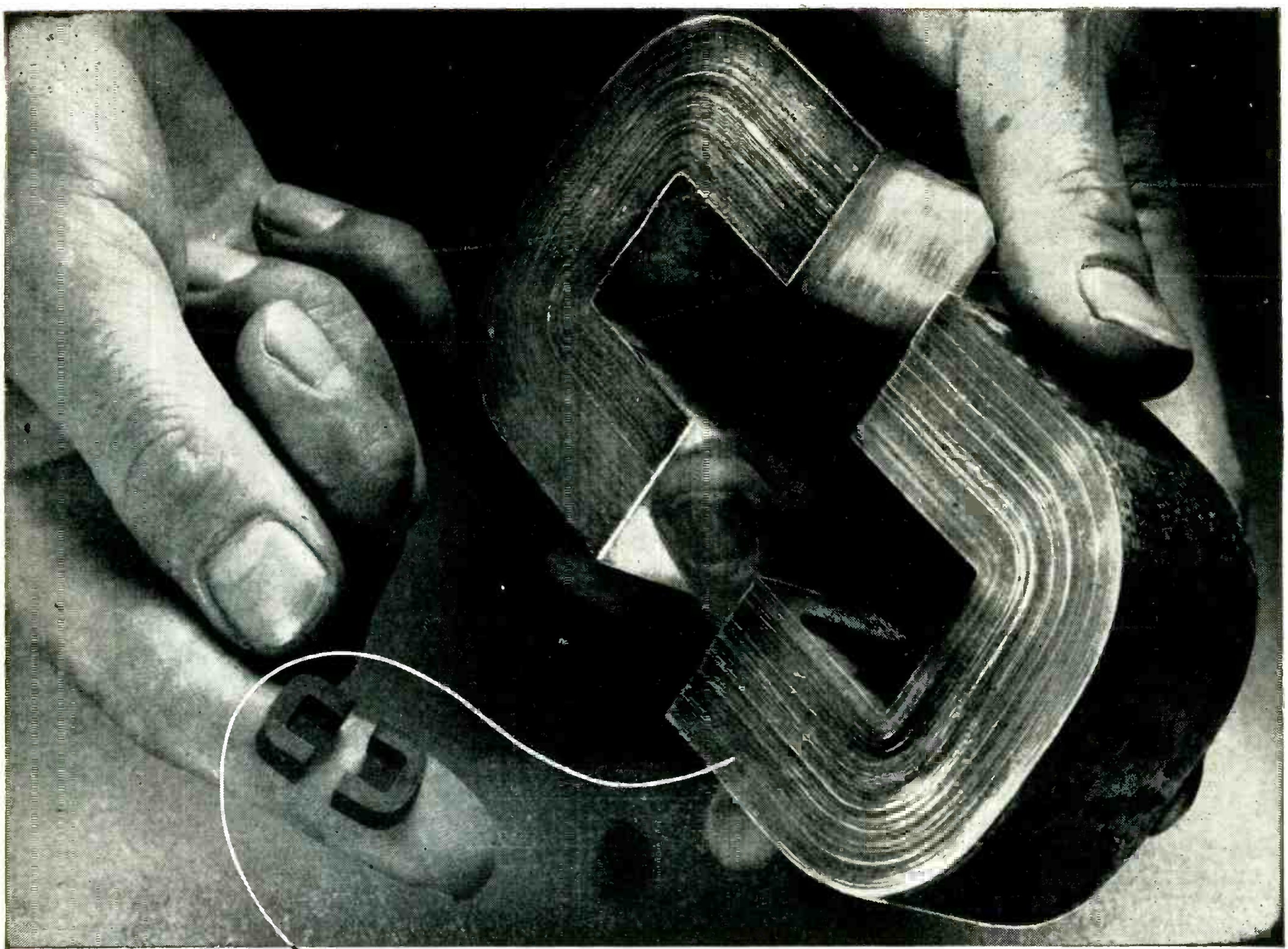
INSTRUMENT CORPORATION OF AMERICA
BLACKSBURG • VIRGINIA

UNDER EXCLUSIVE LICENSE OF ELECRO TEC CORPORATION



Want more information? Use post card on last page.

www.americanradiohistory.com



SILECTRON C-CORES...BIG or LITTLE

...any quantity and any size

Wound from precision rolled oriented silicon steel strip as thin as .00025"

For users operating on government schedules, Arnold is now producing C-Cores wound from ¼, ½, 1, 2, 4 and 12-mil Silectron strip. The ultra-thin oriented silicon steel strip is rolled to exacting tolerances in our own plant on precision cold-reducing equipment of the most modern type. Winding of cores, processing of butt joints, etc. are carefully controlled, assuring the lowest possible core losses, and freedom from short-circuiting of the laminations.

We can offer prompt delivery in production quantities—*and size is no object, from a fraction of an ounce to C-Cores of 200 pounds or more.* Rigid standard tests—and special electrical tests where required—give you assurance of the highest quality in all gauges. ● *Your inquiries are invited.*

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

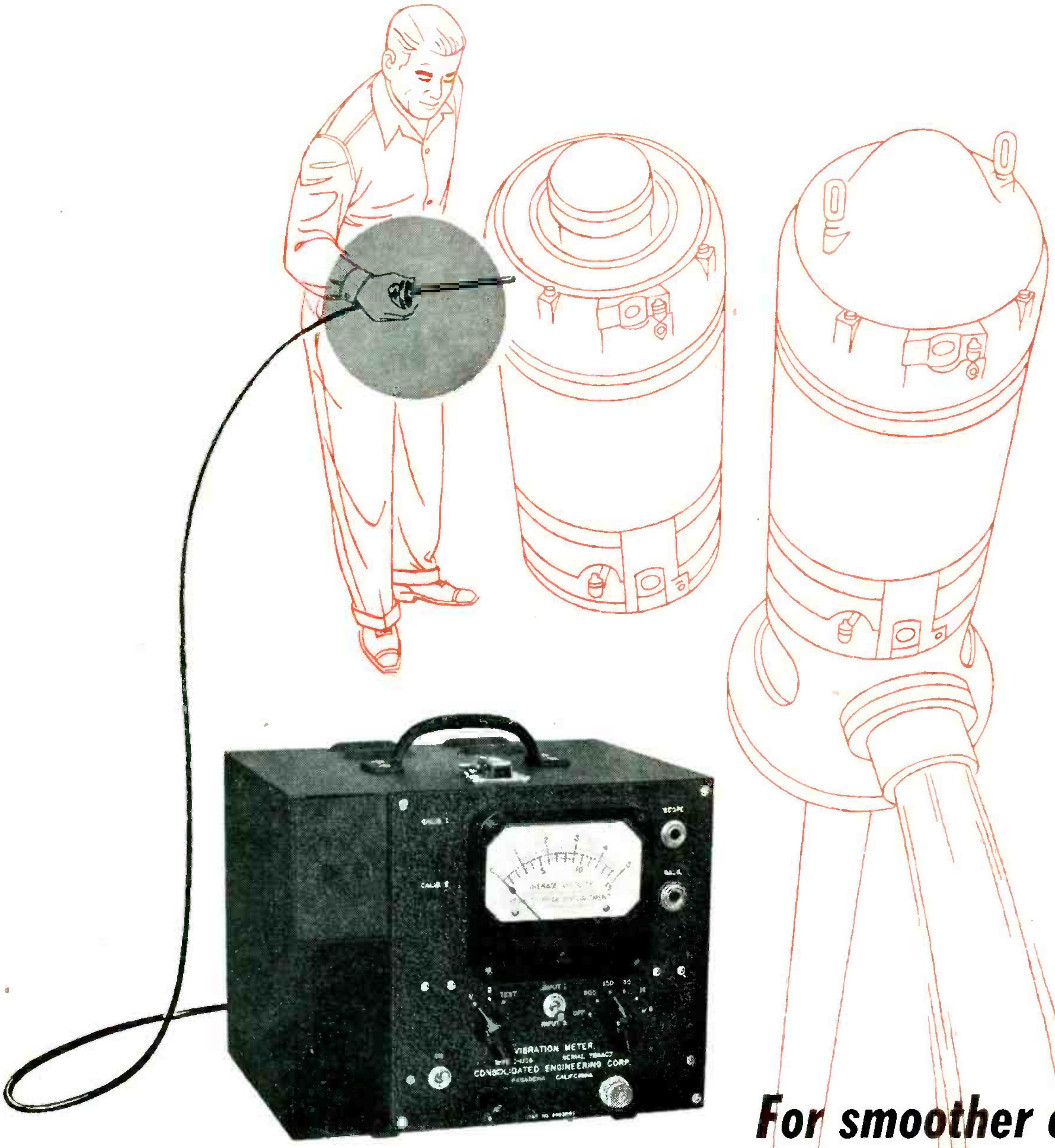
General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . Boston: 200 Berkeley St.
New York: 350 Fifth Ave. Los Angeles: 3450 Wilshire Blvd.

W&D 4363

Want more information? Use post card on last page.

www.americanradiohistory.com



For smoother operation and longer life

EVERY MOTOR at U. S. Electrical Motors, Inc., is checked for dynamic balance before being placed in service. Vibration elimination, important in all motors, is vital to the satisfactory performance of vertically mounted motors that drive deep-well pumps. Their high centers of gravity magnify and transmit any imbalance through long vertical shafts to submerged pumps. To prevent damage to motor, shaft and turbine impellers, every U. S. Verti-closed motor is pre-checked with Consolidated instrumentation. Vibration monitoring is a profitable practice, paying off in greater customer satisfaction. If vibration elimination would improve your process or your product, our long experience in the field of dynamic measurement can help you.

Vibration Meter—and Vibration Pickup, a simple, effective dynamic measuring combination. Consolidated makes many types of transducers, amplifiers, bridge balances and recording oscillographs for use in science and industry. Write for CEC Bulletin 1505B-X10

Consolidated Engineering
CORPORATION

300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.,** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington, D. C., Philadelphia, Dayton.*

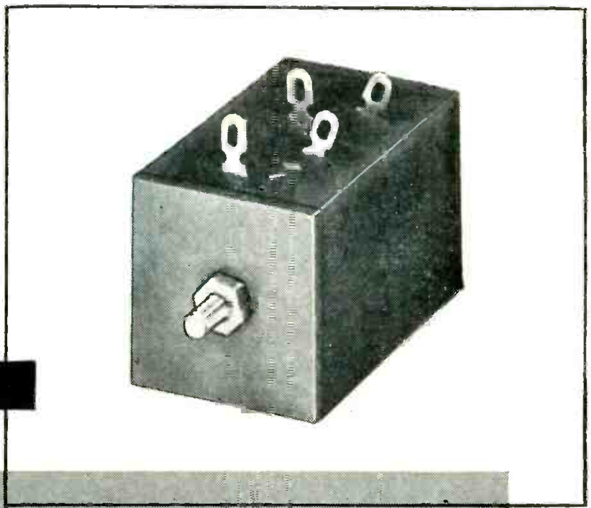
analytical instruments for science and industry

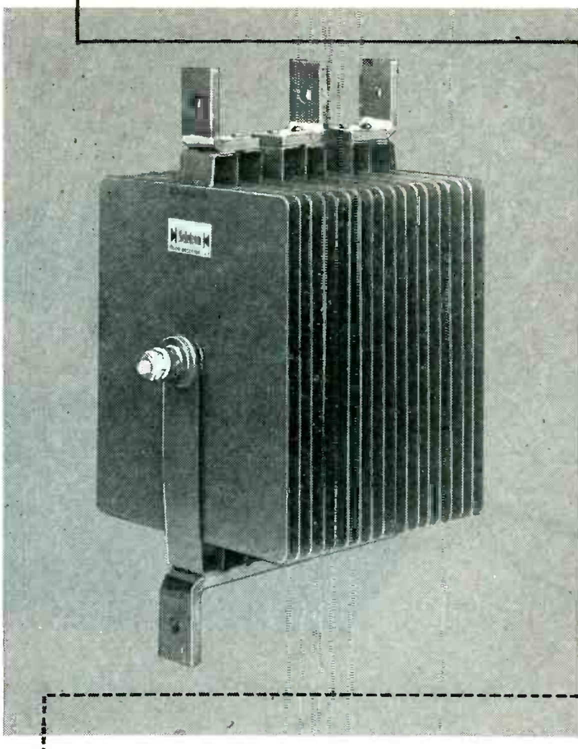
www.americanradiohistory.com

Key Components in Hundreds of Applications . . .

Seletron

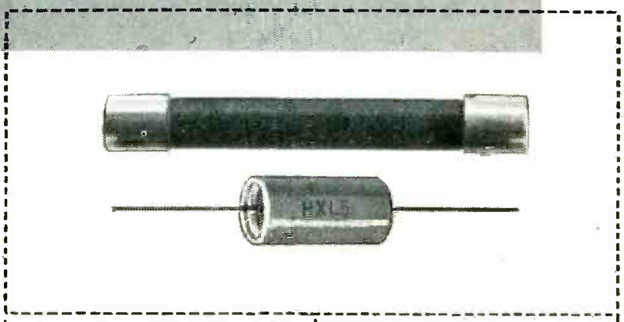
SELENIUM RECTIFIERS

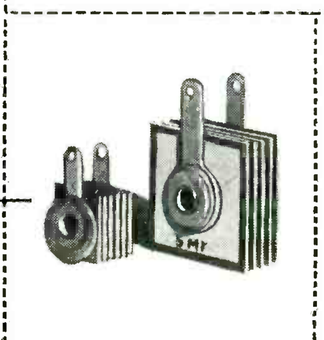


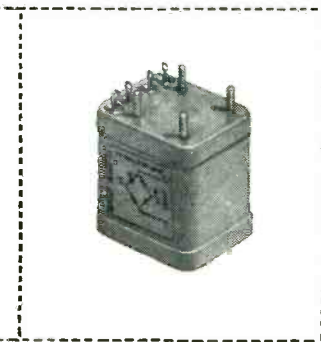


- Arc Welders
- Bowling Foul Indicators
- Computer Power Supply
- Counters
- Dictating Machines
- Electric Brakes
- Electric Clutches
- Electric Razor Device
- Electroplating
- Elevator Controls
- Elevator Motor Operation
- Facsimile Telegraph
- Fast Chargers
- Fence Chargers
- Generator and Motor Fields
- Guided Missiles
- Guided Target Planes
- Gun Fire Control
- Industrial Truck Battery Charging
- Jet Engine Starters
- Low Voltage Lighting Controls
- Magnetic Amplifiers
- Magnetic Memory Devices
- Motor Speed Control
- Motion Picture Arc Projectors
- Oscilloscopes
- Portable Radios
- Radio Transmitters
- TV Boosters
- TV Sets
- Therapeutic Machines
- U.H.F. Convertors
- Voltage Regulators
- X-Ray Machines

Our engineering department will be glad to aid you in the solution of your rectification problems. Submit your requirements and let us make recommendations . . . without obligation, of course! See our catalog in Sweet's Product Design file, or write us for Bulletin No. E-1







RR

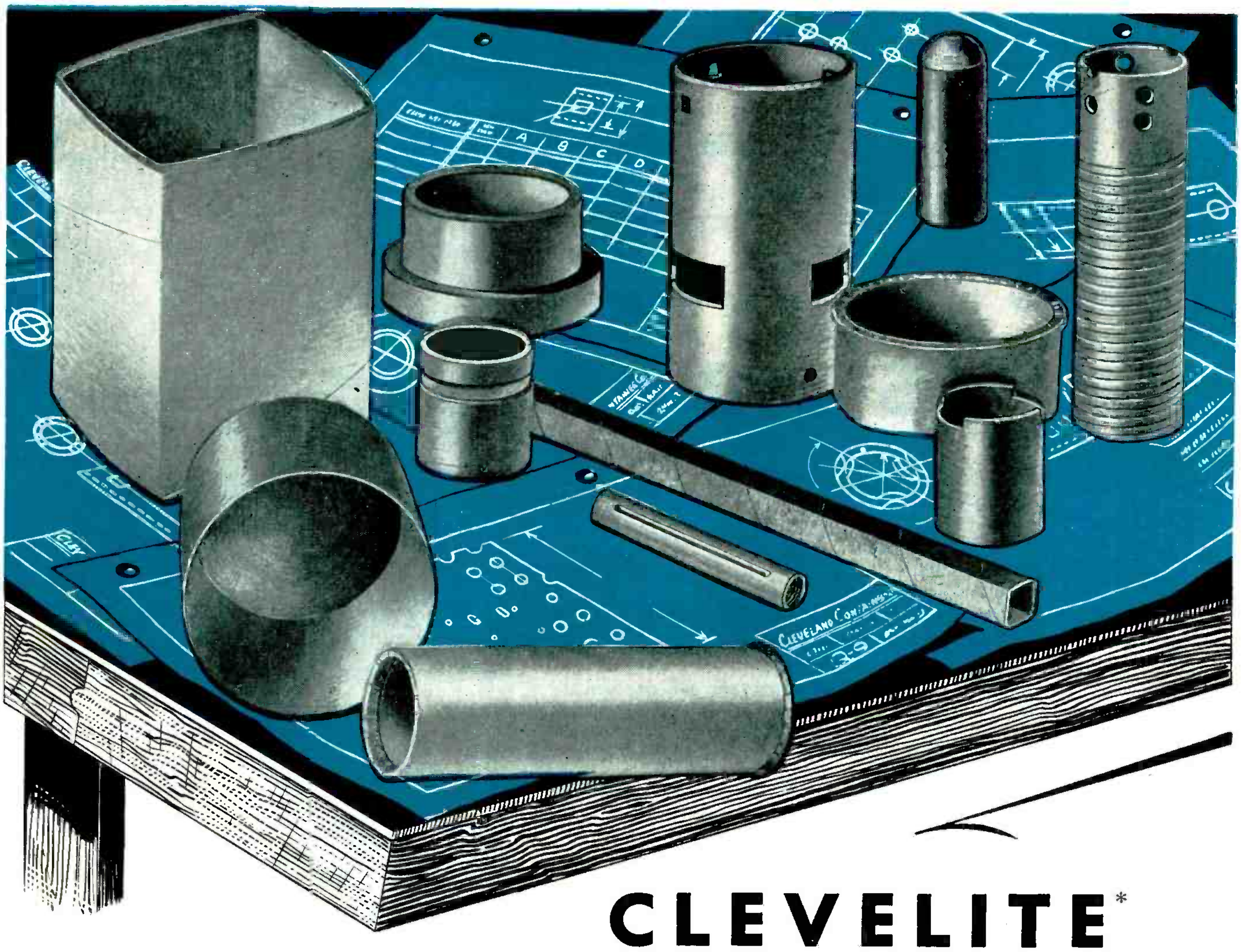
Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

Since 1922 in Radio and Electronics

SALES DEPARTMENT: 251 WEST 19TH STREET • NEW YORK 11, N. Y.
FACTORY: 84 NORTH 9TH STREET • BROOKLYN 11, N. Y.

www.americanradiohistory.com



CLEVELITE*

LAMINATED PHENOLIC TUBING

A GRADE FOR EVERY NEED!

Diameters — wall thicknesses and lengths to meet regular or special adaptations.

IN RADIO AND TELEVISION their use is almost universal. They have high insulation resistance and low moisture absorption. Their low dielectric loss is suitable for ultra high frequency applications.

CLEVELITE is produced in seven grades.

GRADE	APPLICATION
E	Improved post-cure fabrication and stapling.
EX	Special grade for TV yoke sleeves.
EE	Improved general purpose.
EEX	Superior electrical and moisture absorption properties.
EEE	Critical electrical and high voltage application.
XAX	Special grade for government phenolic specifications.
SLF	Special for very thin wall tubing having less than .010 wall.

Why Pay More?

For the Best...

Call CLEVELAND!

is more than ever before—the first choice in the electronic and electrical industries.

It combines proven performance with low cost and excellent service!

Wherever high dielectric strength, low moisture absorption, mechanical strength, low loss and good machinability are of prime importance . . . the combined electrical and physical properties of

CLEVELITE
are essential

• • •

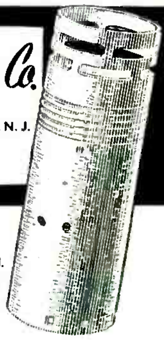
IMMEDIATELY AVAILABLE!

Tell us your needs.

*Reg. U. S. Pat. Off.

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N. Y., Jamesburg, N. J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario



REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO
WEST COAST IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES

Want more information? Use post card on last page.

www.americanradiohistory.com

Spectrum ANALYZER TS-148/UP

NEW AND IMPROVED DESIGN

OUTSTANDING PERFORMANCE

MORE RUGGED CONSTRUCTION

TS-148/UP

ACCESSORIES & CASE

SHIPPING AND CARRYING CASE
Armored foot locker
with foam rubber cushions inserted.

Specifications . . .

Attenuation (Spectrum Amplitude): 3 — 70 db uncal.
Frequency range: 8430 Mcs — 9660 Mcs.
Frequency sweep: 10 — 30 cps continuous.
Frequency swing (FM sawtooth) of analyzer r-f oscillator: 40 — 50 Mcs.
Maximum error: ±4 Mcs.
Maximum dispersion of spectrum: 1.5 Mcs per inch.
Overall i-f bandwidth at half power point: 50 Kcs.
Sensitivity to CW:
a. Spectrum amplified position: 80 db below 1 W per inch deflection on oscilloscope screen.
b. Spectrum position: 55 db below 1 W per inch deflection on oscilloscope screen.
Weight: 86 pounds (complete in armored case with all accessories).

Partial list of satisfied users of the G & M TS-148/UP include:
Bell Aircraft Corp. (Lab.)
California Institute of Technology (Lab.)
Consolidated Vultee Aircraft Corp. (Lab.)
Douglas Aircraft, Inc. (Lab.)
Fairchild Engine & Airplane Corp. (Guided Missiles Div.)
French Naval Base (Toulon)
Gilfillan Bros. (Electronics)
Royal Canadian Air Force (Lab.)
Westinghouse Electric Corp. (Lab.)

We also manufacture . . .

- I-96-A VHF Bench Test Equipment.
- IE-17-A SCR-536 Test Equipment.
- IE-19-A VHF Portable Test Equipment.
- MB-2 Marker Beacon Test Equipment, Portable.
- TS-E6 Slide Back Voltmeter for E-3, E-4, E-5, etc. Firing Systems).
- TS-E7 Moving Target Simulator (for E-3, E-4, E-5, etc Firing Systems).
- TS-170-C ILS Portable Test Equipment.
- TS-173-C ILS Portable Test Equipment.
- TS-239/UP Wide Band Oscilloscope.
- UPM-1 Radar Test Set.
- Special items to order, such as:
  - 1 KW Transmitters and Jamming Equipment.
  - 5 KW Transmitters and Jamming Equipment.
  - Direction Finders.
  - Communication Receivers, etc.

WRITE OR WIRE FOR PRICES AND DELIVERY SCHEDULES

"Where Hi-Quality is Fundamental"

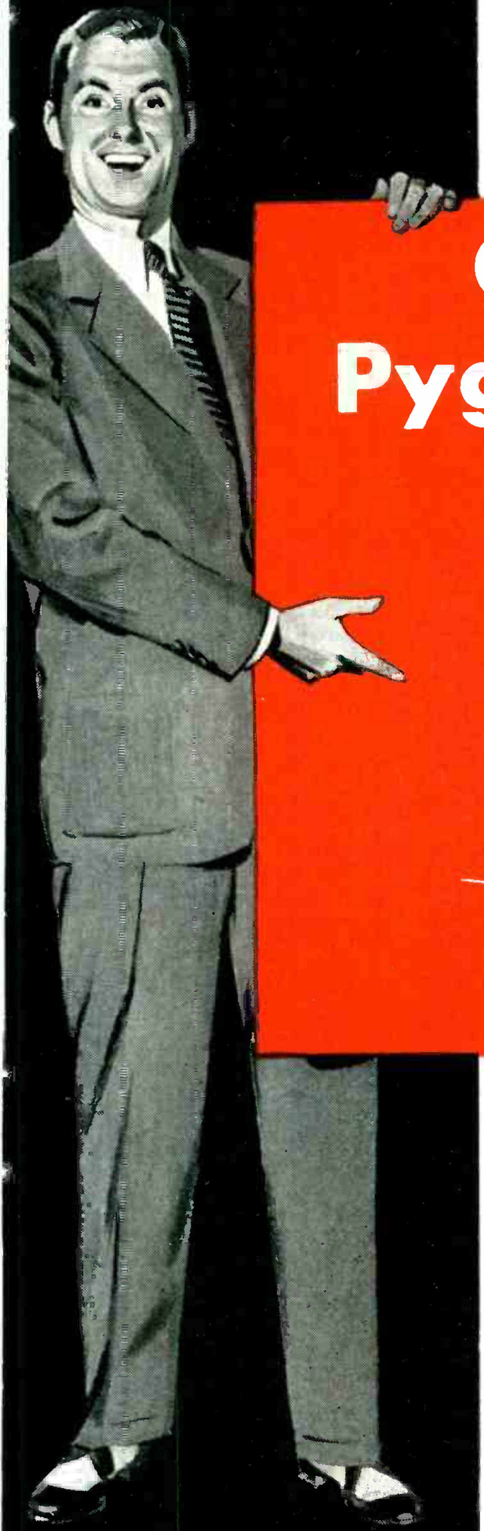
G & M EQUIPMENT CO., INC.
7309-7327 VARNA AVENUE
NORTH HOLLYWOOD, CALIFORNIA

Phones-
POplar 5-4185
STanley 7-1624
STanley 7-2212
STanley 7-1086

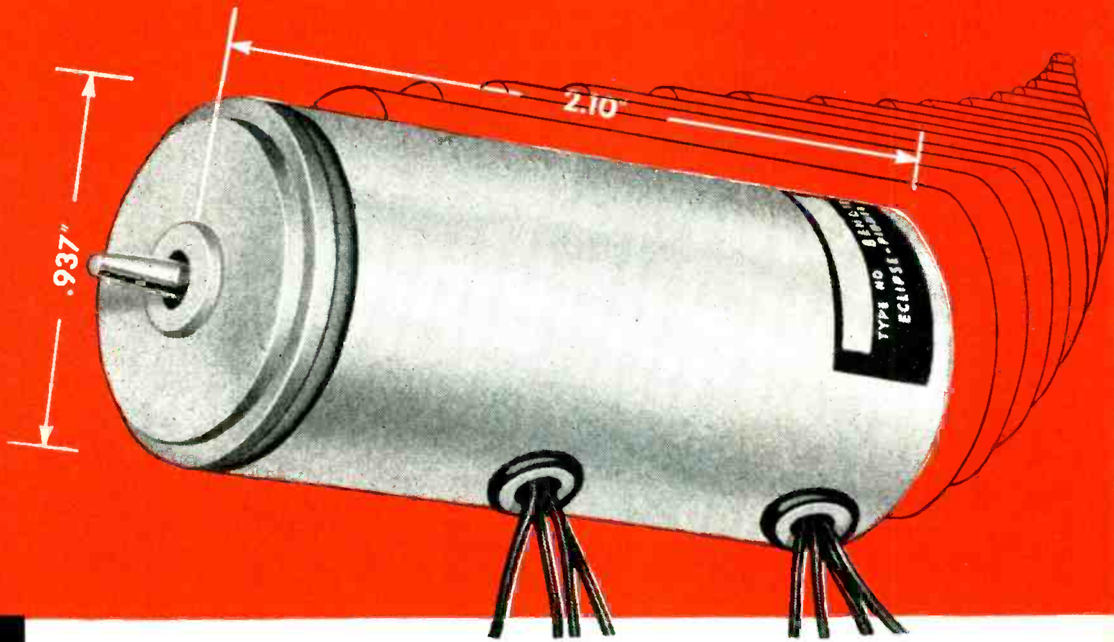
TELETYPE: N.H. 7063 WESTERN UNION: ZDV CABLE: GMEINC

www.americanradiohistory.com

They're Here!



Corrosion-Resistant Pygmy Motor Generators



by Eclipse-Pioneer

TYPICAL ELECTRICAL CHARACTERISTICS

GENERATOR DATA

Lir earity—½ of 1% to 4000 rpm
Output—300 mv/1000 rpm with 18 volt, 400 cycle excitation
Null—10 mv or less

MOTOR DATA

18 or 26 volt, 400 cycle, 2-phase low inertia motor

For further information, write Department C.

THE NAME Bendix AVIATION CORPORATION MILLIONS TRUST

ECLIPSE-PIONEER DIVISION OF . . .

TETERBORO, N. J.
Export Sales: Bendix International Division
205 East 42nd St., New York 17, N. Y.

www.americanradiohistory.com

TO INDICATE aircraft position with no ground-to-air communication

Combat mission . . . or freight flight . . . now we are working to help the pilot locate his position without a radio beacon — merely by equipment right in the cockpit of his plane! Thanks to a Ford Instrument Company design, development and manufacture . . . another step is being taken toward greater flying safety.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electro-mechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

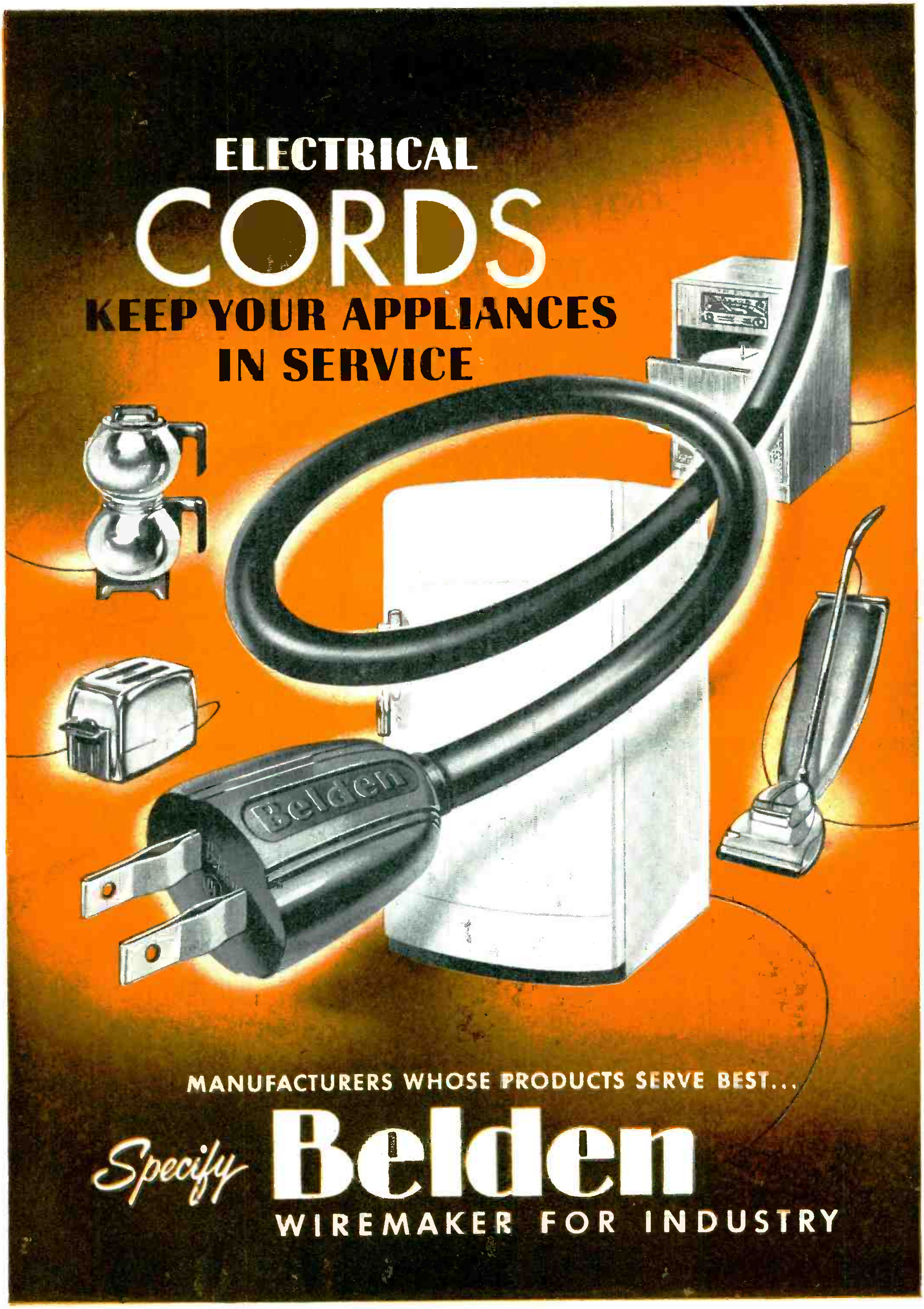
9

FORD INSTRUMENT COMPANY

DIVISION OF THE SPERRY CORPORATION

31-10 Thomson Avenue, Long Island City 1, N. Y.

Want more information? Use post card on last page.



Want more information? Use post card on last page.

www.americanradiohistory.com

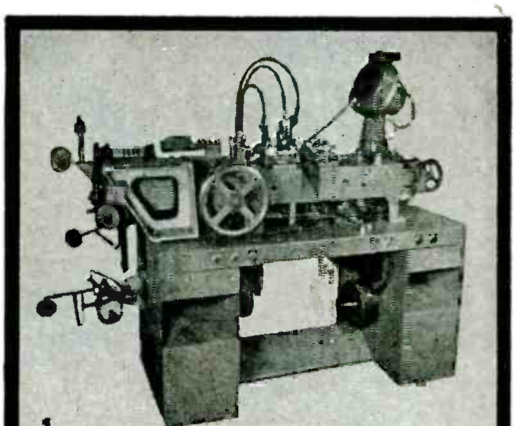
KAHLE MACHINES

for Automatic Production of
TRANSISTORS
ELECTRONIC TUBES
from
Sub-miniature to Cathode Ray

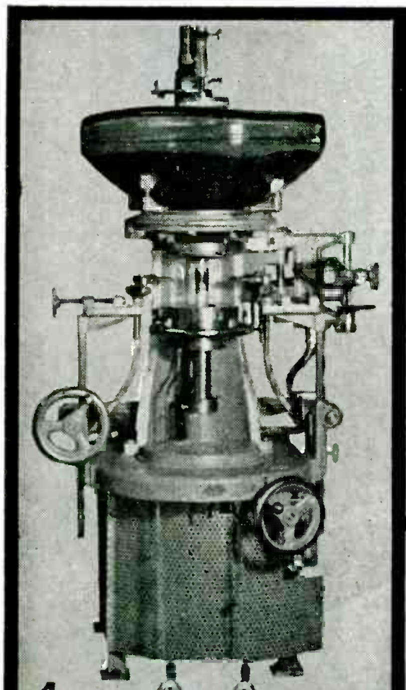
More than forty years of precision-engineering experience is built into the Kahle machines which are supplied to the electronics industry for general purpose or for special purpose. Hundreds of production problems have been presented to Kahle – in every case Kahle has designed and developed a machine to produce results as specified. Kahle specializes in equipment for manufacturing sub-miniature, miniature, standard, cathode ray, transmitting tubes and transistors . . . and other glass parts in limited quantity for laboratory needs or for maximum production runs.

Illustrated at right and below are a few representative machines:

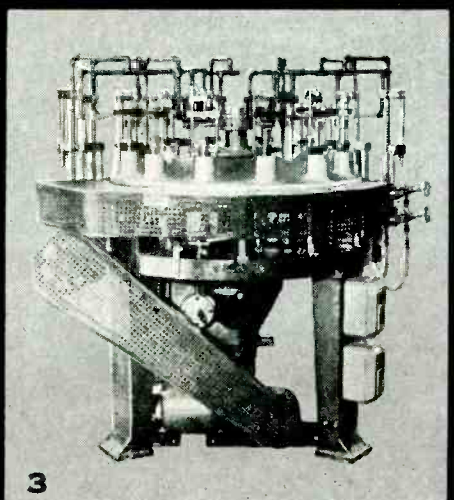
(1) MODEL 2148, *Automatic Lead Wire Welding Machine,* **(2) MODEL 2179,** *Automatic Button Stem Machine;* **(3) MODEL 1384,** *Sub-miniature Button Stem Machine;* **(4) MODEL 2185,** *CR Tube Combination Neck Cutting and Neck Splicing Machine.*



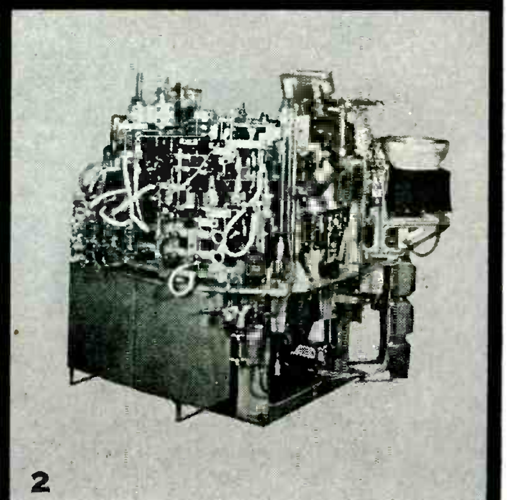
1



4



3



2

Write Kahle now for full details **Kahle** ENGINEERING COMPANY

1353 SEVENTH STREET NORTH BERGEN, N. J.

Want more information? Use post card on last page.

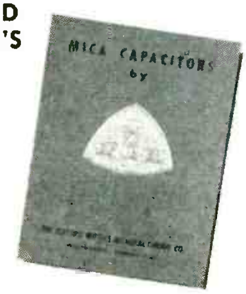
www.americanradiohistory.com

ALL fixed mica El-Menco Capacitors are *factory-tested at double their working voltage.* Yet, you pay no premium for their superior performance. Meeting all significant specifications of JAN-C-5, they are being used in more and more military and civilian electronic applications.

Type CM-15, our tiny silvered mica capacitors, includes capacities from 2 to 420 mmf. at 500vDCw — 2 to 500 mmf. at 300 vDCw. Our other types — silvered and regular — offer ranges up to 10,000 mmf. Why not test them? *The Electro Motive Manufacturing Co., Inc., Willimantic, Conn.*

Jobbers and distributors are requested to write for information to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y. — Sole Agent for Jobbers and Distributors in U. S. and Canada.

WRITE FOR FREE SAMPLES AND CATALOG ON YOUR FIRM'S LETTERHEAD

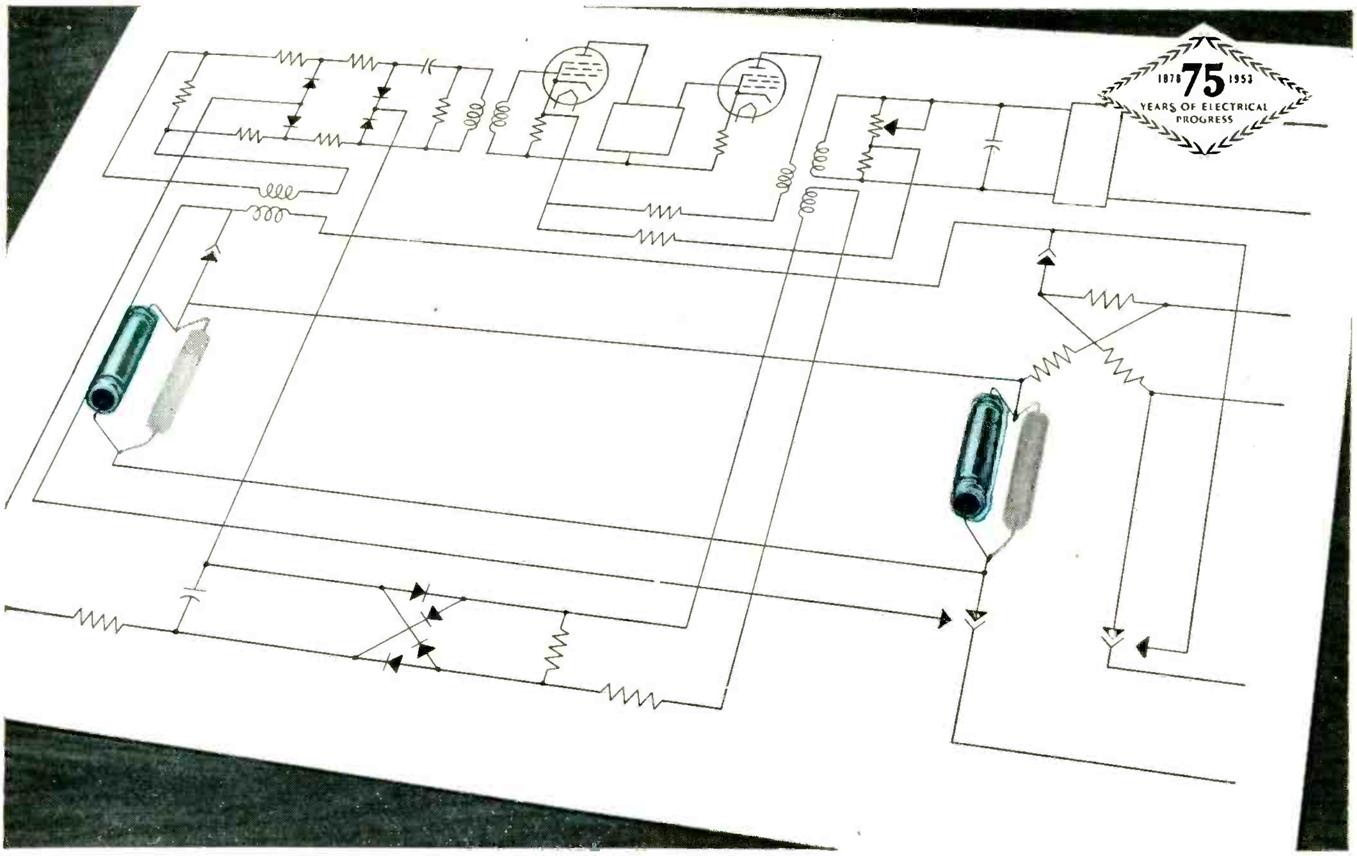


MOLDED MICA El-Menco MICA TRIMMER CAPACITORS

Foreign and Electronic Manufacturers Get Information Direct from our Export Dept. at Willimantic, Conn.

THE ELECTRO MOTIVE MFG. CO., INC. **WILLIMANTIC, CONNECTICUT**

www.americanradiohistory.com

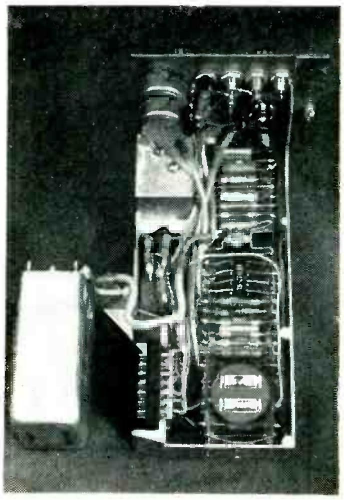


Small G-E Tantalytic Capacitors do big job in new Bell System carrier circuit

The new Bell System N Carrier System is a 12-channel, double-sideband system for single cable application . . . providing low loss, stable, high velocity service for toll and exchange circuits in the range from 15 to 200 miles . . . at a minimum manufactured, installed and maintenance cost. This system requires the use of miniaturized components which will yield large reductions in size and weight yet still give maximum service.

G-E Tantalytic capacitors are a "natural" for the system to handle the job of series d-c blocking, r-c timing and d-c power noise filtering. Recently developed, these polar and non-polar electrolytic capacitors are recommended for virtually all low-voltage d-c applications (ratings from 175 muf at 5 vdc to 12 muf at 150 vdc) where small size, large capacitance, long operating life and long shelf life are major considerations. And since they offer greater capacitance per unit volume than aluminum electrolytics and paper capacitors, they are ideally suited for miniaturized equipment. In some short-time applications, i.e. guided missiles, it is now possible to operate these capacitors in a temperature range from −55 to +110C with proper voltage and life derating.

If your application calls for a small size capacitor with superior performance, it will pay you to investigate the new G-E Tantalytic capacitor. For further information on Tantalytic and other General Electric specialty capacitors for a-c and d-c applications, see your local G-E representative or write for "Tantalytic Capacitors" Bulletin GEC-808 to General Electric Co., Section 442-5, Schenectady 5, New York.



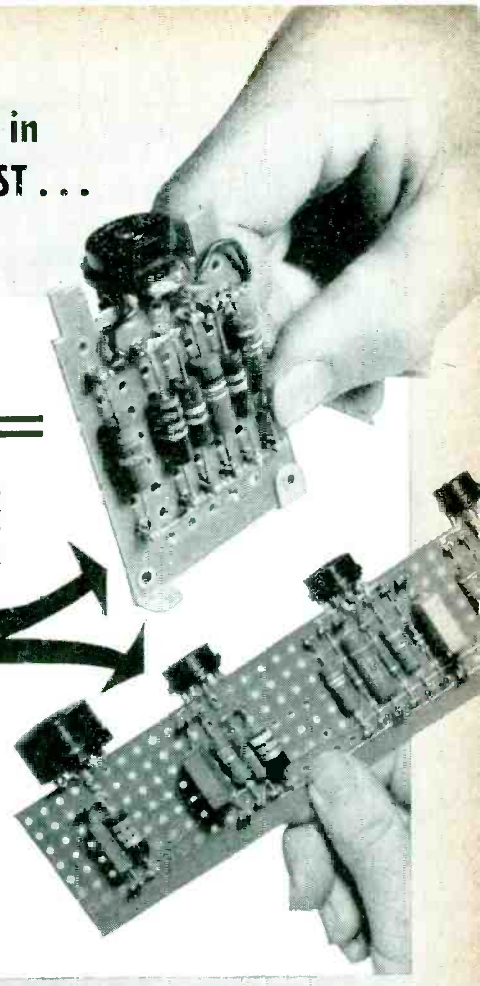
G-E TANTALYTIC capacitors installed in telephone carrier amplifier.

You can put your confidence in—

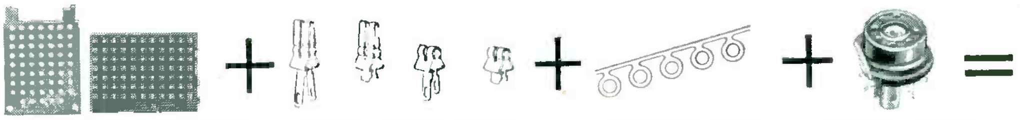
GENERAL ELECTRIC

www.americanradiohistory.com

At Last! STANDARD COMPONENTS to mount your circuitry in vertical planes that SAVE SPACE... SAVE PRODUCTION COST... ARE NATURALS FOR PLUG-IN CONSTRUCTION



It's as simple as this —



ALDEN PRE-PUNCHED TERMINAL MOUNTING CARDS pre-cut to proper size for Alden 7-pin, 9-pin, 11-pin and 20-pin Plug in Packages. Or in 3' strips for chassis — cut it off as you require.

ALDEN MINIATURE STAKING TERMINALS mount in any pattern on Terminal Mounting Cards. Ratchet slots hold elements for soldering without pliering or wrap-around.

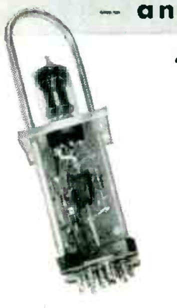
ALDEN JUMPER STRIP stakes right under Terminals providing common circuit without soldering.

ALDEN CARD MOUNTING TUBE SOCKETS for miniature 7-pin and 9-pin and octal tubes.

ALDEN TERMINAL CARD MOUNTING SYSTEM

Take the above basic components, lay them out on full scale Planning Sheets found in Alden Handbook. Following the Plan Sheet, Miniature Terminals and Tube Sockets stake into place on Card. We can do it for you if you have volume production, so Cards come to you ready to snap electronic elements and wiring into place for quick soldering. Both sides can be used for wiring. Your design and production are simplified. Wiring is an open, easy-to-work sub-assembly, so units can come through production independently or be easily subcontracted.

— and how beautifully these circuitry planes become plug-ins



ALDEN PLUG-IN PACKAGE

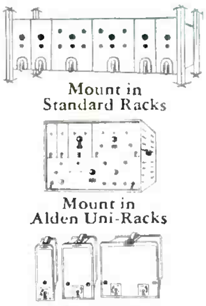
4 SIZES OF PLUG-IN PACKAGES

Alden standard Bases, Lids, Handles, Cans, Sockets for 7, 9, 11 and 20-pin packages house Terminal Card Circuitry with tremendous flexibility for endless variety of open and shielded packages . . . making it easy and inexpensive to give your equipment reliability in service with instantly replaceable plug-ins for all sub-units.

7-pin 9-pin 11-pin 20-pin

Package components and matching sockets.

4 SIZES OF PLUG-IN CHASSIS



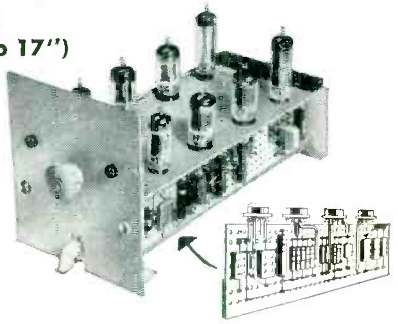
Mount in Standard Racks

Mount in Alden Uni-Racks

In Portable Cases

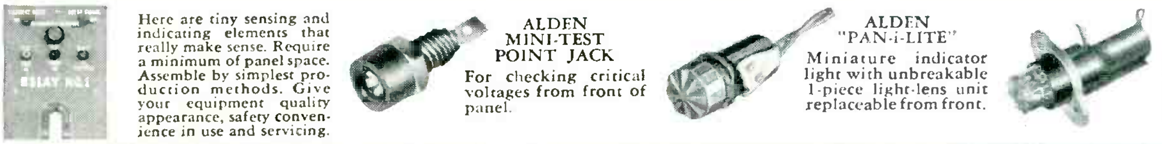
2", 4", 8" (also 17")

Your circuitry on Terminal Card strips snaps right into Alden Basic Chassis. Vertical mounting and hinged front panel give beautiful accessibility and space saving. Chassis fit interchangeably in standard racks, Alden Uni-racks and Alden Portable Carrying Cases. Chassis widths available in 2", 4", 8" and 17"



ALDEN BASIC CHASSIS

— and how easy to assign to each plug-in unit a tiny tell-tale to spot trouble instantly



Here are tiny sensing and indicating elements that really make sense. Require a minimum of panel space. Assemble by simplest production methods. Give your equipment quality appearance, safety convenience in use and servicing.

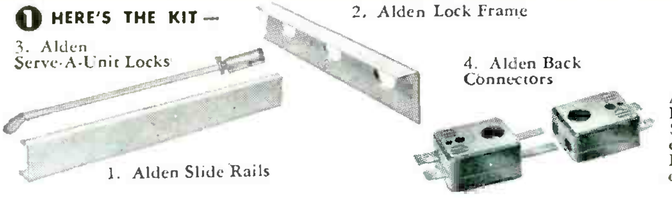
ALDEN MINI-TEST POINT JACK
For checking critical voltages from front of panel.

ALDEN "PAN-i-LITE"
Miniature indicator light with unbreakable 1-piece light-lens unit replaceable from front.

ALDEN "FUSE-LITE"
Fuse blows — Lite glows. Simply unscrew 1-piece light-lens unit and blown fuse comes out with it.

— and give chassis easily traceable interconnects and 30-second replacement

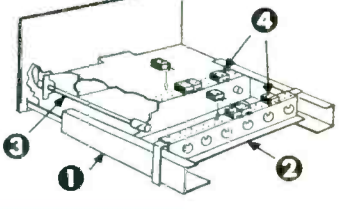
1 HERE'S THE KIT —



1. Alden Slide Rails
2. Alden Lock Frame
3. Alden Serve-A-Unit Locks
4. Alden Back Connectors

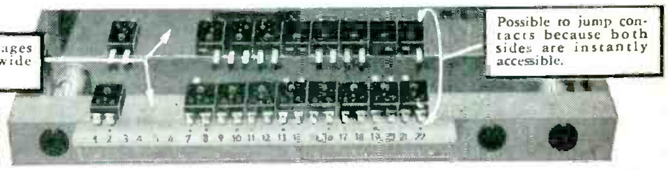
2 HERE'S HOW TO USE IT —

Arrange Alden Side Rails (1) and Alden Lock Frame (2) to suit your chassis. Alden Serve-A-Unit Locks (3) mount in your chassis to engage pre-punched holes in Alden Lock Frame (2) to pilot, draw in, lock or eject.



3 HERE'S WHAT YOU COME OUT WITH —

Organize all incoming and outgoing leads with Alden Back Connectors (4) on Lock Frame, where they can be numbered and color coded, and where there is even enough space for pictorial description, so circuitry "reads like a book." Arrange mating Back Connectors on chassis.



Critical voltages isolated by wide spacing.

Possible to jump contacts because both sides are instantly accessible.

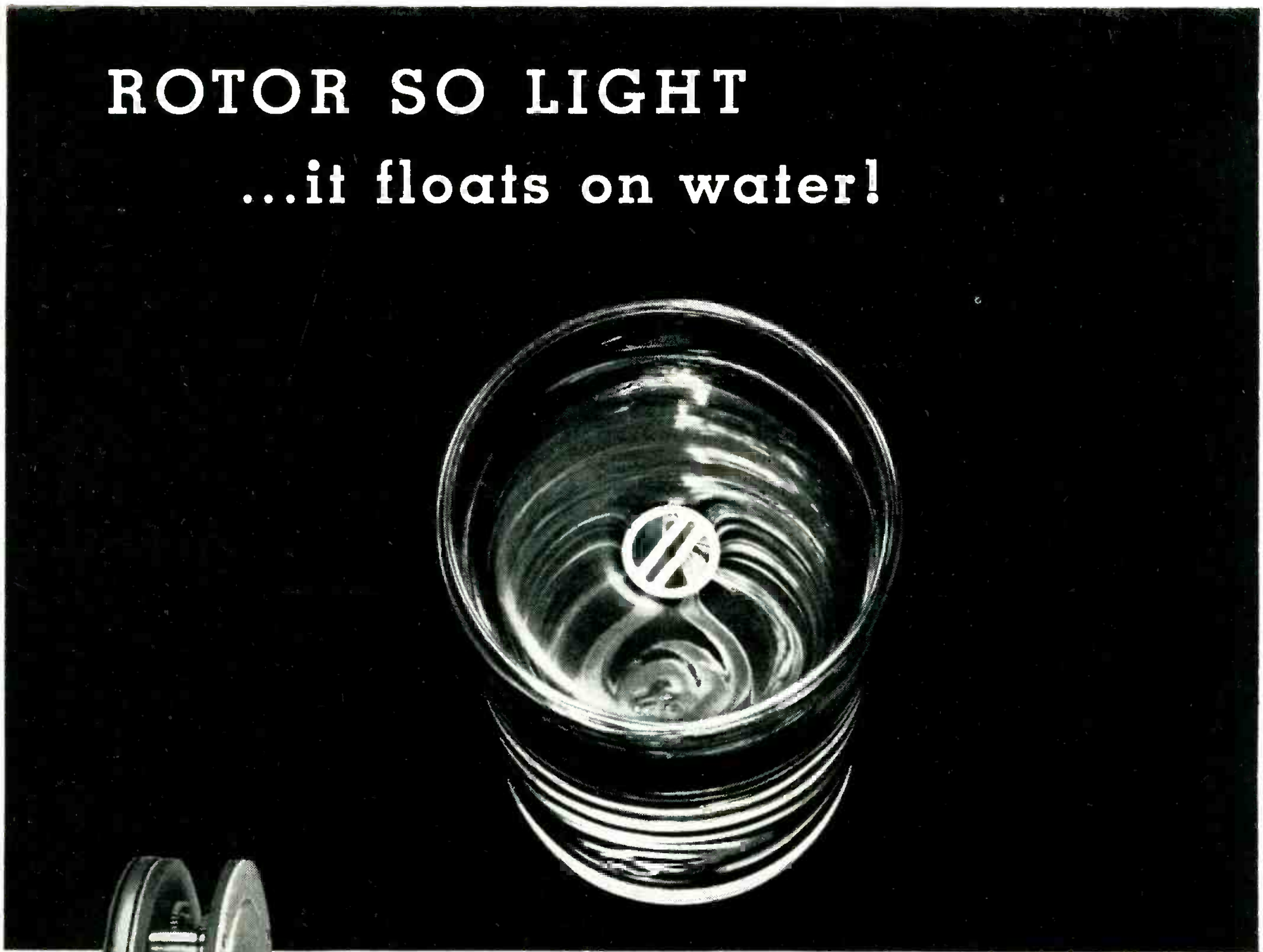
Connectors are spread out in an orderly row, giving a central point of check where all leads are instantly accessible, identified by number and color-coding.

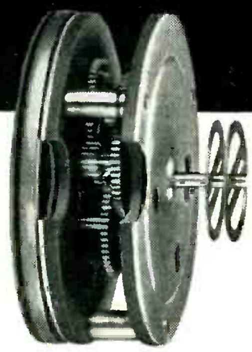
GET THE COMPLETE STORY — REQUEST "ALDEN HANDBOOK" — SENT FREE

ALDEN PRODUCTS CO. 127 N. Main St., Brockton 64, Mass.

NA-ALD

www.americanradiohistory.com





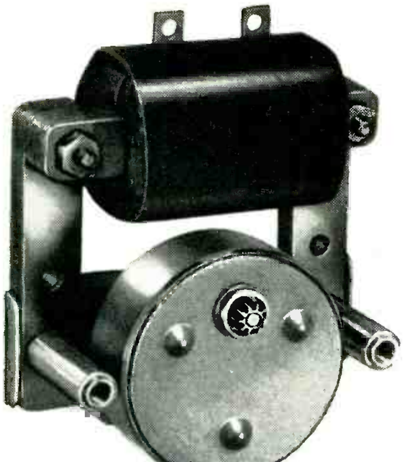
Rotor unit of H-3 motor
with cover removed

Telechron Synchronous Timing Motors

Hard, special-formula steel. Yet the rotor floats. It's so light, mere surface tension holds it up. Imagine what an advantage like this can mean to you when you specify Telechron Synchronous Timing Motors for your equipment.

There's little inertia to overcome. So Telechron motors start almost instantly—reach full speed in less than 3 cycles (1/20th sec.). Low-weight rotor virtually floats in the magnetic field. Rotor shaft rides on a film of oil—no metal-to-metal contact—giving longer life, and assuring true synchronous operation.

These advantages are yours in all models of Telechron Synchronous Timing Motors—no matter what the application. Let us help you select the model that will best give you the performance you are looking for.
Write for complete catalog and information on our Application Engineering Service.
Telechron Department, General Electric Company, 48 Homer Ave., Ashland, Mass.



Model H-3—for radio timers,
process timers, and time switches

Telechron®

MARK OF TIMING LEADERSHIP

Want more information? Use post card on last page.

www.americanradiohistory.com

THE QUALITY SEAL THAT IS PRICE-CONSCIOUS

This famous trademark has dual significance: Hallmark of quality in hermetic seals, it is also the symbol of HERMETIC's earnest desire to make such units available to industry at prices that make sense.

HERMETIC recognizes the importance of price to industry. Therefore, it makes every effort to keep prices in line . . . without *subordinating its own high quality standards.*

To maintain these long recognized standards, every phase of production, every operation, is supervised by specially trained engineers. And, more inspectors, more inspections, more testing equipment are used to check electrical and mechanical characteristics . . . including the ultimate mass spectrometer test.

It is because of this quality and wide acceptance that HERMETIC now manufactures the largest line of hermetic seals in the world . . . and has produced more innovations than any other supplier in its field. Little wonder that HERMETIC has received generous endorsements from our country's Services and from industry.

Moreover, the HERMETIC line has grown increasingly. New developments, advanced design and quality standards, which enhance the value of every control on which HERMETIC headers are used, have attracted more and more buyers.

Now is the time for you to check with HERMETIC to find out how these headers can be adapted to your particular products. Send for your FREE copy of HERMETIC's colorful, informative 32-page brochure, the most complete presentation ever offered on hermetic seals.

Hermetic Seal Products Co.

31 South Sixth Street, Newark 7, New Jersey

FIRST AND FOREMOST IN MINIATURIZATION

Want more information? Use post card on last page.

www.americanradiohistory.com

Keep TABS on WIRING PERFORMANCE

with—

Tested and
Approved
Beyond
Specification

CHESTER *plasticord-plasticote* WIRES & CABLES

Chester ENGINEERED plastic insulation, laboratory and field tested to more than meet specifications provides both easier working qualities and longer service life. These rugged plastic coatings offer maximum immunity to abrasion, weather, oil and most chemicals. Smooth and pliable, they pull through channels and conduit easily and offer excellent appearance in open wiring. Chester single or multi-conductor wires and cables are available for electrical, electronic, TV, radio, telephone and many other industries. Call or write for illustrated bulletins, today!

JAN-C-76 WIRES* SRIR, SRHV, SRRF, WL

LACQUERED AND NYLON WIRES

105°C, 90°C, 80°C UL APPROVED; 120°C*

*Solid colors or spiral marking

SHIELDED WIRES & CABLES

FLEXIBLE CORD

INSTRUMENT WIRES

TV LEAD-IN WIRES

COAXIAL CABLE

COMMUNICATION WIRES & CABLES TO SPECIFICATIONS

SPECIAL WIRES & CABLES TO SPECIFICATIONS

"Chesty" HAS THE ANSWERS — Plasticord and Plasticote wires are available in standard constructions or custom built to specifications. For a practical solution to unusual insulated wiring problems, call or write.

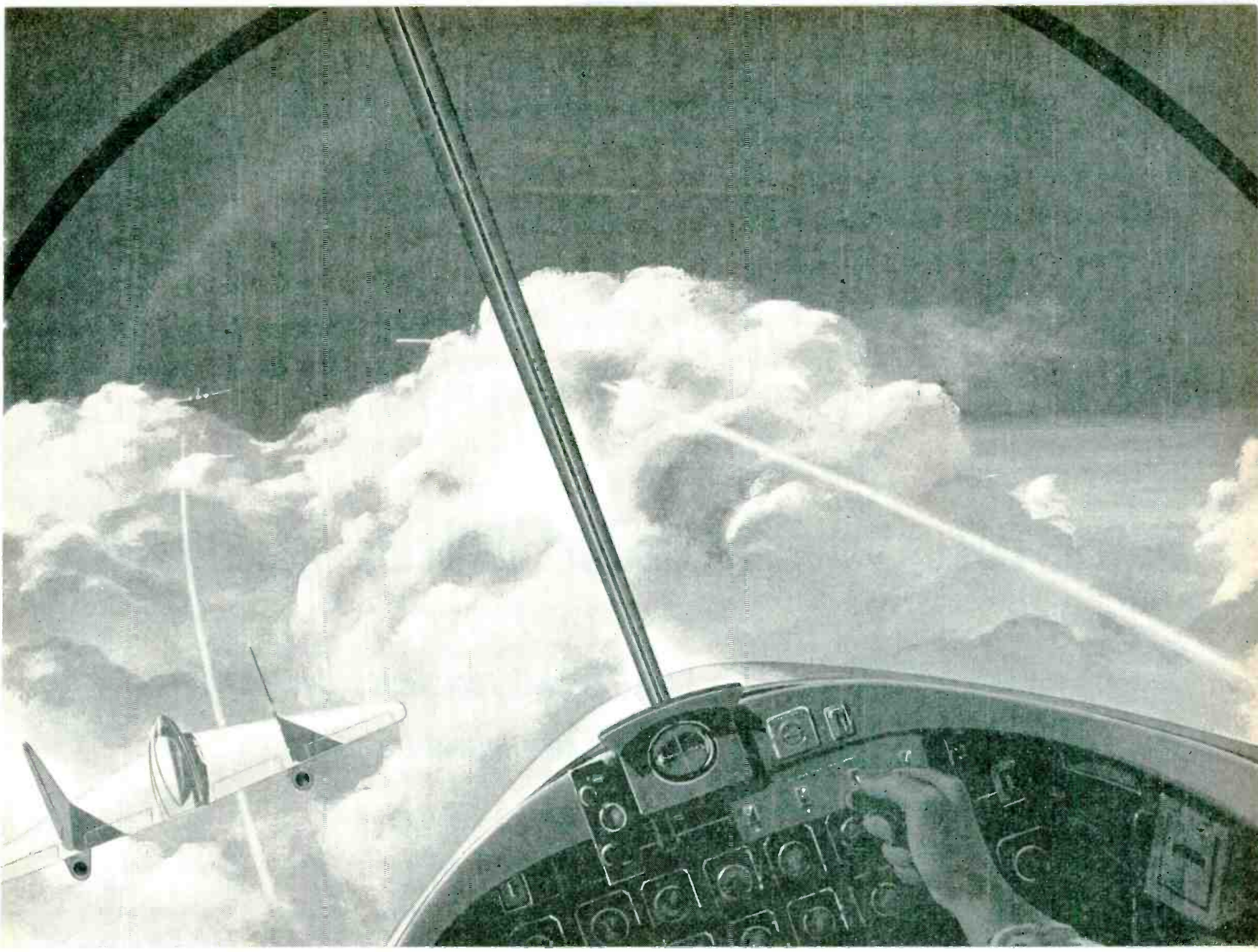
REGISTERED U.S. PAT. OFF.

CHESTER CABLE CORP.

CHESTER • NEW YORK

Want more information? Use post card on last page.

www.americanradiohistory.com



TOO LATE TO HIDE . . . from a RELIABLE missile

ACCURATE CONTROL IS A MUST IN GUIDING THE MISSILE, BUT . . . WILL CONTROL FAIL IN THESE LAST TWO SECONDS?

Hundreds of test hours become worthless, should a component fail at this critical moment. A major source of last-minute failure is the unpredictable jamming of a hydraulic control valve by just a single particle of dirt.

Now, Sanders Associates, Inc. offers a hydraulic valve that is accurate . . . *and reliable*. Utilizing a unique form of mechanical feedback, this new valve creates forces as high as 500 pounds to break free any jamming particles. Interfering metal chips are literally chopped up. Here is a self-clearing valve that operates without oil filters, even with dirt, sludge and metal particles in the hydraulic fluid supply . . . *this is reliability* . . . "built-in" reliability.

Sanders Associates, Inc. is active in complex research and development programs where new concepts of accuracy and reliability are essential. Typical of the product development under such programs is this two-stage hydraulic servo valve . . . a key component in guided missiles, fire control, auto-pilots, automatic machine control and other applications where the transfer from electrical to hydraulic energy *must* be both accurate and reliable.

Address inquiries to Dept. 40-E.

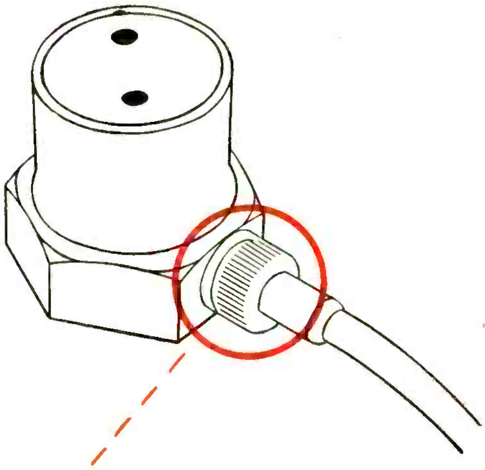
SANDERS ASSOCIATES

INCORPORATED

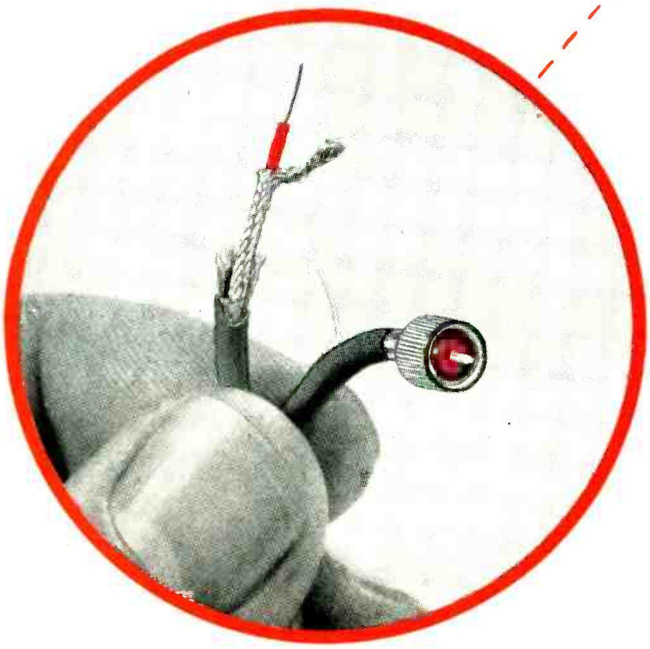
137 CANAL STREET
NASHUA, NEW HAMPSHIRE
TELEPHONE: NASHUA 5570

RELIABILITY IN ELECTRONICS

www.americanradiohistory.com



Du Pont TEFLON* provides excellent dielectric properties...



...heat resistance and strength in new miniature parts

Coaxial connectors and cable made by Microdot Division, Felts Corporation, S. Pasadena, Calif.

The demand for micro-miniature components in scale with miniaturized circuit designs has created an insulating problem. Miniature circuits often develop high heat and carry an increased electrical load that can result in failure of these tiny components.

The Felts Corporation faced such a problem with its miniature coaxial connector. They needed a material for the connector and primary wire insulation that had good dielectric properties and a wide resistance to heat, chemicals and corrosion. It also had to be moisture-resistant and strong.

After testing many materials, they chose Du Pont "Teflon" tetrafluoroethylene resin. "Teflon" is an excellent insulator. It has a dielectric constant of 2.0 and a loss factor of 0.0005. Its power factor is less than 0.05% even at frequencies as high as 30,000 megacycles. And these dielectric properties are unaffected by temperatures from -80°F. to 500°F. Du Pont "Teflon" is inert to all chemicals except molten alkali metals and fluorine. It is tough and durable—will not crack or arc. "Teflon" has zero water absorption and helps reduce self-generated noise at high termination impedances.

Du Pont "Teflon" serves many uses in electrical equipment—stand-off and feed-thru insulator terminals, insulation for wire, cables and motor windings, and other parts where high temperatures, dielectric strength and durability are required. Perhaps "Teflon" can help you improve or develop a product. For full information, write: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 228T, Du Pont Bldg., Wilmington 98, Delaware.

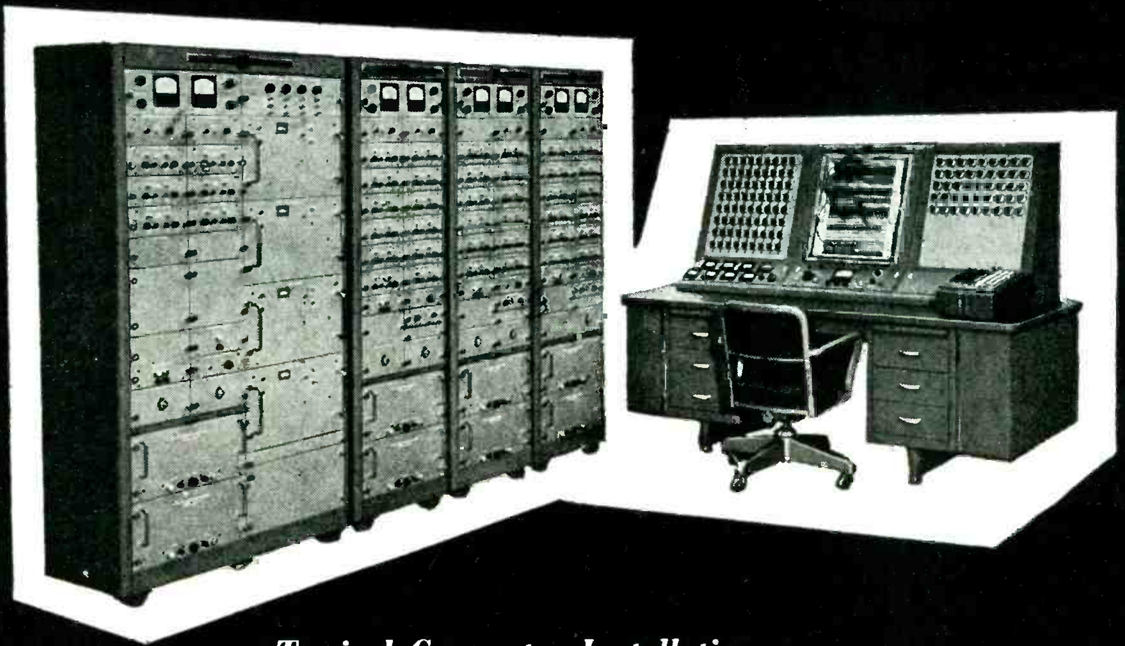
*REG. U. S. PAT. OFF.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Polychemicals
DEPARTMENT
PLASTICS • CHEMICALS

www.americanradiohistory.com

PRECISION
ANALOG COMPUTER



Typical Computer Installation

- A new chassis design—each chassis formed in a U-shape effecting an unusually compact arrangement of components and providing the facilities for extremely efficient cooling.
- A new high gain, low drift, contact stabilized d-c amplifier with outstanding accuracy, frequency response and output power characteristics.
- A new system (optional) for selecting and setting an attenuator to a value within approximately ± .01 % by depressing the keys of an adding machine type keyboard.
- Compatibility with other makes of analog computing equipment which allows the precision components of this system to be used with other manufacturers' systems.
- A new high quality patch board assembly, using an 1800 position pre-patch panel made of metal to avoid leakages between terminals and to improve overall computer accuracy.
- All computing resistors and capacitors contained in an oven to maintain them at a constant temperature to insure reliable and accurate performance.
- Centralized operation of the entire computer from a control console providing maximum ease of operation and flexibility in the use of the system plus minimizing the cost of expansion.

ELECTRONIC ASSOCIATES *Incorporated*

Long Branch, New Jersey
Send for complete data

www.americanradiohistory.com

for PROVEN RESULTS *specify*

McGRAW-HILL

Mailing Lists

You can save time, avoid needless expense, increase your results by having McGraw-Hill Lists do your mail advertising job!

Three quarters of a century of practical experience is made available to you when you turn your direct mail jobs over to McGraw-Hill. And these seventy-five years of leadership in the development and perfection of lists *assure you the maximum results at the lowest cost* per order or inquiry.

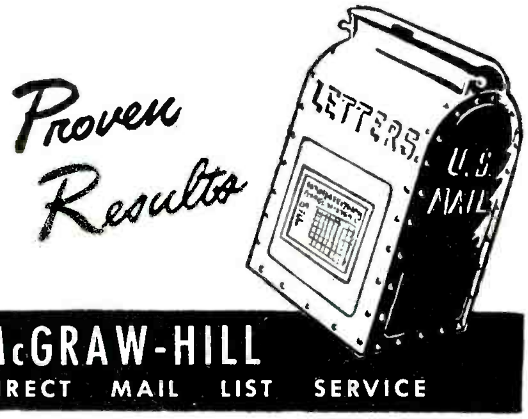
Those who are acquainted with mailing lists know that year-after-year acceptance of lists does not come by chance or luck. Accepted lists, like McGraw-Hill's, hold their places by merit alone. Nor does success one day guarantee success the next. Vigilant eyes must constantly add new names, delete, change, check, recheck, etc. Inferior lists are dropped as soon as shortcomings are noticed . . . "good lists" yield to better lists.

For seventy-five years expert list users have preferred McGraw-Hill by long odds. No matter how few names you use—whether your business is large or small—the best lists, McGraw-Hill Lists, are the most economical in the long run.

The world-wide reputation McGraw-Hill has earned as builders of the finest mailing lists was born of constant research in our office and in the field—constantly adding new names . . . developing new markets, new avenues of revenue for direct mail list users.

McGraw-Hill Mailing Lists are built —and constantly maintained—to provide, as accurately as humanly possible, complete rosters of the industries we serve.

Investigate their tremendous possibilities in relation to your own product or service. Your specifications are our guide in recommending the particular McGraw-Hill lists that best cover your market. When planning your industrial advertising and sales promotional activities, ask for more facts or, better still, write today. No obligation, of course.



McGraw-Hill Publishing Co., Inc.

DIRECT MAIL DIVISION

330 W. 42nd Street, New York 36, N. Y.

Direct Mail Division, McGraw-Hill Publishing Co.
330 West 42nd Street, New York 36, N. Y.

Please send me, **at no cost**, mailing list information that will cover my markets.

Name .... Title ....

Company ....

Address ....

City and State ....

Product or Service ....

Faster...For testing...

COMPACT, PORTABLE
BENCH-TYPE TESTING UNIT FOR RAPID HIGH and LOW TEMPERATURES

Primarily developed for a branch of the armed forces, this high and low temperature testing unit has a temperature range from -80° F. to +185° F. Rapid temperature pull-down to -80° F. requires 30 minutes or less. Heat application is accomplished through reverse cycle refrigeration. Hazards of open heating elements are eliminated. Test chamber dimensions are 12"x12"x12" and the overall dimensions are 50" long, 26" high and 20" deep. Approximate weight is 450 pounds. The unit is compact and is entirely self contained. Controls are simplified and easy to operate. Equipped with air-cooled compressors, the unit is quiet in operation. Cabinet is of stainless steel with all controls visible. A blower is provided for even distribution of temperatures and greater testing accuracy. The door illustrated is a latch type door providing for complete removal from the cabinet. Holes may be drilled for electrical contacts.

This is one of the many examples of WEBBER engineering skill and another of the many firsts built by WEBBER in the low temperature field.

Write for more complete information:

INDUSTRIAL FREEZER DIVISION

WEBBER MANUFACTURING COMPANY, INC., 2745 MADISON AVENUE, INDIANAPOLIS 3, INDIANA

(Formerly Webber Appliance Co., Inc.)

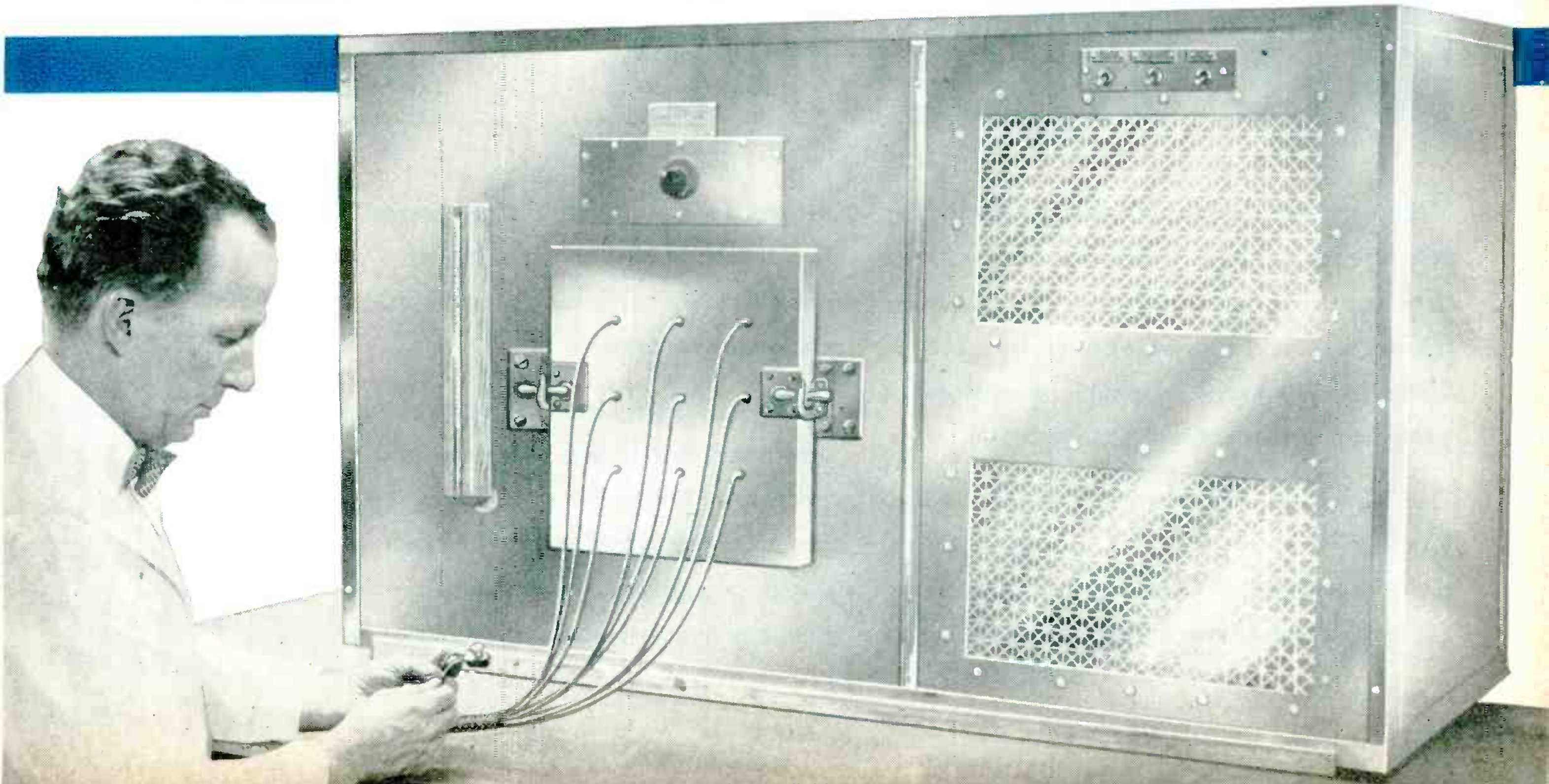
WEBBER

TRADE MARK

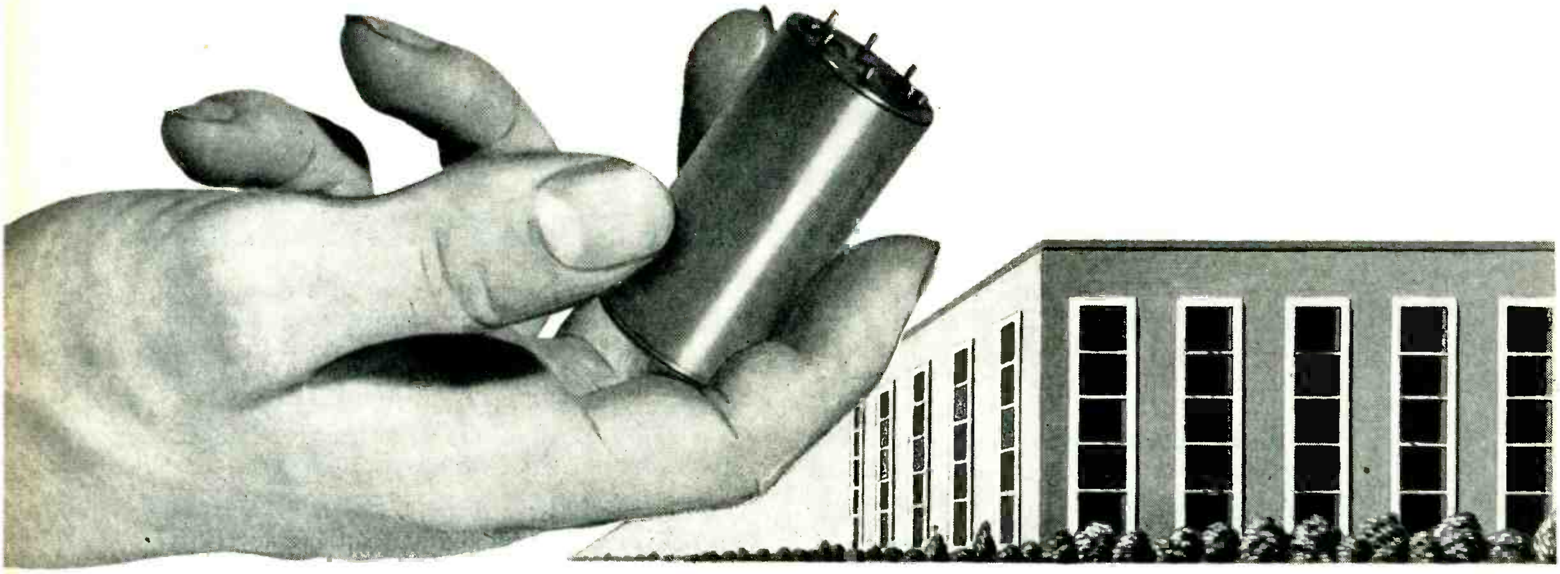
COMPLETE TEMPERATURE RANGE
TESTING UNITS

LOW-TEMPERATURE
INDUSTRIAL FREEZERS

THERE'S A WEBBER UNIT FOR EVERY NEED



www.americanradiohistory.com



THE UNITED STATES TIME CORP. and SANDERS ASSOCIATES, INC. join hands

to make available for the first time on a mass production basis . . . at volume prices—

WORLD'S SMALLEST

SUBMINIATURE PRECISION

RATE GYROSCOPES

LESS THAN **1** INCH DIAMETER

LESS THAN **2** INCHES LONG

LESS THAN **3** OUNCES

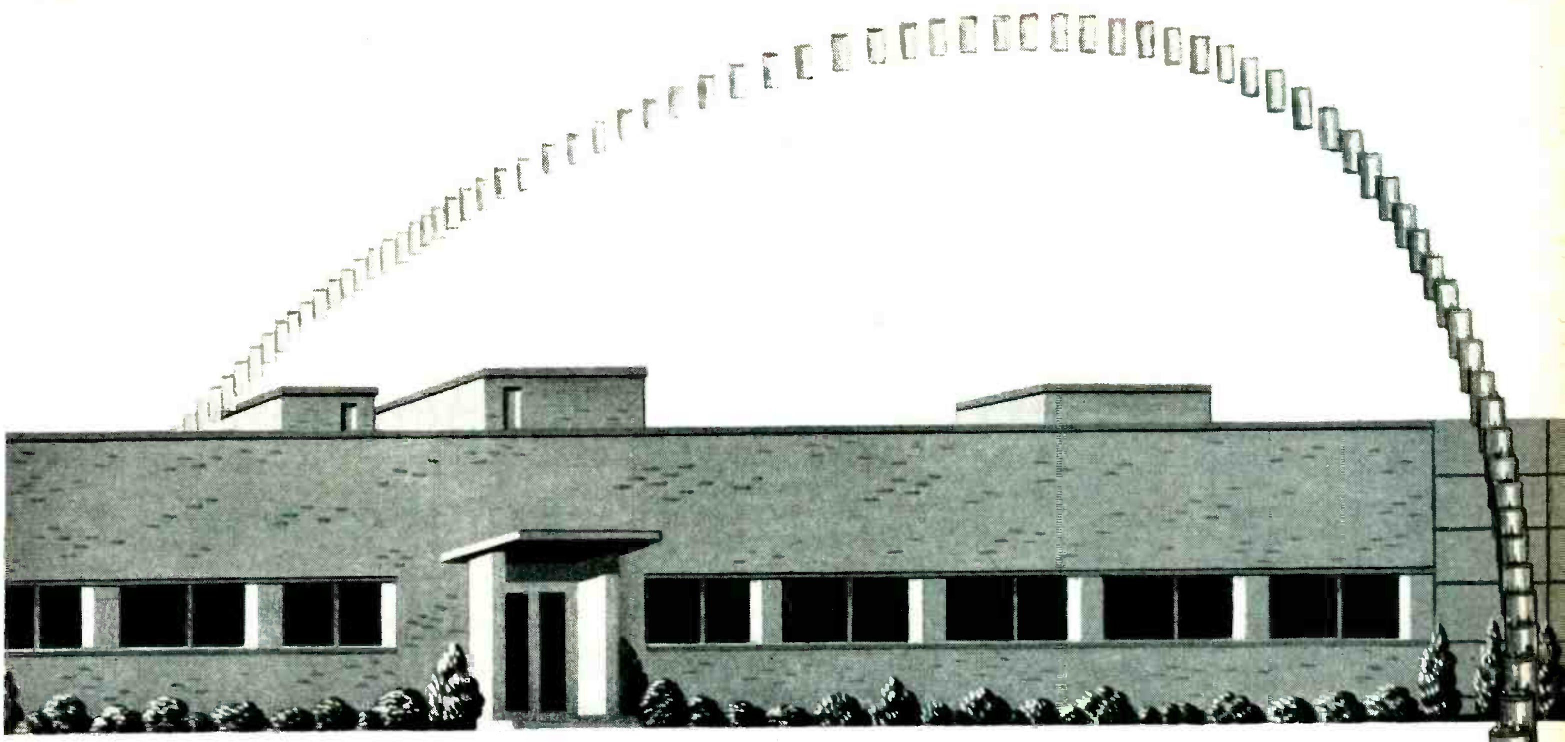
These gyros, developed and perfected by Sanders Associates, are now made available in volume through the close-tolerance, mass production techniques and facilities U. S. Time has acquired in nearly a century of precision manufacturing experience.

U. S. Time is the world's largest manufacturer of wrist watches and mechanical time fuses. Twelve years ago it began manufacturing precision gyroscopes for the armed forces. During this period, it has produced gyros at the rate of *17,000 per month* in its ultra-modern, completely air-conditioned plant.

Now—the skills and experience gained in attaining this outstanding record in mass precision production are being applied to the manufacture of Sanders Associates' Rate Gyro—the ultimate in subminiaturization, flight proven in production missiles.

another

www.americanradiohistory.com



SUPERIOR PERFORMANCE CHARACTERISTICS
RELIABILITY ACTUALLY INCREASED

- temperature compensated
- hermetically sealed
- fast starting
- high resonant frequency
- unusually insensitive to shock and vibration

CHARACTERISTICS

Range	...420 degrees/sec.	40 degrees/sec.
Resolution	better than 0.05 degrees/sec.	better than 0.005 degrees/sec.
Linearity	approximately 0.1%	
Sensitivity	5.6 volts RMS AC output at 420 degrees/sec.	5.6 volts RMS AC output at 40 degrees/sec.
Resonant Frequency	85 CPS	30 CPS

Nominal Damping	..0.5 critical	0.5 critical
Motor Excitation	... 6.3 volts, 400 cycles, 2 phase, 3 watts	26.0 volts, 400 cycles, 2 phase, 4 watts
Pickoff Excitation	...6.3 volts, 400 cycle	
Starting Time	......	15 seconds
Max. Operating Linear Acceleration	60 G any axis	20 G any axis

ENVIRONMENTAL CONDITIONS

Altitude — 0-60,000 feet
Max. Survival Shock Acceleration — 1000 G any axis
Temperature Operating Range — -55C to 85C
Tested Operating Life — over 1000 hours
Max. Vibration (0-300 CPS)...5 G any axis

VARIATIONS IN DESIGN POSSIBLE TO MEET SPECIFIC REQUIREMENTS

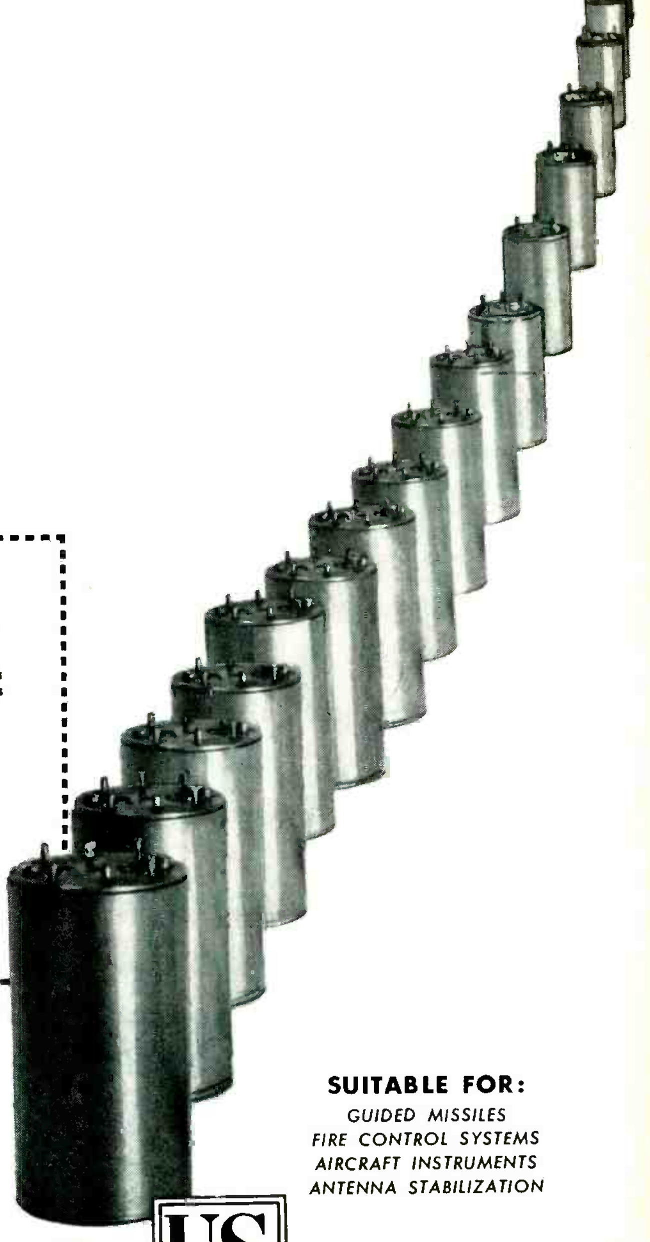
INQUIRIES INVITED. **Write to Dept. 101**

The United States Time Corporation

500 FIFTH AVENUE, NEW YORK 36, N. Y.

Main Plant — Middlebury, Connecticut

Other Plants — Waterbury, Connecticut; Little Rock, Arkansas, Abilene, Tex., Dundee, Scotland

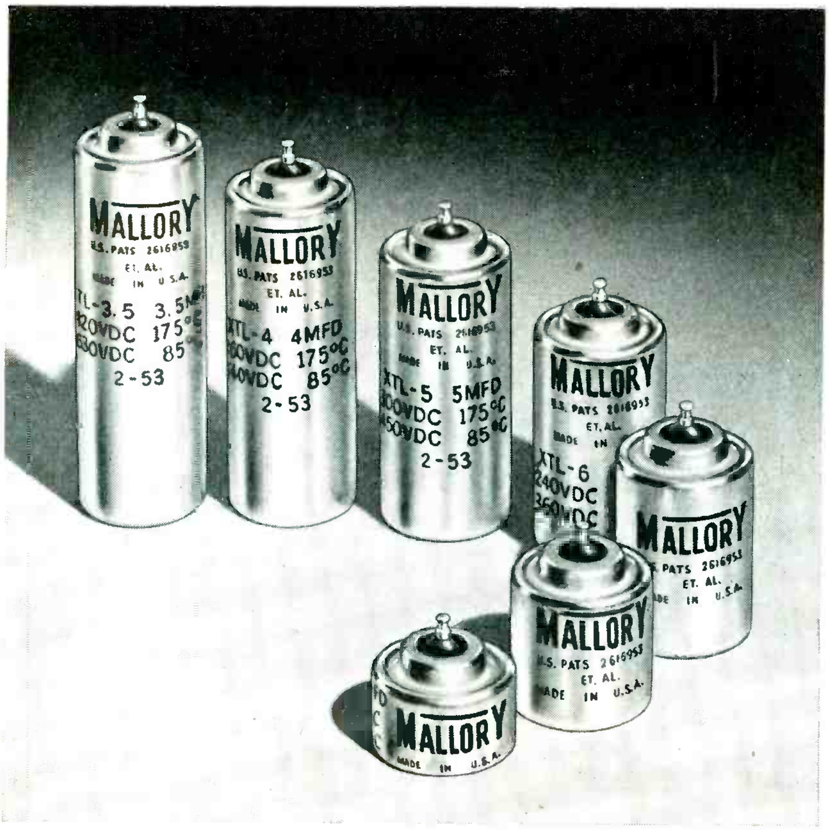


SUITABLE FOR:

GUIDED MISSILES
FIRE CONTROL SYSTEMS
AIRCRAFT INSTRUMENTS
ANTENNA STABILIZATION

US TIME

www.americanradiohistory.com



Tantalum Capacitors For Extreme Temperatures

−55°C to +175°C

New Standard 7/8 Inch Case Size Saves up to 20% in Weight . . . 16% in Volume

When the Tantalum Capacitor was introduced by Mallory, it provided the first answer to dependable operation in the extremely high ambients such as result from miniaturization of electronic equipment.

Now, Mallory has reduced the higher capacity 1⅛″ Tantalum Capacitors to ⅞″, thereby establishing a single standard case diameter. This refinement not only simplifies installation and mounting hardware; it will also produce substantial reductions in the weight and size of high capacity units.

Be sure and look into the advantages of Mallory Tantalum Capacitors for your equipment. Our engineers will be glad to talk over any problem you may have in the application of capacitors, the development of special types, or the simplification of related circuits.

FOR MORE INFORMATION . . .

Write for your copy of the new Technical Bulletin on Mallory Tantalum Capacitors. It contains complete mechanical and electrical data and performance characteristics.

Expect more . . . Get more from **P.R. MALLORY & CO. Inc. MALLORY**

Parts distributors in all major cities stock Mallory standard components for your convenience

P.R. MALLORY & CO. Inc. MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO. INC., INDIANAPOLIS 6, INDIANA

Want more information? Use post card on last page.

www.americanradiohistory.com

CROSS TALK

▶**RESEARCH** . . . Answer to the current Washington controversy over who should pick up the check for basic research—government or industry—is obviously "both." Unless such research is supported at all educational levels, civilian business as well as the military program will eventually stall.

Production techniques have already progressed far ahead of research in many fields. Engineers engaged in the growing of synthetic mica find themselves handicapped by inadequate background on crystals. Producers of devices employing barium titanate can go just so far by almost arbitrarily trying more and more complex mixes. There are many unknowns in the important semiconductor equation.

In the long run, basic research pays off. Without it, tomorrow would bring military and management, as well as engineering, frustrations.

▶**TRANSISTORS** . . . First use of transistors in mass-produced tv sets may be to replace two germanium diodes and a triode tube in noncritical circuits. Junction types are, we understand, already being used experimentally in this application. Circuit parameters are such that good performance is obtained from near-rejects. Higher temperatures than those normally encountered in home equipment do not appear to upset operation.

▶**INTERFERENCE** . . . Radiation of unwanted signals has existed since the early days of wireless. It became more troublesome with the advent of radio and is a very real problem indeed in this age of television and electronics in industry.

F-m tuners frequently interfere with tv. Television interferes with itself. Uhf sets sometimes interfere with other services. Color could interfere still more if manufacturers do not take seriously suggestions for minimizing radiation which will be in their hands before its commercial advent. Diathermy and industrial heating apparatus have been serious offenders.

It is difficult to visualize circuitry inherently incapable of radiating; oscillators are part and parcel of the art. Confinement of radiation to specific frequencies is not a good long-range solution; there are no frequencies that can be so wasted. The only sensible solution is to confine unwanted signals to the devices that generate them. Nothing, in our opinion, is more worthy of concerted industry action.

▶**HI-FI** . . . We've been wondering if the type of customer who has in the past bought big phono-combinations would be permanently lost as tv cuts deeper and deeper into the radio business. Will car sets, portables and clock-type table models alone satisfy music lovers and others who like to listen rather than look?

It is now becoming clear, not only to us but to a number of old-line radio manufacturers, that while high-fidelity equipment is not likely to achieve the unit volume which once belonged to consoles it can represent important dollar volume.

Sixty-four-dollar question is the extent to which hi-fi should be "packaged." On the one hand, packaging in a single unit simplifies manufacture and distribution and reduces cost. On the other, a variety of readily interconnected units is very appealing to the customer and has the virtue of permitting subsequent equipment improvements.

We're inclined to think that a compromise between the single-unit and the six or seven-unit approach may be the answer.

▶**COMPLAINT** . . . Talked to a number of maintenance men in industrial plants this month, and many complained about the types of circuit diagrams manufacturers of electronic equipment supply. It seems that a high percentage of these diagrams may be crystal clear to a communications man but don't make sense to all-around mechanics.

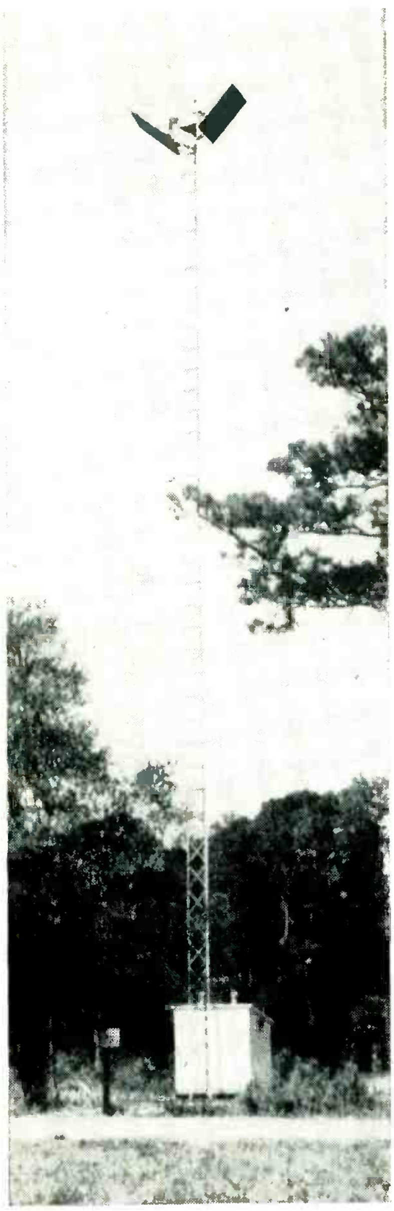
A breakup by units rather than overall-unit schematics would help materially. So would semi-mechanicals and common electrical symbols, we are told.

www.americanradiohistory.com

Electronic Equipment

Mobile and point-to-point radio uses expand. Industrial electronics speeds freight-handling, simplifies maintenance of tracks and pole lines, and finds new applications in signaling. Radar, television, magnetic amplifiers and transistors all prove useful

By JOHN M. CARROLL
Assistant Editor
ELECTRONICS



Microwave tower on the Santa Fe's radio-relay network presents new look in railroad radio

ELECTRON TUBES are not newcomers to the railroad industry.

One of the first applications of the electron tube in industry came in 1922. Four 32-volt pliotrons were used to amplify block-signal-code impulses inductively picked up from the tracks. These coded impulses operated cab-mounted signal lights to inform the engineer of track conditions ahead[1]. By 1931, 4,500 locomotives were using cab signals; 4,551 locomotives are equipped today.

Railroads have been hesitant in adopting electronic signaling equipment for use out on the main line, clinging rather to fail-safe electromechanical devices. Electronic signals are used mainly to furnish supplementary data. In freight-car classification and forwarding yards, however, operation is not as critical as on the road, so modern electronic equipment such as television and radar is rapidly coming into use to speed the nation's freight handling.

Mobile Radio

Most of the electron tubes at work for the railroads are in communications equipment. The vhf railroad-radio service has made impressive strides in the past few years. Over 12,000 transmitter authorizations have been granted in the 159 to 162-mc band. Several roads, notably the Pennsylvania, have also adopted inductive carrier for train-to-base and train-to-train communications; 1,735 installations have been made. Figure 1 shows the expansion in railroad communications during the last four years.

Bell-System telephones board crack trains furnish public communications for passengers. Two services are used: the highway mobile telephone service, 30-44 mc, and the urban mobile service, 152-162 mc.

With their great fleet of coastal and harbor vessels, the railroads are also large users of marine radiotelephone equipment. The New York Central is planning installation of low-frequency automatic-direction-finding equipment on its Weehawken ferry. The system will comprise a receiver aboard ship and a low-power beacon located on the ferry slip. The system will permit operation under poor visibility conditions.

Point-to-Point

Maintaining communications along right-of-way is a major function of railroad communications engineers. Carrier-telephone equipment finds use throughout their extensive wire-line plant.

Microwave radio-relay systems have been installed by the Rock Island and the Santa Fe railroads. The Santa Fe system replaces 315 miles of open-wire telephone line. It operates in the 6,575 to 6,875-mc band and consists of terminals at Galveston and Beaumont, Texas, with three intermediate repeater stations. All stations have standby r-f equipment. Eight duplex voice channels are provided by pulse-amplitude modulation of the shf carrier. One channel is a party line

www.americanradiohistory.com

in Railroading

Electronic freight handling. Television camera picks numbers as car enters yard; electronic scales weigh car and record weight

Maintaining freight-yard communications; vhf radio in switch engine features fail-safe operation. Talk-back loudspeakers keep yard workmen in touch

with drop and insert at each repeater. It also carries a fault-alarm tone.

Figure 2 is a block diagram of one of the repeaters in the Santa-Fe relay. Incoming f-m signals at 6,830 mc are mixed with the 6,740-mc signal from the klystron local oscillator. The 90-mc i-f signal is detected and applied through a direct-coupled voltage amplifier to the repeller of the klystron.

The klystron is thus made to follow the incoming signal in frequency and functions both as receiver local oscillator and transmitter for the next leg of the relay.

The Rock Island's system spans 106 miles between Norton and Goodland, Kansas. It operates in the 6,575 to 6,875-mc band and consists of two terminals and four repeaters.

Early Microwave

Experiments with railroad microwave radio date from 1946, when the Rock Island used 2,660-mc equipment for cab-to-caboose and cab-to-wayside communications[2]. Since then, however, vhf radio has gained general acceptance for railroad mobile communications.

Early experiments with microwaves for right-of-way communications were carried on in 1949 on the Long Island, where 8-channel, 6,660-mc equipment was used for remote operation of power-distributing substations, remote control of switches and signals, metering electric power, telephone, telegraph and facsimile communications[3].

Major factor inhibiting more widespread use of microwave by the railroads has been the attitude of some telephone companies towards interconnection of their facilities. Railroads have historically enjoyed interconnection privileges with their wire-line circuits for both on-line and off-line calls. Interconnection with microwave links is not granted in these contracts.

Transistors

Both magnetic amplifiers and transistors are finding application in railroad work. Magnetic-amplifier regulators have been used with axle-driven generators to supply power for radio equipment installed in freight-train cabooses.

A transistor amplifier used in Baltimore and Ohio telephone subsets helps overcome attenuation on heavily-loaded train-dispatching circuits. A junction transistor with base input is used. The amplifier operates from the 4½-volt local battery used to supply current to the carbon microphone. The transistor amplifier is normally connected in the receive position and is controlled by a push-to-talk button. The circuit shown in Fig. 3 uses an *npn* junction transistor.

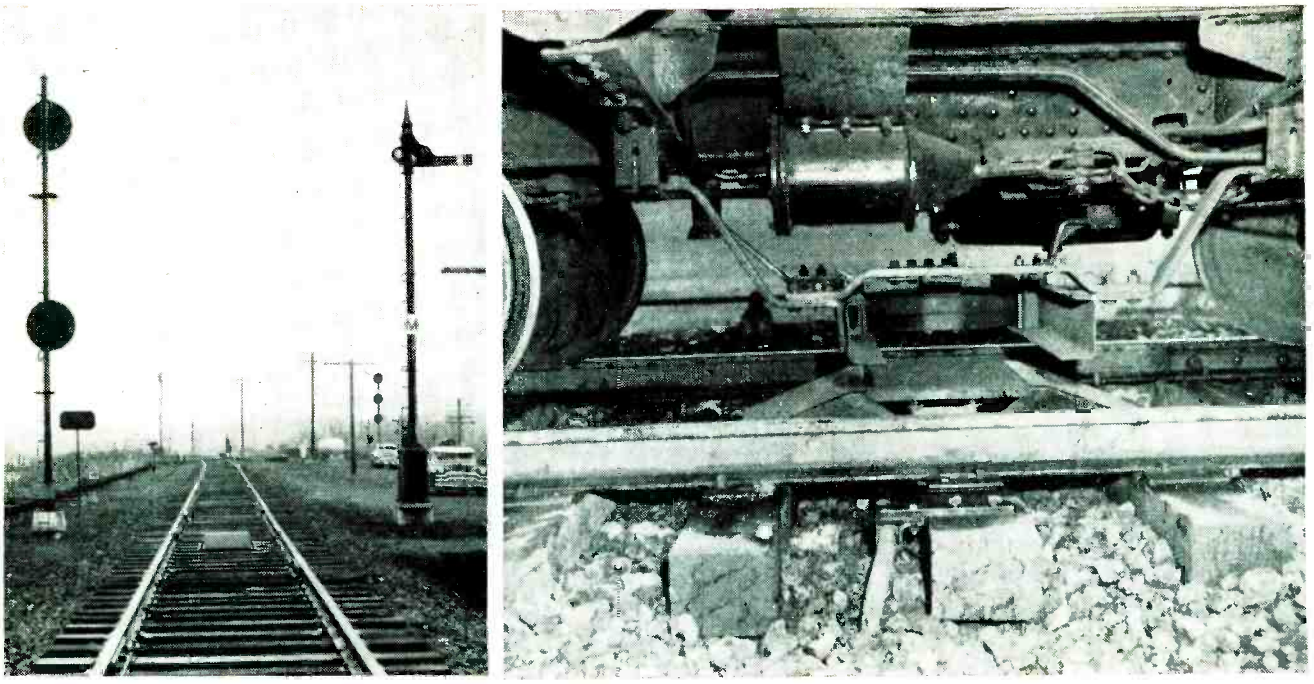
Input in receive position is from a line-bridging transformer. On transmit, the carbon microphone works into a resistor in the base circuit. Although amplification is limited by circuit noise along the line, subsets now in use have gains of 20 db. This gain exceeds that of telephone repeaters used on dispatching lines.

About 15 transistor-amplifier subsets are presently in use. These were built by B & O personnel. The subset has been recently redesigned for mass production.

Politics

Bills to transfer authority over railroad electronic equipment from the FCC to the Interstate Com-

www.americanradiohistory.com



Electronic train identification. Oscillator tank coil in weatherproof housing between tracks couples to tuned circuit in rubber doughnut suspended below caboose, producing change in output

merce Commission are among the hardy perennials on Capitol Hill[4]. Most recent one, HR 3,095, tossed in the hopper by Rep. Melvin Price (D., Ill.) would give the ICC authority to require railroads to install certain electronic or electrical safety equipment subject to FCC approval of required licenses, station permits or other required permits. The FCC would still retain its jurisdiction over communications equipment.

Equipment mentioned in the bill includes: telegraph, telephone, radio, inductive carrier for wayside and/or train communication; also, block signals, interlocking, automatic train stop, train control and/or cab signals and similar equipment.

Freight-Yard Electronics

Making up freight trains constitutes a large-scale industrial operation. In modern freight-car classification yards, electronic equipment is making a major contribution to safe and speedy freight handling.

In a typical operation, freight cars are pushed by a switch engine to the top of a rise called the hump. An industrial television camera may then pick up the car numbers and relay them to a clerk.

The cars are decoupled and weighed on electronic scales; the car's net weight is recorded for the weighmaster by an electric printer. Remote switches are then operated and the car rolls by gravity into one of several tributary tracks where the freight trains are made up.

A radar speed meter clocks the car as it rolls down grade. This warns the operator in the yard's control tower if the car's speed is too great for safe coupling with others on the tributary track. The operator can then manipulate remote controls that check the car's speed by engaging the retarders. These are long steel clamps or shoes that work against spring pressure to squeeze the car's wheels.

Electronic Weighing

The electronic car scales can weigh 4 to 5 standard 40-foot freight cars per minute. Cars are pushed over the scale at 2½ mph, which leaves each car alone on the scale for about 3 seconds. Two weight indications are provided, a large visual indicator and a remote printer. The printer automatically subtracts tare weight from gross weight. Full-scale reading is 400,000 pounds and the scales are accurate within 100 pounds.

The scale platform is a 90-foot section of track divided into four sections. Eight waterproof-jacketed weighing cells support the scale

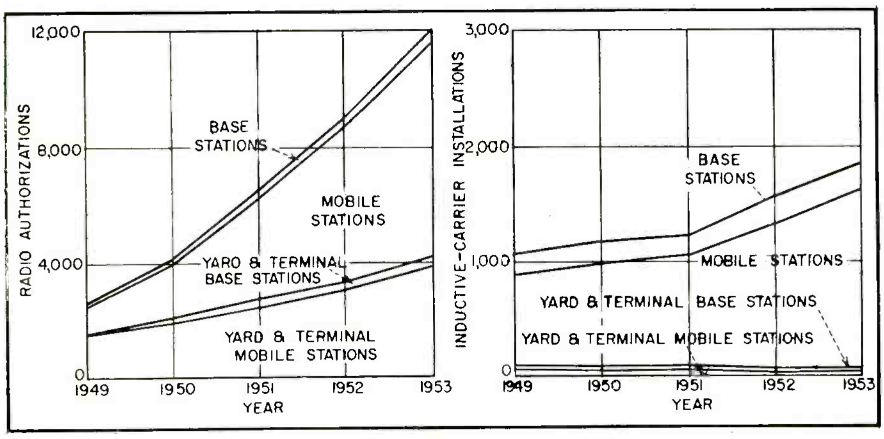
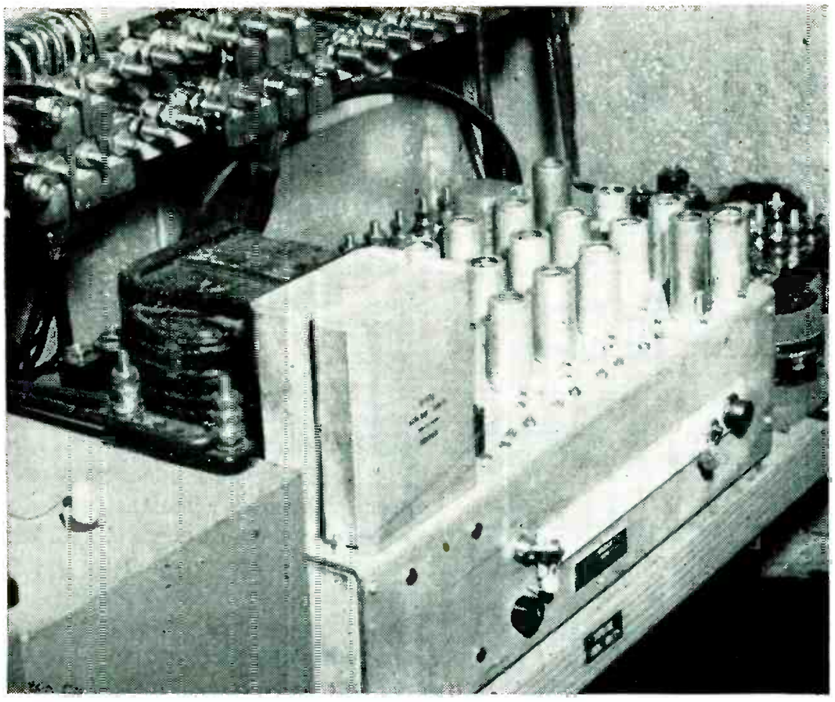


FIG. 1—Railroad radio booms while inductive carrier installations increase slowly

www.americanradiohistory.com



Sweep-frequency oscillator unit in concrete bungalow adjoining railroad tracks sweeps from 160 to 310 kc

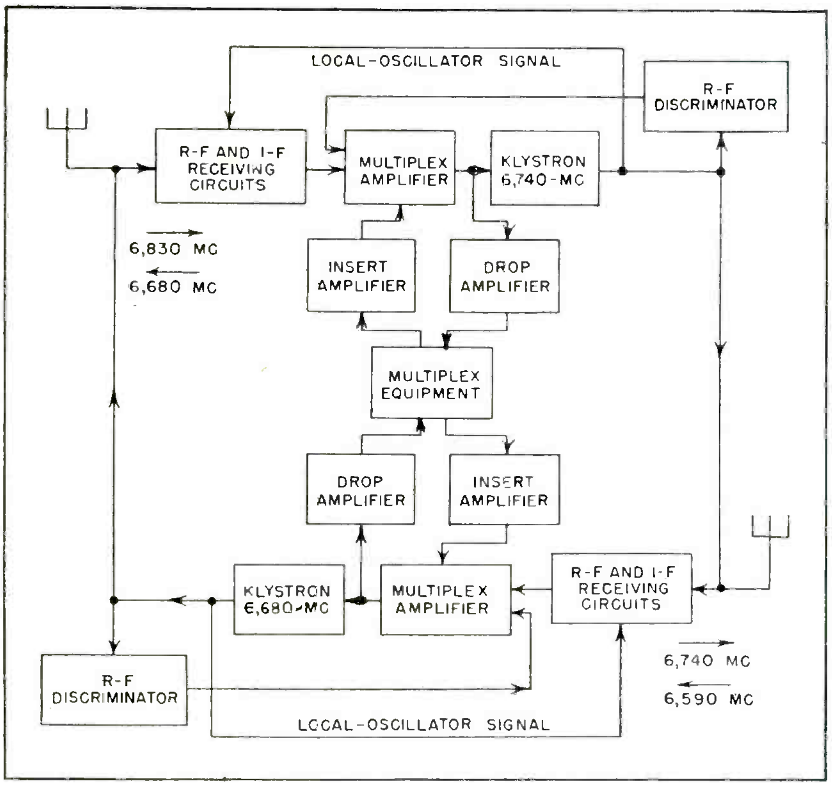


FIG. 2—Microwave repeater used on Santa Fe has single klystron for receiver local oscillator and transmitter

platform. The cells are essentially resistance-wire strain gages, connected in a 400-cps Wheatstone-bridge circuit. An a-c amplifier amplifies the unbalance of the bridge and actuates a servomechanism that operates to restore bridge balance. Weight-scale pointers are coupled to this servomechanism.

Radar Eases Jolts

The radar speed meter works on the Doppler principle. A 2C40 lighthouse triode operating as a fixed-frequency oscillator delivers 4.5 watts c-w to two half-wave dipoles fed in phase. Frequency is 2,455 mc, in the industrial-medical-scientific band. Oscillator resonant circuits comprise a cylindrical-grid cavity and associated anode in combination with a feedback cavity cut for the operating frequency.

A small amount of transmitter power is mixed in the receiver input with the signal reflected from the target, the freight car. The receiver output frequency thus depends upon the speed at which the car is moving. This frequency is detected and used to operate two voltmeters calibrated directly in miles-per-hour. One meter is mounted in the case with the transceiver while the other is located on the retarder-operator's desk.

Intercoms

Freight-yard communications are vital for safe and efficient operation. Southern's modern Norris Yard at Birmingham, Ala. uses 40 paging and 150 talk-back loudspeakers to coordinate operations. Two hundred ground-line loud speakers are also installed. To operate one of these as a microphone, the talker depresses a foot pedal, that also mutes all nearby units to eliminate sources of acoustic feedback. Conversations can be carried on using any nonadjacent loudspeakers.

Twenty-two vhf receivers and 21 transmitters also help knit yard operations together. The equipment fails safe in that a 1,200 cps beep tone is transmitted regularly for one-half second at ten-second intervals. Hearing this tone in his loudspeaker, the engineer is assured that he is not depending upon a dead radio receiver for instructions.

Train Identification

A train-position indicator introduced some years ago on the Rock Island used signals having frequencies identified with fixed points along the line[5]. When keyed by the train, these signals were passed over wayside wires, through appropriate filters, amplifiers, trigger-tubes and relays to actuate signal lamps and recorder pens that showed the train's progress.

On the Erie, an electronic train-identification system enables the

www.americanradiohistory.com

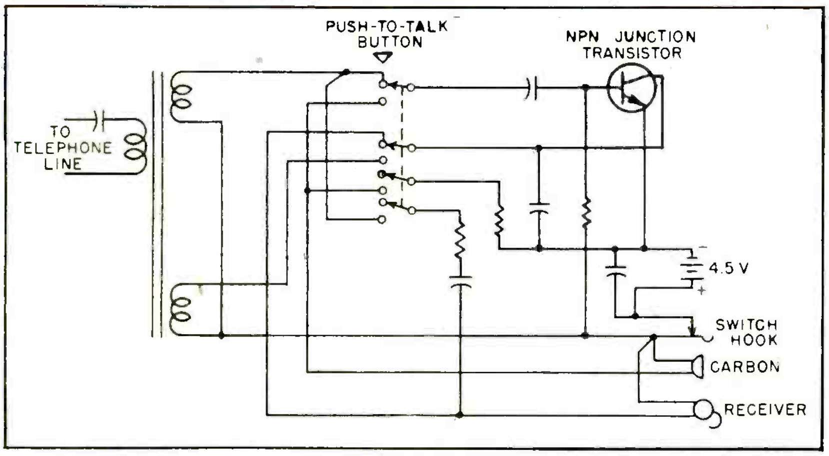


FIG. 3—High-efficiency railroad dispatcher's telephone subset uses junction transistor

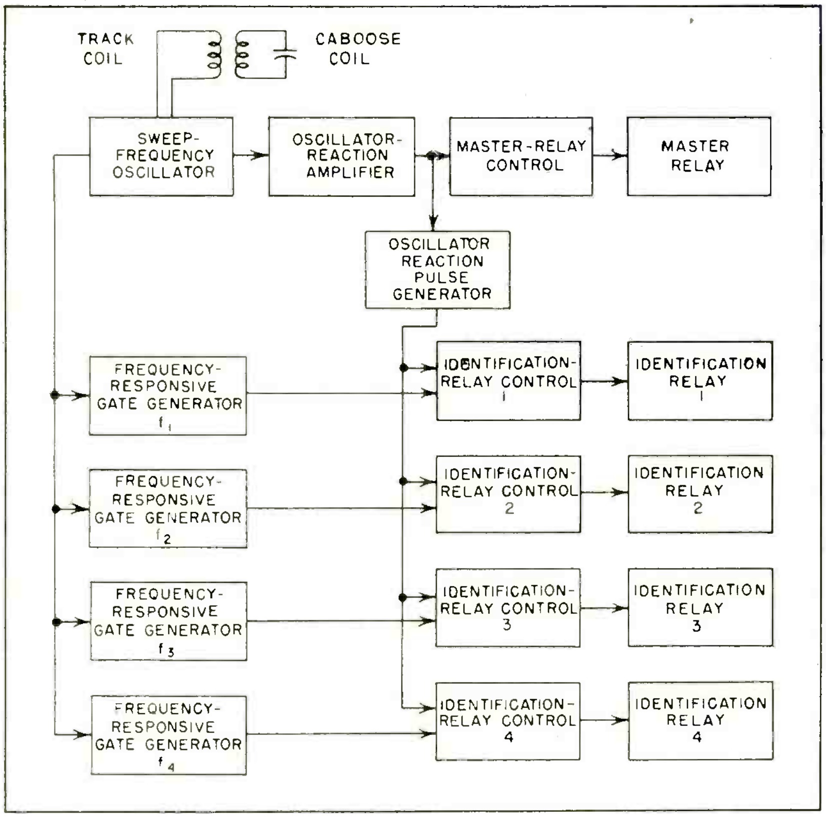


FIG. 4—Electronic train watcher identifies trains passing unattended junction. Train is tagged by tuned circuit suspended below caboose

dispatcher at Salamanca, N. Y. to identify westbound freight trains passing from single-track, manual-block to double-track, automatic-block territory at an unattended junction at Waterloo, 22 miles distant.

Four freight trains are operated over this division and each is identified by an individual lamp on the dispatcher's board at Salamanca. The lamps are selected by code-rate signals transmitted each time the caboose of a westbound freight passes the junction. A numbered recording pen is also actuated on a strip-chart recorder to indicate time of identification.

The code-rate signals consist of pulses sent over wired carrier from electromechanical transmitters. Each of the four cabooses is represented by a different pulse-repetition rate, which may be 120, 180, 240 or 405 pulses per minute. The proper code-rate signal is put on the wire by a relay selected by the electronic train identifier.

Each caboose is tagged by an r-f tuned circuit sealed in a rubber doughnut suspended beneath it. Each circuit is tuned to a distinct frequency in the 160-310-kc band. The tank circuit of an 160-310-kc sweep-frequency oscillator is located in a weatherproof housing between the tracks. As a train approaches the junction, a track relay turns on the sweep-frequency oscillator and the four code-rate transmitters.

A portion of the sweep-oscillator power is applied to four frequency-sensitive gate generators, f_1 to f_4 in Fig. 4. These gate generators each produce a pulse when the oscillator sweeps past its resonant frequency. These resonant frequencies correspond to those of the caboose tuned circuits. The four gate pulses are applied sequentially to each of the identification relay control circuits. The control circuits are coincidence gates and remain cut off unless a caboose is passing over the sweep-oscillator tank circuit.

Operation

When a caboose passes over the track coil, its inert tuned circuit couples to the oscillator tank, causing a change in oscillator output. The oscillator reaction amplifier detects this reaction and amplifies it, applying it to the master relay control and the oscillator-reaction pulse generator. The master relay control energizes the master relay indicating the presence of a caboose.

Simultaneously, the oscillator-reaction pulse generator produces an enabling pulse that is applied to all four identification-relay control circuits. Coincidence occurs only in the control circuit associated with the caboose-coil resonant frequency. When both master and identification relays are energized, the proper code-rate transmitter keys the 17-kc wire-line carrier and remote identification is made. The dispatcher acknowledges the signal by pushing a button that sends a disabling signal over another carrier channel to restore the equipment to its normal condition.

Remote Control

The wire-line-carrier transmitter and receiver shown in Fig. 5 can be used both to actuate remote signal

www.americanradiohistory.com

ter and stripchart recorder. If the joint is ½-in. low, two lights flash. The surface-fault detector records elevation differences between the center measuring truck and either the car's front or rear truck.

When a low joint is encountered, the contactor in the thyratron grid circuit is closed, connecting the grid to the positive terminal of the 22½-volt battery. The gas-filled tube fires and draws heavy current. The plate-circuit relay is energized, closing contacts that energize a second relay. This relay's contacts close to actuate the bell, light and counter. Another set of contacts on this relay opens the thyratron plate circuit; thus the tube is deionized and remains ready to detect the next track flaw.

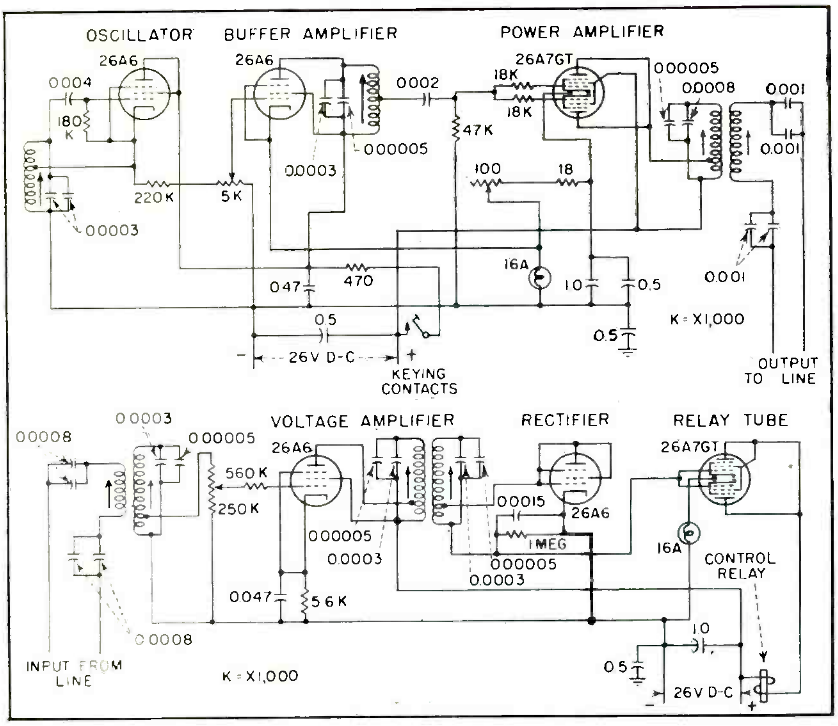


FIG. 5—Carrier-current control unit for remote signaling comprises 17-kc transmitter and receiver

devices and to indicate their position. The transmitter as shown operates on 26 volts d-c using special railroad-type tubes. Heater power may be 26 volts, a-c or d-c. The transmitter delivers 0.1 watt r-f into a 600-ohm line at a carrier frequency of 17 kc. The carrier transmitter output is keyed by the electromechanical code-rate transmitter while the rectified receiver output operates the appropriate code-rate-sensitive relay.

Maintenance of Way

America's railroad industry must maintain an immense physical plant. Electronics is on the job here too. For several years, self-propelled track inspection cars have patrolled 200,000 track-miles annually at 12 mph searching for potentially defective rails[6]. Internal fissures in the steel, particularly transverse ones, can grow suddenly to such a size that the rail will break under load. The track inspection car passes a heavy current, 8,000 amperes at 1.8 volts, through the rails, recording local variations in magnetic field due to fissures. Defective rails are located on a strip chart and automatically sprayed with white paint.

Smoothness of roadbed is monitored by the Chesapeake & Ohio's roadway inspection car. The car has a gyro-balanced measuring truck suspended beneath it. An eight-pen strip-chart recorder notes the rail profile, alignment of the rail, difference in elevation between rails and the general surface of the track. In addition, bells ring and lights flash as the car passes over low joints or faulty surface.

Five thyratron circuits like the one shown in Fig. 6 record right-rail joints ¼-in. low, right-rail joints ½-in. low, track surface, left-rail joints ¼-in. low and left- rail joints ½-in. low. When a rail joint ¼-in. low is detected, a light flashes, a bell rings and the fault is recorded both on an electromechanical coun-

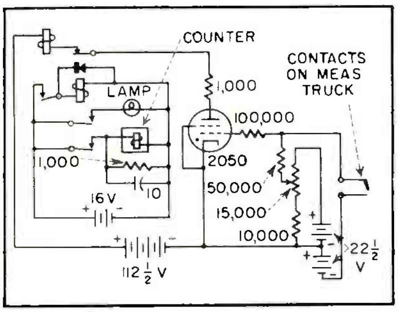


FIG. 6—Thyratron rail-fault detector helps maintain roadbed smoothness by locating low rail joints and surface irregularities

Fault Finder

The railroads operate many thousand miles of pole line in their communications service. The Southern Pacific and the C & O are making use of a radar-like device to locate troublesome faults along their lines. This device transmits a pulsed very-low-frequency signal that is reflected by the mismatch presented by a line fault.

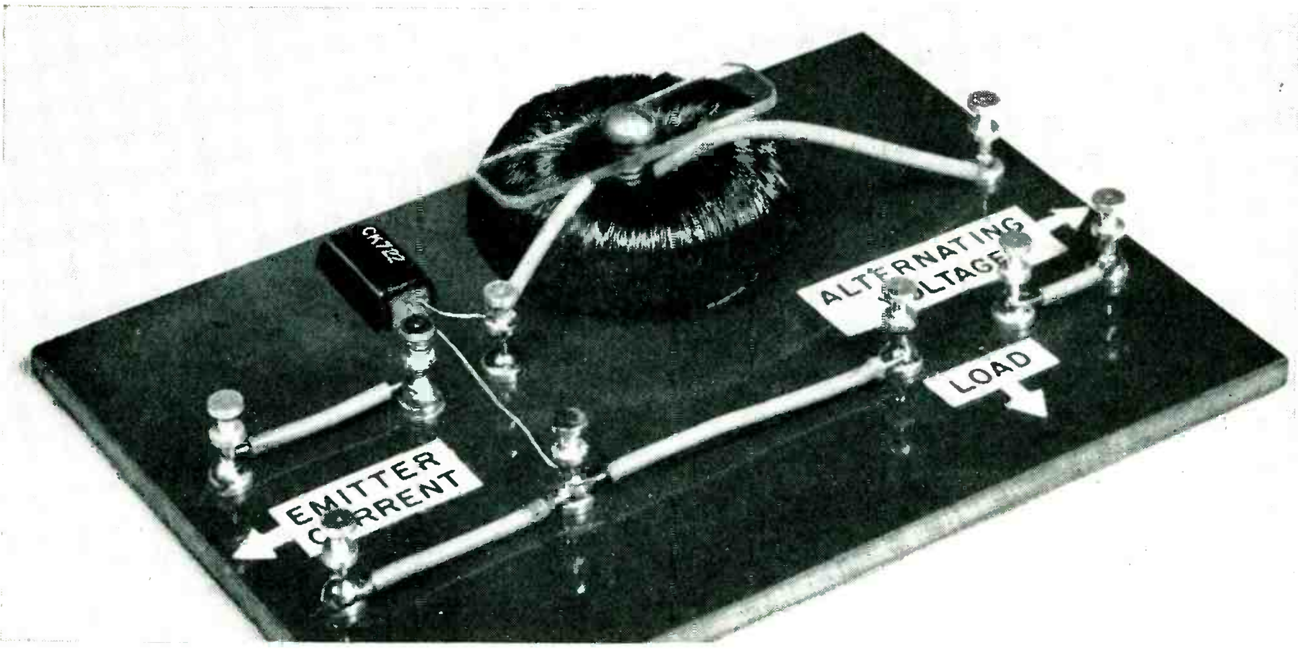
The carrier frequency selected depends upon the transmission characteristics of the line and may be from 400 cps to 30 kc. The pulse repetition rate is adjustable from 200 to 2,000 cps. The distance from the line fault to either the transmitter or to some known mismatch may be determined by aligning the received echo on the face of the cathode-ray tube with either the outgoing transmitter pulse or with the echo from a known mismatch. The phase-shifter dial is generally calibrated in miles. Line fault locators are under development that display the distance from a line fault to a known mismatch directly in miles using a decade counter.

REFERENCES

(1) Electronic Equipment in Train Control, ELECTRONICS, p 219, Dec. 1931.
(2) E. A. Dahl, 2,660-Mc Train Communications System, ELECTRONICS, p 118, Jan. 1946.
(3) Microwaves For Railroad Control, ELECTRONICS, p 150, Jan. 1949.
(4) J. Courtney, Railroad Radio . . . From FCC to ICC, ELECTRONICS, p 92, June 1946.
(5) E. A. Dahl, Train Position Indicator, ELECTRONICS, p 122, Oct. 1946.
(6) R. D. Walker, Jr., Railroad Track Inspection Car, ELECTRONICS, p 66, Oct. 1949.

www.americanradiohistory.com

Transistor-Controlled



Experimental transistor-controlled magnetic amplifier using single-winding toroid with CK722 junction transistor. With 60-cps, 12.5-volt rms carrier voltage applied to terminals at right, output signal currents up to 100 ma peak can be obtained in connected load for emitter input signal currents under 0.5 ma peak

By RICHARD H. SPENCER

Department of Electrical Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts

TO UNDERSTAND the operation of the transistor-controlled magnetic amplifier, a comprehension of magnetic-core behavior is required.

Magnetic cores are usually characterized by their B-H curves. If a winding is placed on a core, the curve is conveniently converted to a flux-current plot. Figure 1 shows a representative B-H and flux-current plot for a grain-oriented nickel-iron core when excited at a particular frequency.

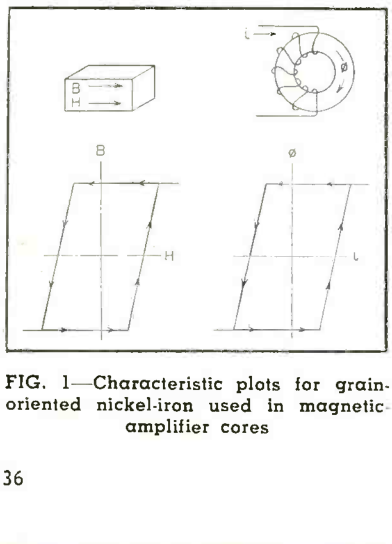


FIG. 1—Characteristic plots for grain-oriented nickel-iron used in magnetic amplifier cores

The independent variable of the flux-current plot is usually thought of as the current, but there is no reason why the flux cannot be so considered.[1,2] Indeed, by going one step further and showing the relationship between flux and winding voltage, a whole step in circuit analysis is saved.

Circuitwise, not flux but the related quantity, voltage, is of importance. Flux and voltage both appear in the elementary expression $e = -N(d\phi)/dt$, where e is the winding voltage, N is the number of turns of winding and ϕ is the flux through the winding. The solution of this differential equation is

$$\phi = -\frac{1}{N}\int e\,dt$$

The flux axis of the flux-current plot may thus be replaced by this expression and $\int e\,dt$ considered as an independent variable directly proportional to flux. The winding current may now be determined simply by observing $\int e\,dt$ which has accumulated at the terminals of the winding. Flux no longer need be considered at all.

Analysis of Simple Series Circuit

The behavior of the simple circuit of Fig. 2A can be examined by using this principle for analysis. The circuit consists of a winding on a magnetic core in series with an alternating voltage source and a small resistance. Assume that the operating point on the $\int e\,dt$ versus i plot is point a of Fig. 2B at the start of the positive half-cycle of supply voltage. To determine the current, examine the added $\int e\,dt$ which has developed across the winding terminals and note the current corresponding to this added $\int e\,dt$ on the plot of Fig. 2B. With a small series resistance the iR drop is assumed negligible and the full supply voltage is considered as impressed on the winding.

www.americanradiohistory.com

Magnetic Amplifier

Combining the junction transistor with a magnetic amplifier, using Ramey reset control circuit, utilizes best characteristics of each. Circuit is simple, delivers greater power than transistor alone, and responds to signal changes in one carrier-frequency cycle

For a very small increase in the source voltage v_s, the operating point moves from point a to point b; that is, very little $\int edt$ need be applied to the winding to cause the current to become the value at point b. As more integral of voltage accumulates across the winding, the operating point moves from b toward c.

For simplicity, it is assumed that the total integral of voltage applied during the positive half-cycle is just sufficient to cause the operating point to reach c. This point is then reached at the end of the positive half-cycle of supply voltage. When the supply voltage becomes negative, $\int edt$ becomes less and the operating point moves along the left side of the $\int edt$ versus i plot, eventually returning to point a when the added $\int edt$ equals zero at the end of the negative half-cycle.

The current that flows under these conditions is called the magnetizing current; it does not exceed the relatively low values corresponding to points c and e. Waveforms illustrating this mode of operation are shown in Fig. 2C.

An important extension of the circuit just described is the addition of an ideal diode poled as shown in Fig. 3A. To determine the currents in this circuit, again assume the same initial point a with conditions as before. The circuit behavior during the first positive half-cycle of supply voltage is identical to that of Fig. 2A. The diode has no effect during this part of the operation. As the voltage source becomes negative, the diode absorbs the entire

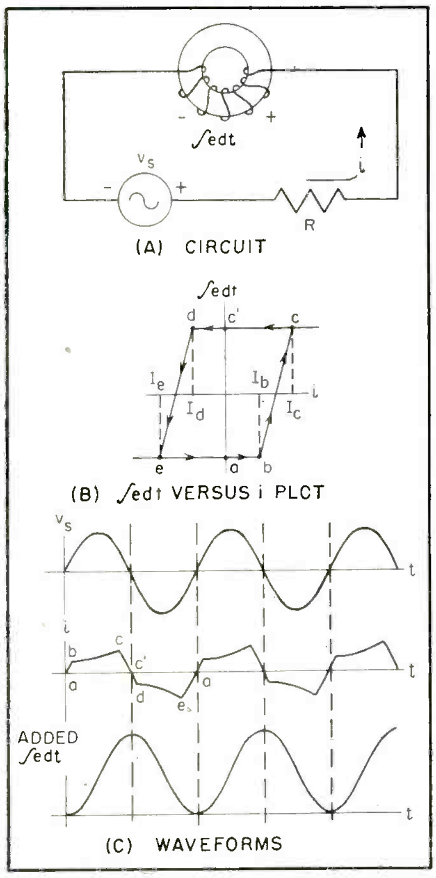


FIG. 2—Simple series circuit using magnetic core. Only small magnetizing current flows

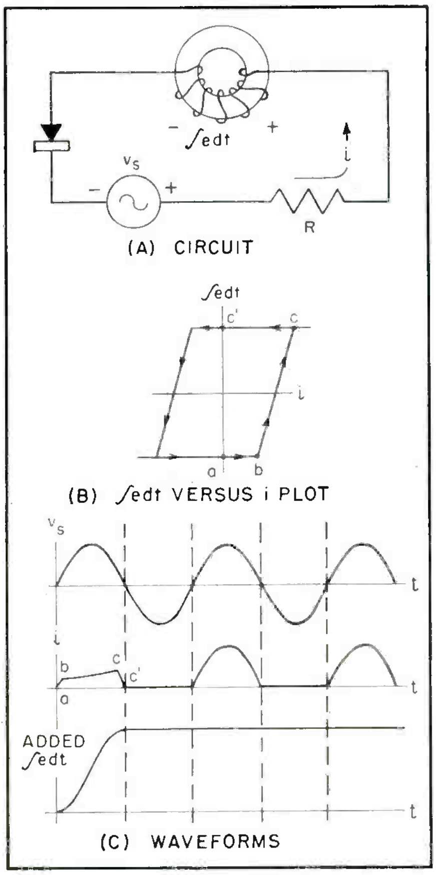


FIG. 3—Crystal diode in simple series circuit. Current on positive half-cycle is determined by v_s and R

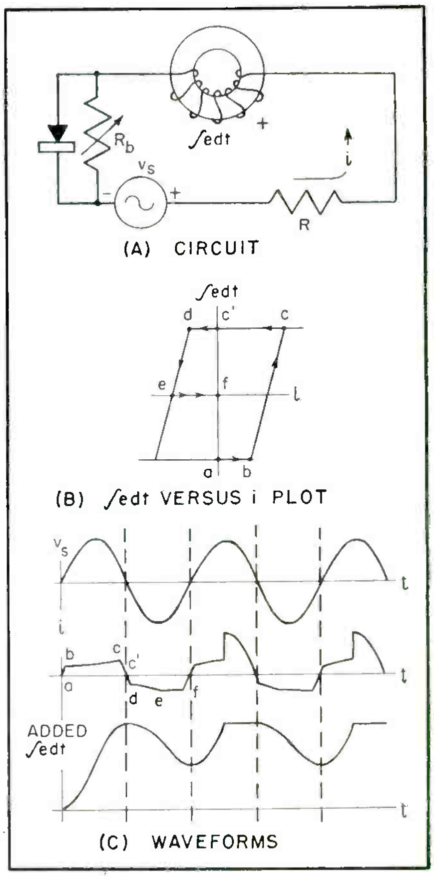


FIG. 4—Modified diode circuit using shunt rheostat to establish operating conditions between those of Fig. 2 and 3

www.americanradiohistory.com

supply voltage and no negative voltage is applied to the winding. The operating point stays at point c' during the entire negative half-cycle of supply voltage; that is, no change in $\int edt$ occurs during the negative half-cycle of supply voltage.

During the following positive half-cycle, the source tends to apply an added positive $\int edt$ to the winding but the core is now saturated, and the winding current tends to become very large; the small resistance which was previously ignored now absorbs the entire supply voltage. The waveform of the current follows that of the supply voltage for the positive half-cycle of supply voltage. Again, as the supply voltage becomes negative, the diode absorbs voltage and no current exists. The circuit behavior is as if the magnetic core were not even present. Large currents may exist and considerable power be delivered to the resistor.

Circuit With Rheostat Control

Two conditions of core operation have been described. In the first, the series resistor absorbed very little power since the core limited the circuit current to the magnetization value. The second condition allowed large currents to exist, limited only by the value of the resistor.

The only difference in these two circuits was the use of an ideal diode. Suppose that a variable resistor R_b is placed across this diode as shown in Fig. 4A. If the resistance is made very low, the operation is that of the first case—small circuit current. If the resistance is made large, the operation is that of the second mode—large current.

With these two modes in mind, consider the resistor at an intermediate value. If the operation during the negative half-cycle is examined, one finds that R_b (the drop across R is negligible) absorbs some of the supply voltage and the core the remainder. If a suitable value of resistance is selected, half the integral of supply voltage accumulates across the resistor, and half across the winding. In this instance, the core operating point moves from c' through d to e, just half-way down the left side of the $\int edt$ versus i plot, during the negative half-cycle of supply voltage.

During the next positive half-cycle of supply voltage, the core absorbs the supply voltage until $\int edt$ is the saturation value. The required additional $\int edt$ to reach saturation is only half of that available from the supply. When this amount of additional integral has been supplied, the core is saturated and the current suddenly increases to the value v_s/R and follows the supply-voltage waveform for the remaining interval of the positive half-cycle of supply voltage. Waveforms are shown for this mode of operation in Fig. 4C.

Rest-Control Action

The above discussion has shown that the current through resistor R may be controlled with the circuit of Fig. 4A merely by varying a second resistor R_b. The value of this resistor determines the point on the $\int edt$ versus i plot at which the core is left at the end of the negative half-cycle of supply voltage. This point in turn determines the duration of time in which load current exists in the following positive half-cycle of supply voltage. Restated, the condition of the core at the end of the negative half-cycle of supply voltage determines the operation during the positive half-cycle. Resistor R_b need only pass currents up to the peak magnetization current to control load currents many times greater.

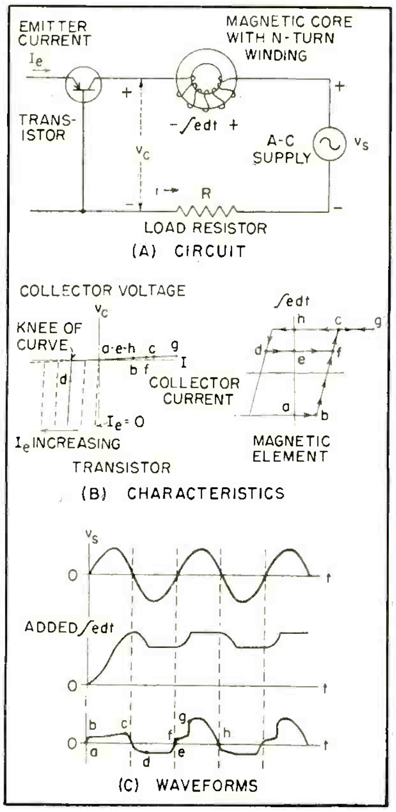


FIG. 5—Operation of transistor-controlled magnetic amplifier circuit

Available transistors have characteristics which allow them to perform the function of the ideal diode and resistor; that is, a transistor can be considered as a diode in which the back current is readily controlled.

Transistor-Controlled Magnetic Core

Figure 5A shows the circuit of a transistor-controlled magnetic amplifier. This circuit is the same as that of Fig. 4A except that a transistor takes the place of the diode and its paralleling resistor.

The characteristics of the circuit elements are shown in Fig. 5B. Assume as before that at the start of the positive half-cycle of supply voltage, the magnetic element is at point a. As the characteristics show, the transistor may be considered as a very low resistance during this half of the operating cycle.

With the supply voltage becoming slightly positive, the operating point of the magnetic element moves from point a to point b, with the magnetic element absorbing essentially zero voltage. To move from point b to point c, however, requires that the core absorb a time integral of voltage equal to the difference in ordinates from point c to point b. During this absorption of voltage, the circuit current increases from I_b, the value at point b, to I_c, the value at point c. These currents are shown both on the transistor characteristic and the magnetic-element characteristic. With the supply voltage adjusted as before, this added $\int edt$ is just sufficient to bring the operating point to c during the positive half-cycle of operation.

As the supply voltage passes through zero the negative half-cycle starts. During this negative half-cycle, the transistor characteristics become significant and the constraint imposed by a particular

www.americanradiohistory.com

value of emitter current must be considered. Such a constraint requires that the transistor operate on a specified curve of the family shown in Fig. 5B. This curve shows that the transistor acts as a low resistance until the collector current I exceeds the value at the knee of the characteristic, after which it acts as a high resistance.

Thus, during the negative half-cycle the magnetic element again absorbs the supply voltage, and the operating point moves down the left-hand side of the $\int edt$ versus i plot until the magnetic-element current reaches the value of current corresponding to the knee of the transistor curve. The transistor then absorbs all the supply voltage and maintains the magnetic-element current at a substantially constant value. The operating point corresponding to this condition is shown as point d.

When the negative half-cycle is completed, the magnetic element is left at point e and the device is ready for the following positive half-cycle of operation. During this positive half-cycle, an added $\int edt$ accumulates across the core winding and the operating point moves from e to f and then to c. As the voltage integral tends to increase beyond the value required to reach point c, the core no longer absorbs voltage and the entire supply voltage is impressed across the load resistor. There is then a resultant sudden change in circuit current to the value at point g, determined simply by the instantaneous value of supply voltage v_s and the value of load resistor R. The core remains saturated during the remaining portion of the positive half-cycle and power is delivered to the resistor.

When the supply voltage reaches zero, the positive half-cycle is completed and the core if left at point h. The waveforms corresponding to this operation are shown in Fig. 5C. By varying the emitter current of the transistor, any value of $\int edt$ can be applied to the winding during the negative half-cycle, and thus the interval of time in which load current exists during the following positive half-cycle is controllable.

An experimental circuit which has been investigated is shown in Fig. 6A. The parameter values are in part determined by three transistor properties: (1) The peak voltage which may be applied to the transistor collector electrode; (2) the maximum permissible collector current; (3) The allowable collector dissipation, which limits the amount of collector current in the opposite-from-normal polarity.

Property 1 limits the peak supply voltage usable. Property 2 determines how much reset current is available. Property 3 determines the peak load current. Associated waveforms are shown in Fig. 6B.

Extensions of Circuit

A more efficient use of the circuit results if the collector and base terminals of the transistor are paralleled with a good diode. Such an arrangement was constructed employing a 4JA1A1 junction diode.

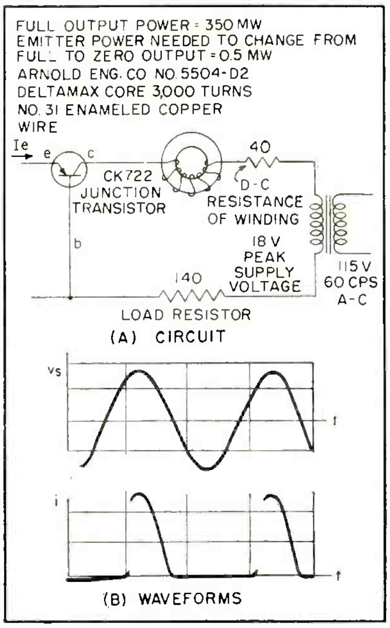


FIG. 6—Experimental version of final circuit, with waveforms of a-c supply voltage and load current

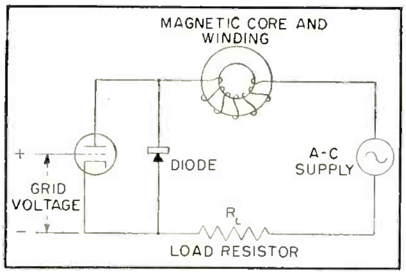


FIG. 7—Vacuum-tube equivalent of magnetic amplifier circuit having grounded-emitter transistor shunted by diode

This was capable of supplying one watt of power to the control phase of a two-phase servo motor.

An auxiliary diode also allows the transistor to be placed in the grounded-emitter connection. This connection allows the input signal to work into a higher resistance than is presented by the grounded-base connection. As shown in Fig. 7, a vacuum triode paralleled with a diode can be made to operate in approximately the same manner as the transistor circuit.

Conclusions

This paper describes a combination of magnetic core and transistor which permits an efficient coupling of these devices. Load powers in excess of those capable of being handled by a transistor alone are available in this configuration. The circuit operates in the Ramey manner,[1,2] manifesting complete response to a change of input signal in one cycle of carrier supply frequency. The device forms a convenient stepping stone from the powers available from transistors to the powers available from magnetic amplifiers. Many variations of the basic circuit are possible and should find wide application.

Appendix

In designing a magnetic element for use in the transistor-controlled magnetic amplifier, several factors must be determined. Once a particular square-loop core material has been selected, three choices remain to be made—the core length, core cross-section and the number of turns of winding. The transistor and the circuit performance requirements determine these factors.

Consider first that the peak voltage chosen for the supply must not exceed the maximum allowable transistor collector voltage, but at the same time should be capable of causing the core to change from negative to positive saturation. For the particular core material chosen there exists a given value of saturation flux density. Half a cycle of supply voltage should be capable of changing the core flux from the negative to the positive saturation value. The voltage induced in the

www.americanradiohistory.com

core winding is $e = -d\lambda/dt$ where λ represents the flux linkages of the coil and is equal to NAB. Here N is the number of turns on the core, A is the cross-sectional area of the core and B is the flux density in the core.

With e constrained to be a sine wave of peak amplitude E_o

$$e = E_o \sin \omega t = -NA\frac{db}{dt}$$

Integrating these terms over a half-cycle of e verifies that $E_o = \omega NAB_s$.

The maximum allowable transistor current must be able to provide enough ampere-turns to saturate the core, hence with H_s representing the saturation magnetizing force, $NI_o = H_s l$. Here N is the number of turns on the core, l is the length of the core and I_o is the allowable transistor current.

To form a third expression involving the three unknowns, use the criterion that the winding resistance be some fraction F of the minimum allowable circuit resistance. The minimum allowable resistance is the peak value of supply voltage E_o divided by the maximum allowable forward (low-resistance direction) current of the transistor I_+. Thus the winding resistance should be FE_o/I_+. With the assumption that the average turn length on a practical toroid of mean length l is $l/2$ and the effective window area is $nl^2/4\pi$ (n being the efficiency of using the area), the winding resistance is $R = \rho L/A = 2\pi N^2\rho/nl$, where ρ is the resistivity of the winding material and N the number of turns on the toroid. The three expressions for determining l, A and N are thus

$$E_o = \omega NAB_s$$

$$NI_o = H_s l$$

$$\frac{2\pi N^2 \rho}{n l} = \frac{FE_o}{I_+}$$

The solution of these expressions gives

$$N = \frac{n E_o I_o F}{2\pi H_s \rho I_+} = \frac{K}{2\pi}$$

$$A = \frac{2 H_s \rho I_+ \pi}{\omega B_s F I_o n} = \frac{2 E_o}{\omega B_s K}$$

$$l = \frac{n E_o I_o^2 F}{2\pi H_s^2 \rho I_+} = \frac{I_o K}{2\pi H_s}$$

$$K = \frac{n E_o I_o F}{H_s \rho I_+}$$

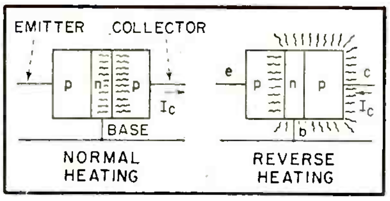


FIG. 8—Nature of power dissipation in a junction transistor

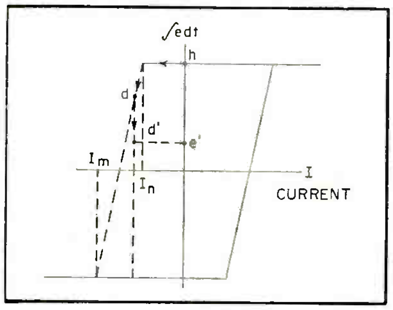


FIG. 9—Composite characteristic of magnetic core, illustrating behavior during reset half-cycle

For an example, the values of the constants for the illustrative amplifier were $\rho = 1.8 \times 10^{-8}$ ohm-meters, $E_o = 18$ volts, $I_o = 0.5$ ma, $n = 0.5$, $F = 0.2$, $H_s = 26$ ampere-turns per meter, $\omega = 377$ radians per second, $B_s = 1.2$ webers per square meter and $I_+ = 100$ ma. Using these constants, the following calculated parameter values were obtained; in parentheses after each is the value actually used, for comparison: $N = 3{,}060$ (3,000) turns; $A = 4 \times 10^{-6}$ (23×10^{-6}) square meters; $l = 0.059$ (0.075) meters. As the calculations show, these expressions should be used to provide nominal parameters only.

Collector Dissipation

In the junction transistor a limit is placed on the collector dissipation. For normal use of the transistor this dissipation takes place at, or very near, the collector junction; if the dissipation becomes too great, the junction itself may be destroyed and the transistor become useless.

In the case of current passing through the junction in the backward direction, the heating of the transistor is not localized at the junction, but occurs throughout the base and collector materials. These two modes of dissipation are illustrated in Fig. 8.

Since the volume of the transistor is small, it is thought that the dissipation should still be kept to the value specified for normal operation. To determine how much current could safely be passed in the backward direction, the static volt-ampere characteristic of the transistor was measured and the load current limited to a value causing the average dissipation at full amplifier output to be less than the rated value.

Core Behavior

During the reset half-cycle (negative half-cycle of supply voltage) the magnetic element operating point moves from point h to point d on the characteristic of Fig. 9. At the current corresponding to point d, it was said that the transistor operating point was at the knee of its characteristic and any further increase in transistor voltage did not increase the circuit current substantially. However, since the current is held at an almost constant value after point d is reached, the core no longer operates on the same magnetization loop and the composite characteristic of the core must be considered.

The portion of the loop from point d to saturation becomes almost a vertical straight line. The very small increase of current permitted as the transistor voltage increases is effective in causing a reset to d' greater than that to d as would be predicted from the normal magnetization characteristic. This behavior removes the possibility of making an easy analysis of the circuit, but does not destroy the usefulness of the circuit. The limits of the reset current I_n and I_m still remain the same, and the current swing for total control is the difference between these two values.

The work on which this article is based was supported by the Office of Naval Research and the Navy Bureau of Ships. The author expresses his appreciation to his associates, including Professor T. S. Gray, for their helpful suggestions.

REFERENCES

(1) R. A. Ramey, On the Mechanics of Magnetic Amplifier Operation, *AIEE Trans*, 70, Part II, p 1,214, 1951.
(2) George M. Attura, Magnetic Amplifier With Reset Control, ELECTRONICS, p 161, June 1953.

www.americanradiohistory.com

Components Department Aids Project Engineers

Almost one-half more of a project engineer's time is available for actual design if responsibility for meeting military specifications on components and materials is transferred to a centralized group that serves all project engineers

By STANLEY KRAMER and SEYMOUR GURIAN

Applications Engineer, Germanium Division — *Assistant Sales Manager, Communications Division*

Radio Receptor Company, Inc., Brooklyn, New York

INCREASING DEMAND by the government upon civilian contractors and industry to produce government material and equipment has brought about a new problem, that of government-contract administration. The government requires and demands stringent adherence to the many diverse specifications under which the contract is awarded, covering manufacturing procedures, materials, processes, parts, operation, packaging and shipment.

Specifications Problem

Under the project-engineer system, the project engineer, being responsible for the entire job, is faced with an insurmountable load of specifications to which he must adhere. Not only must his design meet specifications in operation, but the components and parts that go into the final manufacture of the overall equipment must also conform to their individual specifications. As a result, a great many man-hours that would normally be devoted to design work by the project engineer are spent delving into specifications, interpreting them and carrying on correspondence with the government agencies concerned for waivers and deviation approvals.

By divorcing the project engineer from responsibility for compliance with all specifications other than those directly related to the design of the equipment, at least one-half more of his time can be put into actual design.

Responsibility for meeting the other specifications is turned over to a group designated with the sole responsibility of contract administration. Its prime functions are to provide the project engineer with sufficient information about the specifications on his particular contract and to handle all of the administrative and engineering functions other than those strictly concerned with design. This includes contract analysis, approval of component parts, waivers, deviations, descrip-

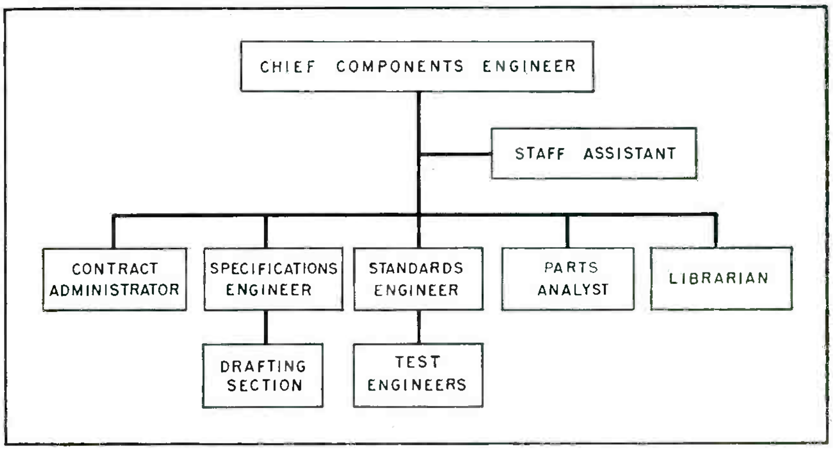


FIG. 1—Organization chart of new components group

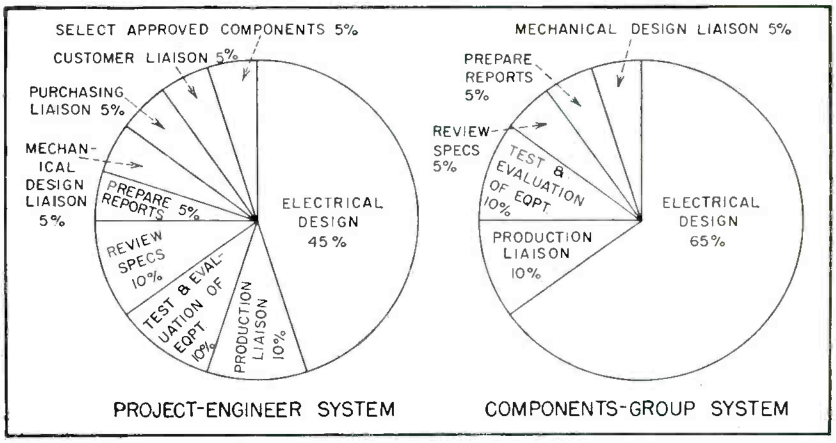


FIG. 2—Average distribution of project engineer time on a military contract with old system (left) and with new components-group system taking over much of his clerical work (right)

www.americanradiohistory.com

tive patterns, drawing specifications and supplying a flow of components, materials and processes acceptable to the government agency concerned for use in this end equipment. This group is called the components group, and is organized as shown in Fig. 1.

Organization of Group

The chief components engineer is responsible for the function of the entire group. He also serves as the liaison man for dealing directly with representatives of the government agencies concerned, and is the final review point for all parts, materials and processes employed in this particular project.

The contract administrator is responsible for analyzing the contract, picking out all the specifications that are part of the contract, and collecting all subsidiary specifications. He then prepares a contract analysis that is used as a guide for the project engineer and the components group in the choice of parts, materials and processes. Another responsibility is that of maintaining correspondence of an official nature with the government to record waivers and interpretations of the specifications.

The specifications engineer is responsible for completing components drawings so that the specifications include all of the government standards for finishing, material, processes, workmanship, marking and other details. His drawings must meet the requirements of the government agencies. These manufacturer's drawings are ultimately submitted as part of the overall equipment for future procurement needs.

The prime responsibility of the standards engineer is to maintain a flow of approved components for use in the equipment. The standards section has a sample-test laboratory where all component parts are sample-tested for compliance with the design requirements of the project and the added requirements of the government specifications which are applicable.

Test results are recorded in the form of an engineering sample report that is ultimately transmitted to the procurement department.

The parts analyst heads a section responsible for the complete descriptions of the component parts used in the overall equipment, along with preparation of parts lists, preferred lists for procurement, processes, bills of materials and nomenclature assignments. This section also is responsible for stock numbering and for supplying information to the instruction-book department for the ultimate completion of the instruction book.

The librarian provides the entire organization with a complete set of government specifications, civilian specifications, catalogs, brochures, technical literature and standards as set up by the organization.

The existing purchasing department retains all of its normal functions, except that it is limited to procuring components that have individually been tested and approved by the components group.

Customer Liaison

The chief components engineer is the sole representative of the organization in direct relationship with the government agency. Much more uniform operation is attained, since only one individual meets with the government agents and therefore controls policy as well as operation. In an organization where many projects are simultaneously in progress, one representative is able to bring about approvals for all projects at the same time since many of these projects are interrelated in design and construction even though made for different government agencies. Where one piece of equipment is being purchased by several military agencies at the same time, such as by the Air Force, Navy and Signal Corps, it has been found extremely advantageous for the chief components engineer to sit with all agencies at the same time and bring about a common set of specifications, engineering design, components, materials and processes. This eliminates the necessity for extreme controls at the production and assembly lines.

Comparison of Systems

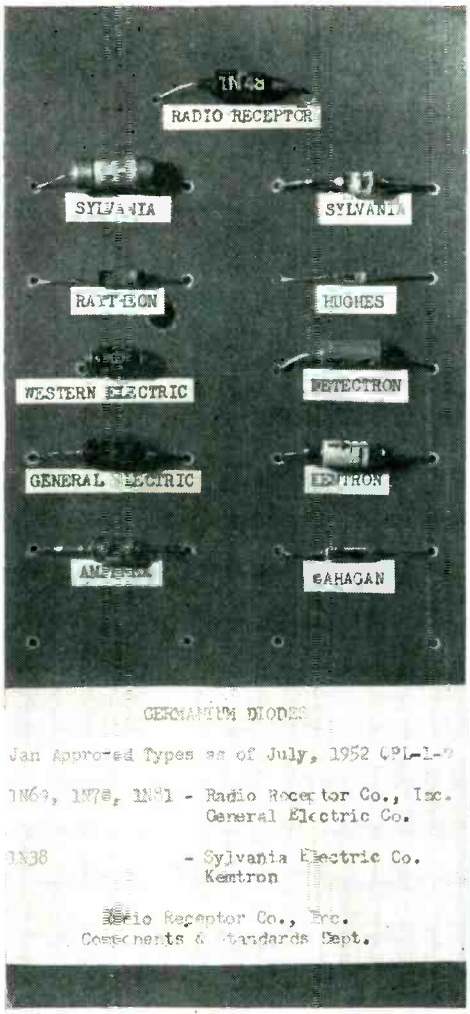
Where the project engineer is in direct relationship with the government engineers, one project may get approval for a particular component while the project for another agency is denied such approval. This means that the production line must segregate its output for individual waivers, necessitating individual stock control systems, individual procurement and parallel assembly facilities. The new components-department system eliminates this.

In the project-engineer system, when a particular component is required to fit design needs, the project engineer must investigate, on his own, the ability of the component manufacturer to produce this component according to government specifications, and must gain approval of the component by the government agency for which his project was designed.

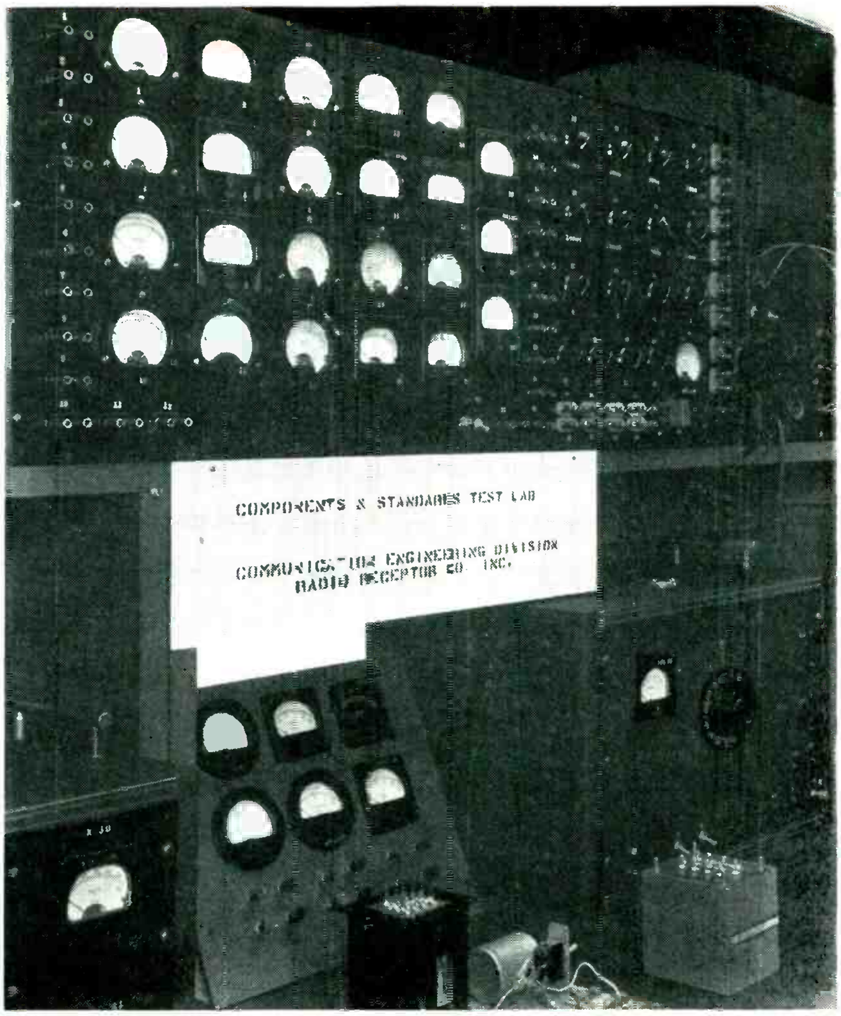
When twelve or more projects are run simultaneously, it means that twelve or more project engineers are performing the same task. Under the components-group setup, these problems are relayed instead to the standards engineer. He at one time investigates the component, submits the component for approval to the various government agencies, subjects this component to sample-tests at his own laboratory, and issues to all project engineers the results of this investigation. In addition, he maintains a catalog of acceptable components for use on military equipment, thus performing in one-twelfth of the time what twelve project engineers would be capable of performing, working independently.

The specifications engineer is able to provide a certain amount of uniformity throughout the organization in the choice of components by establishing so-called preferred lists of acceptable components. This assists the procurement arm of the organization as fewer types of components are required to be purchased and stocked than previously. In addition, he raises the general level of standards for the entire organization by devoting a good part of his time to weeding out those components that are generally inferior to present engineering practices. Such components do creep into design equipment when the project engineer chooses them because of incomplete knowledge of components then available in industry.

www.americanradiohistory.com



Representative sample board maintained by components department. Types having JAN approval can be used without further checking



Portion of test facilities for type-approval of components. Patch cords are used to connect meter jacks at upper left with component under test on bench and simulated loads at center of panel. Universal power supplies are on bench

The specifications engineer also supplies uniform manufacturing drawings that can be used by all project engineers at the same time. Heretofore, the project engineers had their own draftsmen and designers assigned to them, and each project engineer specified the components and drawings in his own manner. Now, this is done in a uniform system. Usually one drawing takes the place of twelve or more individual drawings and satisfies the requirements of all projects simultaneously. The chief components engineer places his signature on each drawing to certify compliance with specifications, approval status and acceptability of the component for the specified application.

The parts section provides the same type of saving of time and energy in the sense that a description for a part is written once. It is necessary only, in order to bring out a tabular list of parts, to review part descriptions, collate the masters and run off a set to make a new tabular list of parts.

Conclusions

A study was made to determine the amount of time, labor, money and energy saved by the components-group method of operations. Results are shown in Fig. 2.

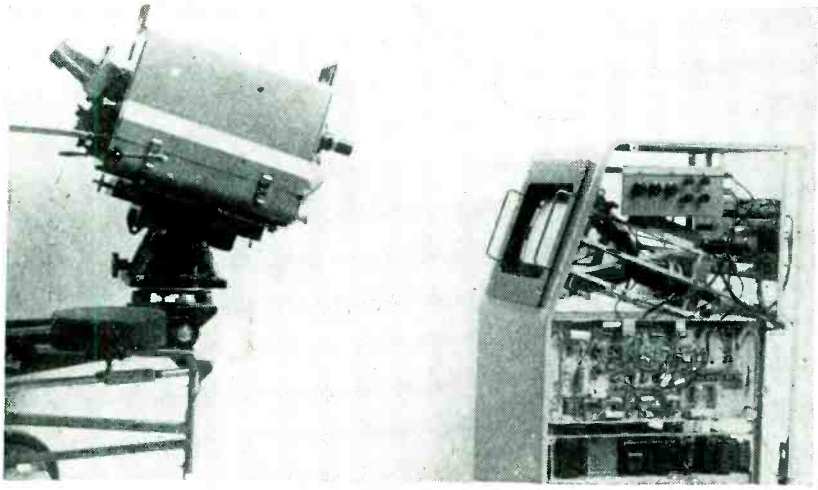
The cost of setting up a components group is not a factor as all of its functions are of necessity already being performed by someone somewhere in the plant. Once running, there is a major saving because centralized checking is more efficient.

When the country is in full production, there is a definite shortage of qualified design engineers. Saving of time and money is then enhanced by the freeing of skilled and hard-to-get design engineers. The new system thus enables an organization to use its limited manpower in the most efficient manner.

Sales representatives of components manufacturers, in addition to calling on purchasing, are also required to contact the components group to establish approval of their products. This means seeing only one man, getting a more thorough product evaluation and giving the salesman assurance that the information will be disseminated to the right engineers when they need it. Before, in a large company it was often necessary for a salesman to call on as many as 40 engineers to insure that his message got to all prospects for his products.

www.americanradiohistory.com

Standards Converter



By A. V. LORD
Research Department
BBC Engineering Division
London, England

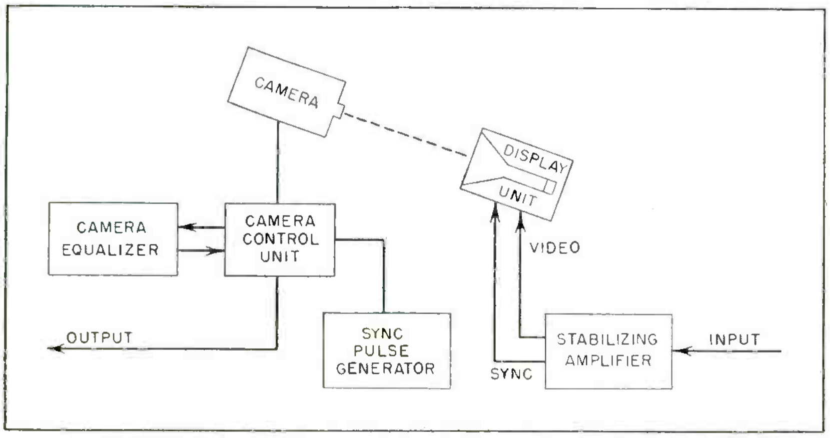


FIG. 1—Scanning-standards converter includes high-quality receiver that presents picture to be converted on long-persistence cathode-ray tube. Resulting optical image is scanned by image-orthicon-type camera operated according to desired scanning standard

Multiple scanning standards in use throughout the world have posed the problem of developing a satisfactory method for converting television pictures from one set of standards to another.

One type of standards converter is illustrated in Fig. 1. It consists of an arrangement whereby the picture to be converted is displayed on a high-quality cathode-ray tube and the resulting optical image is rescanned by a television camera operated according to the required standard.

Experiments have revealed three problems that require solution before satisfactory results can be obtained. The first problem arises because the display on the cathode-ray tube is an intensity-modulated light spot rather than a continuous image. If the scanning camera should then behave like a simple phototube in which any variation of the total light flux causes current fluctuation in the output circuit, a signal will appear at the output corresponding to the brightness variations of the cathode-ray-tube spot. Thus an unconverted component of the input signal will appear at the converter output. This effect is illustrated in Fig. 2.

A second difficulty encountered arises from interference or strobing patterns produced when the scanning beam of the camera tube explores the line structure of the image to be converted. This is known as line beating.

The third problem is associated with any difference of field frequency that may exist between the two standards. Such a frequency difference results in a cyclic variation of the vertical distance on the target of the camera tube, separating the image of the cathode-ray-tube spot and the camera scanning beam.

Unconverted Signal

The characteristics of the camera tube are important in eliminating from the output signal any unconverted components of the input signal. If the camera tube used in the converter is either an iconoscope or orthicon, the intensity-modulated photo-emission at the mosaic results in a varying displacement current flowing in the signal-plate circuit. For the image iconoscope, a similar effect takes place through an intensity-modulated electron beam in the image section of the tube.

Camera tubes whose output signal is derived from the return scanning beam, such as the image orthicon, do not behave as simple phototubes and therefore do not suffer from photo-signal difficulties.

Another solution to the unconverted signal problem may be to separate the input and output signals by high-frequency modulation of the reading beam together with insertion of a suitable bandpass filter in the output. Perhaps a more convenient method is to employ a phosphor in the converter cathode-ray tube that has a persistence characteristic extending over a time in the order of one television

www.americanradiohistory.com

For International TV

Interchange of television programs between countries using different scanning standards is made possible by converter consisting of camera viewing picture on cathode-ray tube. Proper choice of camera and picture tube overcomes chief technical difficulties

field. Thus the camera tube is presented with a nearly continuous image rather than an intensity-modulated spot.

Figure 3 illustrates how phosphor afterglow characteristics influence the ratio of converted-signal to photo-signal interference. The curves represent the afterglow characteristics of two phosphors having different decay constants. For the same amplitude of converted-signal output, the same total light flux should fall on the camera target during storage time; the area under the two curves must be equal. Therefore the phosphor having the shorter persistence must be operated with a higher initial brightness.

The photo-signal is generated by the camera tube operating as a phototube and its amplitude is directly proportional to the peak brightness of the screen. Thus, to deduce the improvement in the ratio of converted signal to photo-signal that will be obtained when phosphor persistence is increased, it is necessary to calculate the ratio of the peak brightnesses at which the two phosphors must be operated to give the same amplitude of converted signal.

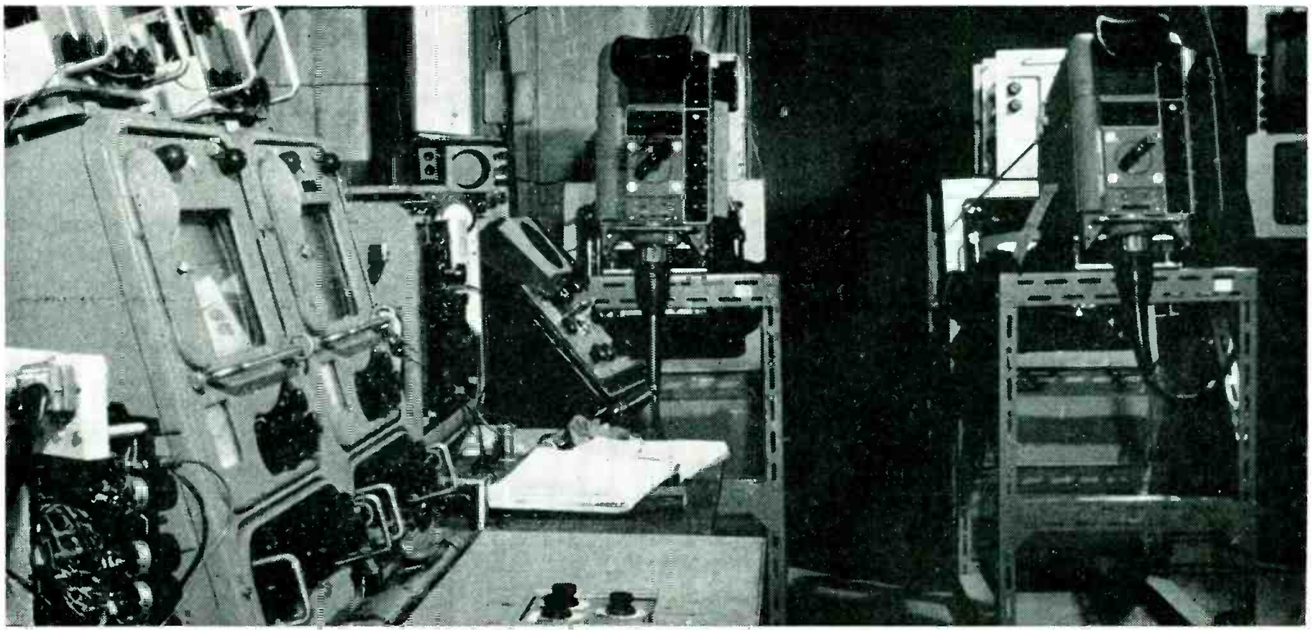
Three phosphors having exponential decay characteristics have been tested and Table I shows the relevant values of decay time constant $1/\alpha$ for each type.

Use of phosphors *B* or *C* on the conversion crt will improve the ratio of converted signal to photo-signal approximately 23 db as compared with phosphor *A*.

The exact determination of this ratio is governed by many factors, including camera-tube storage characteristics and the distribution of light and dark areas in the primary pictures. Experiments show that a satisfactory ratio can be achieved using phosphor *B* or *C* and that persistence is insufficient to cause serious blurring on moving subject matter.

Line-Beating

The second problem in standards conversion arises because the pattern or raster swept out by the writing spot consists of very thin horizontal lines between which there are unscanned areas. The reading process then introduces interference beat patterns except where the reading spot exactly retraces the written pattern. The difficulty may be overcome if the dimension of the wrinting spot in the field direc-



Equipment for converting between French 819-line standards and British 405-line standards is located at Cassel in northern France. Twin standards converters are at right with monitor console, left. Television scenes of coronation ceremony were routed through Cassel via microwave links to feed a five-nation television network

www.americanradiohistory.com

tion is made exactly equal to the distance separating two successive lines of the primary field. This required shape may be approximated by suitable arrangement of the focusing fields but may be obtained more conveniently by spot wobble, high-frequency deflection of the spot in the field direction. Spot wobble permits close control of the effective spot dimension achieved.

Field-Frequency Differences

If the converter camera tube is of either the iconoscope or image-iconoscope type, satisfactory conversion will be effected only between standards having identical field frequencies. Moreover, with these tubes it is necessary to maintain a certain phase relationship between the field synchronizing pulses of the two standards to maximize the converted signal output. With either the orthicon or image-orthicon, it is not necessary to maintain a particular phase relationship between the writing and reading processes although a frequency difference will introduce additional problems.

When the field frequency of the writing standard is lower by a ratio of 8:10 than that of the reading standard, every fifth reading field will be devoid of signal, and conversely if the field frequency of the writing standard is higher than that of the reading standard every fourth reading field will provide a signal of double amplitude. These irregularities in the reading signal cause intolerable flicker. Furthermore, if the two standards are of the interlaced type then broadening the reading spot effectively halves the normal vertical resolution.

When the reading standard is of the interlaced type and the reading beam has a high resolving power, charge storage may last as long as two reading-field periods and the reading signal amplitude will never fall to zero. If the field frequency of the writing standard is lower than that of the reading standard the output signal, during the time of ten reading fields, will consist of four fields of an amplitude derived from the reading of one writing field and six fields of a nominally double amplitude derived from the reading of two superimposed and stored writing fields.

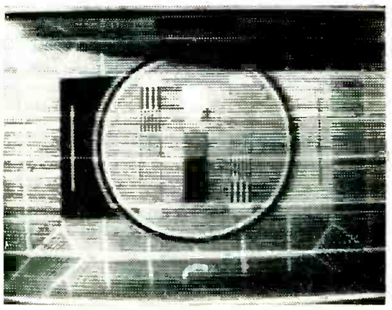


FIG. 2—Photo-signal interference. Unconverted component of input signal shows up as bright horizontal bars on standard BBC test pattern

When the field frequency of writing is higher than that of reading, there are again two amplitudes of reading signal, corresponding, this time to the reading of two or three superimposed and stored writing fields. In both the above cases intolerable flicker results.

If, however, the writing process is arranged to continue substantially throughout one writing field as it will with a long-persistence phosphor, signal variations due to differing field frequencies will be considerably reduced.

A further reduction in signal fluctuation will result either if the reading beam does not effect complete erasure of the written pattern or if the storage surface is such that the efficiency of charge storage is reduced when the charge stored exceeds a given maximum value. Either or both of these effects may be approximated by suitable operation of an image orthicon as the storage and reading device.

Experiments with suitable long-persistence phosphors and an image-orthicon camera tube show that successful conversion may be carried out between standards whose field frequencies differ by a few percent but that if the field-frequency difference is of the order of 20 percent, the signal output tends to become unacceptable due to flicker effects.

Studies have shown that for a conversion where the field frequency is increased from 50 to 60 cps the output signal will be flicker-modulated at beat frequency to a depth of approximately 24 percent. When the field frequency is increased from 50 to 51 cps flicker modulation falls to 3 percent.

Flicker modulation is also high, 15 percent, when the field frequency is changed from 60 to 50 cps, and that for a conversion from 51 to 50 cps, the flicker modulation is low, 3 percent. The greater output signal will always be obtained for a conversion involving field-frequency reduction.

Practical Arrangement

In a system developed the signal to be converted is first applied to a stabilizing amplifier (Fig. 1). This unit performs three principal functions. First, black-level stabilization of the input signal removes any interfering signals such as hum. Next, synchronizing pulses, derived from the input signal, are made available for locking the time-bases of the display unit. Finally, the unit provides some measure of high-frequency preëmphasis to the input signal to compensate for aperture losses in the conversion cathode-ray tube.

The display unit contains the conversion cathode-ray tube. Line broadening or spot wobble is made available in the display unit by an auxiliary deflection coil excited by a low-power oscillator. Flyback sup-

Table I—Decay Characteristics of Three Cathode-Ray-Tube Phosphors

Phosphor	Decay Time Constant $1/\alpha$ in Milliseconds	Ratio of Decay Time Constants in Db
(A) Mixed sulphide (zinc sulphide + zinc-cadmium sulphide)	0.47	0
(B) Willemite (zinc orthosilicate)	6.72	23
(C) Zinc-berylium silicate	7.48	24

www.americanradiohistory.com

pression is applied to the cathode-ray tube to permit the primary picture to be set up well beyond the point where flyback lines would normally be visible. Thus the contrast law of the picture displayed may be somewhat modified to suit the contrast characteristic of the camera. Satisfactory results may be achieved by this means although a fully flexible gamma circuit would be the ideal solution to the problem.

The image produced at the screen of the display cathode-ray tube is viewed by the image-orthicon camera. To equalize the aperture loss of the conversion camera, an equalizer is inserted in the video signal path between the camera-head amplifier and the main amplifier in the control unit. It is highly desirable that this equalization be achieved before insertion of blanking signals into the video waveform.

The equalizer used is of the time-derivative type and it has been found that the principal aperture losses of the conversion camera may be compensated by subtracting from the camera signal an amplified version of its second derivative. This type of equalizer is also ideal for preëmphasizing the input signal in the stabilizing amplifier.

The pulse generator provides all timing, blanking and synchronizing signals for the conversion-camera channel.

The optimum setting for all focus controls may be found by removing the wobble from the display-unit scanning spot to obtain a line-beating pattern on the final picture. All focus controls are now adjusted for maximum visibility of this pattern after which the spot-wobble is restored and its amplitude adjusted to remove the interference pattern. Some residual beat pattern will be observed unless a high degree of field-scan linearity is maintained.

The overall contrast law of the system may be adjusted by the display-tube bias control with a consequent adjustment of gain to maintain constant peak-white brightness.

The iris and target-bias controls of the camera tube will also affect the converter contrast characteristic and will, in addition, influence the performance of the apparatus when a small difference of field frequency exists between the original and converted pictures. This is because the storage characteristics of the camera tube are dependent upon luminous input and target potential.

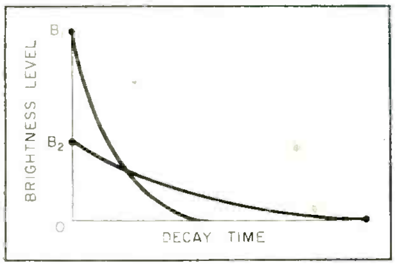


FIG. 3—Phosphor afterglow characteristics show that the phosphor having the shorter decay time must be operated at a higher initial brightness level, B_2

FIG. 4—French mademoiselle appears on British television screens. Picture originated in Paris at the 819-line standard and was distributed throughout BBC network at 405 lines

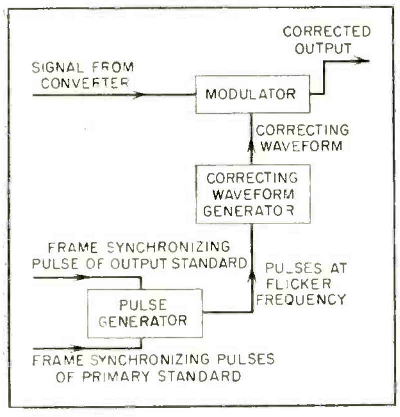


FIG. 5—Suggested method for obtaining flicker-free output when converting from U. S. scanning standards to British

Results

A twin-channel version of this converter was developed early in 1952 and used during an exchange of television programs originating in Paris at the 819-line standard and distributed through the BBC network at the 405-line standard. (See ELECTRONICS, Industry Report, p 8, Aug. 1952.)

Figure 4 is a photographic reproduction of the converted picture as received in London.

Figure 5 shows a possible method of obtaining a flicker-free output signal when converting between U. S. and British standards. The signal output of the standards converter is applied to a modulator in which variations of amplitude due to the change of field frequency are removed. This is done by a control waveform of suitable amplitude and waveshape applied to the modulator.

To insure that the control waveform has the correct frequency and phase relationship, a pulse generator is driven by field-frequency pulses derived from both the primary and output signals of the standards converter.

BIBLIOGRAPHY

CCIR, "Television Systems", Documents of VIth Plenary Assembly, Rpt No. 15, p 207, 1951.

W. D. Kemp, Television Recording, *Proc IEE*, p 115, Apr.-May 1952.

F. N. Gillette, G. W. King and R. A. White, Video Program Recording, ELECTRONICS, p 90, Oct. 1950.

A. Cazalas, Problème de la Transformation des Standards de Télévision, *L'Onde Electrique*, p 178, Apr. 1951.

J. D. McGee, "Electronics", p 135, Pilot Press, 1947.

J. D. McGee and H. G. Lubszynski, E. M. I. Cathode-Ray Television—Transmission Tubes, *Journ IEE*, **84**, p 468, Apr. 1939.

V. K. Zworykin, G. A. Morton and L. E. Flory, "Theory and Performance of the Iconoscope", *Proc. IRE*, **25**, p 1,071, Aug. 1937.

A. Rose and H. Iams, The Orthicon, a Television Pickup Tube, *RCA Review*, p 186, Oct. 1939.

J. D. McGee, A Review of Some Television Pickup Tubes, *Proc. IEE*, **97**, p 377, Nov. 1950.

H. Iams, G. A. Morton and V. K. Zworykin, The Image Iconoscope, *Proc IRE*, **27**, p 541, Sept. 1939.

A. Rose, P. K. Weimer and H. B. Law, The Image Orthicon—a Sensitive Television Pickup Tube, *Proc. IRE*, **34**, p 424, July 1946.

H. W. Leverenz, Luminescence and Tenebrescence as Applied to Radar, *RCA Review*, p 199, June 1946.

W. N. Sproson, M. Gilbert and W. West, Some Fundamental Aspects of Color Television, *Proc. IEE*, p 842, Apr.-May 1952.

T. C. Nutall, More About Spot Wobble, *Wireless World*, **56**, p 189, May 1950.

V. K. Zworykin and E. G. Ramberg, Standards Conversion of Television Signals, ELECTRONICS, **25**, p 86, Jan. 1952.

L. Lax and D. Weighton, A Gamma-Control Circuit using Crystal Diodes, *Proc. IEE*, p 804, Apr.-May 1952.

G. G. Gouriet, Spectrum Equalization by Direct Operation on the Time Function, *Wireless Engineer*, May 1953.

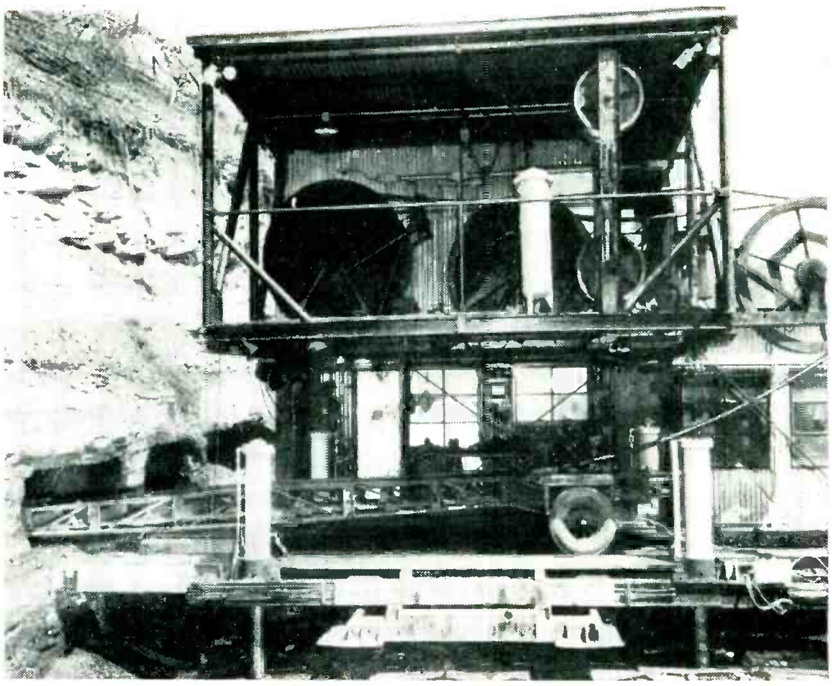
T. H. Bridgewater, Paris-London Television, *Electronic Eng.*, **24**, 410, Sept. 1952.

M. Knoll and B Kazan, Storage Tubes and Their Basic Principles, John Wiley and Sons, New York, 1952.

F. Schroeter, Image Storage Problems, *Bull Schweiz Elektrot Verein*, **40**, p 564, 1949.

www.americanradiohistory.com

Mining-machine engineer points to differential pickup mounted on cutting tooth of outer cutting head, used to deliver signal proportional to hardness



Mining machine, with cutter and front end of first portable conveyor already underground at start of new tunnel. Power and control cables, stored on large upper-deck reels, ride in L-shaped hooks at far side of conveyor. Windows of control station can just be seen at right on machine

Remotely-Steered

Nobody goes underground. Operator in control room outside of mine watches two cathode-ray screens as crawler-mounted cutter burrows into hill. Differential pickups on cutter teeth generate signals proportional to hardness of strata in vein. Selsyns synchronize rotation of cutters with polar presentations on scopes to give positional information

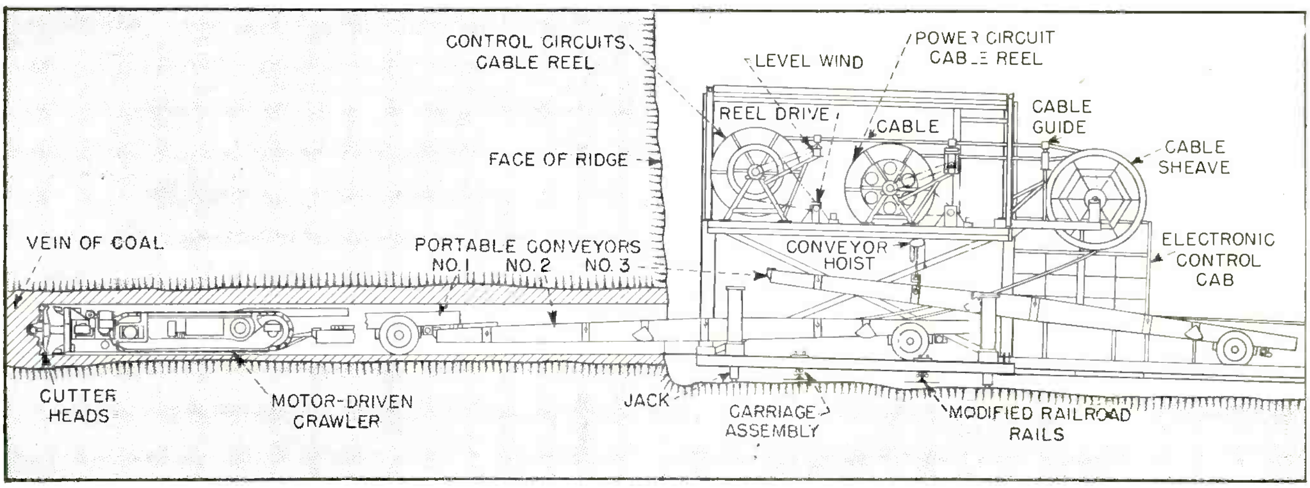
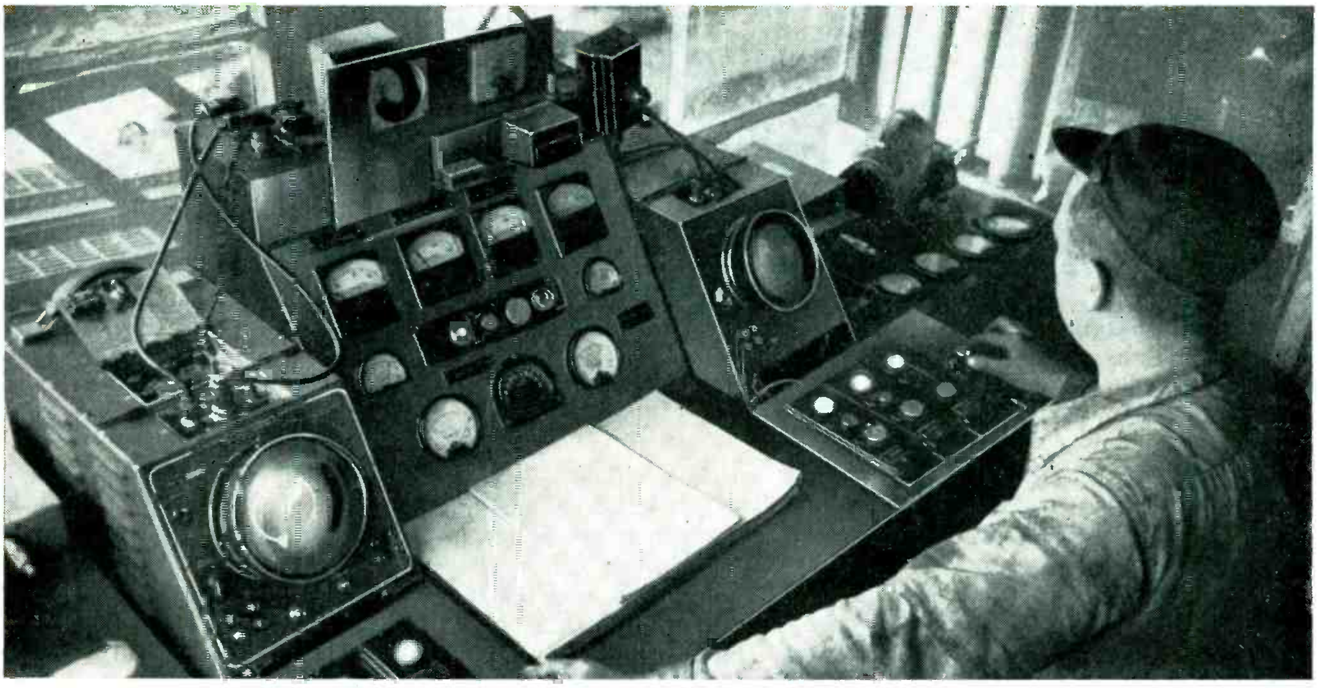


FIG. 1—Side view of new mining machine, which runs on cross rails paralleling face of hill when moving to new position for start of next tunnel. Crawler powered by electric motors supports rotating cutters that break up coal for conveyor feed out of tunnel to waiting trucks. Thirty-foot conveyor sections, added or removed as needed, are towed by crawler as it advances into vein of coal

www.americanradiohistory.com



Operator at control station on first floor of mining machine steers cutter along vein by watching pips on two cathode-ray polar-coordinate indicators. Approximately twenty electrical indicating systems, connected to crawler equipment by 57-conductor cable, tell exactly what is going on underground. Operator can steer machine by remote control to mine the desired coal to best advantage, using pips corresponding to bare coal layers and to slate or shale roof and bottom of cut as guides

Coal-Mining Machine

By **JOHN MARKUS**
Associate Editor, ELECTRONICS

THE BLUE CREEK, West Virginia coal properties of Carbide & Carbon Chemicals Co. lie high up in scalloped ridges. The typical ridge has some soil on top, then 35 feet or more of rock. Below this is the first of several lush coal seams, which lie in wavering layers. Strip mining is out, because there's too much rock to remove. Deep mining is no better, because the ridges aren't big enough to justify the expensive installation. A new unmanned, remotely-controlled machine was developed especially to do this mining job economically.

New Mining Technique

A horizontal shelf is bulldozed along the side of the ridge, roughly following the coal seam. On this, a railroad track is laid to carry the machine.

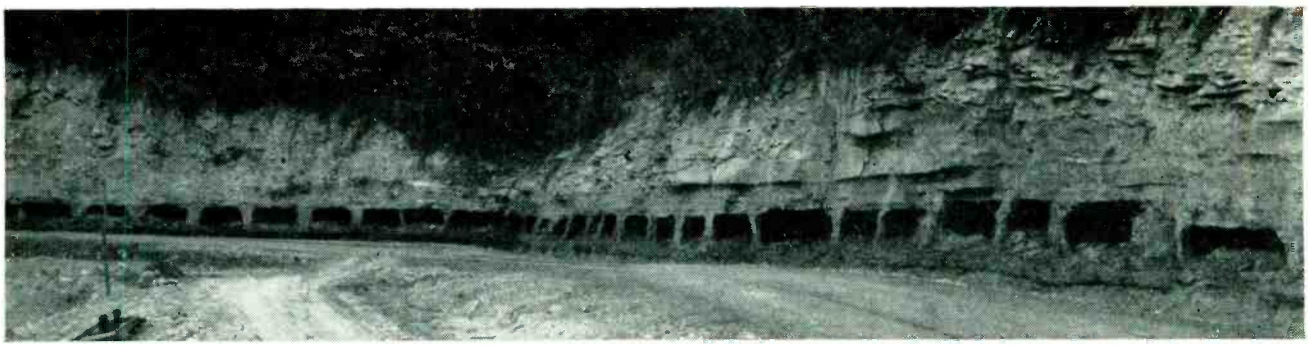
The mining rig is a self-propelled double-deck structure, constructed as in Fig. 1. On the lower deck is the control room and a runway or launching platform for the mining machine. This deck is also provided with a conveyor that receives coal from the mining conveyor and feeds it to truck-loading equipment at the rear. The upper deck contains the huge reels from which the power and control cables pay out as the cutter advances into the hill.

The coal-cutter or miner is mounted at the front of a crawler driven by a large variable-speed electric motor. Separate electric motors drive the four overlapping rotating cutting heads tipped with tungsten-carbide bits. The coal in between the four round holes made by the heads is broken out by bulldozer blades on top and bottom, to give a horizontal hole 116 inches wide and 38 inches high, rounded at the ends.

When the cutter has penetrated the seam to the length of one section of conveyor belt (about 30 feet), it is stopped and a couple of minutes is spent hooking in another conveyor section. The cutter can then go another 30 feet. Maximum depth of holes presently is 690 feet, which is the limit of the conveyors now on hand. With additional conveyors, up to 1,500 feet of penetration is considered entirely practicable. The entire string of conveyors is pulled in by the crawler as it pushes the cutters into the coal vein.

When the hole has been mined to the desired distance, the cutter is withdrawn and the whole rig is rolled a little way down the track to the next spot to be mined. Enough coal is left between drillings to hold up the top of the ridge. Leaving 3-foot ribs between holes and making second cuts in each where practicable, recovery is approximately 60 percent. Maximum production ranges up to $1\frac{3}{4}$ tons per

www.americanradiohistory.com



Appearance of hillside after coal vein has been mined by machine. Three-foot ribs are left between 116-inch-wide cuts to hold up hill. In present operation, holes go in only 690 feet because additional conveyors are not yet available

minute or up to 100 tons an hour.

By making one or more cuts below the first, thicker seams can be mined. Normal practice at Blue Creek is to make a second cut.

Since the cutter is not accompanied by an operator, steering required developing 20 indicating and control instruments and equipment. One cable carrying 14 conductors is used for power, and another cable having 57 conductors is used for the indicating equipment. Hydraulically powered reels with spooling devices are used to reel in, pay out and store the cables. The capacity of each reel is 1,000 feet on the present machine.

The coal seams wander up and down in pronounced waves. If the cutter is not guided, it will stray from the steam, either wasting its time in already mined territory, or ruining its cutter heads on the hard stone that sandwiches the coal layer. To solve this problem, a sensing tooth is mounted on each of the outer cutting heads. These teeth project about an inch beyond the cutter and are spring-loaded. The amount of deflection of a sensing tooth varies with the hardness of the various layers in, above and below the coal seam.

On each sensing tooth is mounted a differential pickup designed to be responsive chiefly to movements in line with the forces acting on the tooth during cutting. General vibration of the cutting head thus does not affect the pickup output signal. Electrical connections to the low-impedance pickup are made through slip rings and brushes associated with the drive shaft of the cutting head. No preamplifier is needed at the cutter even with 1,000 feet of connecting cable.

Rotation of the sensing tooth is synchronized with the travel of the electron-beam spot around the circle of the polar-coordinate oscilloscope in the control by the method shown in Fig. 2. A selsyn transmitter is gear-driven by the cutter shaft and is electrically connected to a selsyn receiver and a-c power source at the control station. The selsyn receiver motor in turn drives a two-phase generator that is connected to the circular time base input terminals of the cathode-ray oscilloscope.

Scope Indications

The output signal of the pickup is fed to the high-impedance signal input terminals of the oscilloscope through an impedance-matching transformer. When a sensing tooth cuts through anything harder than coal, it deflects more and vibrates momentarily, causing the pickup output voltage to go up. This produces radial deflections or pips on one part of the circle on the screen. Movement of the pip in either direction on the circle normally means that the machine is going up or down. The top of the cut corresponds to 12 o'clock on the scope screen and the bottom of the tunnel to 6 o'clock. A pip at 3 or 9 o'clock would therefore indicate a thin seam of hard bone coal halfway down from the top of the cut.

When starting into the vein, the operator notes where the bone coal pips are. If the pips stay at these positions as the machine goes in, the operator knows that he is following the vein.

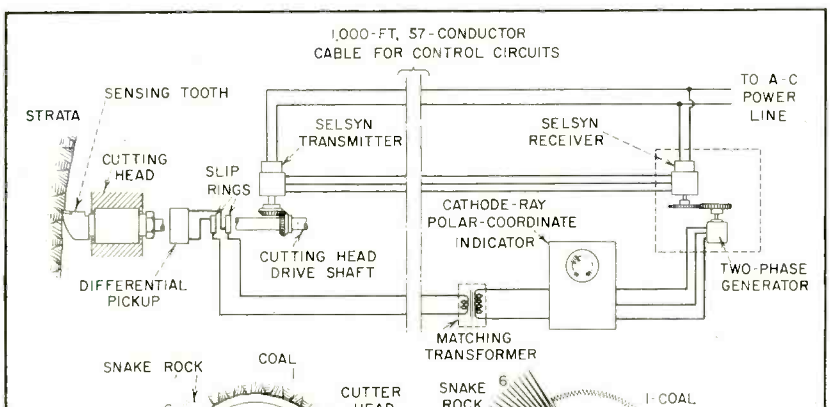
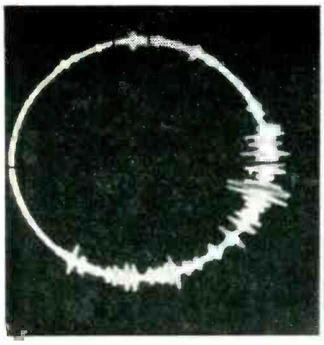
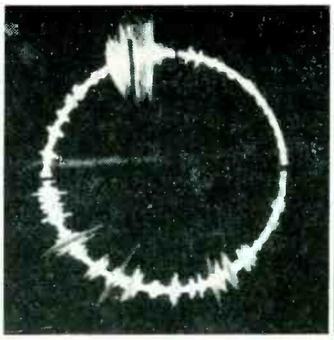


FIG. 2—Electronic control system for steering cutter accurately, at predetermined distance from roof or floor of wavy, wandering coal vein, for distances up to 1,500 feet in from control station

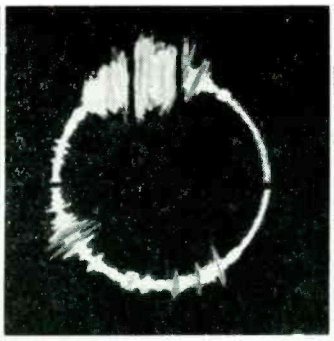
www.americanradiohistory.com



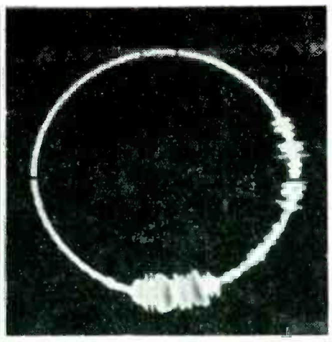
Normal cutting, just hitting draw slate at top or 12 o'clock and going through bone coal strata at about 3:30 o'clock



Hitting mixed slate and sandstone at top, indicating that cutter should be run down to stay in seam



Full contact with sandstone top; bone-coal pip at 8 o'clock instead of 3:30 also means cutter has gone way too high



Going into bottom shale on second or bottom cut; this means operator should bring cutter up immediately

Examples of cathode-ray patterns that guide operator in steering robot coal miner, with interpretations of significance. Operator would rarely see the two right-hand patterns, because they generally mean he had been napping or had ignored earlier warning indications that the cutter was going astray underground

Two complete strata-indicating systems or stratoscopes are required, one on the outermost cutting tooth of each outside cutting head, to indicate tilting of the cutter and to permit accurate operation in sidewise-slanting seams. The patterns appearing on the two screens therefore represent the strata being cut at that time by the sensing teeth.

Steering correction is applied by actuating a hydraulic jack to raise or lower the cutting head, which is pivoted on the main body of the miner.

Drift from one side to the other can be caused by faulty direction, by worn bits on either side or by a change in the character of the coal. A light beam can be employed for checking straightness of the tunnel, but the major reliance is placed on a drill at the rear of the machine on the side next to the rib. Every 30 feet, when a new conveyor is added, the drill bores through the rib. The drill reverses automatically as soon as it breaks through, and the length it goes is registered on a dial in the control cab. If drifting is occurring, guide shoes at the front of the machine are energized to correct direction by pushing against the side of the hole.

Conclusions

The new continuous coal-mining machine opens to economical recovery vast, rich coal lands that hitherto have been too expensive or too difficult to work. Even here cost cutting is achieved, possibly as great as 40 percent of present conventional coal-mining methods. With this machine, the company expects no trouble in supplying its own fuel needs at slightly under $3 a ton delivered.

Another benefit of automation in coal mining is elimination of underground mining accidents. Nobody goes underground here; if jamming or mechanical trouble develops, the machine can pull the conveyors and cutter out backward with winches, after first retracting the cutter-head bulldozer blades to get more clearance. As each conveyor section emerges, it is unhooked and hoisted out of the way for later use when going in again.

Output of 50 tons per 8-hour manshift continuously and up to 100 tons per man per shift in softer coal veins is commanding the attention of the entire coal industry. Although electronically controlled mining deep underground is not possible with the present unit, engineers feel they can modify the machine for this purpose also.

BIBLIOGRAPHY

Digging Coal—No Hands, *Business Week*, p 70, Nov. 8, 1952.

Underground Mining from the Surface with the Carbide Miner, *Coal Age*, p 73, Dec. 1952.

Paul L. Alspaugh and Graham Cook, Earth Strata Cutting Indicator, U. S. Patent 2,620,386.

ELECTRIC MOTORS USED IN MINER

Cutter heads—two 60-hp a-c, geared down to drive heads at 60 rpm

Crawler drive—special 7½-hp d-c motor energized by m-g set on top floor of mining rig; field voltage control on d-c generator varies speed of advance from 0 to 30 inches per minute. Usual speed of 20 inches per minute yields about 2 tons of coal per minute. Tramming in retraction and launching at speeds up to 30 ft per minute is provided by additional 20-hp a-c motor on crawler

Conveyor motor on crawler—7½ hp a-c (moves coal back from cutter heads to input of first portable conveyor)

Portable conveyors—3-hp a-c motor on each of 22 units, for driving conveyor belts independently (conveyors themselves are towed by crawler)

Hydraulic jacks on crawler—½-hp a-c pump motor

Guide-shoe adjustment on crawler—⅓-hp a-c

Spiral-correction on crawler—⅓-hp a-c

Rib-thickness drill—2-hp a-c

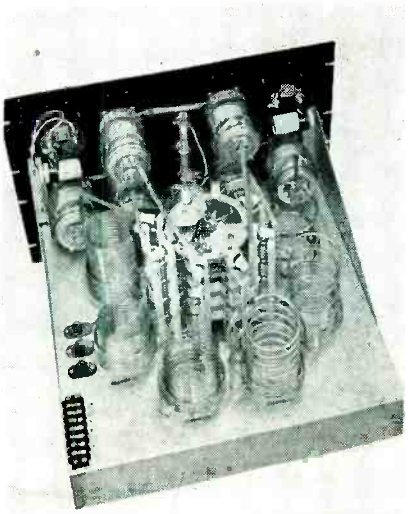
Platform conveyor on mining machine—5-hp a-c

Transfer conveyor on mining machine—3-hp a-c

Elevating conveyor to truck-loading hopper—7½-hp a-c

Total power demand with all conveyors in operation—200 kw

www.americanradiohistory.com



Transmitter final amplifier uses single 4-250A tetrode

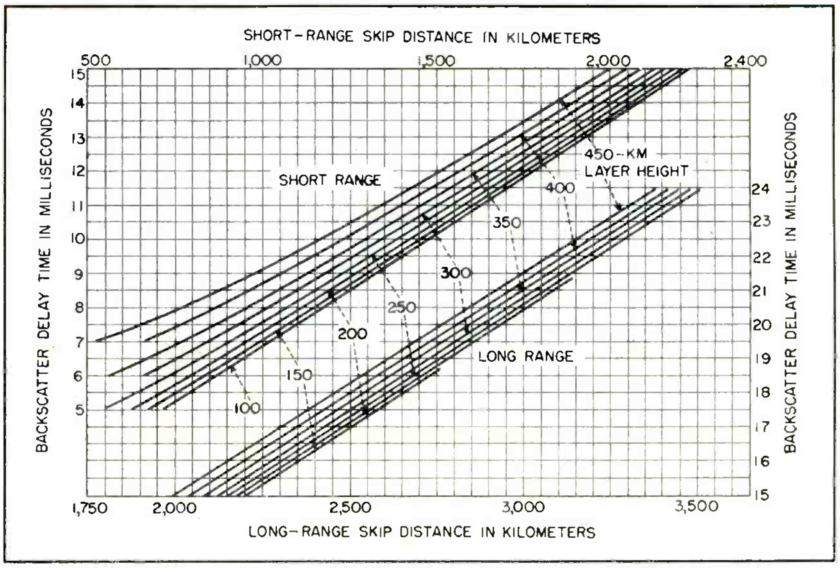


FIG. 1—Conversion chart used to obtain skip distance from time delay between transmitted pulse and reception of backscattered signals

COZI Communication Zone Indicator

Optimum working frequency for prevailing ionospheric conditions is determined instantly. Recently declassified equipment utilizes backscatter of transmitted pulses obliquely incident on the ionosphere to provide indication

By LEONARD C. EDWARDS

*Raytheon Manufacturing Company
Equipment Engineering Division
Newton, Mass.*

IN LONG-DISTANCE radio communication, there exists the problem of determining the optimum operating frequency at a given time for a given communications link. The problem arises from changing ionospheric conditions. Common practice today is for operators to depend for their knowledge of propagation conditions upon their own past experience and the monthly predictions of ionospheric conditions, published by the Central Radio Propagation Laboratory.

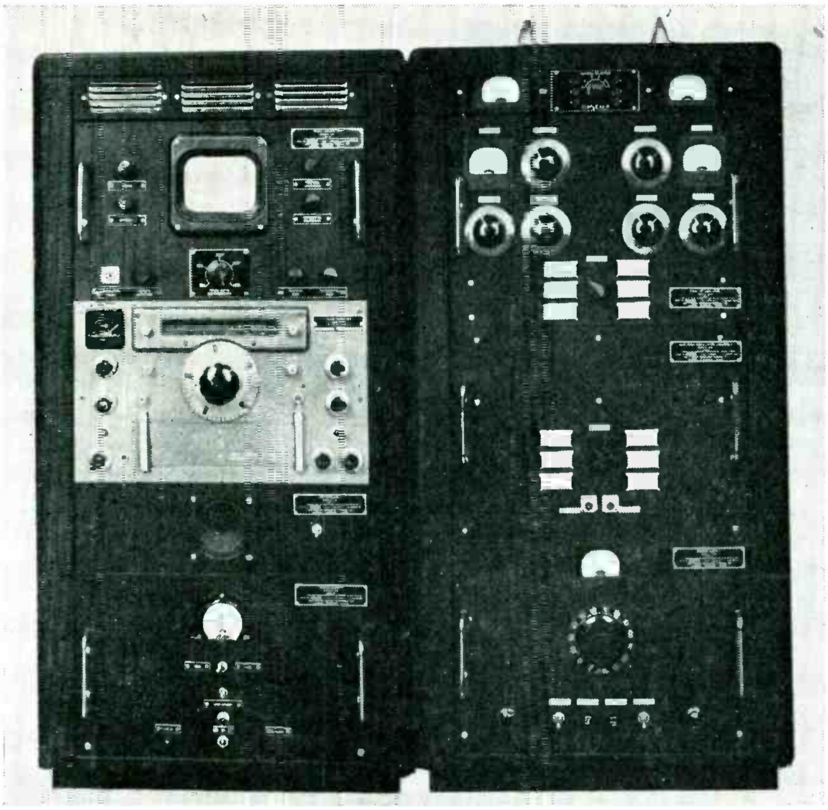
The equipment to be described is commercially available for determining the optimum operating frequency by instantaneously measuring skip distances and communication zones. Designated by the Air Force as the Propagation-Frequency-Evaluation Set, AN/GPQ-3 (XW-1), the equipment is known to those concerned with its development as COZI, Communication Zone Indicator. It has only recently been declassified.

General Description

The Propagation-Frequency-Evaluation Set is a low-power oblique-incidence ionosphere sounder designed primarily to indicate skip distances and communication zones within the range 500 to 2,000 miles. The equipment consists of a transmitter, receiver, timer, indicator and antenna duplexer. These units are contained in two small cabinet racks as shown in the photograph.

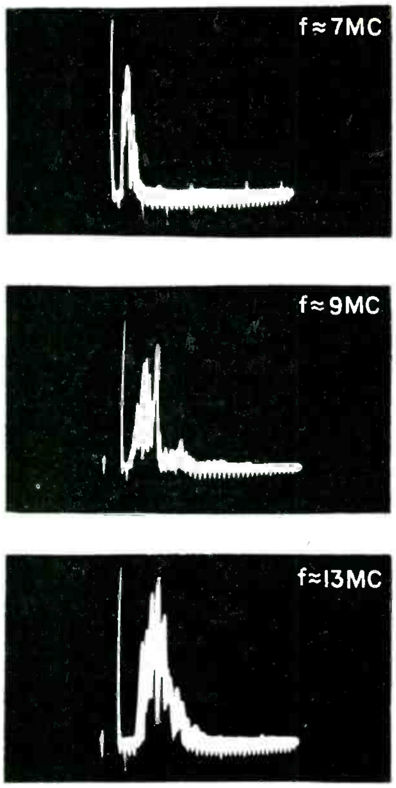
Operating principles are similar to those of ordinary radar. Transmitted pulses reflected by the ionosphere strike the earth at and beyond the skip distance and are scattered in all directions. Some of this scattered energy returns to the transmitting source, retracing its outgoing propagation path. It has been shown that the portion of the energy that arrives first may be associated with skip distance.

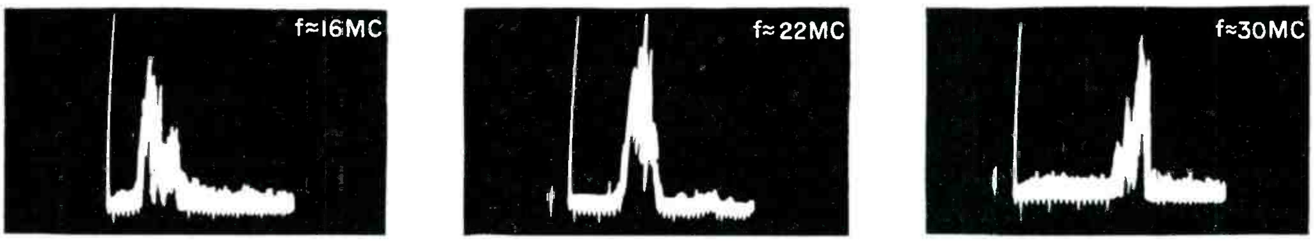
www.americanradiohistory.com



Communication Zone Indicator. Left-hand bay contains timing, indicating and receiving units. Transmitter and antenna duplexer are at right

PULSE WIDTH - 2500 MICROSECONDS





Presentations of backscatter, showing increase in skip distance as transmitter frequency is increased

An example of the calibrated A-scope presentation of the transmitted pulse and echo return, or backscatter, appears on the next page. Range markers indicate one-millisecond intervals. The transmitted pulse appears to the left at the beginning of the sweep and the leading edges of the backscatter returns from the one and two-hop skip distances appear at 15 and 28 milliseconds. The frequency of operation was approximately 16 megacycles, the peak pulse power 500 watts, the pulse length 2,400 microseconds and the antenna a horizontal rhombic beamed westward from a point on the northeast coast of the U.S. Experiment has shown that the backscattered signals received when transmitting broad pulses at low power, 1,500-2,500 microseconds, 500 watts, are stronger than the signals received when using much higher power but narrower pulse, 20-50 kw, 50-200 microseconds.

Skip distance depends upon the frequency of the transmitted wave. The higher the frequency the greater the skip distance. To picture the variation of skip distance with frequency, it is necessary only to sample the ionosphere at several frequencies in the communication band with an oblique-incidence sounding device and convert the measured delay time of the backscattered signals to skip distance. The chart shown in Fig. 1 is determined by simple geometric consideration of the propagation path. It has been used successfully to obtain skip distance from measurements of backscatter delay time. The estimation of reflecting layer height does not introduce errors of appreciable magnitude.

Transmitter

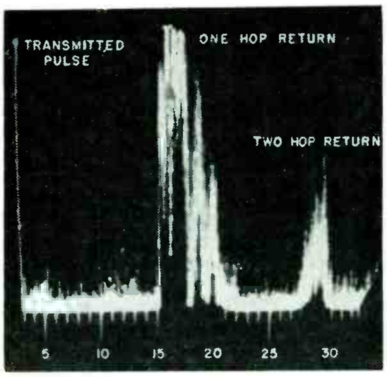
Designed to operate on any one of six pretuned frequencies in the 5 to 32-megacycle band, the COZI transmitter has a peak pulse power output of 600 to 900 watts, a pulse length variable from 500 to 2,500 microseconds and pulse-repetition rate of 20 pulses per second. After the initial setup, frequency changing in the transmitter is accom-

www.americanradiohistory.com

plished merely by changing two switch positions.

Six identical plug-in exciter subchassis are provided which, by use of the proper plug-in coils, cover the 5 to 32-megacycle band in six overlapping ranges. Each exciter subunit consists of a Pierce oscillator, pulsed frequency doubler, amplifier and second frequency doubler feeding the final amplifier. The crystal oscillator operates continuously. Pulsing is accomplished at the first frequency doubler. This avoids the problems of pulsed crystal oscillators; however, it introduces the difficulty of harmonic feedthrough into the receiver between pulses. The fourth harmonic of the crystal is the frequency to which the receiver is tuned. To prevent blocking the receiver, it is necessary to provide adequate shielding and to keep the output of the crystal oscillator as low as possible. Necessary pulse amplification is provided in the later stages.

The final amplifier consists of an Eimac 4-250A tetrode and six separate tank sections. The tank coils are turret mounted and the vacuum tuning capacitors are front-panel mounted as shown in the photograph. The output is taken by link coupling at the cold end of the output tank coil. The load impedance must be essentially resistive in the order of 300 to 800 ohms. Although this is an unbalanced output, the unbalanced currents are not a serious factor when operating into a balanced load impedance.



Range-scope presentation shows transmitted pulse and backscattered signals

Duplexer

Since it is desirable to use the same antenna for both transmitting and receiving, duplexing circuits are provided for operation into either balanced or unbalanced load impedances. The duplexer is a six-channel, lumped-constant device. Each channel covers the frequency range of the corresponding transmitter channel and is pretuned to the desired frequency by front-panel screwdriver adjustment of slug-tuned coils. A schematic of the balanced duplexer is shown in Fig. 2. During pulse transmission, the gas tube conducts and shorts the receiver input, preventing damage from the high r-f voltage on the transmission line. The small input capacitors present a high impedance compared with the impedance of the transmission line. During reception, the duplexer is essentially a T-network matching the transmission line to the receiver input.

The first COZI equipments used a standard commercial receiver, the National Company HRO 50-1, suitably modified for pulse reception and equipped with a video output stage.

Timer-Indicator

Mounted on a single chassis with the indicator, the timer provides the transmitter with a 150-volt modulating pulse continuously variable in width from 500 to 2,500 microseconds. The fixed 20-cps repetition rate is derived from the 60-cycle power-line frequency. The timer also provides a 40-millisecond sweep with on and five-millisecond markers to the indicator. The sweep and markers are also derived from the power-line frequency and are thus synchronized with the transmitted pulse.

The indicator displays video signals from the receiver as a type-A presentation on a five-inch cathode-ray tube. Horizontal gain and positioning controls permit full-screen linear expansion and investigation of any eight-millisecond portion of the 40-millisecond sweep. The vertical gain control is sufficient to permit suitable A-scope presentation of video input signals of 1 to 50 volts. Figure 3 is a block diagram of the timer-indicator.

Antenna Installation

Characteristics of the antenna installation used with the COZI equipment influence the accuracy of the data provided. Since there may be considerable azimuthal variation in skip distance, it is advantageous to use an antenna with relatively narrow horizontal directivity and high gain. Any increase in the resolving power of the antenna increases the accuracy of the data provided. There is no preference as to the polarization of the antenna. For point-to-point communications, either horizontal rhombic or vertical half-rhombic antennas are well suited to the COZI equipment. They provide the desired directivity and gain and are sufficiently broadband that a single antenna may be used over the entire frequency range. The disadvantage of the simple long-wire untuned antenna is that the direction

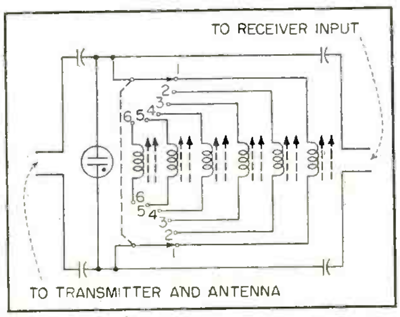


FIG. 2—Antenna duplexer circuit

Table I—Skip Distance as a Function of Frequency

Approximate Frequency (Megacycles)	Backscatter Delay Time (Milliseconds)	One-Hop Skip Distance (Kilometers)
7.0	5.0	less than 500
9.0	6.0	600
13.0	8.0	1,020
16.0	10.5	1.420
22.0	14.5	2,050
30.0	21.0	3,025

www.americanradiohistory.com

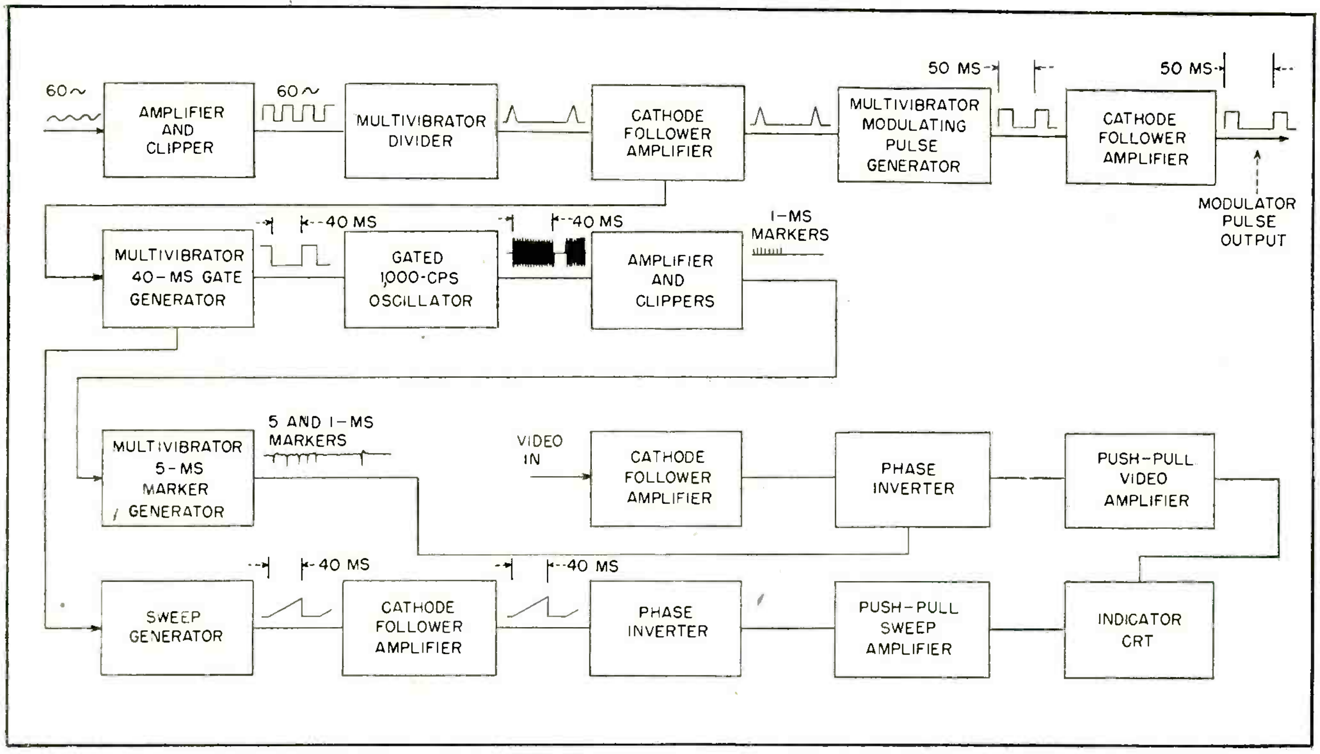


FIG. 3—Block diagram of timing and indicating circuits

of transmission is fixed. No indication of azimuthal variation of skip distance may be obtained. It has been found decidedly advantageous to obtain such information to identify properly the mode of propagation. It is sometimes difficult to differentiate between scattered echoes returning over E and F-layer paths. Since the azimuthal variations of E (especially sporadic E) and F-layer propagation paths have somewhat different characteristics, the data presentations obtained using a rotatable antenna are helpful as an aid to interpretation. Usually, obtaining azimuthal information at a single frequency in the 10 to 15-megacycle band is sufficient to clarify the situation. Yagi antennas of at least three elements possess the necessary characteristics, and arrangements for rotation are relatively simple.

Data Presentation

The COZI equipment was set up for demonstration purposes at a Raytheon ionosphere-sounding station in New England. The unit was pretuned to frequencies near 7, 9, 13, 16, 22 and 30 megacycles feeding a horizontal rhombic antenna beamed southward. Twelve pictures of the A-scope presentations were taken, two on each frequency. The entire operation was accomplished at a normal working pace in eight minutes. This represents the time taken to switch the transmitter and duplexer through the six frequencies, to retune the receiver each time and to photograph the scope face.

The pictures obtained when the pulse width was 2,500 microseconds are shown as a series of six waveform photographs. Note how the time delay to the scatter group increases with increasing frequency. With this data and the chart, Fig. 1, skip distance may be tabulated as a function of frequency. See Table I.

This method of determining skip distances on various frequencies or evaluating propagation conditions at some particular time has been used successfully in numerous tests designed specifically to check the validity of the technique. The tests were conducted over several years and under as varied conditions as were conveniently possible. The tests were performed by the ionosphere-sounding station in New England and other stations both fixed and airborne at distances up to several thousand miles. Never did an attempted contact fail when backscatter indicated that communication should be established. The results of the various tests demonstrate conclusively the value of this technique for determining skip distances and communication zones.

The author wishes to express his gratitude to D. A. Hedlund for his helpful criticisms during the preparation of this manuscript and to A. L. Anderson for editing and preparing the paper for publication.

This technique and equipment for evaluating ionospheric propagation conditions was developed under the auspices of the Air Research and Development Command's Rome Air Development Center.

BIBLIOGRAPHY

W. G. Abel and L. C. Edwards, The Source of Long-Distance Backscatter, *Proc. IRE*, **39**, No. 12, Dec. 1951.
A. H. Benner, Predicting Maximum Usable Frequency from Long-Distance Scatter, *Proc. IRE*, **37**, No. 1, Jan. 1949.
W. Dieminger, The Scattering of Radio Waves, *Proc. of the Phys. Soc.*, **64**, No. 2, Feb. 1951.
T. Kono, Experimental Study on Scattered Echoes. Rpt. of Ionosphere Research in Japan, Vol. IV, No. 3 and 4, 1950.
A. M. Peterson, The Mechanism of F-Layer Propagated Backscatter Echoes, *Journ. of Geophys. Research*, **56**, No. 2, June 1951.

www.americanradiohistory.com

TRANSISTORS: Theory and Application

Operation

Part VI

By ABRAHAM COBLENZ and HARRY L. OWENS

Signal Corps Engineering Laboratories
Fort Monmouth, New Jersey

IN THE PRECEDING ARTICLE in this series the theory of operation of the point-contact transistor was discussed. In this article the theory of operation of junction transistors will be presented, and a brief description will be given of the method of manufacture of these units.

Biases

In considering the problem of the application of bias to the point-contact transistor a mnemonic was introduced to assist in the establishment of the polarities of the applied voltage. This mnemonic can be used to establish polarities of biases for junction transistors even without full knowledge of the theory of operation.

In Fig. 1 an equivalent sketch is shown which represents a *pnp* junction transistor. The name is based on the fact that physically it is made of three alternate layers of *p*, *n* and *p*-type materials respectively as shown in the figure.

From left to right the connections are emitter (E), base (B) and collector (C). To determine the polarity of the emitter bias, the following reasoning applies:

(1) Since the emitter is a p material, the impurity atoms are acceptors. In the p material, near the p-n junction, it is convenient to consider an array of fixed negative charges shown by the encircled negative signs in Fig. 1. Together with the corresponding positive array on the other side of the junction due to the donors in the n material, the acceptors form a small potential hill indicated by the dashed battery across the emitter junction.

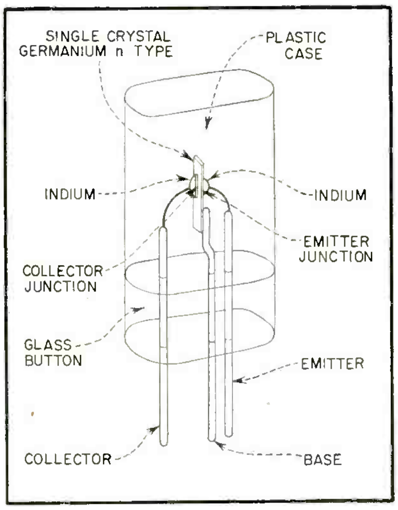
(2) The emitter is always biased in the forward or low-resistance direction.

(3) To connect the bias battery in the low-resistance direction it is necessary to overcome or flatten the potential hill mentioned in (1); and hence the polarity is as shown, positive to emitter, negative to base.

An entirely analogous process of reasoning, recalling that the collector is always biased in the high-resistance direction, yields a polarity in collector circuit as shown; positive to base, negative to collector.

Theory of Operation

The p material in the emitter region contains an excess of holes which are the majority carriers. Under the influence of the electric field as supplied by the battery E_e, holes will acquire sufficient energy to move into a conduction band, become carriers of electric current, and be transported into the n region. The n region is of the order of 1 mil in width. Holes drift toward the collector primarily by diffusion and also under the influence of the electric field due to the battery E_c with recombinations taking place all the time. Holes which emanate from the n region actually slide down a potential hill in terms of the donor and acceptor picture. The fact that the holes, which are the current carriers in the *pnp* transistor, slide down a potential hill means that many of them will get across; many holes mean many carriers, and many carriers mean low resistance.



Artist's drawing of inside of typical pnp junction transistor made by diffusion or alloy process

The high resistance in the collector circuit is not due to the resistance across the collector junction or the p material at the collector. In the *pnp* transistor, initially, the collector-circuit resistance is low due to the effect of the holes sliding downhill from the n to the p region as discussed above. This effect is shown in Fig. 2A as a low resistance in region AB of the V_c-I_c or collector characteristic. As the collector voltage is increased, more current carriers are needed to sustain this low resistance than are available from the supply of holes. There is an apparent sharp increase in the circuit resistance as the voltage keeps rising but the current remains small.

www.americanradiohistory.com

# of Junction Transistors

Physical and electrical properties of diffused-junction and grown-junction transistors are discussed in detail in this sixth article of a series on transistor electronics. Also covered are transistor tetrodes, pnpn junctions and the phototransistor

Collector circuit resistances of the order of megohms are possible, and in general the V_c-I_c curve for the junction transistor is steeper in the operating region at C than is the corresponding curve for the point-contact transistor.

This can be seen by comparing Fig. 2A and 2B. Comparison of 2A and 2B also shows that whereas the high-resistance region of the collector characteristic is approached slowly in the point-contact transistor, it is approached abruptly in the junction type.

The point-contact transistor is composed largely of n-type material and while the main streamlines of current carriers are in an approximately straight line from the collector to the base, there are secondary streamlines which follow curved paths. Therefore, there is made available a relatively large volume of material from which electrons may be supplied. Even when the current carriers necessary to sustain the low resistance are nearly exhausted, enough electrons can be drawn in from adjacent regions with the help of the positive space charge to permit a small current flow. Such an arrangement will not permit a very abrupt change in the voltage-current relationship.

In the junction transistor, however, when the holes which act as carriers are exhausted beyond the point where they maintain the low-resistance characteristic, there is no further way in to augment the carriers except to increase the emitter current. However, increasing the emitter current leads to thermal difficulties which limit the permissible emitter current. Thus the available carriers are limited in number to those which can be supplied from the narrow n region and after a critical voltage is attained, no additional carriers are available. The collector resistance rises sharply.

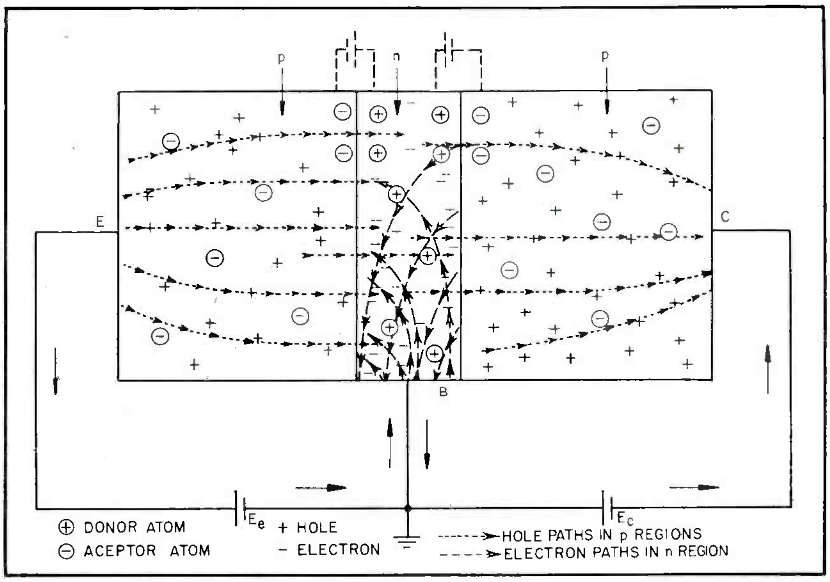


FIG. 1—Diagram of carrier paths in a *pnp* junction transistor show how conduction in p regions is principally by holes. Holes from emitter p region pass through base n region, suffer recombinations and complete circuit through collector p region. Base current is small because I_e and I_c flow in opposite directions as shown. Equivalent batteries (dashed) simulate effect of potential hills

A certain amount of recombination of holes and electrons is unavoidable when the holes transfuse into the n region. This means that not all of the carriers which represent the emitter current I_e will reach the collector where these carriers contribute to I_c. On this basis it is impossible for the current gain or alpha of a junction transistor to be unity or greater than unity. Further, the wider the n region, the longer the holes will reside in a material whose excess carriers are electrons, the greater will then be the number of recombinations, and therefore, the poorer the alpha or current gain of the transistor.

As an illustration, a barrier-region width of 15 mils or more is considered not to produce a usable transistor and the width of the region is usually kept in the neighborhood of 1 mil. In addition to the reason of current gain it is

www.americanradiohistory.com

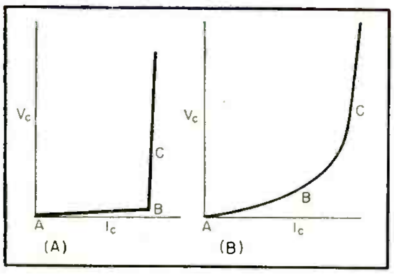


FIG. 2—In (A) is shown collector characteristic for junction transistor. Note very steep operating region at point C indicating high collector-to-base resistance. In (B), the point-contact characteristic, collector resistance of about 18,000 ohms at operating point C is indicated, compared with 1 megohm for junction type

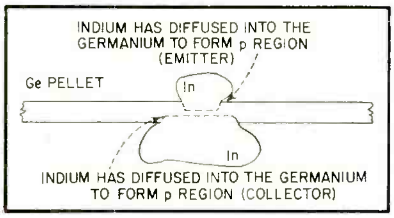


FIG. 3—Essentials of diffusion process for manufacturing *pnp* junction transistors are shown. Undiffused portion of indium (or gallium) dot is used to make appropriate connection

undesirable to make the *n* region too wide because this increases the overall transit time and would tend to make the frequency response poorer.

Germanium Preparation

Germanium used in transistors is usually obtained from germanium dioxide by heating in a hydrogen atmosphere. Further purification is achieved by a zone-melting process that causes impurities to concentrate in one end of a bar, leaving the other end quite pure. A single crystal is then formed and individual transistor slabs are cut out with diamond saws.

PNP Transistors

One method of making *pnp* transistors is the diffusion or alloy process.[1] Starting with a pellet or die of *n*-type germanium about 50 mils square and 10 mils thick, a bead of a *p*-forming element such as indium or gallium is placed on top of the germanium slab approximately in the center and the entire assembly is heated in an oven to a temperature below the melting point of germanium but above the melting point of the indium. The result is that the indium or gallium diffuses into the germanium slab approximately as shown in Fig. 3 by the top blob in solid lines. The process is then repeated on the other side as shown by the lower blob. In diffusing into the germanium during the heating process the trivalent *p*-forming impurity, gallium or indium, forms *p*-type germanium on either side of the central and unaffected *n*-type layer with the result that a *pnp* structure is obtained.

NPN Transistor

In Fig. 4 is shown pictorially the construction and method of biasing of the *npn* transistor. The unit consists of alternate layers of *n* and *p* material, the center or carrier layer being *p* type. The mnemonic for determining of the polarities of the applied biases which has been discussed for the point-contact and *pnp* transistors is directly applicable to this case also: (1) the donors have a positive charge in the *n* region and the acceptors have a negative charge in the *p* region; (2) low resistance is necessary in the emitter circuit and high resistance in the collector circuit; and (3) the applied battery overcomes the potential hill in one case and accentuates it in the other.

The theory of operation as in the case of *pnp* transistors is extremely simple. Under the influence of the applied electric field, electrons cross the barrier from the emitter *n* region to the base *p* region where some of them recombine with the holes which are the majority carriers of the *p* region. Thereafter, under the influence of the applied collector battery, electrons move towards the collector terminal to establish the collector circuit.

Analogous to the case for the *pnp* transistor, the electrons are initially sliding down hill from the base region into the collector *n* region and the collector circuit resistance is low. Figure 2 is entirely applicable for this case also. When the supply of electrons necessary to maintain this low-resistance region has been exhausted, further increases in collector potential do not yield proportionate increases in the number of carriers available resulting in a very high resistance of the order of megohms. In general, this resistance is somewhat higher in *npn* transistors than in the *pnp* type.

Due to the recombinations in the base region the collector current changes are less then the emitter current changes so that the alpha of the *npn* transator, as for any junction transistor, is always less than one. This failure of i_c, the a-c component of collector current, to equal i_e, this a-c component of emitter current represents a current loss. However, it is more than compensated for by the substantial resistance gain possible. Values can be given to illustrate this fact both for the *pnp* and *npn* types and to afford a comparison with the point-contact transistor.

Typical Values

Typical ranges for alpha are: point-contact types, 2.0 to 2.5; junction types, 0.95 to 0.99. These figures indicate how the point-contact type affords a current gain and the junction type a current loss. Typical values of emitter-to-base resistance, r_{11}, and collector-to-base resistance, r_{22}, for the point-contact type have already been given as 300 and 18,000 ohms. These values should be compared with the corresponding values of 500 ohms and 1,000,000 ohms for the junction types.

Mention has already been made that the voltage gain of the transistor is the product of the current gain by the resistance gain.[2] It follows that the voltage gain of $2.5 \times 18{,}000/300 = 150$ for the point-contact type must be compared with $0.95 \times 1{,}000{,}000/500 = 1{,}900$ for the junction types.

Thus substantial voltage gains are feasible with the junction transistor especially since *npn* junction transistors have been made which showed a collector-to-base resistance of 10 megohms. Certainly the potentialities for large voltage and power gains appear to rest more with the junction types than with the point-contact types. At the present time the point-contact types enjoy a superiority over the junction types mostly in the matter of frequency response and in their suitability for

www.americanradiohistory.com

switching applications.

So far most commercial *npn* junction transistors have been made by the grown-junction method[3] in contradistinction to the diffusion method commonly used for *pnp* units.

P-Layer Formation

The preparation of the germanium up to the pulling stage is common to the construction of the *pnp* and *npn* units. For *npn* units, in the pulling process, a *p* layer is formed perpendicular to the long or pulling axis of the single crystal. This is done by dropping into the melt a small bit of *p*-forming trivalent impurity such as gallium or indium. Refer to Fig. 5. The *p*-forming impurity rapidly diffuses throughout the melt due to thermal currents and the agitation of the bath resulting from the rotational motion superimposed on the vertical pulling motion.

As the crystal is pulled up, a *p* layer adheres to the crystal. After a carefully controlled time, an *n*-forming pentavalent impurity such as arsenic is added in a controlled amount, returning the bath to its predominantly *n*-type character.

An interesting phenomenon which occurs in this process is that in the conversion from *n* to *p* and *p* to *n* types, the melt goes through what may be described as a zero hole-electron pair stage, wherein the effect of the trivalent and pentavalent impurities cancel and at one instant the net number of carriers may be zero. Because of the constant addition of impurities, however, it should be clear that in practice more than one such *npn* sandwich may not be feasible before stopping the operation.

While this process may not appear to provide particularly close control of the width of the *p* layer, nonetheless excellent *npn* junctions can be formed. In general, the grown junction method produces *p-n* junctions which have electrical characteristics comparable to those produced by the diffusion method. By careful control as the single crystal is slowly pulled upward, a suitably thin region of the crystal is obtained as *p* type, and the proper *npn* sandwich is formed, with a barrier layer of about 1 mil wide.

The ingot resulting from this process is then cut into slabs at right angles to the long axis of the crystal, each slab being about the size of a half dollar and about a fourth as thin. Thereafter, the slabs are diced into suitable sizes for the transistor, each pellet being about 0.100 inch long, with a cross section about 30 mils on a side. Each pellet is a true germanium sandwich of *n* material on the outside and *p* material between. Considerable skill and craftmanship are needed to locate the actual *p* region and to weld a fine connecting wire to it.

Generally speaking, the junction transistors are inferior to point-contact transistors in the matter of frequency response due to the larger inherent capacitance of the junction units and to the longer transit time. Nonetheless, junction units have been made which exhibit a frequency response very favorably comparable with that of point-contact units. The record for frequency response, of the order of 300 mc, is still held, however, by the point-contact unit.

Two Methods

There have been discussed thus far two principal methods for construction of junction transistors: the diffusion method commonly used to make *pnp* transistors, and the grown-junction method usually used to make *npn* transistors. It must not be inferred that these are the only two methods presently known for the construction of these two types. The diffused junction technique can be used to create *npn* units, and the grown-junction technique is quite feasible for the construction of *pnp* units. At present, the most common techniques are the ones first described—diffusion for *pnp*, and grown-junction for the *npn*. The metallurgy of the techniques for both processes, as applied to both transistor junction types, must still be considered to be in a state of development, and there is room for important improvements in this field.

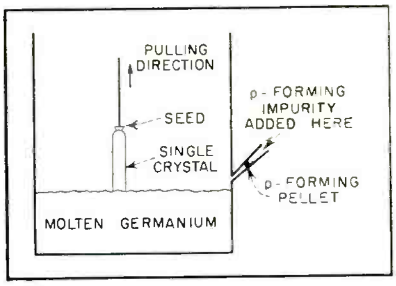


FIG. 5—Sketch indicates technique for preparing grown-junction transistors. The p-forming pellet melts and spreads through molten germanium

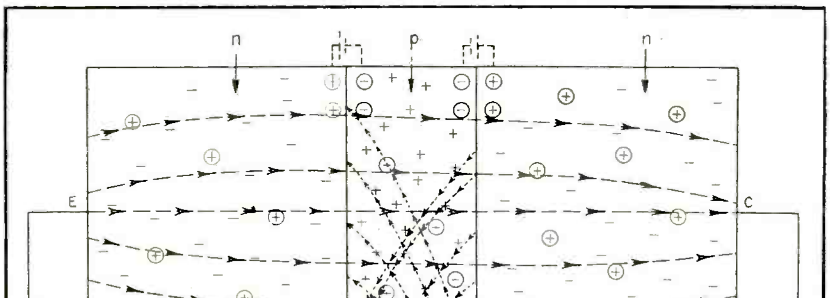


FIG. 4—Diagram of carrier paths for an npn junction transistor. Conduction in n regions is by electrons; in p region by holes. Again dashed batteries simulate potential hills

Rate-Grown Junctions

A new technique, announced quite recently, for the manufacture of junction transistors, is the so-called rate-grown junction.[4] It is based on the following three signifi-

www.americanradiohistory.com

cant aspects of the metallurgy:

(1) Most impurities in germanium, except boron and silicon, prefer the liquid phase rather than the solid state. Stated differently, at the border between a solid and molten region, the atoms of most of the impurities tend toward the molten region, or are more soluble in the melt than in the solid.

(2) The extent to which the impurities are soluble in the solid, or the solubility, varies with the rate at which the germanium crystal grows during the crystal pulling or creation process. Solid-phase solubility of impurities in monocrystalline germanium increases with the rate of growth of the germanium crystal. This is particularly true for antimony although it is not true for trivalent impurities such as gallium and indium.

(3) For gallium or indium, which are trivalent, *p*-forming impurities, the solubility in the solid phase is very nearly independent of the rate of growth of the crystal.

These unusual characteristics of the crystal growth process are utilized to make alternate *p* and *n* regions in the rate-grown-junction method. When the crystal growth rate is small, the solubility of the *n*-forming impurities, such as antimony, in the germanium is small, but the solubility of the *p*-forming impurities, gallium and indium, is constant and relatively large. Hence, more *p*-forming impurities enter the solid phase and a *p* region results.

When the crystal growth rate is large, the solubility of the pentavalent, *n*-forming impurity antimony in the solid phase, is large compared to the constant solubility of the Ga or In, and the majority carriers will be *n* type. By cycling the crystal growth rate, alternate regions of *n* and *p*-type germanium can be formed. Excellent *npn* and *pnp* units have been made in this way; however, the method is at a very early stage and considerable improvement in technique must be effected before the process becomes an established art in the manufacture of junction transistors.

Transistor Tetrode

There has recently been announced[5] a four-terminal transistor which represents a modification of the *npn* junction unit. While complete information on this new addition to the transistor family is still not available, the essentials of the modification can be described.

A second ohmic contact is made to the base region on the face of the far opposite that used for the normal base contact, as shown in Fig. 6. A bias is applied to the second base terminal, (b_2), making it negative with respect to the base terminal b_1. This bias is large compared to the emitter-to-b_1 bias. The theory of operation of the *npn* transistor states that electrons from the emitter *n* region cross over into the center *p* region due to the flattening of the potential hill between the emitter *n* and the base *p* regions.

For example, assume that the applied forward bias potential is approximately 0.1 volt, battery E_e. As the figure shows, a bias of approximately 6 volts is applied to the upper base terminal b_1, and along the edge of the *p* region, near the emitter side, a potential gradient from -6 v to 0 exists, from top to bottom. The *p* region may be considered a continuous resistor, and along this resistor will exist an (assumed) uniform drop.

Electrons from the base will arrive at the emitter-base barrier at a pressure or potential of -0.1 volt, approximately. The significant point then, is that only those electrons which arrive at the emitter-base junction far enough down so that their -0.1 potential is negative with respect to the potential level of the gradient as determined by resistor *R*, will get across. For such electrons, the effective potential hill is flattened. Electrons near the top of the bar, arriving at the barrier with a potential of -0.1 v, encounter a gradient level of almost -6 volts, and for them the potential hill is in essence raised. Few, if any, will get across.

The net effect then is to render impassable the portion of the barrier shaded in the figure, and to restrict the lines of current flow through the *p* layer to the region near b_1 as shown. The same effect is obtained by imagining that the negative electric field effectively forces the current stream lines of electrons down toward the lower region as indicated.

The circuit effects obtained by this technique include improved voltage gain at higher frequencies, and a lower collector capacitance. In practice, the *p* region for these units is also made somewhat narrower than is the practice for *npn* units, and this further improves the frequency response by reducing the transit time.

A parameter to be introduced in a subsequent article, the base resistance, r_b, is much decreased by the tetrode principle. A decrease in base resistance produces the improved voltage gain frequency response and reduced positive feedback.

The base resistance, for the junction units, may be thought of

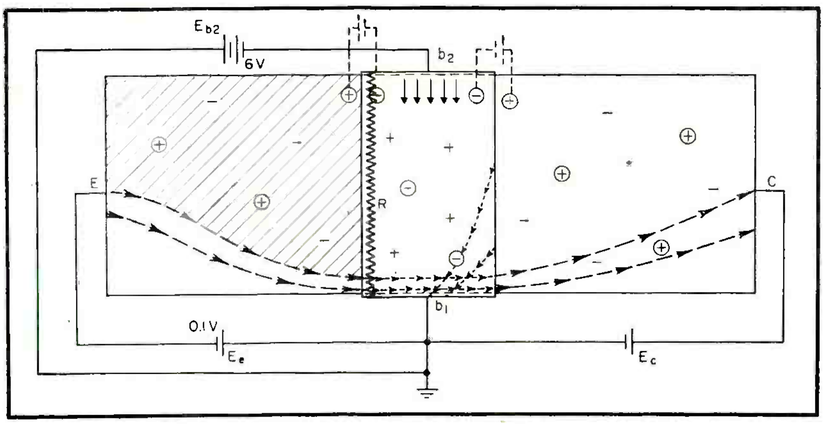


FIG. 6—Transistor tetrode operation depends on added field supplied by battery connected to side of base opposite usual base connection. Added field bunches electrons in emitter region. Equivalent batteries simulate potential hills, and resistance *R* represents uniform voltage divider within base region from top to bottom of germanium bar

www.americanradiohistory.com

as the equivalent resistance introduced into the external circuit by virtue of the motion of carriers thru the base region on their way to and from the emitter and collector barriers. The transistor tetrode is not yet available commercially.

P-N Hook Transistor

Another special type of transistor[6] which holds forth great promise for important current gains and efficient amplification, is the *pnpn* type of junction transistor. A conventional *pnp* transistor, with the collector region replaced by a *p-n* junction, may be operated in such a way that a hook-shaped potential hill is created at the final junction; hence the name *p-n* hook.

The essentials of the mechanical construction are illustrated in Fig. 7, but it is to be noted that the central *n* and *p* regions are quite narrow. The device will not operate satisfactorily if the central *p* region is too wide.

The theory of operation is based on the fact that holes which are the carriers in the left-hand *pnp* region, on arriving at potential hill No. 3, encounter the positive field of the right-hand *n*-region donors, and are trapped, that is, their further travel is impeded. The accumulation of holes at the barrier creates a positive space charge which tends to annihilate the effect of potential hill No. 3. Electrons from the collector, passing through the right-hand *n* region would ordinarily find a high-resistance path due to the array of acceptors in the central *p* region at the right-hand barrier.

The effect of the holes accumulating at potential hill No. 3 is to decrease this negative field at the barrier, and electrons from the collector are enabled to cross this barrier into the central *p* region.

Since these electrons must travel through the *p* region mainly by diffusion, it must be made very thin or narrow to prevent excessive recombinations. Note that in the overall system one recombination process is already going on as the holes from the left-hand *p* region moves through the central *n* region, and this recombination introduces its own loss. Electrons which survive the trip through the central *p* region easily slide down potential hill No. 2, enter the central region which is the *n* base, and complete the circuit.

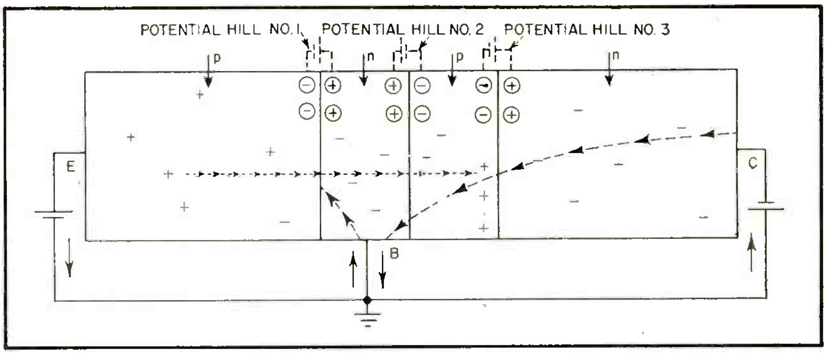


FIG. 7—Simplified diagram shows operation of *pnpn* hook transistor. Current gains of more than 20 have been exhibited by this type

Thus the holes allowed to take part in the left-hand *pnp* arrangement and as modulated by an a-c input signal, control a much enhanced electron current due to the positive space charge, and very appreciable current gains are possible.

Although junction transistors have a current gain or alpha less than unity, the current gain of junction transistors employing the hook principle may be greater than unity. Current gains of 20 and greater have been reported.

Phototransistor

An important member of the transistor family is the phototransistor.[7] While the physical construction is that of a *p-n* diode, the device is considered to belong to the transistor category because light performs a function analogous to the emitter.

The theory of operation is based on the ability of light to impart enough energy to electrons in valence bonds to raise them to the conduction band. The disruption of the valence bonds increases the available electron and hole supply, and these act as current carriers to decrease the resistivity. Thus, when light shines on the junction, a marked decrease in the resistance is observed, or, for constant impressed voltage, a marked increase in current.

Phototransistors at present are commercially available in limited quantities. They are extremely practical in that large voltage swings are attainable and they are small in size and weight.

A phototransistor need not be a junction unit—practical phototransistors may be made using point-contact principles as well.

Summary

The salient points of this article are:

(1) Holes are the current carriers in the *pnp* transistor, and electrons in the *npn* transistor.

(2) Junction transistors are capable of very high orders of voltage and power gain compared to the point-contact units.

(3) The transistor industry is at present in need of improved metallurgical processes for the construction of *p-n* junctions and the processing of germanium (and silicon) in general.

(4) Special transistors such as the *pnpn* and phototransistors are examples of the steadily-growing list of semiconductor devices with properties unusually attractive for commercial applications.

REFERENCES

(1) R. N. Hall and W. C. Dunlap, *PN* Junctions by Impurity Diffusion, *Phys. Rev.*, **80**, p 467, 1950.

(2) Abraham Coblenz and Harry L. Owens, Point-Contact Transistor Principles, Part V, TRANSISTORS: Theory and Operation, p 158, ELECTRONICS, July 1953.

(3) G. K. Teal, M. Sparks, and E. Buehler, Growth of Germanium Single Crystals Containing PN Junctions, *Phys. Rev.*, **81**, p 637, Feb. 1951.

(4) R. N. Hall, *PN* Junctions produced by Rate-Growth Variation, *Phys. Rev.*, **82**, p 138, Oct. 1952.

(5) R. L. Wallace, Jr., L. G. Schimpf and E. Dickten, A Junction Transistor Tetrode for High-Frequency Use, *Proc. IRE*, p 1,395, Nov. 1952.

(6) W. Shockley, "Electrons and Hole in Semiconductors," D. Van Nostrand Co., p 112, 1950.

(7) J. N. Shive, Properties of M-1740 Photocell, *Proc. IRE*, p 1,410, Nov. 1952.

www.americanradiohistory.com

How To Measure Low-Level R-F Signals

Cross-correlation system is useful in detecting and measuring low-level r-f radiation despite high ambient noise level. Technique can be applied to measure attenuation of r-f filters and check effectiveness of shielding or other radiation suppression measures

By **KENNETH E. MORTENSON**
Electrical Engineering Department
Rensselaer Polytechnic Institute
Troy, New York

RADIO-FREQUENCY measurement is often complicated by poor signal-to-noise ratio of the signal to be measured. This can occur when a signal generator and receiver are used to measure the attenuation of r-f filters. The output of the filter may be too small compared to receiver noise to detect let alone measure. Another example might be measurement of radiation from shielded oscillators, amplifiers, cables and other equipment where atmospheric noise or interfering signals prevent detection of the radiation. Measurement of a signal with poor signal-to-noise ratio can be accomplished using a simple correlation technique.

Cross-Correlation

The signal to be measured can have a poor signal-to-noise ratio, but a second signal having a good signal-to-noise ratio must be available. These signals must originate from the same source (Fig. 1). The original source would be a signal generator for filter measurements or the driving source for radiation measurements. The transfer medium would be either the filter to be measured or the radiating system and appropriate pickup. Both the direct and indirect signals go into the measuring device or cross correlator.

Correlation System

Consider the system shown in Fig. 2. Two coherent sine-wave signals enter separate channels of amplification. Both channels are superheterodyne receivers served by a common local oscillator. Sufficient amplification is provided such that the signals cause appreciable deflection of an oscilloscope beam. A straight diagonal line will be observed on the scope provided the two signals are adjusted to the same amplitude and put in phase by the delay circuits. If noise is present on the indirect signal, it will appear as random light traces expanding in the horizontal direction an amount depending upon its amplitude. Such a response is illustrated in Fig. 2. By proper adjustment of the scope-beam intensity control, it is generally possible to eliminate entirely the noise traces leaving only the straight line of correlated response.

The indirect signal can be replaced by a calibrated sine-wave and a direct comparison made on the screen to determine the input magnitude of the indirect signal. The calibrating signal must either be derived from the original sine-wave source or synchronized with it.

If receiver noise is not the limitation, another measurement technique is to remove both the direct and indirect signals after having noted the peak horizontal deflection caused by the indirect signal, exclusive of noise. Then cause an equal deflection by a sine-wave, properly tuned and calibrated, injected into the input circuit of the indirect channel. This method does not require a calibrating signal originating at the same source as the original signal.

Filter Attenuation

In a setup for measuring filter attenuation, the signal generator has a calibrated output of 100,000 μv maximum and an uncalibrated one-volt output. The receiver has

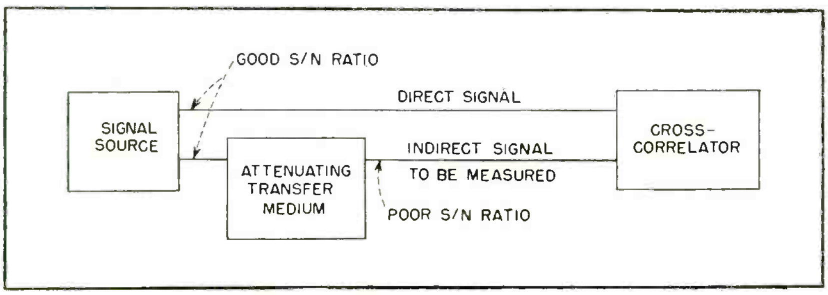


FIG. 1—Basic components of a cross-correlation system

www.americanradiohistory.com

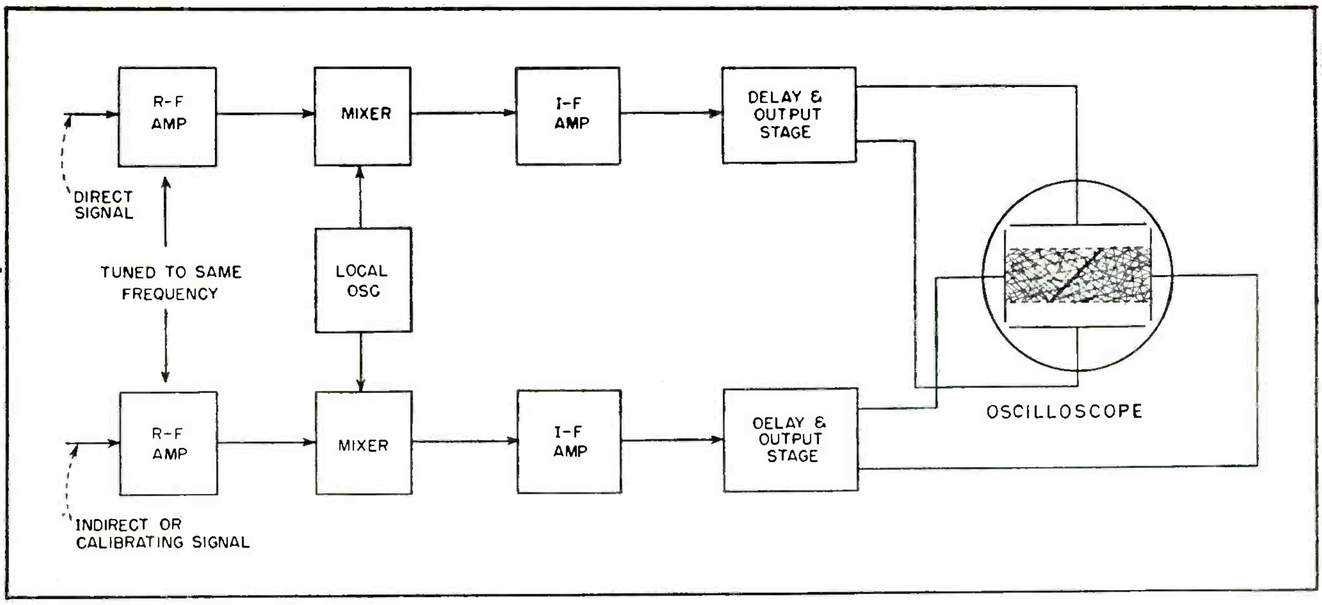


FIG. 2—Twin-channel superhet and crt oscilloscope provide one-to-one Lissajous pattern to detect and measure signals with poor signal-to-noise ratio

an equivalent input noise level of 1 µv at maximum gain and the filter has a nominal attenuation of 120 db. Even using the maximum calibrated output of the signal generator, an output signal-to-noise ratio of one tenth would exist. Under these conditions no comparison could normally be made.

Measurement

Using cross-correlation measurement can be made, however. With both receiver channels tuned to the signal-generator frequency, the output from the filter is fed into one channel while the uncalibrated output of the signal generator is fed into the other. An ellipse superimposed on light, random noise traces will appear on the scope. By adjusting the gain and the delay circuits of each channel, a straight diagonal line will be obtained. In general it will be possible to eliminate large amplitude noise traces by adjustment of the intensity control. Measurement is made by substituting the calibrated output of the signal generator for the output of the filter. By adjusting the output of the signal generator and readjusting the delay circuits, the same screen response will be obtained. The ratio of the two signal-generator readings, input to correlator divided by input to filter, will yield the measured attenuation.

The primary limitation imposed by signal-to-noise ratio depends upon the dynamic range of the amplifiers and the deflection system of the cathode-ray tube. A signal-to-noise ratio of 1-to-20 for the indirect signal has been observed directly on the screen, and if the noise traces are allowed to go beyond the limits of the screen, much smaller signal-to-noise ratios can be handled.

Overdriving the amplifier with noise can block it, resulting in no output. However, it should be possible to use limiting action in the indirect signal channel to prevent such overloading.

Other Aspects

The direct signal will usually be considerably greater than the indirect signal at the input terminals of the amplifiers. Thus the direct-signal channel can be operated at such a level that amplifier noise will be negligible compared to the signal. If the direct-signal amplifier should be overdriven even with minimum gain, a frequency-insensitive attenuator should be used before the input stage of the channel. Should the direct-signal input be at such a low level that amplifier noise is appreciable, the detecting system will still function properly. However, instead of having light noise traces expanding in the horizontal direction only, an entire rectangle will be filled. But in the center will still remain the straight-line response. Thus, noise can be present in both the direct and indirect channels if there is no correlation between the noise.

Receiver Channels

Maximum receiver-output frequency should not exceed 30 mc. If the input frequency to the amplifiers is very high, it may be necessary to use two intermediate frequencies to obtain a suitable output frequency for deflection of the crt beam. Two such frequency translations may also be required if the input level is particularly low and sufficient gain can not be provided at one intermediate frequency without introducing amplifier-stability problems. For every frequency translation introduced, a common local oscillator must be employed. The amplification required will depend upon the signal input levels and the voltages needed for full deflection. However, it is usually desirable to incorporate enough frequency selective stages to minimize the background noise.

The author wishes to thank T. Martin for his assistance in carrying out the experimental work and H. Harris and V. Babits for their critical review of the paper. Coles Laboratory of the Signal Corps sponsored the research contract under which this technique was developed.

www.americanradiohistory.com

Optical Feedback for

Poor stability of the phototube is corrected by feeding back out-of-phase current through amplifier. Resultant reduction of light from compensating glow lamp in collimator cancels original measured increase in light, effecting negative feedback. Improvement in stability does not sacrifice sensitivity

By VICTOR H. SELIGER
Forest Hills, N. Y.

For low-level photometry,[1-5] multiplier phototubes offer many advantages to the electronics designer. They have high photometric sensitivity (as much as 300 amperes per lumen) are small in size (about 5 cu in.), draw little power (about 1.5 w. maximum), and have long service life.

Unfortunately, the phototubes currently available exhibit serious defects[3,4,5]. These faults seem to be characteristic of electron multiplier devices, and therefore not likely to be eliminated in the near future by improved manufacturing techniques or design elaboration. The defects may be divided into two categories:

(1) Large random variations in sensitivity, including severe short-time fatigue.

(2) A great dependence of the sensitivity on the dynode voltage. The sensitivity of the type 931-A photomultiplier varies roughly as the 6.5th power of the dynode voltage. An economical and straightforward method for rendering negligible both of these defects by applying a novel form of negative feedback is described below.

Optical Feedback

In the proposed method, the feedback signal is introduced optically. The effect of this technique is to substitute the relatively high photoelectric stability of a conventional glow lamp for the poor stability of the multiplier phototube. Feedback has been used before to stabilize the phototube against dynode voltage changes by applying the correcting signal effectively in series with the dynode supply.[2] This technique involves the use of well-regulated and carefully adjusted power supplies, and results in a logarithmic output characteristic, which is sometimes useful but often undesirable. The arrangement to be described compensates effectively for wide variations in both dynode voltage and tube sensitivity, while maintaining a linear output characteristic and high overall sensitivity.

System Description

Figure 1 shows a photometer in which a multiplier phototube, current amplifier, feedback light source and light collimator have been arranged in a closed loop configuration. The phototube and current amplifier constitute the forward portion of the loop, the latter serving to amplify further the current output signals of the tube. The feedback light source comprises the feedback portion of the loop and the light collimator serves as the comparator, or error-detecting element. The operation of the closed-loop photometer is most readily described by listing a sequence of events following a change in measured light intensity. This sequence is as follows:

(1) An increase in input light intensity produces an increase in photomultiplier tube output.

(2) This positive current change is applied to the input of the current amplifier, which has an odd number of phase-inverting stages. The resultant output current change is much larger than the input signal, and is inverted in phase. The effect is therefore that of a decrease in instantaneous amplifier output current.

(3) The decrease in current is applied to the feedback light source, causing a reduction in instantaneous feedback light output.

(4) The reduction in feedback light output appearing at the light collimator tends to cancel the original increase in measured light intensity, thereby effecting negative feedback.

More quantitatively, the system

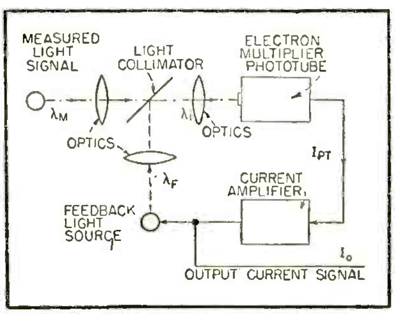


FIG. 1—Block presentation of the feedback photometer

www.americanradiohistory.com

Multiplier Phototubes

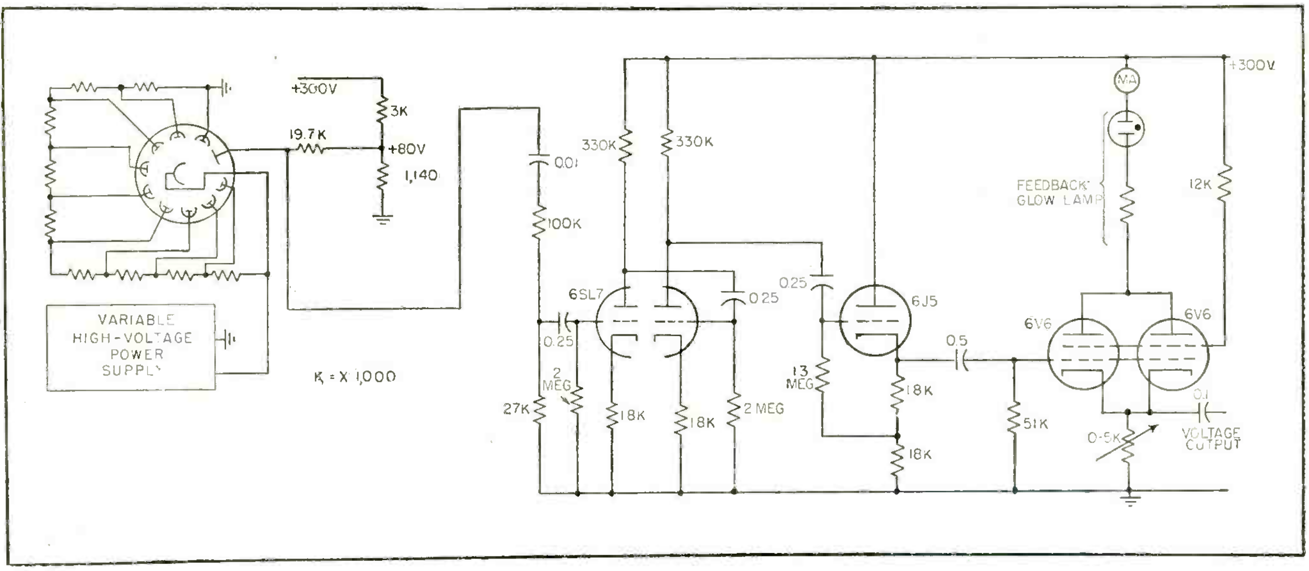


FIG. 2—Multiplier phototube, left, and current amplifier used to invert phase and control glow lamp

may be described as follows:
Let

λ_M = measured light intensity in lumens
λ_F = feedback light intensity in lumens
λ_i = collimator output light intensity in lumens
I_{PT} = phototube output current in amperes
I_O = amplifier output current in amperes

Then the four essential elements of the closed-loop photometer can be characterized by the following constants:

Light collimator:

$$\lambda_i = k_1 \lambda_M + k_2 \lambda_f \quad (1)$$

where
k_1 and k_2 represent the attenuations of the optical system, including the collimator

Photo-tube: Sensitivity $S = \frac{\Delta I_{PT}}{\Delta \lambda_i}$ in amperes per lumen (2)

Current Amplifier:

Current gain $-|K| = \frac{\Delta I_O}{\Delta I_{PT}}$ (3)

Light Source:

Transformation ratio $R = \frac{\Delta \lambda_F}{\Delta I_O}$ in lumens per ampere (4)

Thus, for changes of input intensity within the linear operating region of the photometer

$$\Delta I_O = -|K| \Delta I_{PT} = -|K| S \Delta \lambda_i \quad (5)$$

and
$$\Delta \lambda_i = k_1 \Delta \lambda_M + k_2 \Delta \lambda_F = k_1 \Delta \lambda_M + k_2 R \Delta I_O \quad (6)$$

From Eq. 5 and 6

$$\Delta I_O = \frac{-|K| S k_1 \Delta \lambda_M}{1 + |K| S k_2 R}.$$

The exact analogy between this system and conventional feedback circuits is more readily seen if we let

$$\mu = |K| S k_1$$

$$\text{and } \beta = \left(\frac{k_2}{k_1}\right) R$$

Then, if S' is overall sensitivity of the feedback photometer, in amperes per lumen,

$$S' = \frac{\Delta I_O}{\Delta \lambda_M} = \frac{-\mu}{1 + \mu\beta}$$

Here, μ represents the effective forward gain of the system, in amperes per lumen, while β represents the transfer function of the feedback loop, in lumens per ampere.

It is apparent that if $\mu\beta >> 1$, we can write

$$|S'| \approx \frac{1}{\beta} = \frac{k_1}{k_2 R}$$

an expression independent of variation in $|K|$ and S. Thus, for sufficiently high values of the parameters $|K|$, S, k_1, and k_2, the sensitivity of the feedback photometer can be made arbitrarily high and arbitrarily independent of phototube and amplifier variations. The only theoretical system restrictions are an upper limit on sensitivity provided by inherent system noise; and limiting stability equal to that of the feedback light source.

To eliminate the zero-balance problem common to d-c amplifiers, it is best to confine the photometer to measurement of changing values of light. This is easily carried out by various conventional means, depending on the application. Two such means are the use of stroboscopic illumination in applications in which the quantity measured is a reflected light, and the use of a mechanical light chopper whenever the output of a luminous source is to be measured.

Experimental Results

The theoretical results derived above were verified in practice by a photometer[6] constructed along the lines indicated in Fig. 1. A type 931-A multiplier phototube was used as being representative of phototubes employed in the field. The circuit configuration was the conventional one shown in Fig. 2. A type AR-1 argon glow lamp was selected for the feedback light

www.americanradiohistory.com

source because its light output is reasonably linear with current input, and its output range and spectrum are compatible with the 931-A characteristics.

Light Collimator

A semitransparent mirror of approximately equal transmission and reflection characteristics was employed as the light collimator. The remainder of the optical system comprised three condensing lenses, a frosted glass filter for diffusion, and a Wratten 2B ultraviolet blocking filter arranged as in Fig. 3. The current amplifier schematic is shown at the right in Fig. 2.

In addition to the optical system of the photometer itself, a measured light source as shown in Fig. 1 was provided. This light source, another type AR-1 glow lamp, was supplied with current pulses of variable amplitude from a square-wave generator. Its controlled output, consisting of approximately rectangular pulses of light, was measured by the photometer during test runs.

To demonstrate the theoretical results most simply, photometer sensitivity measurements were made on a comparative basis; output responses were compared in terms of given input current pulse amplitude to the measured light source glow lamp, rather than in terms of light pulse amplitude directly. The consistency of results obtained was more than ample to justify this method of measurement.

The results of principal interest are shown graphically in Fig. 4, which illustrates the great reduction in dependence of photometer sensitivity on dynode voltage when the feedback loop is closed. In particular, note that for dynode voltages above 900 volts, the relative change of sensitivity for a change in dynode voltage is negligibly small. This condition is to be contrasted with an average open-loop relative change of some 700 percent!

Stability Increase

The theoretical increase of stability with feedback is given by the factor

$$\frac{1}{1 + \mu\beta}$$

The curve of Fig. 4 is in excellent agreement with this theoretical increase in stability. Furthermore, it should be noted that, for example, at a dynode supply voltage of 900 volts, the closed-loop sensitivity was roughly 200 times the open-loop sensitivity (owing to the presence of the high-gain current amplifier). This factor was much higher at lower dynode voltages, where the open-loop sensitivity was much less, while the closed-loop sensitivity was only slightly decreased.

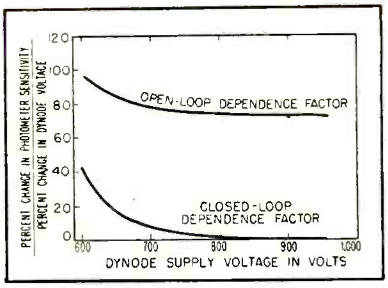


FIG. 4—Effect of feedback upon stability

The experimental results strikingly illustrate the improvements in stability and sensitivity which can be realized by the use of optical signal feedback in multiplier phototube circuits. In general practice, significant improvement can be obtained economically. A small amplifier and a feedback light source and optics suffice to replace the poor stability of the phototube as normally used by the relatively good stability inherent in an inexpensive glow lamp, sensitivity being in no wise sacrificed. This method seems promising for many low-level photometry applications.

The results described in this article were obtained during work on a thesis at the Polytechnic Institute of Brooklyn.

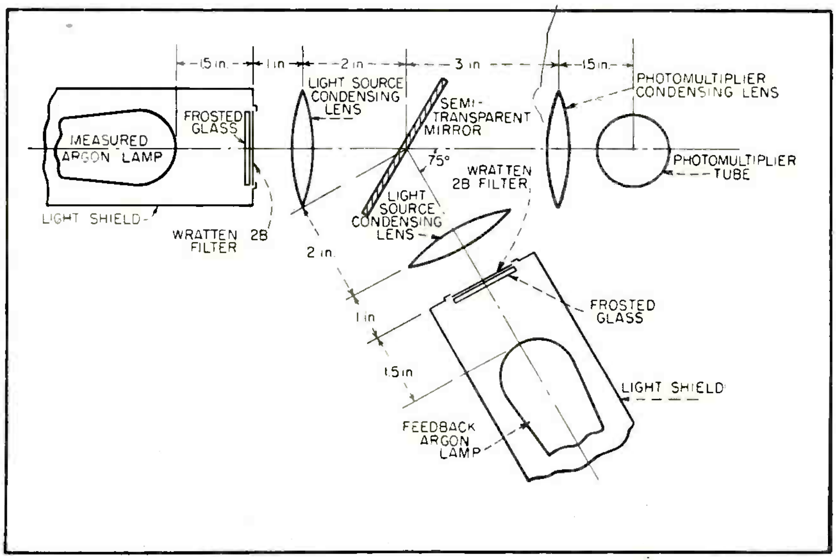


FIG. 3—Dimensions of the optical and light system employed in the photometer. Calibrated light source is introduced at left

Acknowledgement

Thanks are due H. S. Rogers, president of the Institute, for permission to publish this material, and gratitude is expressed to Theodore C. Gams, chief engineer of Douglas Laboratories, whose suggestions and encouragement were of invaluable assistance in the development of the method herein described.

BIBLIOGRAPHY

(1) Sweet, Direct Reading Color Densitometer, ELECTRONICS, p 102, Mar. 1945.
(2) Sweet, Logarithmic Photometer, ELECTRONICS, p 105, Nov. 1946.
(3) Sommer, The Multiplier Photo-Cell, Its Advantages and Limitations, *Electronic Engineering*, p 164, Sept. 1944.
(4) Nicol, Multiplier Photocells, *Metal Treatment*, p. 217, Winter, 1948-1949.
(5) Engstrom, Multiplier Phototube Characteristics: Application to Low Light Levels, *Jour. Opt. Soc. of Amer.* p 420, June 1947.
(6) Seliger, A Stabilized Electron Multiplier Photometer, unpublished thesis submitted in partial fulfillment of requirements for degree of M.E.E., Polytechnic Institute of Brooklyn, June 1951.

www.americanradiohistory.com

Designing Discone Antennas

Cross-sectional area of the antenna can be minimized for a given bandwidth and matching to a 50-ohm transmission line can be optimized for a given cone angle without introducing complexities of construction or feed, using experimental data recently obtained

By J. J. NAIL

Federal Telecommunication Labs., Inc.
An I. T. & T. Associate
Nutley, N. J.

THE DISCONE ANTENNA[1,2,3,4] is intended primarily for vertical polarization and, like a vertical dipole, gives an omnidirectional pattern in the horizontal plane. The discone's most distinctive feature is its simplicity of construction and feeding. Its most important characteristic is satisfactory operation over a wide band of frequencies.

Kandoian[1] has given dimensions for two discone radiators that performed satisfactorily but were not necessarily optimum. Since this information was published, additional work has been done that allows the cross-sectional area of the antenna to be minimized for a given bandwidth and permits the match to a 50-ohm transmission line to be optimized for a given cone angle. This information permits the most efficient design for a particular application without introducing dimensions that must be held to close tolerances or complicating in any way the original simplicity of construction and feeding.

The geometry of the discone is such that an analytical expression for the field components that will satisfy Maxwell's equations is involved and, so far as is known, has not been obtained in a useful form.

The investigation to be described was experimental in nature. It is the purpose of this paper to summarize the work in such a manner as to enable the designer to choose the smallest flare angle compatible with bandwidth requirements, choose the proper disk size and disk-to-cone spacing for optimum match to a 50-ohm line and predict the free-space radiation-pattern characteristics.

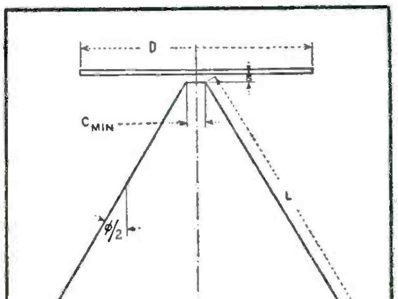


FIG. 1—Discone antenna parameters

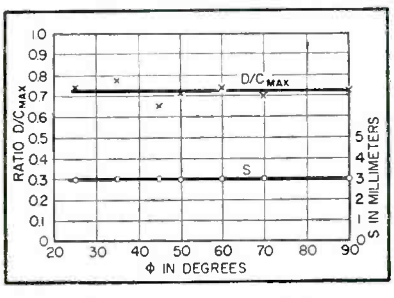


FIG. 2—Optimum values of disk-to-cone spacing and disk diameter versus flare angle

Impedance

A sketch of the discone radiator is shown in Fig. 1. The following nomenclature will be used

ϕ = cone flare angle (total)
L = cone slant height
C_{MAX} = maximum cone diameter
C_{MIN} = minimum cone diameter
D = disk diameter
S = disk-to-cone spacing

For a fixed value of L, C_{MIN}, ϕ and frequency, the vswr on a 50-ohm line was measured for various combinations of disk-to-cone spacing S and disk diameter D. A series of such measurements allows a value of S and D to be chosen that gives the best match over the largest range of frequencies. This process was repeated for several values of ϕ and the results obtained are plotted in Fig. 2.

Each point represents an optimum value of disk diameter and disk-to-cone spacing for a given value of ϕ in that these values

This work was supported in part by contract with the Bureau of Ships, Navy Dept.

www.americanradiohistory.com

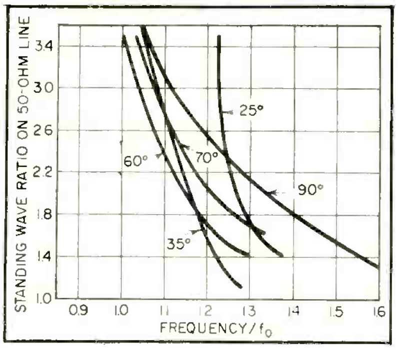


FIG. 3—Standing-wave ratio versus ratio of lowest operating frequency to f_o when f_o is frequency at which slant height is a fourth wavelength

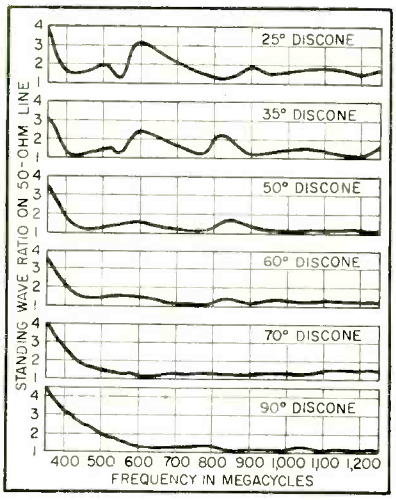


FIG. 4—Standing-wave ratio versus frequency for several discone angles

produce the best match to a 50-ohm line over the largest frequency band. These measurements were repeated keeping ϕ fixed and varying L and C_{MIN} independently. From these data it was determined that the optimum values of D and S are independent of L and C_{MIN}. If the data shown in Fig. 2 are averaged as shown, the optimum values of S and D/C_{MAX} may be considered to be independent of ϕ, allowing the following simple design formulas to be written

$$S = 0.3\ C_{MIN}$$
$$D = 0.7\ C_{MAX}$$

These relations are independent of L and ϕ; bandwidth is inversely proportional to C_{MIN}.

Flare Angle

The slant height is a function of frequency. For all values of flare angle considered, 25 through 90 deg, the slant height is always slightly greater than a quarter-wave length of the lowest frequency at which the antenna is to be operated. The ratio of the lowest operating frequency to the frequency at which the discone slant height equals one-quarter-wavelength is plotted as a function of vswr for various flare angles in Fig. 3. This ratio is called K. Then the minimum slant height is found by multiplying a quarter-wavelength at the lowest operating frequency by K.

Utilizing this design information, six discone antennas, each antenna employing a different flare-angle cone, were designed for optimum bandwidth. The vswr produced by each radiator on a 50-ohm line is plotted as a function of frequency in Fig. 4.

The mismatch as plotted is caused by the antenna alone, the discontinuities produced by fittings having been averaged out using the cycling, or beat, method. The values of L are 9.8, 8.9, 8.5, 8.2, 8.1, and 7.9 inches for the 25, 35, 50, 60, 70 and 90-degree cones respectively. The value of C_{MIN} (0.4 in.) was the same for all the cones.

The large-angle discone exhibits some of the characteristics of a high-pass filter in that once the slant height of the cone exceeds approximately $\lambda/4$, the match to a 50-ohm line remains good over an extremely wide frequency range, higher-order-resonance effects being negligible. For smaller-angle cones the mismatch may exceed the allowable limit when the slant height approaches $\lambda/2$. From Fig. 4, the behavior in this critical region may be determined allowing the minimum flare angle for a given bandwidth.

To demonstrate the high-pass characteristics of a large-flare-angle discone, the data plotted in Fig. 5 and 6 were taken. The measured characteristics shown here include discontinuities produced by fittings.

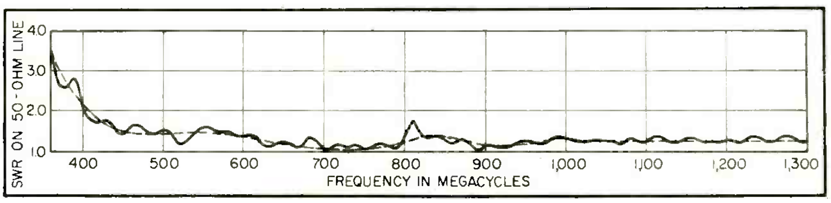


FIG. 5—Optimum parameters, standing-wave ratio versus frequency, for 60-deg discone

Another method of reducing size is to use a section of large-flare-angle cone near the feed point joined with a cone of reduced angle. Although this possibility has not been fully explored, it was found that the mismatch at 1.8 f_o for the 35-deg discone could be reduced to 2 to 1 on a 50-ohm line by inserting a small section of 60-deg cone at the feed point. The length of the 60-deg cone that was required in this case was only about 0.085L.

All the measurements discussed have been for a discone antenna with no insulators between disk and cone. A weatherproof and a semiweatherproof mechanical design have been developed that allow the discone to be built from the design data presented with negligible change in performance. The semiweatherproof design, which should prove adequate for all except the most severe operating conditions, consists of a thin-walled cylindrical insulator made from a low-loss dielectric fitted between disk and cone with weep holes drilled in the bottom of the insulator parallel to the surface of the cone. The weatherproof design consists of a thin-walled cylindrical radome surrounding the semiweatherproof discone.

The H-plane pattern of a discone antenna is independent of angle while the E-plane field closely approximates that of a dipole at frequencies near f_o. However, as the operating frequency is increased, there is a tendency for the E-plane pattern to push downward, away from the plane containing the disk.

Normalized E-plane field patterns for discone antennas designed for

www.americanradiohistory.com

optimum impedance characteristics are shown in Fig. 7 for values of ϕ of 35, 60 and 90 deg. Near f_o the patterns are nearly independent of flare angle, there being a slight tendency for the pattern to become broader with increased values of ϕ. In this region, the patterns are nearly the same as those of a short dipole. At frequencies above approximately 1.5 f_o, the shape of the resulting pattern is affected significantly by the cone flare angle, the decrease in field with frequency in the horizontal plane being somewhat less for the larger flare angles.

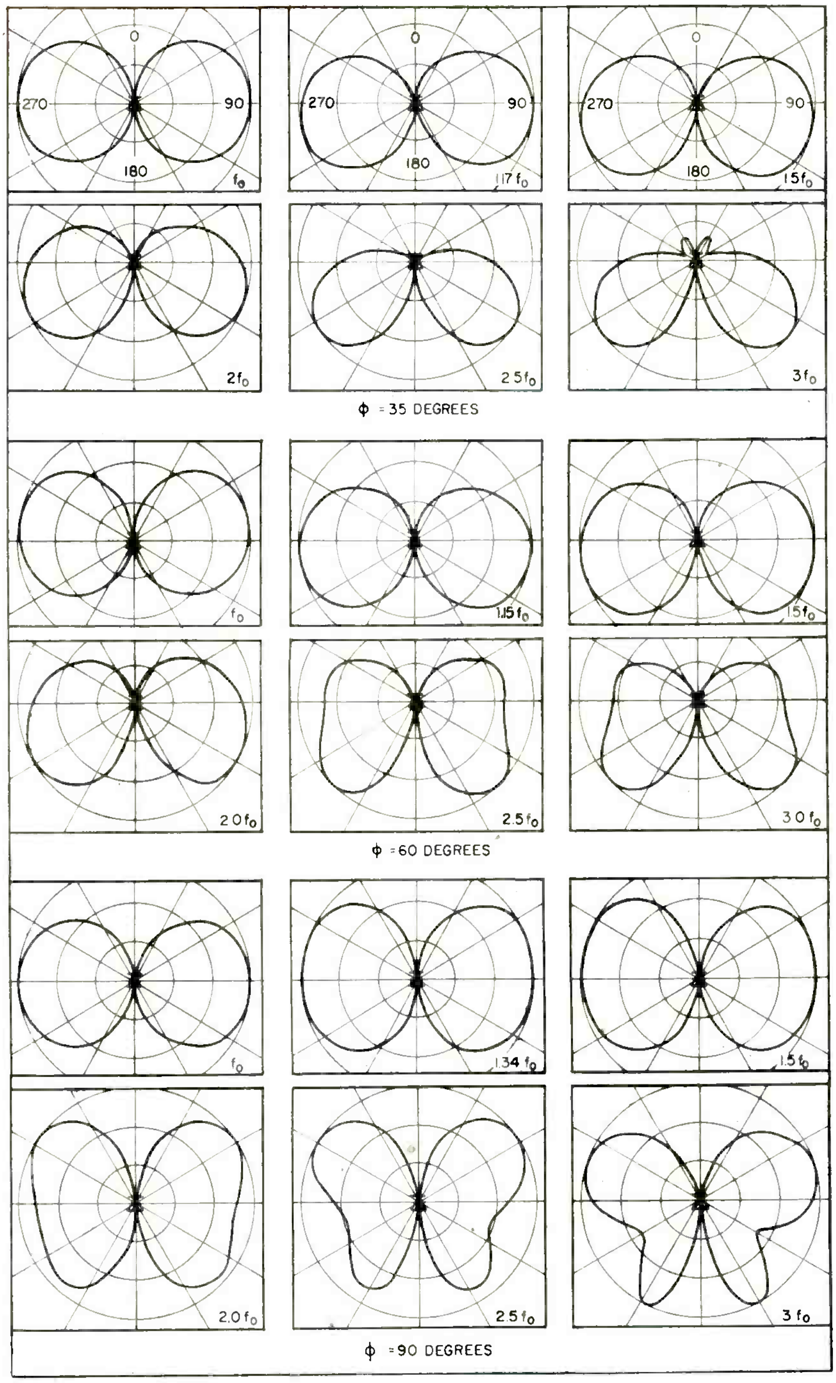


FIG. 7—Relative E-plane normalized field patterns for different angles of ϕ

Gain Figures

For example, the gain in the horizontal plane (θ = 90 and 270 deg) is approximately 2 db less than a dipole for the 60-deg discone at 3 f_o while for the 90-deg discone at 3 f_o the gain in the horizontal is less than that of a dipole by about 1.5 db. Measurements made up to 5 f_o on the 60-deg antenna indicate that the maximum loss in the horizontal plane is 3.3 db with respect to a dipole and occurs at 3.75 f_o. At 4.85 f_o the loss is 2.5 db. Although no investigation has been made, it appears that the larger-flare-angle discones ($\phi \geqq 90$ deg) give better performance in the horizontal plane over large frequency bands than the smaller-flare-angle discones.

A limited number of measurements has been made that confirm small changes in the ratio of S to C_{MIN} and D to C_{MAX} have an insignificant effect on pattern characteristics.

At this time considerably more effort has been devoted to perfecting the impedance characteristics of this antenna than to improving the pattern characteristics. Additional effort is to be directed toward correcting the pattern assymmetry inherent above 2 f_o to 3 f_o with the aim of ultimately obtaining good performance over a 10-to-1 frequency range.

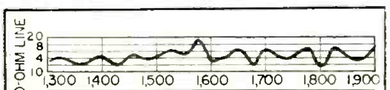


FIG. 6—Optimum parameters at higher frequencies than shown on Fig. 5

The writer wishes to express appreciation to A. G. Kandoian and W. Sichak for their many useful comments and suggestions, to C. R. Brown and W. Spanos for assistance in taking the pattern data and to H. Augenblick, formerly of FTL, for assistance in taking and analyzing the impedance data.

REFERENCES

(1) A. G. Kandoian, Three New Antenna Types and Their Applications, *Proc IRE*, 34, p 70W, Feb. 1946.
(2) A. G. Kandoian, W. Sichak and R. A. Felsenheld, *Elect. Comm.*, 25, p 139, June 1948.
(3) J. M. Bower, Discone—40 to 500 Mc Skywire, *CQ*, 5, p 11, July 1950.
(4) Mack Seybold, The Low Frequency Discone, *CQ*, 6, p 13, July 1950.

www.americanradiohistory.com

Junction Transistor

By **PETER G. SULZER**
Kensington, Maryland

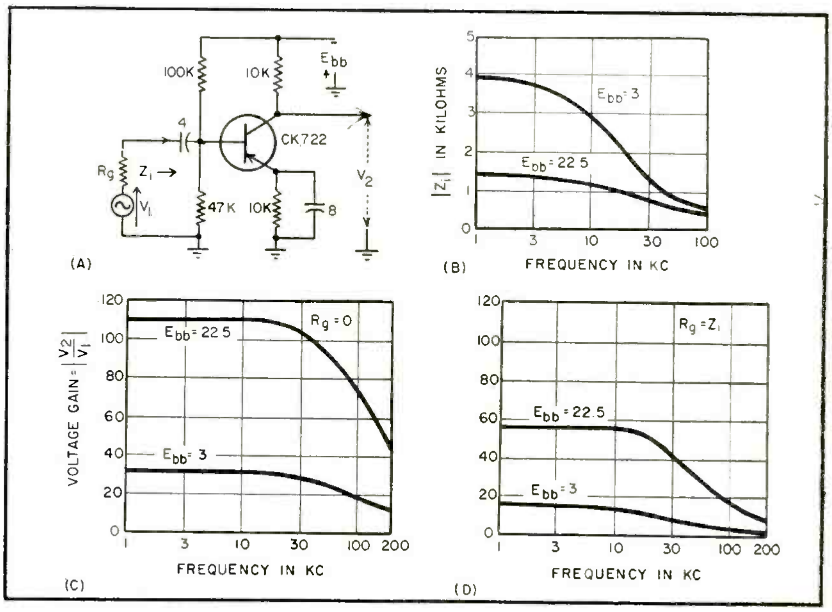


FIG. 1—Voltage amplifier using d-c stabilized grounded-emitter circuit is shown in A. Curves show circuit operating characteristics

AVAILABILITY of large quantities of transistors from several manufacturers has stimulated many new application hunts. It is usually necessary for the experimenter to spend considerable time scanning the literature to locate simple building-block circuits, and then quite often, he finds that special developmental or experimental transistors have been used in described circuits.

This article describes a number of simple circuits using commercially-available junction transistors. Although some variations in characteristics of a given transistor type still exist, many applications are feasible, and through simple design techniques, the effects of these variations may be reduced to a minimum.

Voltage Amplifiers

The voltage amplifier of Fig. 1A employs the grounded-emitter circuit[1] and provides a high gain with a moderately low value of input impedance. The base is connected to a voltage divider, and a bypassed resistance is inserted in series with the emitter to provide direct-current stabilization[2]. Such stabilization is essential to compensate for variations between transistors and to decrease the effects of temperature drift.

With the circuit constants shown in the diagram, approximately one-third of the supply voltage is lost across the emitter series resistance. This appears to be a reasonable compromise for equipment design. Stabilization could be improved by decreasing the values of the resistors used in the base voltage divider, but the effective input impedance of the amplifier would be decreased and more power would be dissipated in the divider.

Table I—Summary of Measurements Made on Voltage Amplifier Circuit (Fig. 1A)

	E_{bb} = 3 v			E_{bb} = 22.5 v		
	Min	Ave	Max	Min	Ave	Max
i_b (ma)*	0.10	0.14	0.17	0.61	0.77	0.85
V_2/V_1	20	28	36	56	115	160
Z_i (kΩ)	3	4.1	7	0.8	1.6	3
f_o (kc)	50	80	100	50	85	110
f_o' (kc)	10	18	30	12	23	38

* Less variation between units will be noted if the minimum operating current is 0.25 ma.

Table I shows the performance of the amplifier with two different supplies, 3 and 22.5 volts. The values given are average values for a total of ten samples.

The open-circuit voltage gain V_2/V_1, was measured at 1 kc with a zero generator resistance R_g. The input impedance, which is resistive at medium audio frequencies, was also measured at 1 kc. The cutoff (3-db down) frequency f_o was measured with $R_g = 0$, while the cutoff frequency f_o' was measured with $R_g = Z_i$ at 1 kc. Note particularly the wide variation of f_o'.

Figure 1B shows the variation of the magnitude of Z_i with frequency for a typical CK722 transistor. The rapid decrease of Z_i with frequency is caused principally by the increase in the phase angle of amplification factor α[3,4].

Figure 1C shows the voltage gain with a constant input voltage ($R_g = 0$) as a function of frequency for the same CK722. Here the variation of the magnitude of α is re-

www.americanradiohistory.com

Circuit Applications

Basic circuits using commercially-available junction transistors are described. Included are voltage amplifiers, impedance-changing circuits, phase inverters, oscillators, multivibrators, blocking oscillators and sawtooth sweep oscillators

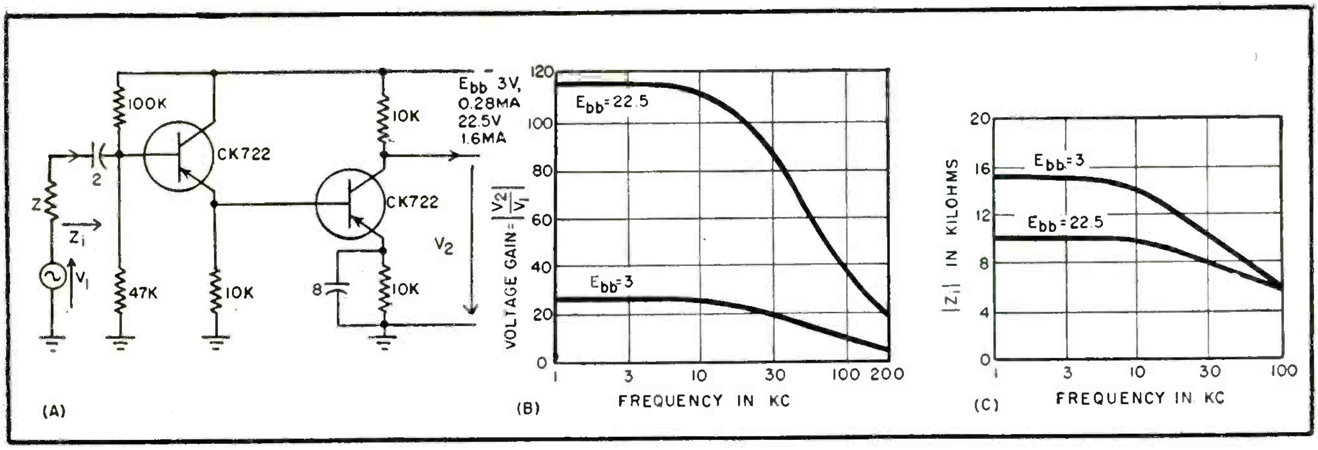


FIG. 2—Two-stage amplifier with high input impedance and direct-current stabilization

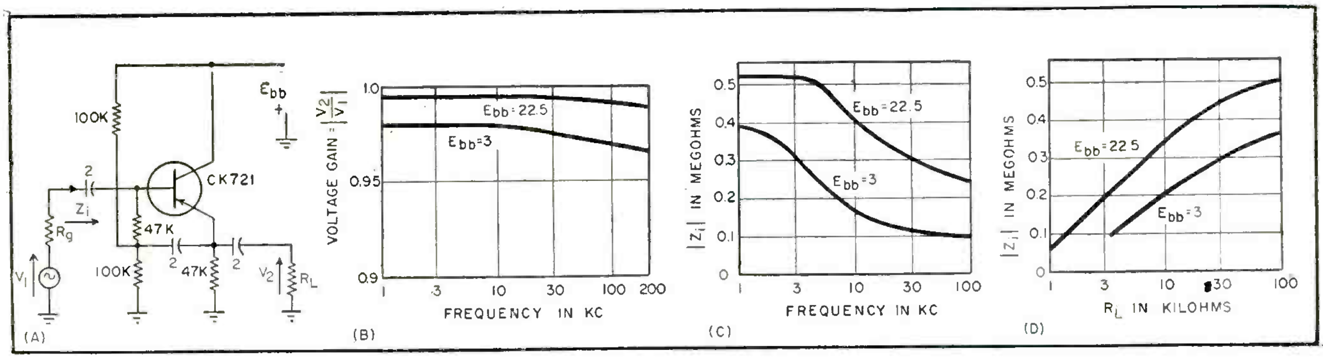


FIG. 3—Grounded-collector stage has high input impedance and low output impedance. Voltage gain approaches unity

sponsible for the decrease in gain at high frequencies.

Figure 1D combines the cutoff effects of the preceding two figures and shows the magnitude of the amplifier gain vs frequency with a generator resistance equal to the low-frequency input impedance ($R_g = Z_i$ at 1 kc). The combined effects of the decrease of both input impedance and gain produce a comparatively poor high-frequency response.

High-frequency response can be improved by driving from a low source impedance. This can be accomplished with the additional advantage of a higher input impedance, by driving the grounded-emitter stage with a grounded-collector stage. It is convenient to employ direct coupling, as shown in Fig. 2A.

The gain characteristic is shown in Fig. 2B, and the magnitude of the input impedance is shown in Fig. 2C. The input impedance is increased by a large factor, and therefore the grounded-collector circuit is a useful interstage coupling element. In this application it might be compared to the use of a cathode-follower tube for coupling between video-amplifier stages to decrease capacitance-loading effects.

Grounded Collector

In applications requiring a high input impedance the grounded-collector circuit of Fig. 3A has been found useful. Direct-current stabi-

www.americanradiohistory.com

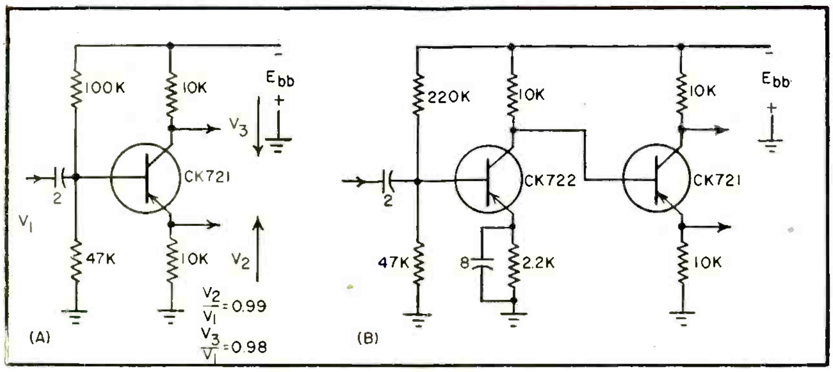


FIG. 4—Basic phase inverter (A) and phase inverter with amplifier

lization is employed as in the previous circuits. Feedback is applied from the emitter to the base voltage divider to decrease the shunting effect of the divider.

Figure 3B shows the open-circuit voltage gain vs frequency. The voltage gain is very nearly unity, particularly with the higher supply voltage, and does not decrease with frequency as much as might be expected.

Figure 3C shows the open-circuit input impedance as a function of frequency. An impedance as high as one-half megohm can be obtained in the audio-frequency range. Loading the circuit will decrease the voltage gain, decreasing the internal transistor feedback and also the external feedback to the voltage divider. The resulting input-impedance decrease is shown in Fig. 3D. The output impedance is comparatively low with the input shorted: 750 ohms with a 3-volt supply, and 100 ohms with a 22.5-volt supply. This test was made at 1 kc. The CK721 was chosen for this application because its high value of α produces a gain closer to unity.

A simple phase inverter is shown in Fig. 4A. Unlike its vacuum-tube counterpart a perfect balance is not automatically produced.

Unbalance Action

A portion of the input current must flow to ground through the emitter, since the transistor is essentially a current-operated device, and therefore, with equal load resistors the emitter will always produce a higher voltage gain than the collector. It is obvious that a higher value of α will produce a better balance. Typical values of voltage gain to both outputs are shown in the figure.

A useful direct-coupled amplifier and phase inverter is shown in Fig. 4B.

Sinusoidal Oscillators

It is apparent that an oscillator can be obtained by connecting a tuned phase-inverting transformer between the output and input of the amplifier of Fig. 1. The use of separate or tapped windings can be avoided with the Colpitts-type circuit of Fig. 5A by connecting suitable reactance from collector to emitter and from emitter to ground. With a 30-volt supply the maximum operating frequency of the ten transistors tested ranged from 0.5 to 5 mc. The average value of maximum frequency was 2 mc, and the average supply current was 1 ma. The average voltage coefficient of frequency was 100 cycles per megacycle per volt with a 50-μμf tuning capacitor.

A Clapp oscillator[5] suitable for operation at 2 mc is shown in Fig. 5B. It contains lower values of reactance across the transistor itself, as well as a low-capacitance series-tuned circuit. A voltage coefficient of frequency of 12 cycles per megacycle per volt was obtained at 30 volts.

A crystal oscillator based on the Clapp circuit is shown in Fig. 5C. Oscillation was obtained at frequencies as high as 4 mc with one transistor out of ten, while seven out of ten would oscillate at 1 mc.

Pulse Circuits

Although the point-contact transistor is very well suited for timing and switching purposes because of its inherent negative-resistance characteristic, junction transistors can also be made to work in such applications. Point-contact units will provide faster switching than junction triodes, but they are more expensive and require more power.

An adaptation of the conventional astable multivibrator is shown in Fig. 6A. An operating frequency of 10 kc is obtained with the values shown in the figure. The circuit will not oscillate with coupling capacitors smaller than 0.001 μf. A maximum frequency of 20

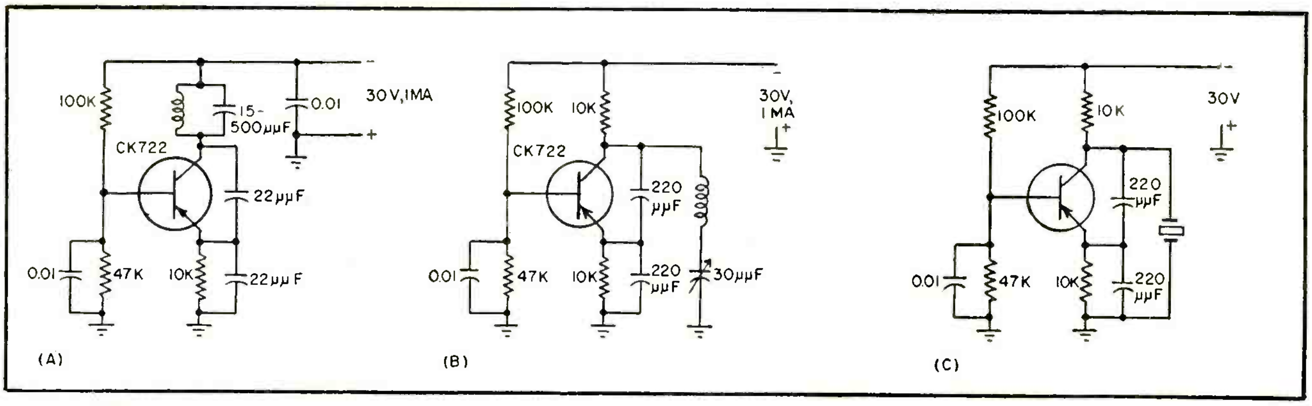


FIG. 5—Three typical transistor oscillators. Upper frequency limit depends, among other factors, on transistor used

www.americanradiohistory.com

kc is obtained by decreasing the base resistances to 50,000 ohms.

Base and collector waveforms are shown in the figure. The rise time of the collector voltage is 4 μsec. For applications requiring a lower operating frequency it should be pointed out that frequency is inversely proportional to RC, providing that R is less than ½ megohm and C is greater than 0.001 μf. Some reverse conduction takes place in the base circuit, which tends to limit the maximum useful value of R. For this reason large frequency variations with temperature changes occur with high values of R.

A monostable multivibrator suitable for pulse generation is shown in Fig. 6B. In the absence of an input pulse JT_1 conducts, while JT_2 is biased to collector-current cutoff by a suitable adjustment of R_1. A negative trigger pulse applied to the collector of JT_1 through a small coupling capacitor will establish conduction in JT_2, driving the base of JT_1 positive with respect to ground, and decreasing the collector current of JT_1. When the collector current of JT_2 has risen sufficiently to permit a loop gain of unity the action becomes cumulative, and JT_1 is rapidly cut off.

With the circuit shown a 9-volt positive pulse with a rise time of 2 μsec is produced at the collector of JT_2. The circuit will remain in this condition until the charge on C leaks sufficiently through R_2 and through the back conduction in JT_1. Shortly after emitter current flows in JT_1 the circuit will restore itself to its original condition.

A pulse duration of 250 μsec with a maximum repetition frequency of 1,000 cps is obtained with the circuit constants given. The pulse duration is proportional to R_2C with C greater than 0.001 μf and R_2 less than ½ megohm.

Bistable Multivibrator

A bistable multivibrator (scale of two) is shown in Fig. 6C. If it is assumed that JT_1 is conducting and JT_2 is cut off, the diode connected to the collector of JT_1 is cut off. A short positive input pulse will therefore appear only at the collector of JT_2, and then at the base of JT_1. The collector current JT_1 will decrease, its collector will become more negative with respect to ground, and JT_2 will conduct. The effect is cumulative with the application of a sufficiently large input pulse, and finally JT_1 is cut-off and JT_2 is conducting. The next input pulse will restore the circuit to its original condition because the input pulse can now pass through the diode connected to the collector of JT_1.

The maximum counting rate (input frequency) is 100 kc with a 22.5-volt supply, and 50 kc with a 4.5-volt supply. The transition time is 4 μsec with a 22.5-volt supply.

Blocking Oscillator

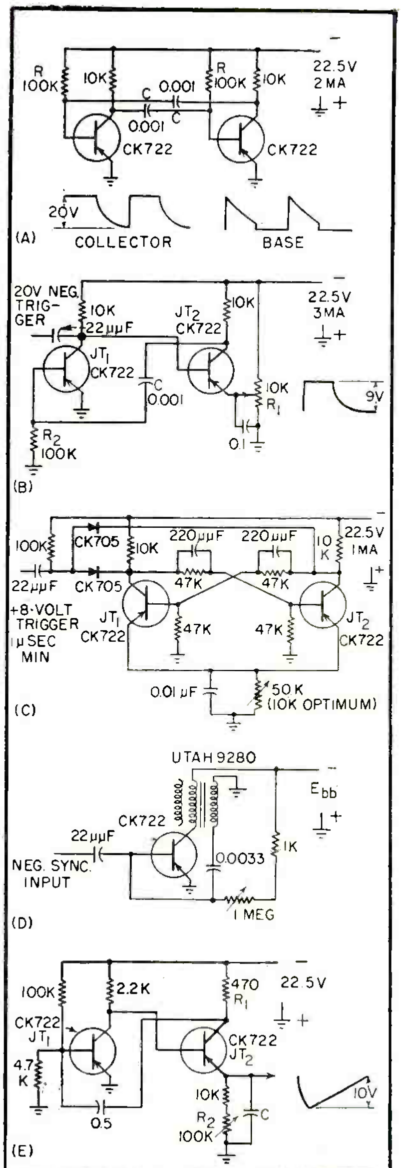
A blocking oscillator is shown in Fig. 6D. The frequency is variable from 3 to 50 kc, and is inversely proportional to RC with R smaller than ½ megohm and with C greater than 0.005 μf. The duration of the initial collector-voltage swing is 5 μsec. The blocking oscillator can be synchronized to a pulse or sinusoidal input by coupling to the base or collector through a small capacitor. Reliable frequency division by integers up to 10 can be obtained.

A transistor version of Puckle's sweep circuit[6] is shown in Fig. 6E. During the short part of the operating cycle JT_2 conducts and charges C. During this time JT_1 is cutoff by the pulse developed across R_1. As the charging current through C decreases, the magnitude of the pulse across R_1 decreases, permitting JT_1 to conduct, and therefore cutting off JT_2.

Capacitor C then discharges through R_2 until JT_2 once more conducts.

A moderately linear, positive-going sawtooth is produced across C during the long part of the cycle. The duty cycle varies from 1/30 to ⅛. The range of operating frequencies is shown in the diagram. Reliable synchronization can be obtained by coupling input pulses or other waveforms to the base of JT_1 through a 10,000-ohm resistor and a 0.1-μf capacitor in series.

The circuits described represent but a small fraction of the more obvious possibilities. It is hoped that they will aid in the application of junction transistors.



C(μF)	0.001	0.01	0.1
F(KC)	13-35	2-10	20-100 CPS

FIG. 6—Pulse circuits include an astable multivibrator (A), monostable multivibrator (B), bistable multivibrator (C), blocking oscillator (D) and transistorized version of Puckle's sweep circuit (E)

REFERENCES

(1) R. L. Wallace and W. J. Pietenpol, Some Circuit and Properties and Applications of *NPN* Transitors, *Proc. IRE*, **39**, p 753, July 1951.

(2) Richard F. Shea, Transistor Operation: Stabilization of Operating Points, *Proc. IRE*, **40**, p 1,425, Nov. 1952.

(3) D. E. Thomas, Transistor-Amplifier Cutoff Frequency, *Proc. IRE*, **40**, p 148, Nov. 1952.

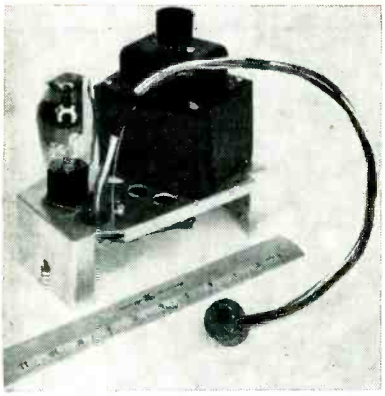
(4) R. L. Pritchard, Frequency Variation of Current-Amplification Factor for Junction Transistors, *Proc. IRE*, **40**, p 1,476, Nov. 1952.

(5) C. W. Clapp, An Inductance-Capacitance Oscillator of Unusual Frequency Stability, *Proc. IRE*, **36**, p 3,020, March 1948.

(6) O. S. Puckle, "Time Bases," p 30 Wiley, New York, 1943.

www.americanradiohistory.com

Design of Export



Power sub-chassis helps to isolate power-frequency fields in an export tv set

By GEORGE D. HULST

Project Engineer
Export Receiver Engineering Laboratory
Allen B. DuMont Laboratories
East Paterson, New Jersey

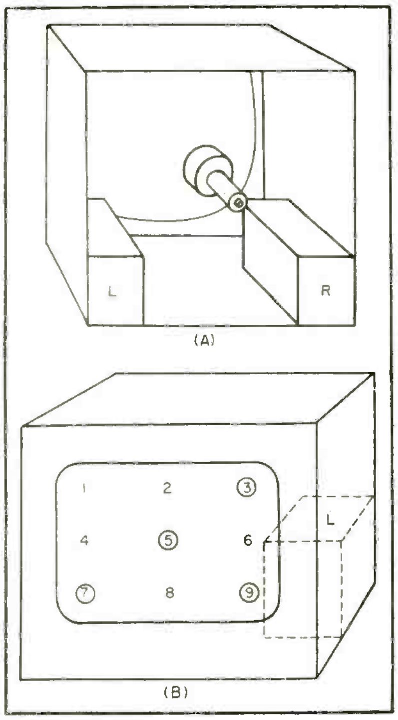


FIG. 1—Sketches show optimum location for power transformer in table-model tv receiver (A) and spots on cathode-ray tube studied in tests (B)

In television systems the vertical scanning of the receiver is synchronized with the transmitter by a transmitted synchronization signal. Operation of the receiver is thus not directly dependent upon the frequency of the power source. However, many television receivers which operate satisfactorily with a power source having the same frequency as their vertical scan exhibit noticeable defects in the picture when energized from a source whose frequency is appreciably different.

Picture Defects

These defects usually take the form of small variations in scanning and are caused by minor amounts of coupling between the power circuit and the cathode-ray beam or scanning circuits. If the vertical scan is exactly synchronized with the power line, these variations are stationary, and deviations of perhaps $\frac{1}{8}$ inch in a 21-inch picture can be tolerated. If slow changes in phase occur between scanning and power, as is now the usual condition in this country, these changes cause a slow weaving and stretching of the picture. In this case, a total deviation of perhaps $\frac{1}{16}$ inch or less is not objectionable.

Where the rate of change of phase is greater than about one cycle per second, however, the motion or wiggle in the picture is very apparent to the eye, and scanning variations that exceed about $\frac{1}{64}$ inch are objectionable.

Such is the case when U. S.-standard broadcasts having 60-cycle vertical scanning are received in areas utilizing 50-cycle power. In this case, the picture defects take the form of picture wiggle or flicker having an apparent 10-cycle repetition rate, which is the difference frequency.

The designer of television receivers for use in such nonsynchronous power areas is therefore faced with the problem of locating and elimi-

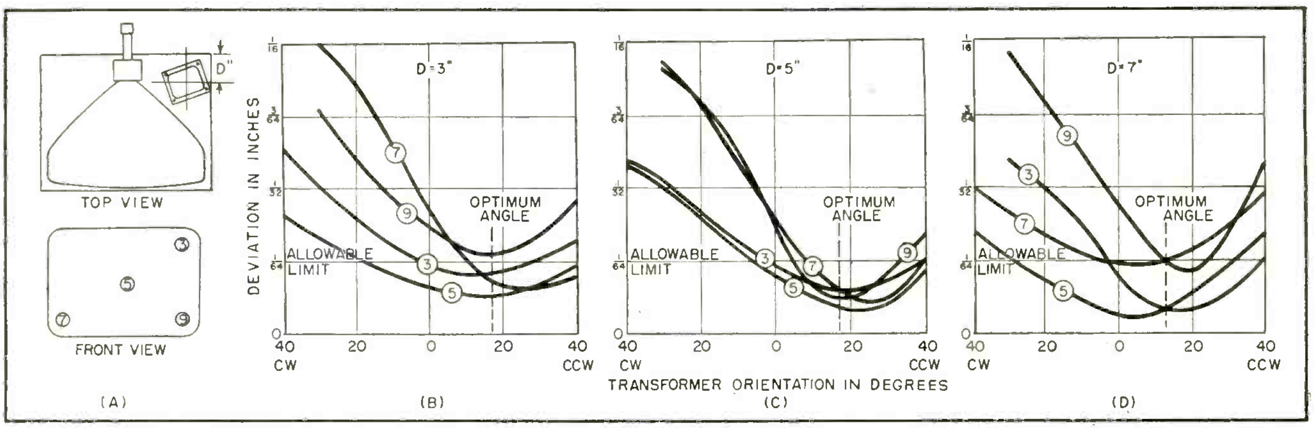
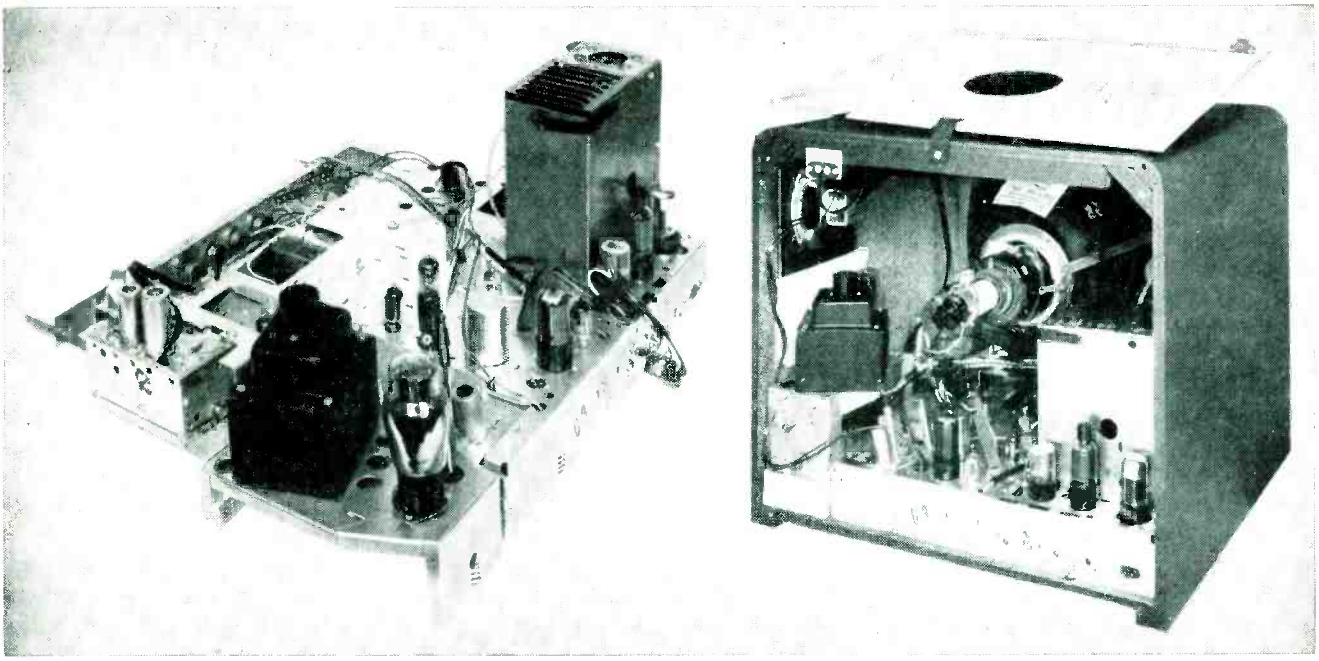


FIG. 2—Curves show effect of placement of power transformer on interaction between power-line and electron beam

www.americanradiohistory.com

Television Receivers

Techniques are discussed for making television receivers independent of power-line frequency. Virtual freedom from interaction is obtained by relatively simple positioning, shielding and filtering techniques applied to conventional sets



Photographs show use of subchassis to isolate power transformer and rectifier from cathode-ray tube to reduce interaction between power-frequency, scanning circuits and the electron beam. Receivers shown are 21-inch (left) and 17-inch models converted for nonsynchronous operation

nating all forms of coupling between the power line and the picture tube having amplitudes of more than about one-tenth that which is usually tolerated.

The causes of nonsynchronous defects are magnetic radiation from the power transformer, filter choke, heater wiring, primary-circuit wiring, B-supply wiring and tube heaters, plus conductive coupling from the B supply and tube heaters.

Receiver Design

In compact designs magnetic radiation from the power transformer is a major design consideration, since any component of magnetic flux not parallel to the electron beam of the picture tube will cause deflection deviations. It is not usually practical to shield magnetically either the transformer or the cathode-ray tube. The power transformer is too large to be positioned underneath the chassis. Copper banding of the transformer to minimize its magnetic radiation is, however, both practical and effective. In addition, the transformer must be positioned and oriented to minimize coupling to the electron beam.

Only two regions within the confines of table-model cabinets are suitable for mounting the power transformer. These regions are the two lower rear corners of the cabinet, the areas marked *L* and *R* in Fig. 1A.

The transformer must be mounted in the lower part of the cabinet to insure proper convection cooling. It must be mounted in a rear corner of the cabinet to avoid the severe magnetic coupling to the picture tube that would ensue if the transformer were mounted near the front or center of the cabinet. Magnetic coupling to the picture tube is further reduced by selecting the exact position and orientation for a given transformer within the preferred region.

Coupling Measurements

Measurement of coupling is complicated by the fact that deviation must be studied which is close to the limit of visual acuity. It is desirable that each separate form of coupling be reduced to a level which produces deviations of the order of one-half or one-third the $\frac{1}{64}$-inch limit established above.

Large quantities of data must be

www.americanradiohistory.com

taken since there are five independent variables, two of these being horizontal position, one being horizontal angle of rotation and two being angle of tilt. A sixth variable, that of height, is not independent of the others, since it is related to that of tilt by means of an axis of symmetry through the center of the cathode-ray tube.

Different parts of the cathode-ray display are effected in different ways. Any optimum condition for the entire picture is, in effect, a compromise between what happens in various parts of the picture. A certain amount of weighting of factors is necessary in this process of compromise.

It is much more important, for instance, to avoid wiggle effects in the center of the picture where most of the action takes place than at the extreme edges of the picture-tube screen.

Measurement Technique

In making deviation measurements the receiver was removed from the cabinet and the power transformer connected to it by extension leads. The transformer could then be moved and oriented easily to ascertain the optimum position and orientation within given space limitations. The set was operated from 50-cycle power.

Measurements were made at nine positions of the cathode-ray-tube face as indicated by the numbers 1 through 9 in Fig. 1B. In general both a direction and a magnitude were recorded. In analyzing the recorded data, it turned out that with the power transformer in the region indicated by the dotted lines, the record of performance at only four points on the face of the picture tube gave a complete summary of performance for the entire picture. These four critical positions are the points 3, 5, 7 and 9, encircled in the figure.

The results for a typical series of measurements on a 21-inch table model are shown in Fig. 2. The transformer was mounted horizontally (Fig. 2A) and centered approximately 3, 5 and 7 inches (Fig. 2B, 2C and 2D respectively) in front of the rear edge of the cabinet and rotated horizontally to determine optimum orientation.

In Fig. 2B (D = 3 inches) the best compromise rotational position is 18 degrees, but the deviation in the lower corner, 9, is too large for an acceptable picture. Figure 2C shows that an optimum position of 20 degrees provides a deviation less by 2 to 1 than the allowable limit. The rotational angle in this case is not particularly critical.

For the 7-inch spacing (Fig. 2D) the compromise angle is 12 degrees, and deviation in the lower corners is barely acceptable.

Other Coupling

Magnetic radiation from the power transformer thus being controlled, other forms of coupling were investigated and independently minimized. The technique for checking the extent of these other forms of coupling, is to reinsert the chassis into the cabinet with the power transformer removed at a distance but connected to it by extension leads.

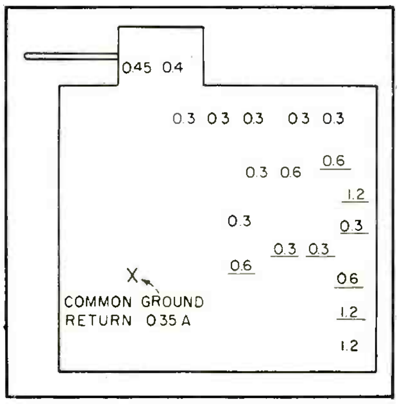


FIG. 3—Drawing shows positions of tubes and filament current of each

Magnetic coupling from filter chokes or similar relatively small magnetic components is conveniently avoided by mounting them underneath the chassis.

Magnetic radiation from the heater wiring provides an appreciable design problem. It has been the practice in the industry to ground one side of the tube heaters to the chassis at each socket. This practice results in heater current flow through the chassis to a common heater return point. This practice, when applied to nonsynchronous receivers, has been found to cause objectionable magnetic coupling to the picture tube.

This coupling can be avoided by the use of a center-tapped 12.6-volt heater winding on the power transformer with the center-tap connected to ground, providing thereby two 6.3-volt sources of opposite polarity to which the heaters are connected. By intermixing tubes in the two heater strings, chassis currents can be localized and heater-current radiation effects avoided. Since the center-tap connection usually carries a small difference current between the two strings, its location also is critical.

In Fig. 3 is shown one arrangement of heaters and ground returns which has proved to be successful. Ground currents of heaters connected to one voltage polarity are identified by underlined numerals indicating the currents of each tube in amperes. Those connected in the other polarity are identified by numerals without underlines.

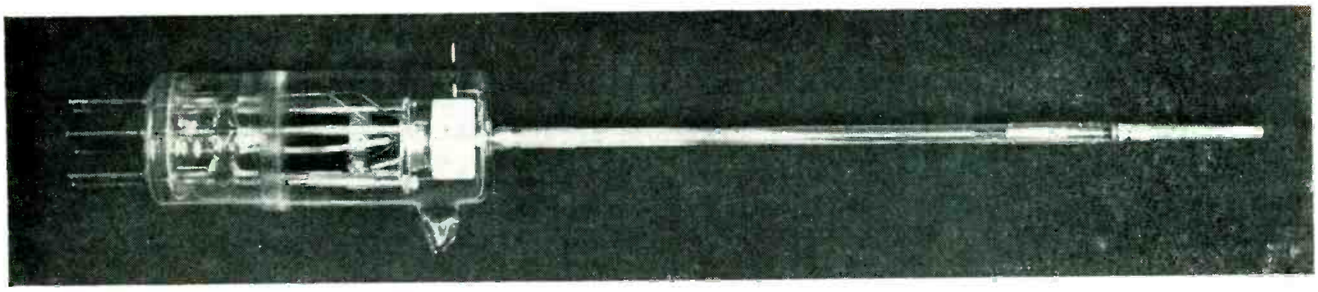
Magnetic radiation from either primary or B-supply currents has not been found to be appreciable. The wiring carrying these currents is usually located underneath the chassis where it is shielded by the chassis from the picture tube.

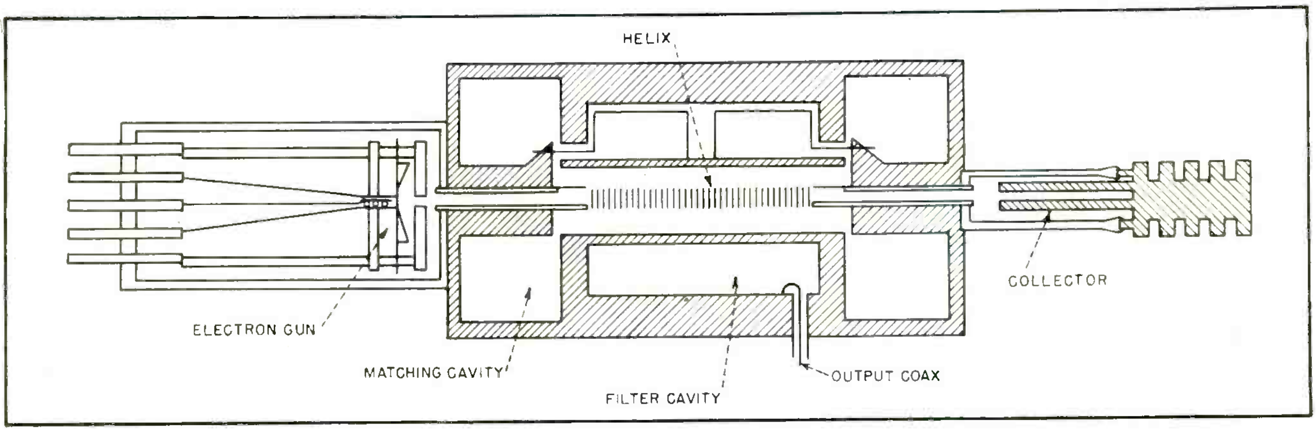
It has been found possible, however, to have appreciable magnetic radiation from the tubes themselves. In particular, radiation effects from the heaters of a 5U4G rectifier were noted when it was located forward in close proximity to the picture tube. This type of coupling was avoided by moving the rectifier tube to a transformer subchassis located to the rear and away from the picture tube.

Conductive coupling between the power circuits and the deflection circuits must be avoided. Adequate filtering of the B circuits is essential in order to prevent ripple in the B supply.

Conductive coupling from the heater circuits is usually in the form of heater-cathode or heater-grid leakage. The deflection circuits in common use today are reasonably immune to such conditions. In designing these circuits large direct voltages between heaters and cathodes should be avoided. Occasional tubes which exhibit heater leakage effects to a noticeable extent are the exception and can be replaced.

www.americanradiohistory.com





One of the traveling-wave tubes tested in oscillator service. Cutaway shows arrangement of an oscillator circuit

Traveling-Wave Oscillator Tunes Electronically

Single electronically-short tube delivers over 100 milliwatts at 3,000 mc and tunes 4.5 percent as helix voltage is varied. Oscillator uses external feedback through a filter to eliminate undesired modes

By H. R. JOHNSON and J. R. WHINNERY*

Research and Development Laboratories
Hughes Aircraft Company
Culver City, California

MICROWAVE TUBES utilizing waves along an electron stream have a wide bandwidth made possible by interaction of non-resonant circuits or fields with the beam. Best known of these wave-type devices is the traveling-wave tube although the double-stream magnetron and velocity-jump amplifier have similar characteristics.

Work on wave-type tubes has been concerned largely with amplifier design, nevertheless the tubes are useful also as oscillators. Traveling-wave-tube oscillators consist of a single tube with feedback through an external filter for elimination of undesired modes. The tubes can be designed for power outputs of one watt or more and are electronically tunable over 4 to 8 percent. A traveling-wave tube designed for use as an oscillator is usually shorter electrically than one designed for amplifier service.

Principle of Operation

A traveling-wave amplifier tube with output and input circuits well matched over a reasonable band-

* Now with the Dept. of Electrical Engineering, University of California, Berkeley, Calif.

www.americanradiohistory.com

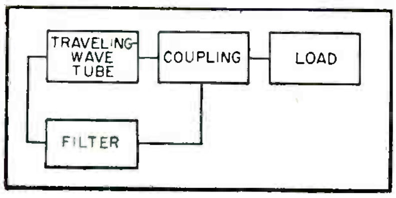


FIG. 1—Block diagram of traveling-wave-tube oscillator

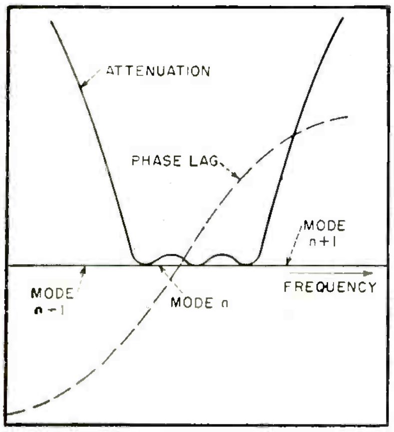


FIG. 2—Phase and attenuation versus frequency for a typical bandpass filter

width and with enough attenuation to prevent oscillations arising from internally reflected waves is connected as indicated in Fig. 1. The output is fed to a matched load with a portion coupled out, passed through a filter and fed back to the input to produce oscillations.

For oscillations to build up, the total electrical length of the closed loop consisting of the tube, matches, filter and connecting cables must be an integral number of wavelengths. In addition, loop gain must be greater than unity. The first condition commonly occurs at several frequencies, each one of which is referred to as a distinct mode of oscillation defined by an integer n. The purpose of the filter is to insure that the second or gain condition is satisfied for only one mode.

Electronic tuning is accomplished by varying the helix voltage, which is equivalent to varying the electron velocity inside the helix. This produces a corresponding change in the velocities of the four helix waves. A given change in electron velocity results in a corresponding change of about half of that amount in the phase velocity of the growing wave. In an oscillator, this change in phase velocity inside the tube must in general be accompanied by a change in frequency. If the phase velocity of the wave around the loop is independent of frequency, an increase in phase velocity because of higher electron velocity must be accompanied by an increase in frequency to remain in the same mode. Ordinary dispersion in the filter circuit, such as is associated with a filter consisting of one or several transmission cavities in cascade, narrows the electronic tuning range. This is so because in such a device a small frequency increase results in a greatly increased phase lag of the wave traveling through the filter.

Tube Design

Gain of the growing wave, expressed in decibels per slow wavelength, is proportional to a dimensionless quantity C, where C^3 is one fourth the ratio of helix impedance to d-c beam impedance. This gain persists over a fractional range of helix-to-cathode potential roughly equal to $4C$; this corresponds to a fractional range of $2C$ in the electron velocity within the helix, or to a fractional range of approximately C in the phase velocity of the growing wave. Thus the total electrical length of the tube at one frequency can be changed by a fractional amount C while maintaining net gain.

For oscillation in a given mode, provided there is no dispersion in either tube or external circuit, a change in electrical length will be compensated for by a fractional change C in frequency. To prevent mode interference, C must be less than the fractional spacing between modes.

In a tube without dispersion in either external circuit or helix, the fractional frequency spacing between modes is $1/n$, where n is the electrical length in wavelengths of the tube and the external circuit. This requirement will be satisfied by traveling-wave tubes with less than about 20-25 db gain. The tubes were designed for gain in this range, and with as high values of C as was convenient (about 0.08).

Filter Design

The two main requirements for the filter are that it transmit the desired mode while suppressing the undesired ones and that it contribute neither appreciable length nor dispersion to the feedback circuit. The ideal filter is one of zero dispersion, but for many easily realizable filters the dispersion is considerable. So long as the plot of phase versus frequency is linear, there is no signal distortion in carrier-operated transmission through such a filter. For the oscillator application, more stringent requirements on dispersion are necessary.

Consider the filter actually used for the experimental tests of the oscillator, a simple transmission cavity with characteristics as shown in Fig. 2. At frequencies well below resonance, it behaves as a line shunted by an inductance of low reactance; therefore the output leads the input by 90 deg. At frequencies well above resonance, it behaves as a line shunted by a capacitance of low reactance, so the output lags the input by 90 deg. Between 3-db points, the total phase variation is 90 deg and is linear; this results in reducing the fractional spacing between modes from $1/n$ to $3/4n$.

If the squareness of the attenuation versus frequency characteristic of the filter is improved by

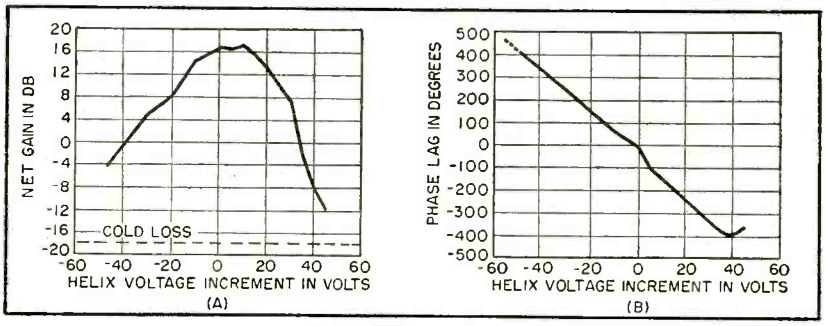


FIG. 3—Phase and gain versus helix voltage for oscillator using tube 135 wavelengths long

www.americanradiohistory.com

using m cavities in cascade, the phase shift over the passband will be roughly $90m$ deg, which will reduce the fractional spacing between modes to $(4-m)/4n$. For two and three cavities the reduction factors are ½ and ¼ respectively. For more than three cavities, it is impossible to separate the modes at all. Such networks are examples of the minimum-phase-shift type, a large class that includes all ladder networks. The phase characteristic of a minimum-phase network is determined once the amplitude characteristic is known for all frequencies.

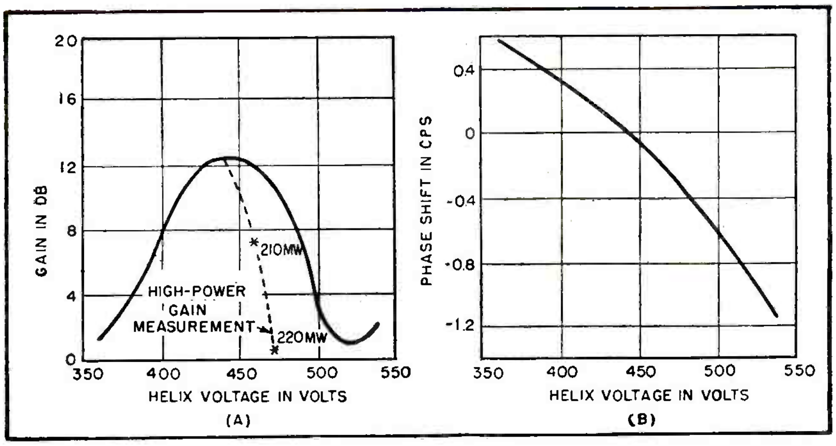


FIG. 4—Phase and gain versus helix voltage for oscillator using tube 14 wavelengths long

Experimental Results

Measurements were first made on a long, low-C, 8,500-mc tube. When the signal was fed back through a tuned cavity, an electronic tuning range of 20 mc (0.24 percent) was observed, whereas theory predicts about 50 mc for an external circuit of zero dispersion and negligible length. To determine whether the fault was with the tube phase-shift versus voltage characteristics or with the external path, phase and gain measurements were made. The results are shown in Fig. 3. For a total tube length of 135 electrical wavelengths, the gain was reasonably high over a range of $\pm$ 20 volts, but the phase changed 400 deg. According to the theory, phase shift over this range should be 406 deg. Theory and experiment agree on a phase shift of 0.18 radian per volt.

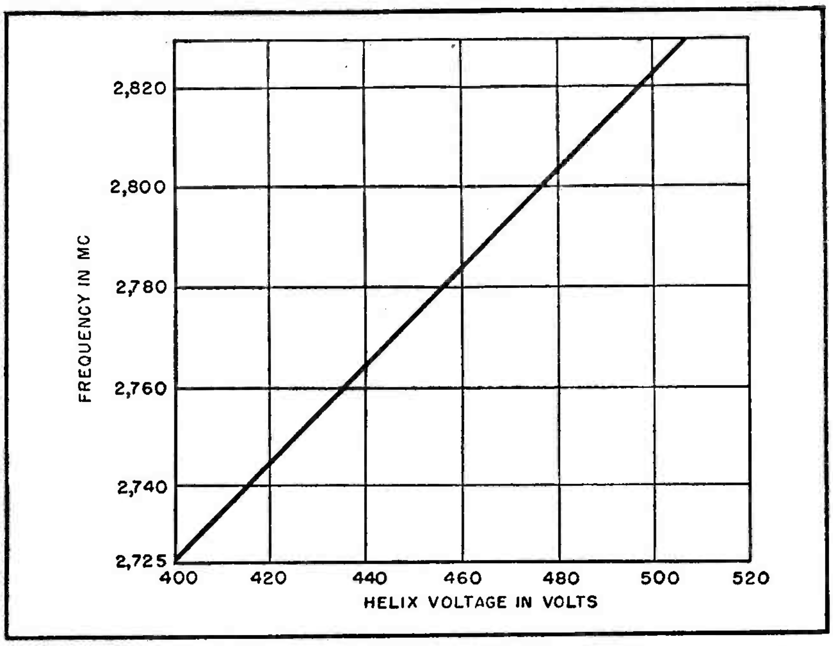


FIG. 5—Tuning curve for oscillator using 14-wavelength traveling-wave tube

The second tube tested was designed as a 3,000-mc oscillator. This tube had maximum small-signal gain at about 440 volts and a beam current of 10 to 20 ma. Electrically it was 14 wavelengths long and had a C-value of about 0.06. Gain and phase measurements made on this tube are indicated in Fig. 4. Again there is appreciable net gain over a fractional range of helix voltage equal to $4C$. Because of the higher beam current and shorter length of this tube, there is appreciable gain over a greater fractional range of helix voltage. The rate of change of phase with voltage is 0.055 radian per volt, whereas theory predicts 0.050 radian per volt. An oscillator test was made with the arrangement shown in the drawing. The total width of the mode was 3.4 percent, as shown in the tuning curve of Fig. 5. Oscillation was detected with a relatively small coupling loop, therefore the power output was small. It seems reasonably certain, however, that more than 100 milliwatts could have been obtained from this tube with some sacrifice in electronic tuning range.

The third oscillator tube tested is shown in the photograph. Electronic tuning from 2,640 to 2,800 mc, a range of 4.5 percent, was obtained between mode edges. A power output of 300 milliwatts was obtained at mode center, but no effort was made to maximize the power; more than a watt should be obtainable. The width of the mode between 3-db points is not much less than the full width because of the steep mode skirts.

BIBLIOGRAPHY

E. M. T. Jones, "Traveling-Wave-Tube Oscillators," Stanford University E.R.L. Tech. Rpt 28, Aug. 15, 1950.

V. H. Schnitger and D. Weber, Untersuchungen Uber Selbsterregte Schwingungen in der Wanderfeldrohre, *Frequenz*, 3, p 189, July 1949.

L. M. Field, "Initial Studies of Harmonic Output Wide-Tuning Traveling-Wave Oscillators," Stanford University E.R.L. Tech. Rpt 20, Sept. 1949.

O. Doehler, W. Kleen and P. Paulluel, Les Tubes à Propagation d'Onde Comme Oscillateurs à Large Bande d'Accord Électronique, *Ann. Radio-Électricité*, 4, p 68, Jan. 1949.

H. Heffner, Stanford University E.R.L. Tech. Rpt 48, June 18, 1952.

H. R. Johnson and J. R. Whinnery, *IRE Group on Electronic Devices*, Winter 1952-53 (in print).

J. R. Pierce, "Traveling-Wave Tubes," D. Van Nostrand, 1950.

H. W. Bode, "Network Analysis and Feedback Amplifier Design," D. Van Nostrand, 1945.

Phase Detector Uses

Type 6BN6 tube produces output voltage that is function of phase-difference between two voltages independent of their amplitude. Three types of corrections are possible for dealing with signals that vary in amplitude. Practical circuit enables measurement of 1 degree phase shift at 10 mc

Use of the type 6BN6 gated-beam tube has been extended to detection of the phase between two voltages. The interest in this tube was motivated by a need to detect phase-shifts in the order of 1 degree or more at 10 mc. However, the results to be presented are useful in the general problem of phase measurement or square-wave production by means of the 6BN6.

The general requirements of a phase detector are that it produce an output voltage that is some known function of the phase-difference between two voltages and that the output voltage be independent of the amplitude of the two voltages. The 6BN6 lends itself well to this problem, as it accomplishes both the amplitude independence and the phase detection in the same envelope.

Operation

The circuit diagram for a simplified phase detector and the plate-current limiter-grid voltage curves for a 6BN6 are shown in Fig. 1. For simplicity, the quadrature grid is assumed to have the same transfer characteristics as the limiter grid. Then the limiter and quadrature grids function approximately as off-on switches with each being able to cut off the plate current independently, but both grids being required to turn it on. As a result of the off-on action of the grids, a sine-wave applied to either grid will produce a trapezoidal waveshape of plate current, provided the amplitude of the sine wave is such that the grid is driven either to cutoff or saturation over a considerable portion of a half cycle.

Applying signals of the desired amplitude, but with different phase, the grids will again produce a trapezoidal waveshape of plate current. However, the width of the trapezoid will be dependent on the coincident portion of the on period of each grid as shown in Fig. 2A. Waveforms in Fig. 2B show the instantaneous plate voltage resulting from 1-mc signals, 14 volts in amplitude, and shifted in phase by 20 deg applied to the grids. These waveforms were measured with a 517 Tektronix scope whose bandwidth is approximately 100 mc.

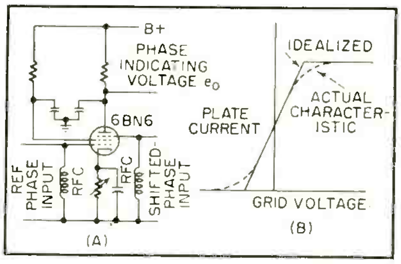


FIG. 1—Simplified phase detector (A) and plate-current limiter-grid voltage curves for 6BN6 (B)

Upon integrating the plate-current waveform over a complete cycle, an average plate current results that is dependent on the area of the trapezoid. Assuming the amplitude of the signal to be sufficient as stated above, and the area under the sloping sides of the plate-current waveform to be negligible compared to the total area, the average plate current is then dependent only on the width of the pulse, which is linearly dependent on the phase-difference in grid voltages.

Thus an output voltage is produced that is linearly dependent only on the phase as it varies from 0 to 180 deg. This is a somewhat idealized case, but is sufficient if signals are comparatively constant in amplitude. If signals are variable in amplitude, however, it is necessary to make certain refinements in the circuit.

In discussing amplitude distortion, it is convenient to define e_a as the a-c component of the plate voltage resulting from amplitude modulating the signals 30 percent at 400 cycles. Then the amplitude rejection is defined as 20 log e_o/e_a where e_o is the plate-voltage change resulting from a phase change of 1 degree. Improving the amplitude rejection requires minimizing the changing area of the plate-current pulse resulting from the a-m.

If the transfer function of the grids is assumed to be idealized as shown in Fig. 1B it is possible to have complete amplitude rejection by biasing the two grids at a point equally distant from cutoff and saturation as shown in Fig. 2B. The characteristics are not ideal, so corrections have been classified as first, second and third-type corrections.

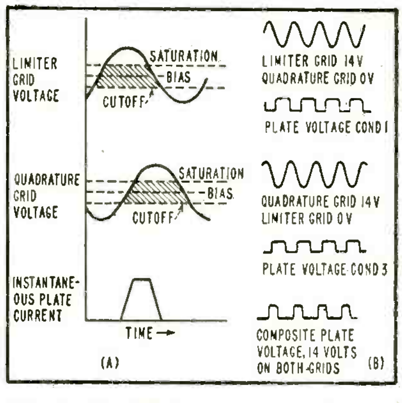


FIG. 2—Predicted waveforms (A) and reproductions of crt waveforms (B)

The corrections are better understood if one expands the plate current i_b in a Taylor series about the bias potential E_c.

$$i_b = a_o + a_1(e_g + E_c) + a_2(e_g + E_c)^2 + \ldots \quad (1)$$

For good amplitude rejection, the

www.americanradiohistory.com

Gated Beam Tube

By FRANK S. HOLMAN, Jr.

Electronics Research Laboratory
Stanford University, Calif.

area $A_1 - A_2$ shown in Fig. 3 must be a minimum. Since the areas are integrations of the plate current, it is intuitively reasoned from the general shape of the transfer curves that a value of E_c can be chosen to minimize this difference in areas.

Now if the transfer functions are reflections about the origin, i_b consists of only odd terms and applying an odd function ($\sin \omega t$) to the grids and integrating term by term, the difference between the two areas becomes zero. The corrections are then:

(1) Let the bias on both grids be the same and adjust this bias by a variable cathode resistor. This correction is significant, since the tube was so designed that with certain potentials on the other electrodes the correct grid bias would be about the same for both grids.

(2) Bias each grid individually, thus placing it at its correct bias.

(3) Vary the plate voltage (plate load resistor) over the range from 80 to 220 volts and minimize e_a/e_o, where e_o results from a given phase-shift, for each value of plate voltage by adjusting the individual grid biases. A plot of the minimized e_a/e_o as a function of plate voltage

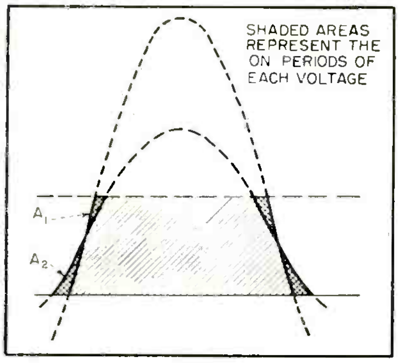


FIG. 3—Enlarged grid voltage curves show two voltages of different amplitude

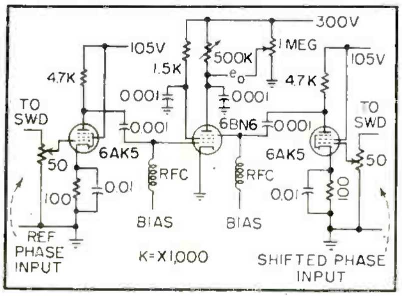


FIG. 4—Circuit used for making measurements with standing-wave detector

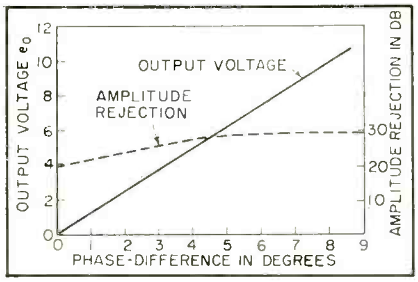


FIG. 5—Output voltage and amplitude rejection for the circuit shown in Fig. 4

will also have a minimum, indicating the plate potential for best amplitude rejection. This corresponds to picking the transfer function that most closely approximates an odd function and consequently maximizes the amplitude rejection.

The correction used can be determined from the type of phase meter desired. For metering over a wide range of phase-difference, the first or second correction is the only one necessary, since changes in phase correspond to changes in plate voltage thus destroying the more sensitive bias settings. For accurate metering over a range of 10 or 15 degrees phase-difference, the third type of correction is desired. A method of making the above adjustment is to amplitude modulate (30 percent) the signals and adjust for minimum modulation voltage in the plate circuit.

In general the sensitivity, or the amplitude rejection, of the phase detector does not depend on the phase-difference between the signals. However, the phase-difference does affect the plate voltage, thus for moderate supply voltages and good amplitude rejection the optimum phase-difference is from 50 to 130 degrees in most cases.

With a given supply voltage the minimum phase-difference is governed by the minimum plate voltage at which the tube can function properly. There is also a maximum phase-difference for a given amplitude of signal, because amplitude variations make the results meaningless above this value. For successful operation it is necessary that the composite plate currents reach saturation before the lagging edge of the leading signal cuts the current off. If this were not the case, the plate current would depend on amplitude as well as phase.

Figure 4 shows the circuit used to measure very small phase-differences at 10 mc and Fig. 5 shows the output voltage and amplitude rejection as a function of the phase-difference. The small phase shifts were obtained by introducing a signal into a sliding contact of a standing wave detector, connecting the two ends of the standing-wave detector to the two inputs of the phase detector, and terminating the lines in their characteristic impedance. The phase-difference between the two ends is thus a function of the position of the sliding contact.

In order to determine the loading effect of the 6BN6 on the 6AK5's, it was necessary to measure the effective input resistance of the 6BN6 as a function of its grid voltage. The measurements were made by noting the Q of a tuned circuit, across the grid to ground, as a function of the peak voltage applied to the grid. The effective input resistance was found to decrease as the voltage increased up to 8 volts peak. At this voltage the resistance was 20,000 ohms, and increased slightly as voltage increased.

Bibliography

General Electric Engineering Bulletin ET-B28, "The Gated Beam Tube and Its Application in Intercarrier Television."

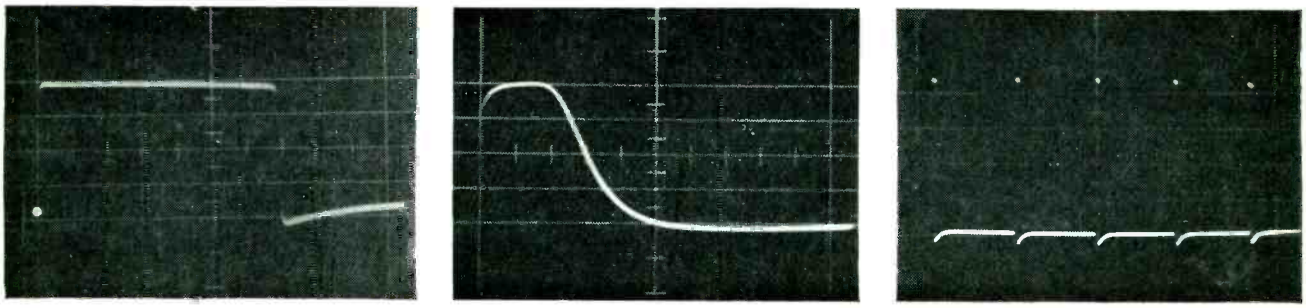
Robert Adler, A Gated Beam Tube, ELECTRONICS, p 82, Feb. 1950.

Louis E. Garner, Jr., Square Wave Generator Using Gated Beam Tube, ELECTRONICS, p 128, July 1951.

S. Rubin and G. E. Boggs, Gated Beam Mixer, ELECTRONICS, p 196, Oct. 1951.

Norris C. Hekimian, Frequency-Deviation Meter Plots Drift, ELECTRONICS, p 134, June 1952.

www.americanradiohistory.com



Oscillograms show typical pulses produced by inexpensive pulse circuit. Left to right are pulses of 500 μsec at 600 cps, 0.3 μsec at 50 kc and a series of 1-μsec pulses at 25 kc

General Purpose

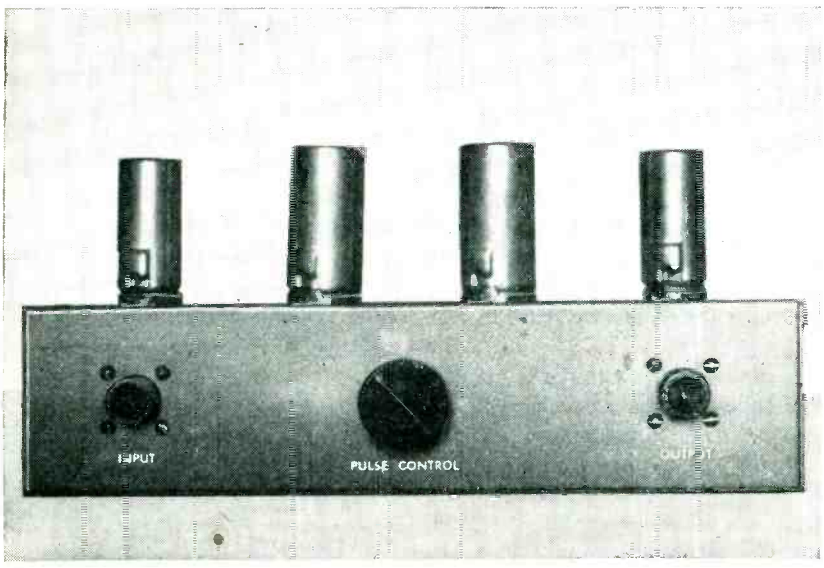
Straightforward circuit uses low-cost components to convert low-voltage sine wave into procession of high-voltage pulses with variable widths down to a fraction of a microsecond. Typical applications are crt markers, gating, counting and frequency division

By ABE HERSHLER and **ARTHUR H. SEIDMAN**
Project Engineer *Senior Engineer*

Electro-Marine Manufacturing Corp. New York, N. Y.

SEVERAL excellent variable-length pulse generators have been described in the literature.[1,2,3] Most of these, however, are restricted in frequency range and output pulse amplitude.

For certain applications it is desirable to have a pulse generator whose input frequency can be varied over a relatively large range and whose input waveform can be arbitrarily smooth and of low amplitude. It is usually desirable to have an output of sufficient amplitude to eliminate need for further amplification.



Front view of completed generator shows simplicity of construction. Channel-lock cabinet used is 10 × 4 × 2½ in.

The unit to be described is simple yet versatile, and it provides excellent output waveform and amplitude. With a sine wave input as low as 100 mv rms from 500 cps to 100 kc, pulses exceeding 100 volts from 0.3 μsec to $1/f$ μsec (where f is the operating frequency in mc) in length with rise times of less than 0.04 μsec can easily be obtained.

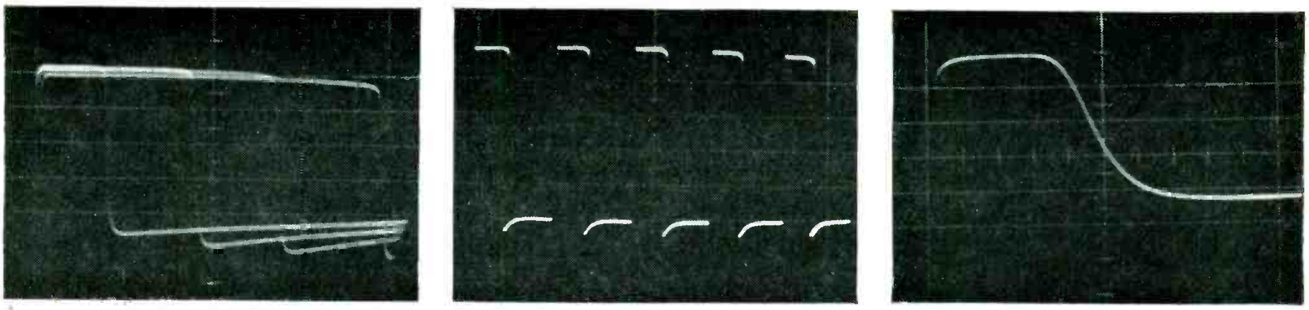
Figure 1 shows a schematic diagram of the pulse generator.

Circuit Description

As shown in the diagram, the input waveform is first raised in amplitude and shaped to provide a trigger for the blocking oscillator. The blocking oscillator, in turn, provides a high-amplitude sharp trigger, relatively independent of the input waveform's shape and amplitude, which fires the multivibrator. The multivibrator produces the variable-length pulse.

Referring to Fig. 1, V_1 is employed as a high-gain over-driven amplifier. The output of this tube

www.americanradiohistory.com



Control of pulse-length adjustment is illustrated at left by pulses of 2, 4½, 7 and 10 μsec. At center are 50-μsec pulses at 10 kc and a 0.5 μsec pulse at 20 kc

Short-Pulse Generator

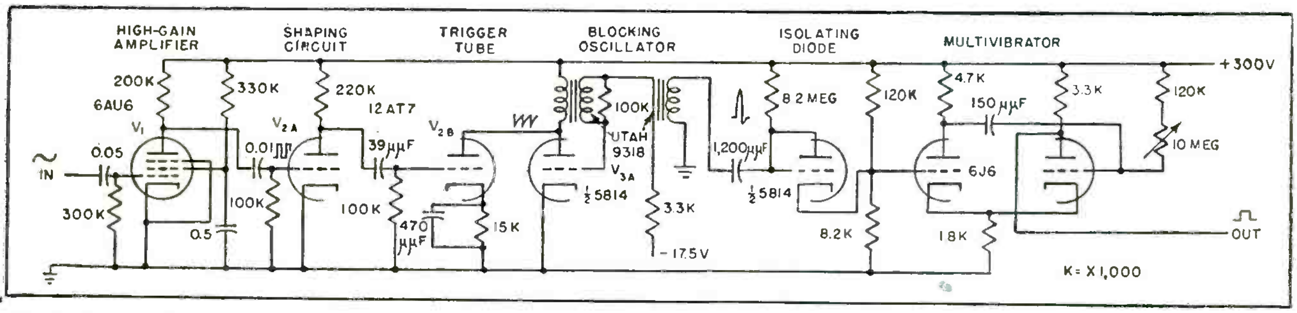


FIG. 1—Circuit diagram of variable-length pulse generator. Power requirement, exclusive of filaments, is about ten watts; regulated B+ and bias supplies are recommended

is fed to a half-section of a 12AT7 and then differentiated to provide a suitably-shaped pulse to fire the parallel trigger tube. Parallel triggering is used with the pulse transformer to isolate the blocking oscillator from its trigger source.[4]

Blocking Oscillator

One-half of a 5814 (or 12AU7) is used in a conventional blocking-oscillator circuit.[5] The developed pulse of the blocking oscillator, the length of which is less than 0.3 μsec and approximately 200 volts in amplitude, is employed as a trigger for the cathode-coupled multivibrator.

Negligible loading of the output winding of the pulse transformer is accomplished by the isolating diode with its 8.2-megohm load. The isolation preserves the amplitude and the waveshape of the blocking-oscillator pulse. The other half triode section of the 5814 (or 12AU7) is connected as a diode, although any other diode may be used as well. The multivibrator circuit is a straight-forward cathode-coupled monostable multivibrator.[6] The 150-μμf capacitor and the setting of the 10-megohm potentiometer determines the length of the generated pulse.

The only parameter in the circuit which is somewhat critical is the bias applied to the blocking oscillator. It should be maintained at the value shown to insure stable operation over the range mentioned, namely 500 cycles to 100 kc, without permitting the blocking oscillator to become free-running. A voltage regulator tube and a suitable dropping resistor could provide the bias. A regulated 300-volt power supply is recommended.

The accompanying oscillograms illustrate the various waveforms obtained from the unit. The amplitudes of the waveforms are in excess of 100 volts.

Applications

For compactness the generator may easily be converted into a self-contained unit. A one-tube Wien-bridge oscillator may be added as a front end, thus eliminating an external sine-wave generator.

The pulse generator may be used wherever well-defined pulses and variable pulse lengths are required; for example, direct Z-axis spot brightening for a cathode-ray tube, gating, counters, markers, and frequency division. By varying the bias on the blocking oscillator, various division ratios may be obtained. Ratios of 1 to 5 have been obtained by the simple expedient of adjusting the bias to a lower value than specified.

Many other applications will suggest themselves to the user of this versatile unit.

REFERENCES

(1) Rufus P. Turner, "Basic Electronic Test Instruments," p 219, Rinehart Books, 1953.

(2) Richard N. Close and Matthew T. Lebenbaum, Design of Phantastron Time Delay Circuits, ELECTRONICS, April 1948, p. 100.

(3) Louis E. Garner, Jr., An Inexpensive Pulse Generator, *Radio and Television News*, p 36, Feb. 1951.

(4) Chance, Hughes, MacNichol, Sayre, and Williams, "Waveforms," p 218, McGraw-Hill, 1949.

(5) *ibid*, p 205.

(6) M.I.T. Radar School Staff, "Principles of Radar," second edition, p 2-53, McGraw-Hill, 1946.

www.americanradiohistory.com

Transient Analysis

Direct-reading instrument, designed for studying persistence of cathode-ray tube screens, measures response under observation at predetermined intervals after step excitation. Only slight modification is required for other applications

By RAYMOND WINFIELD
*Electronic Scientist
Material Laboratory
New York Naval Shipyard
Brooklyn, New York*

When investigating transient waveforms, it is usually necessary to record the waveform for quantitative measurements. Mechanical recorders are satisfactory only where relatively low-frequency components are involved, and for good accuracy high chart speeds must be used. Oscillographic displays require that photographs be taken and generally employ cumbersome and tedious procedure for accurate screen calibration. This is especially true if a wide range of amplitudes is encountered, as is often the case in present-day electronic instrumentation applications.

The instrument to be described is a direct-reading time-selective transient voltmeter intended for persistence measurements on cathode-ray tube screens.

However, the techniques employed should be applicable to a wide variety of additional applications in transient measurements and analysis.

The complete system is shown in block form in Fig. 1 with waveforms to indicate sequence of operations.

Persistence Measurements

Screen persistence characteristics are measured under periodic screen excitation, Fig. 1H. Screen bombardment by the cathode-ray electron beam produces a rapid rise in screen fluorescence followed by a slower phosphorescent decay, Fig. 1G. The magnitude of phosphorescent light output on successive excitations increases, displaying the screen's build-up characteristic. The desired value of phosphorescence Y may lie on any of the decay curves, each curve having a greater light output at a given time after excitation than in the preceding decay interval. Since each decay curve is different, information about the desired point is supplied once during the entire measurement cycle.

To effect a reading of this value, the multiplier phototube signal is allowed to pass from the phototube amplifier to the output meter only after the desired persistence time has elapsed. Ideally, this condition of signal feedthrough is maintained for zero time. At this instant, the signal is fed to a vacuum-tube voltmeter whose deflection indicates the phosphorescent light output from the screen, Fig. 1F.

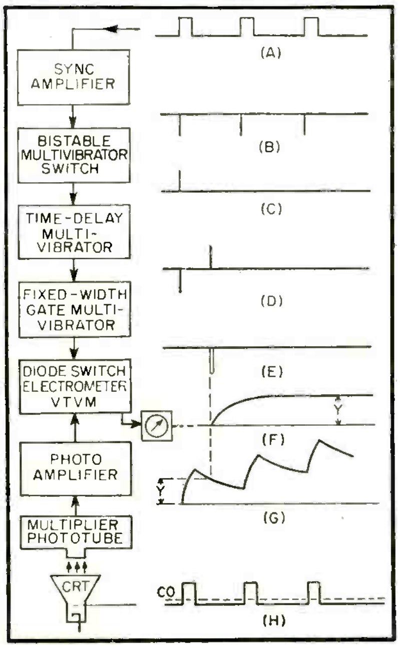


FIG. 1—Block diagram and associated waveforms show sequence of operations

Measurement Cycle

The measurement cycle is initiated by the grid drive signal of the cathode-ray tube, Fig. 1A, 1H, which turns on the electron beam for 1/60 second, once each second. The first leading edge of this waveform establishes zero reference time and is used to trigger a time-delay multivibrator, Fig. 1D, which in turn triggers a fixed-width gate multivibrator, Fig. 1E. This gate is then used to turn on the amplifier and voltmeter circuits for a time equal to the width of the gate pulse. The signal is electronically recorded in this short interval, after which the output meter follows the curve shown in Fig. 1F.

Since the initiating synchronizing signal is periodic, additional gates would be produced, one each second, and the output meter would respond to the changing input to the phototube amplifier at the end of each time-delay interval. To prevent this, a bistable multivibrator is used as an electronic switch to prevent all triggers after the first from triggering the time-delay multivibrator, Fig. 1C.

Circuits

Circuit details are given in Fig. 2 and 3. The synchronizing signal is fed to a sync limiter V_{10} from the cathode of V_{14} and to amplifier V_{8}. Differentiation of the sync signal takes place in the output of V_{14}.

www.americanradiohistory.com

By Time Selection

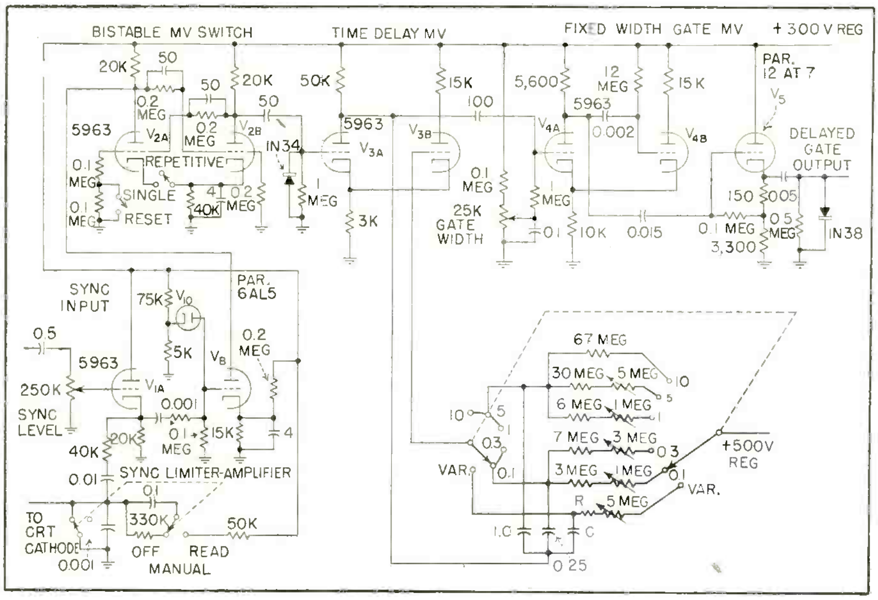


FIG. 2—Complete circuit of sync limiter-amplifier and multivibrator chain

Since the synchronizing signal is obtained from the grid drive voltage of the tube under test, the amplitude will vary with the tube type. For this reason, a sync level control is provided as well as limiting, to keep the maximum trigger voltage at the grid of V_B at approximately 25 volts. This tube is normally biased near cutoff, and with positive sync input, the tube is driven to conduction and triggers the grid of V_{2B}, the normally-conducting half of the bistable multivibrator. These initial conditions are established when an input pulse is generated by pressing the reset switch before the measurement cycle is begun.

The step in plate potential of V_{2B} when the multivibrator flips is differentiated and triggers the time-delay cathode-coupled, monostable multivibrator which delivers a negative pulse to the differentiating circuit at the grid of V_{4A}. The width of this pulse is equal to the desired time delay, (decay time). Subsequent negative triggers from the plate of the sync amplifier produce no further change at the plate of V_{2B} since that tube is already cut off. Therefore, only the first synchronizing pulse is effective in triggering the time-delay multivibrator.

For the specific application shown, delays of 0.1, 0.3, 1, 5 and 10 seconds, preset on calibration, are provided. A variable plug-in delay *RC* is also available. The delay multivibrator is inherently less accurate than Miller type linear sweeps used for highly accurate time delays. However, by returning the grid of V_{3B} to a regulated supply of 500 volts and by regulating the filament voltage, the delay has been found to vary by less than 2 percent in an 8-hour period after initial warm-up.

The output of the time-delay multivibrator is differentiated, Fig. 1D, and the trailing positive pulse triggers the gate multivibrator, V_4 in Fig. 2. This is also a cathode-coupled monostable multivibrator, but differs from the time-delay circuit in that the width of the output is varied by adjusting the bias on V_{4A}.[2] This determines to what value the plate potential will drop when the multivibrator is turned over. This in turn is a measure of how far the grid of V_{4B} is driven negative and beyond cutoff.

Hence, adjusting the gate-width control for a less negative bias will increase the gate width, which is adjustable from approximately 20 to 1,200 μsec. The value chosen for the given application is 500 μsec and depends upon the useful persistence range of the screens under test, which in turn is reflected in the time delays for which the instrument is set up. Since the gate width is only 0.5 percent of the minimum delay of 0.1 second, the change in light output during the 500-μsec gate time is negligible. The output reading can be considered a true indication of the phosphorescence at the end of the chosen decay time.

The output of the gate multivibrator is a negative-going square pulse which cuts off cathode follower V_5, producing a 50-volt negative gate at the grid of V_{6B}, Fig. 3. This tube and V_8 form a modified diode switch with the photo amplifier interposed between the two. With the function switch in the READ-position and no gate present at the grid of tube V_{6B}, the signal at the input to the photo amplifier cannot pass to the input of the electrometer vacuum-tube voltmeter V_9. This occurs because the low plate potential of V_{6A}, due to maximum plate current of V_{6B} corresponding to zero grid bias, is amplified to make the cathode of V_8 negative with respect to its plate for all values of the negative photo input signal.

When the gate multivibrator is triggered, the pulse delivered to the grid of V_{6B} cuts the tube off for approximately 500 μsec. The plate potential of V_{6A} rises and is now passed to the cathode of the diode switch as a negative pulse whose amplitude is proportional to any voltage present at the input to the photo amplifier. It is this pulse which represents the light output of the cathode-ray tube screen at the time the delayed gate is generated.

Diode V_8 now conducts and C_C and C_G are charged, with the voltage across C_G being measured in the cathode circuit of an electrometer vacuum-tube voltmeter.

Electrometer VTVM

This circuit is a modification of a commercial electrometer.[3] The

www.americanradiohistory.com

30,000-ohm resistor in series with the external precision meter was found necessary to reduce excessive damping of the circuit on the selected meter, while the 1.5-volt battery in series with the 60,000-ohm resistor is used to raise the operating current of the 5803 to a value giving good linearity. The extremely low grid current of the 5803 allows the use of the 0.1-μf capacitor C_G as the only grid return without altering the grid potential due to grid-current effects, and produces an extremely high discharge-time constant.

Reading Time

Once the signal charge has been delivered to C_G loss of charge is determined by the potential at the cathode of V_{7A}, the back resistance of V_8, and the leakage of both C_G and C_C. These factors directly affect the reading time, which is the time in which an observer can take a reading before the indication drops a specified amount.

To consider these factors, the operating procedure must be examined. Initially the function switch is set on ZERO 1 position, C_G is shorted out and the electrometer is adjusted to zero. This circuit has a low short-time drift and requires occasional readjustment. In this position the electrometer side of C_C is also shorted to ground and therefore assumes the potential of the cathode of V_{7A}.

When the function switch is thrown to ZERO 2 position, C_G is placed in its normal operating position in series with the photo amplifier output. Diode switch V_8 is now shorted out. Any voltage previously existing at the cathode of V_{7A} is now also across C_C which effectively cancels drift voltage from the photo amplifier, leaving a net output of zero volts across C_G without a signal input. Thus, the function switch may be thrown to ZERO 1 position at any time to zero the photo amplifier automatically.

The cathode of V_{7A} can be adjusted to ground potential with the amplifier zero adjustment when the function switch is in other than READ position and no signal is present. The control need not be adjusted in the normal operation.

If the output of the photo amplifier drifts several volts, then C_C will also operate with this voltage across its terminals in ZERO 2 position and will slowly discharge through its leakage resistance. This will cause C_G to charge slowly and produce a down-scale deflection on the output meter. This will result in calibration error in ZERO 2 position. To make the choice of capacitors somewhat less critical, the circuit shown was chosen to operate the cathode of V_{7A} close to ground potential so that the initial voltage across C_C is nearly zero.

It is desirable to eliminate the coupling battery at the plate of V_{7B} and to ground the 0.2-meg cathode resistor of V_{7A}, thereby eliminating the amplifier zero adjust. Connecting the plate of V_{7B} to the grid of V_{7A} places the cathode of V_{7A} at approximately 170 volts. Because of the switching arrangement, this is cancelled out along with any drift voltage since C_C will now operate at a potential of about 170 volts without a signal. No balancing reference voltage is needed. For a given time interval, however, C_C will discharge by a much greater amount due to the higher initial voltage across it, and will cause a slowly-increasing down-scale deflection since the sum of the voltages across C_C and C_G must equal the cathode voltage of V_{7A}. Use of a laboratory grade capacitor for C_C will correct this.

With the function switch in ZERO 2 position, full scale d-c meter calibration is effected. The output from the phototube for a standard light source is adjusted until the output meter reads full scale. Tube V_{6B} is inoperative with its cathode circuit open, simulating the presence of the delayed gate which cuts off V_{6B}. However, the accuracy of this method is affected by the charging time constant under actual pulse input to the cathode output circuit of V_{7A}, consisting of the forward resistance of diode V_8 and C_C and C_G in series. It is also affected by the leakage resistance of each capacitor since the voltage division between the two is not the same for both a-c and d-c inputs. The leakage time constant of the two capacitors would have to be equal for this to be true.

Capacitor C_C serves the purpose of reducing the charging time constant in addition to zeroing the amplifier automatically as described above. The value used is a compromise to obtain reasonably fast charging time, long discharge time for stability of reading, and to keep down the loss of output voltage due to the capacitance divider of C_C and C_G in series. An alternate method for obtaining a fast charging time is that of cascaded diode-coupled circuits[4,5] where a fast charging circuit is followed by a slow one. This was not attempted because of extra switching circuits entailed.

Reading

After the meter has been zeroed and calibrated, the function switch is placed in the READ position. This completes the cathode circuit of V_{6B}, and places the diode gate V_8 in series with the amplifier output. A reading can now be taken after setting the desired time delay and

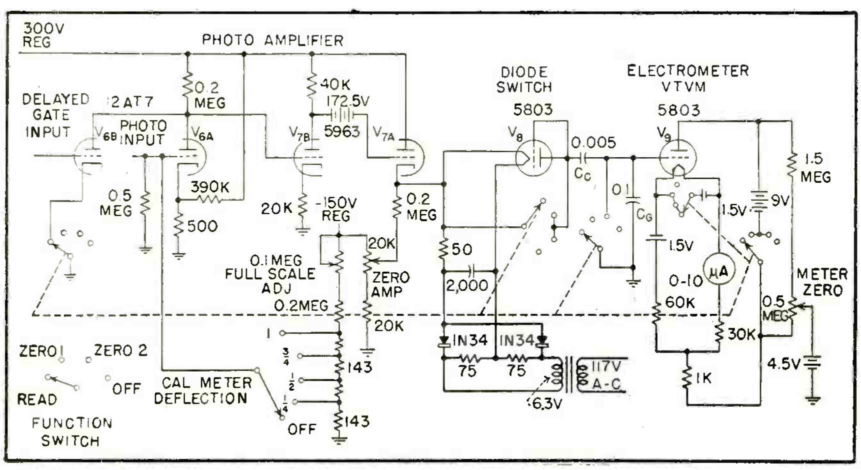
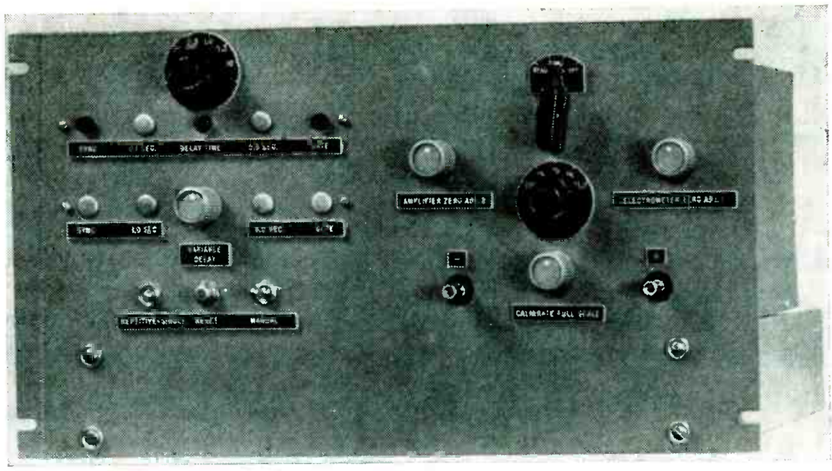


FIG. 3—Gated photo amplifier and electrometer vacuum-tube voltmeter circuits

www.americanradiohistory.com

then turning on the grid drive signal, Fig. 1A and IH, which initiates the measurement cycle. The delayed gate is then generated and cuts off V_{6B} for the duration of the gate width, while C_G is charged. For the component values shown, and using an allowable charging time of 500 μsec (gate width), the output will indicate approximately 96 percent of full scale under actual test conditions in the READ position, with a photo input equal to that giving full scale in ZERO position. Since doubling the gate width produces only about 1 percent increase in deflection, no attempt was made to improve the charging time by reducing the capacitance of C_C. This would require a greater input with a loss of linearity, a higher leakage resistance for C_C, and a greater back resistance for the diode gate V_8.



Front panel view of time-selective transient voltmeter used for cathode-ray tube persistence measurements

Calibration Error

The error in d-c calibration can be eliminated by dynamically calibrating the full scale reading in the READ position where the reading takes place only on arrival of the delayed gate at the grid of V_{6B}, as in an actual test reading. With the use of the MANUAL switch, a trigger is internally generated which results in a gate being delivered to V_{6B} in the same manner as the external synchronizing signal.

If the output of the phototube is adjusted each time after a reading is taken until a full scale reading is achieved, for a standard light source, then all calibration error is eliminated. This method takes slightly longer than d-c calibration but is not at all difficult. The overall linearity in either case is approximately 1 percent of full scale, and the frequency response of the amplifier is adequate for the specified working range. An input of approximately 0.5 volt at the photo input terminal will produce full scale deflection of the output meter.

When the function switch is in the READ position with the gate inoperative the potential at the cathode of V_{7A} is approximately 40 volts higher than in the ZERO 1 and ZERO 2 position due to the change in plate potential of V_{6A}, although this varies with the photo input signal. This will cause C_G and C_G to charge to this value or C_G will discharge if a reading has already been taken. In either case a down-scale deflection will occur unless the back resistance of V_8 is extremely high. Clamping may be used to keep the cathode of V_{7A} near its initial potential.

The diode back resistance is the most critical factor influencing stability of zero and the constancy of deflection. Ordinary receiving-type diodes or high-voltage diodes do not have sufficient back resistance for this application. For example, a discharge time constant of 100 seconds requires a back resistance of 20,000 megohms. This is a relatively short time constant for in 10 seconds the reading will fall approximately 10 percent.

The circuit illustrated can maintain its reading for approximately 5 minutes before the reading will drop more than 2 percent of full scale. This is obviously more than ample time for an observer to take a reading. However, if it is desired to obtain several points on a transient waveform in a single measuring cycle, a large reading time is desirable, especially if a difference in readings is required.

By duplicating the system from the output of the bistable switch to the input of the vacuum-tube voltmeter for each additional point on the transient, the grid of the output meter may be switched to each 0.1-μf capacitor.

Other Features

Additional features are a MANUAL switch for manually de-energizing a cathode-ray tube screen and simultaneously initiating a trigger for producing a delayed gate. It is also used for calibration as described above. For calibrating the time-delay multivibrator, the bistable switch is converted to an amplifier for continuous triggering of the delay multivibrator.

This is accomplished by throwing the REPETITIVE-SINGLE switch to REPETITIVE position. This opens the cathode of V_{2A} allowing V_{2B} to act as an amplifier.

The REPETITIVE position may also be used to monitor the continuous rise in the value of Y, Fig. 1G, in successive decay intervals. Internal calibration voltage is provided for checking the linearity of the photo amplifier and vacuum-tube voltmeter.

The instrument described resulted from work on a project of the Naval Material Laboratory to simplify evaluation of long persistence phosphors originally established at the M.I.T. Radiation Laboratories. The author is indebted to D. H. Andrews and B. Bernstein of the Material Laboratory for their helpful suggestions, and to M. Turntine who constructed the instrument and aided in the testing of the final unit.

REFERENCES

(1) Joseph C. Tellier and Joseph F. Fisher, Testing Long-Persistence Screens, ELECTRONICS, p 126, Feb. 1948.

(2) "Waveforms," Volume 19, Radiation Laboratory Series, p 170, McGraw-Hill Book Company, Inc., New York, 1949.

(3) Vacuum Tube Electrometer, Keithley Instruments, Cleveland, Ohio.

(4) Peak Signal Monitor Circuits, *Electronic Engineering*, p 365, Aug. 1952.

(5) "Waveforms," Volume 19, Radiation Laboratory Series, p 509, McGraw-Hill Book Company, Inc., New York, 1949.

www.americanradiohistory.com

Pulse Averaging Circuit

Voltmeter-type device employing three standard tubes and three crystal diodes measures average of varying input pulse train with pulse widths as small as 0.35 microsecond. Assuming linear output, maximum error is 10 percent full-scale reading. Improvement is obtained by sacrificing minimum pulse width

By F. E. BOYD
and N. W. GUINARD
Naval Research Laboratory
Washington, D. C.

MEASURING THE AMPLITUDE of pulses can become extremely tedious and time consuming especially when more than a few pulses must be observed. In a repetitive system it is not always necessary to determine the amplitude of every pulse since the average amplitude of a number of pulses will yield the desired information. If the spread as well as the average is required, such a device becomes an important auxiliary.

The basic circuit shown in Fig. 1 has been used previously in a counting rate meter[1] but in adapting the circuit for measurement of average amplitude information a number of important modifications became necessary.

Basic Voltmeter

A positive pulse of amplitude E is applied across C_1 in series with diode D_1 and C_2. Capacitance C_1 is much smaller than C_2 and therefore C_1 becomes fully charged during each pulse. Regardless of the relative sizes of C_1 and C_2, the same amount of charge is deposited on each.

$$q = C_1E \tag{1}$$

Diode D_1 serves to isolate C_2 during the discharge period between pulses so the voltage that builds up across C_2 is proportional to the average amplitude of the pulses.

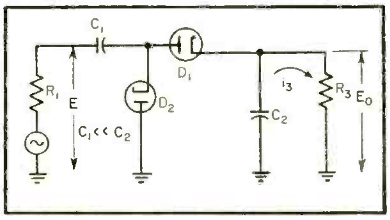


FIG. 1—Basic voltmeter circuit

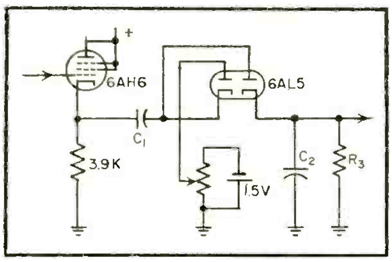


FIG. 2—Circuit using vacuum diode

Output voltage, E_0, is

$$E_0 = i_3 R_3 \tag{2}$$

and since $i = \delta q/\delta t$,

$$i_3 = nq \tag{3}$$

where n is the number of pulses per second. Substituting the value of q from Eq. 1

$$i_3 = n\, C_1\, E \tag{4}$$

and using this value of i_3 in Eq. 2

$$E_0 = n\, C_1\, E\, R_3$$

Since the circuit is sensitive to pulse rate and pulse amplitude, either one can be measured by holding the other constant.

Linearity of the system is dependent on the value of C_1 and the back resistances of diodes D_1 and D_2 in series. But the minimum usable pulse width is the shortest possible time required to charge C_1 fully, and this is dependent on the forward resistance of diode D_1 as well as the output impedance of the driver.

Improved Rectifier

The solution to this situation depends on a diode with zero forward resistance and infinite back resistance. Since this condition is impossible to obtain, two alternatives present themselves. For the measurement of pulses of greater width than one microsecond, a 6AL5 tube is used for D_1 and D_2 as shown in Fig. 2. A battery is inserted to balance out the Edison effect of the diodes. This circuit has good linearity and will give a fairly accurate average for the prescribed pulse. Unfortunately this arrangement will not work for pulses much shorter than a microsecond since the forward resistance of D_1 is too great to allow C_1 to charge fully and therefore the circuit becomes pulse-width sensitive.

Practical Circuit

In the completed circuit, Fig. 3, the charging time constant has been lowered by using crystal detectors in place of diodes and also a very low-output-impedance driver. The forward resistance of a crystal is about 80 ohms as compared with a diode forward resistance of about 200 ohms. Unfortunately, one difficulty arises that is not present when the vacuum diode is used. The crystal resistance is dependent on applied voltage as shown by the curve in Fig. 4.

www.americanradiohistory.com

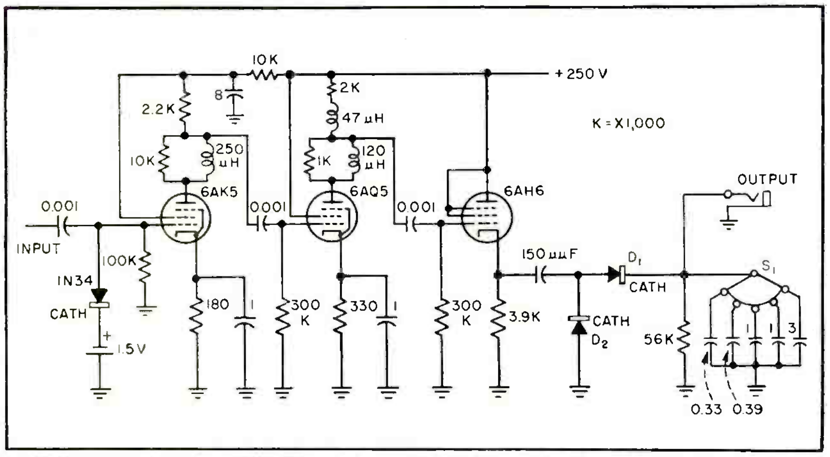


FIG. 3—Pulse-averaging voltmeter circuit

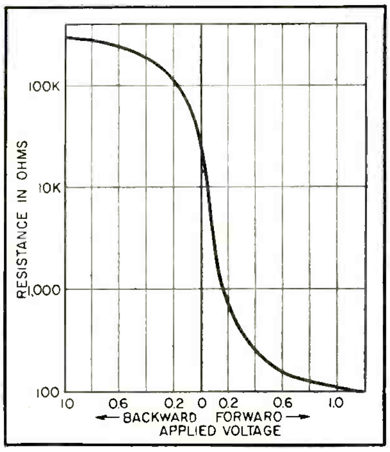


FIG. 4—Resistance of 1N35 unit

When the back voltage is below 50 mv the effective back resistance is relatively low—less than 50,000 ohms. At this point an appreciable portion of the discharge current from C_2 (Fig. 1) is through the back resistance of the crystals. This condition results in the nonlinear output shown in Fig. 5A. By increasing C_1 to 450 μμf. the voltage output is raised appreciably and the nonlinearity is improved to 4 percent of full-scale reading. However, the minimum measurable pulse width is 0.7 μsec, as compared with 0.35 μsec with C_1 equal to 150 μμf. If the value is reduced very much below 100 μμf the performance is adversely affected by stray capacitance.

To minimize the nonlinear output it is important to select crystals for use at D_1 and D_2 that have higher back resistance at low levels of applied voltage. This can be done by measuring the back resistance with 50 mv applied. In general, the individual units of the type 1N54 crystals exhibit higher back resistance than the type 1N34 units.

Temperature Characteristics

Crystal characteristics vary radically when units are subjected to high temperatures, such as occurs when enclosed in apparatus containing a number of tubes or dissipating elements in a confined space. Therefore, care should be exercised in physical arrangement and ventilation.

Another compromise which must be made concerns R_3. The output voltage must be a quantity large enough to measure conveniently. Because the current is small, R_3 must be fairly large. Yet, R_3 must be kept much smaller than the combined back resistance of the crystals and of such a value that the time constant $R_3 C_2$ is large enough to average the pulses. Capacitor C_2 is limited by the consideration that the voltage developed across it must be much smaller than that of C_1 so small pulses will not be neglected in the average.

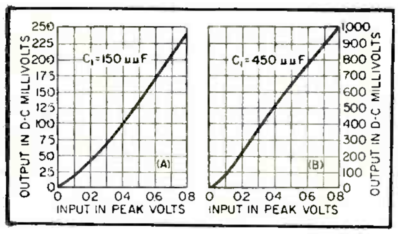


FIG. 5—Amplitude characteristics for two values of series capacitor in Fig. 1 and 2

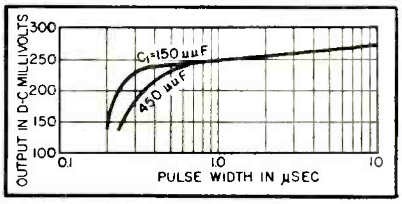


FIG. 6—Effect of pulse width with constant peak amplitude for two values of series capacitor

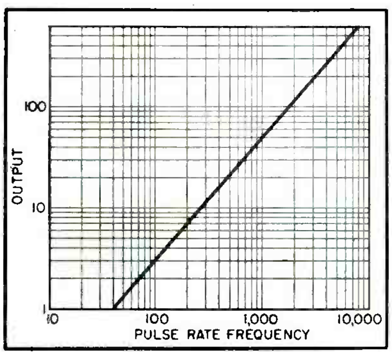


FIG. 7—Effect of pulse rate frequency on output

The first three tubes in Fig. 3 make up a 3.5-mc video amplifier permitting a one-volt positive pulse to give an output of 0.3 volt d-c. A selection of averaging times is available at switch, S_1. The crystal at the 6AK5 grid serves as a limiter, preventing burnout of the other crystals.

This voltmeter is especially sensitive to noise because noise contains many high-frequency components. Output increases with frequency and therefore a small noise voltage produces a relatively large output. In one instance of use where noise was unavoidable, its effect was successfully eliminated by the insertion of a squelch circuit.

For measuring the average of pulses whose width is 1 microsecond or greater the use of the circuit in Fig. 2 is reasonably accurate. The circuit of Fig. 3 will produce an average of a varying pulse train with pulse widths as small as 0.35 microsecond. Assuming linear accuracy, maximum error will be 10 percent of full scale reading.

REFERENCE

(1) *Nucleonics*, p 43, Apr. 1948.

www.americanradiohistory.com

Rate-of-Descent Indicator

Reflected-light system uses phototube-triggered thyratrons to measure vertical speed of landing planes. Unit makes available immediately information that formerly required time-consuming analysis of photographs

By MYLES V. BARASCH

Staff Engineer
Missiles and Control Equipment
North American Aviation, Inc.
Downey, California

BASIC information required during acceptance tests of aircraft includes the vertical component of the rate of descent just prior to touchdown. This information is used as an aid in determining the impact on landing gear and other structures of the plane.

Prior to the development of the unit to be described cameras were used exclusively for obtaining rate-of-descent data. Airfield installation required cameras to be loaded and set with precision. Reduction of the information obtained by this method required considerable time and in many cases results would vary as much as 30 or 40 percent.

The employment of a doppler radar to measure rates of descent has been tried, but such a system requires aircraft modifications that increases weight, cost, and complexity. These factors have discouraged the use of doppler radar other than for flight tests.

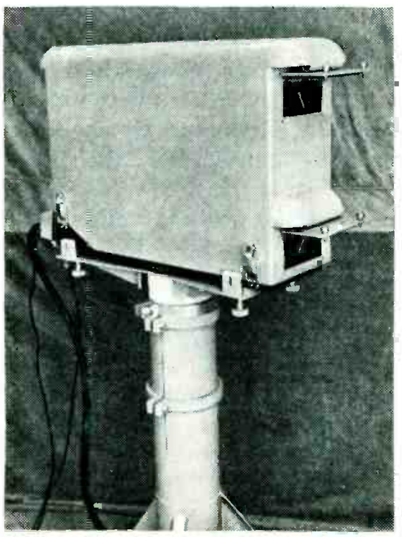
TRODI

Factors considered in developing the Touchdown Rate of Descent Indicator (TRODI) required that a minimum of equipment be installed in the aircraft, and rate-of-descent values should be immediately available on direct-reading meters. The unit also had to be light weight, portable and easy to calibrate.

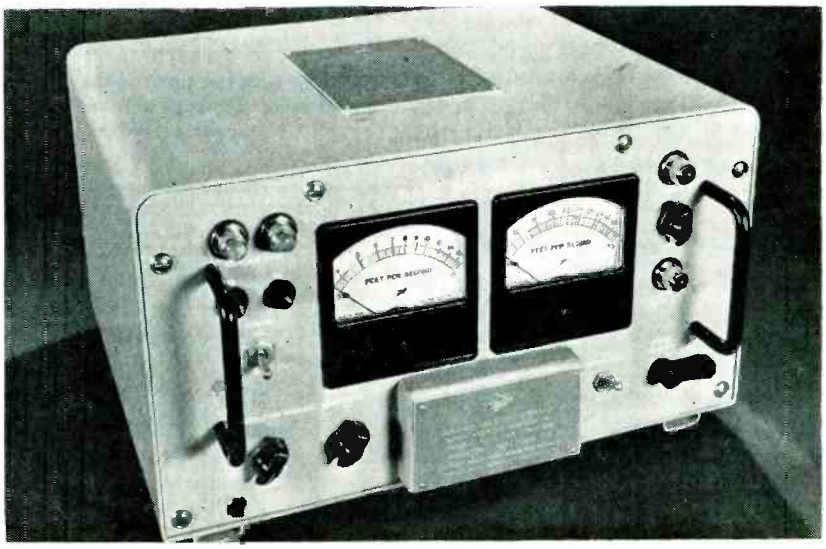
To satisfy these requirements, a unit combining electromechanical and optical components was designed. Readings obtained are a function of the time it takes an aircraft to descend a vertical distance of one foot.

A trihedral prism weighing less than 1¼ pounds is the only part of the system installed on the plane. The trihedral prism because of its three mutually perpendicular reflecting surfaces, will reflect any incident light directly to its source as shown in Fig. 1.

The prism is mounted on the landing-strut that will be nearest the detector unit during landing. If the design of the aircraft makes a strut unavailable for the installation of the prism, another location may be chosen, preferably near the plane's centerline to reduce the pos-



Detector portion of unit transmits and receives light beams



Nonlinearity of velocity scale makes two meters necessary to cover range from 3.5 to 35 ft per sec

www.americanradiohistory.com

Speeds Aircraft Tests

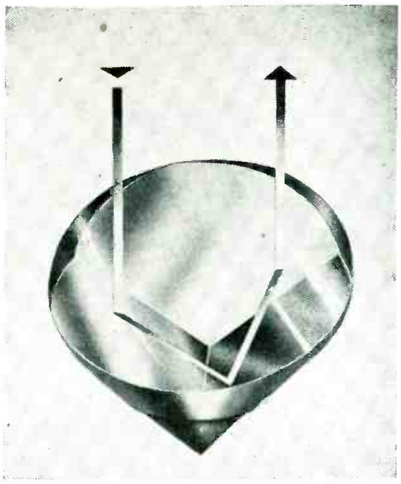


FIG. 1—Prism returns light to its source

Two-unit descent indicator measures time required for plane to descend one foot

sibility of false readings caused by aircraft roll. The prism must be mounted so that it can see the detector unit, but need not be aimed precisely toward it. The prism is mounted pointing 15 degrees outboard of the longitudinal axis of the aircraft. The prism installation is simple and in no way critical, requiring no modification of the aircraft.

The basic installation consists of a detector assembly and indicator assembly. A block diagram of both units is shown in Fig. 2.

The Detector

The detector assembly projects and receives beams of light. It contains two light sources and a rotating disk that chops the beam of light at a frequency of 5,600 cps.

Light from a vertical lamp filament passes through a heat-absorbing glass into a lens system and is focused on the plane of rotation of a radially-slotted chopping disk. A stationary vertical slot with a width approximately equal to that of the disk slots is mounted immediately in front of the chopper.

Chopped light from the disk is reflected downward through a prism toward the axis of the lower receiving lens. This prism, composed of two right-angle prisms housed together, rotates the filament image 90 deg. so that its length is in the horizontal direction.

The light then passes through a cylindrical lens mounted in contact with the prism. The focus of this lens is placed at or near the filament image and the rays of light leaving the lens fan downward.

A right angle prism reflects this fan forward into a horizontal plane. The fan is nearly 30 deg. wide and less than one deg. thick vertically. The width equals the angular spreading of the rays leaving the chopper, while the thickness is determined by the cylindrical lens.

By means of a similar optical system, an upper fan of light is projected forward one foot above the lower fan. The thickness of the two fans increases with distance and they overlap and merge at a distance of about 70 feet. At 200 feet, each fan has a width of about 107 feet and a thickness of about 3 feet.

Receiver

When an aircraft descends through the upper fan-shaped beam, the trihedral prism on the landing gear returns the light beam to its source. Light transmitted by the detector is reflected back to this region. Some of this light enters the receiver lens, which focuses the light on a slotted plate. As the trihedral prism descends, its image on the plate ascends. The ascending image falls briefly upon the slit and through a lens system on a 931A phototube. An amber filter is used to increase the signal-to-noise ratio by excluding much of the blue sky light, while admitting most of the light returning from the trihedral prism.

The optical system that transmits the beams of light determines a fan of illumination several inches or feet thick. The receiving optical system determines a fan of sensitivity such that the light source must be in this fan to illuminate the phototube. The fan of sensitivity is about 30 deg. wide and is fixed by the length of the slit in the plate and the focal length of the receiving lens. The thickness of the sensitivity fan is about 0.5 inch at a distance of 200 feet and lies wholly within the fan of illumination.

When light reflected by a trihedral prism entering the upper fan of illumination reaches the upper slit, the upper phototube is briefly illuminated and its resultant pulse triggers a timing circuit in the in-

www.americanradiohistory.com

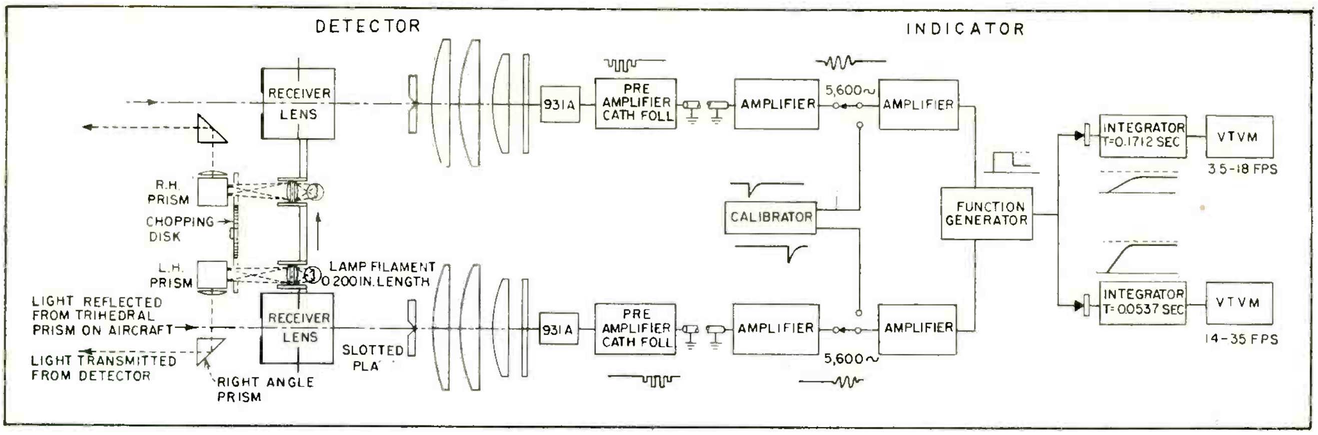


FIG. 2—Block diagram of optical and electronic system of rate-of-descent indicator

dicator unit. The lower phototube is unaffected at that time, because no light from the prism can enter the lower slit. As the prism descends into the lower fan of illumination, the lower phototube is affected and this second pulse triggers its timing circuit in the indicator. The time interval between the two triggers is measured and, since the two fans of sensitivity are precisely one foot apart, the rate of descent is determined.

The Indicator

The method of measuring the time interval, as the aircraft drops the one foot between the two optical receiving fans is illustrated in the block diagram, Fig. 2.

Light reflected to the upper phototube from the trihedral prism is modulated at 5,600 cps. This light causes a 5,600-cps current to flow through the multiplier phototube creating a voltage across its plate-load resistor. This voltage is amplified by a single triode stage and supplied by a cathode follower through a 250-foot low-capacitance coaxial cable to the indicator unit.

The 5,600-cycle signal received at the indicator unit is further amplified by two triode stages; one utilizing a resonant circuit as the plate load to narrow the bandwidth of the amplifier and improve the signal-to-noise ratio. The amplifier signal is used to trigger a thyratron, which acts as a switch to connect a carefully-regulated voltage to two R-C circuits allowing the capacitor to charge.

The signal caused by the trihedral prism, when it passes through the sensitive area of the lower phototube, is handled in the same manner as the signal to the upper tube. This signal triggers a second thyratron to remove the applied voltage from the R-C combination. The capacitor voltage which is approximately proportional to the elapsed time is applied through a cathode follower to an ammeter in a compensating and balancing circuit.

Meters

Since velocity of descent is equal to one foot divided by the elapsed interval of time, the velocity scale on the meter is nonlinear. This nonlinearity is so great that it is impractical to cover the entire operating range from 3.5 to 35 ft per sec with one meter and still provide good accuracy. To assure accuracy, two R-C networks with time constants adjusted to cover different ranges are charged simultaneously. The rate of descent is thus indicated on two separate meters; one meter covers the slow descent range of 3.5 to 18 ft per sec, the other meter covers the fast descent range of 14 to 35 ft per sec. By this means, the scale divisions are sufficiently separated to permit instruments of 1-percent accuracy to be utilized.

The reading remains on the meters for an appreciable length of time without evident change, providing sufficient time for observation and recording.

The instrument is reset by a control that extinguishes the thyratrons and discharges the memory capacitors.

Gain controls are provided in the two amplifying channels in the indicator unit and are accessible during operation. The gain of the first channel is adjusted so that random noise-pulses trigger the thyratron at approximately 2-minute intervals. Because the second channel cannot be triggered until the first channel is actuated, the gain of the second channel is adjusted to provide a delay of approximately 20 seconds after the first channel is triggered before it will trigger on random noise pulses.

Calibration

To calibrate the indicator unit internally, a precision one-shot multivibrator is provided to produce two pulses separated by time intervals corresponding to 3.5 ft per sec, 14 ft per sec, and 35 ft per sec. These pulses trigger the thyratrons and are utilized to adjust the meters accurately.

When TRODI is used in the presence of excessive ambient light, as when the detector is facing the sun, it is found necessary to increase the brightness of the projected beams. Therefore, a beam-intensity control has been incorporated in the system. This control increases the brilliance of the projection lamps giving a more intense beam and increasing the signal-to-noise ratio. Beam-intensity controls are located on the detector and indicator units, to enable beam intensity to be increased from either position.

www.americanradiohistory.com

Toroid Design Charts

Reference to these charts permits speedy determination of Q, frequency range, size and type of permalloy core, wire size and number of turns for toroidal transformers to meet performance specifications in the 1-kc to 100-kc frequency range

By R. E. PROUTY

Sound Division, Airborne Sonar Branch
Naval Research Laboratory
Washington, D. C.

IN DESIGNING toroidal transformers it is necessary to determine the proper type (permeability) and size of core and the required size and number of turns of wire. Circuit considerations set the required Q, inductance and operating range. The accompanying charts tie all the parameters together. A majority of the possible combinations for 0.8-in. O.D., 1.06-in. O.D. and the 1.84-in. O.D. molybdenum permalloy cores are covered.

Design

In searching for the ideal toroidal transformer for a given application, the practical limits of each core and wire size are first established.

Each master chart (Fig. 1, 2 and 3) covers one core size. Each chart is plotted on 5-cycle log-log paper. The number of turns of wire necessary to obtain a given inductance for cores with typical mu values can readily be found. The horizontal lines that intersect the diagonal lines at their approximate upper limits establish, for the wire sizes indicated, the maximum number of turns that can be hand wound on that size of core.

By winding over two cores instead of one, the inductance can be exactly doubled for a given number of turns of wire. For example, referring to Fig. 1, the maximum possible inductance obtainable with No. 24 wire on a single core of 125 mu in the 1.84-in. size is 400 mh. In other words a maximum of 1,200 turns

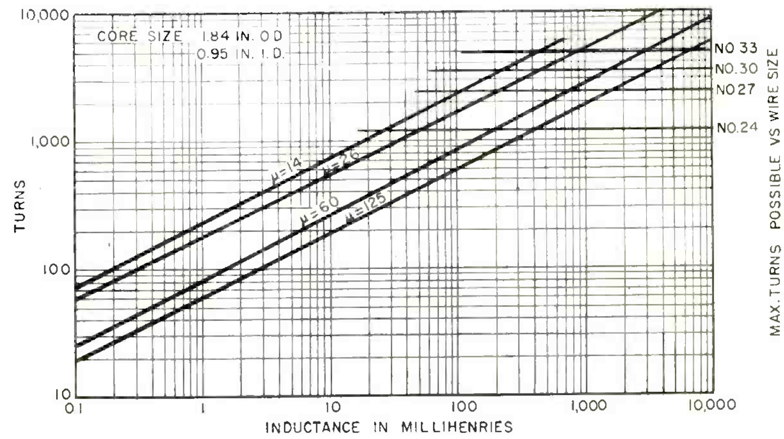


FIG. 1—Master design chart for toroids with 1.84-in. (O. D.) cores

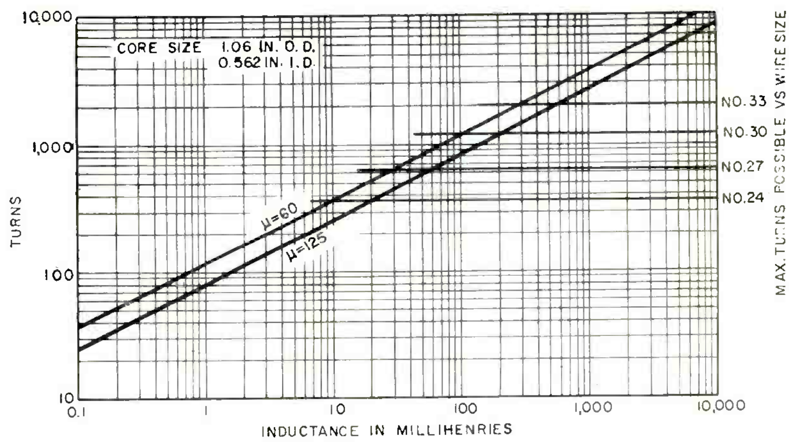


FIG. 2—Master design chart for toroids with 1.06-in. (O. D.) cores

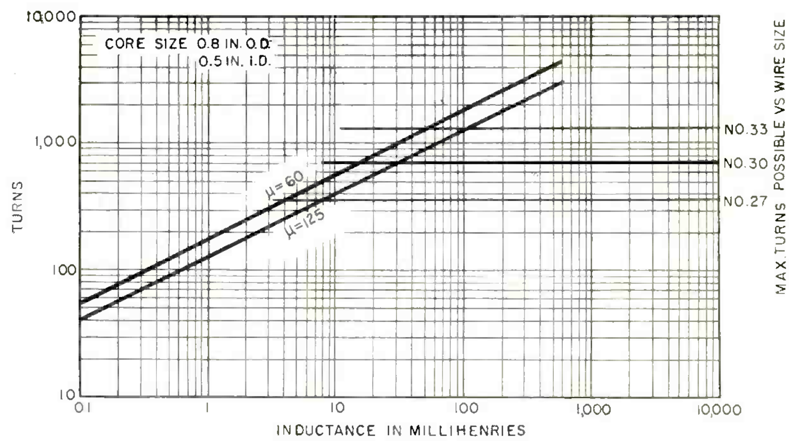


FIG. 3—Master design chart for toroids with 0.8-in. (O. D.) cores

www.americanradiohistory.com

TOROID DESIGN CHARTS *(continued from p 193)*

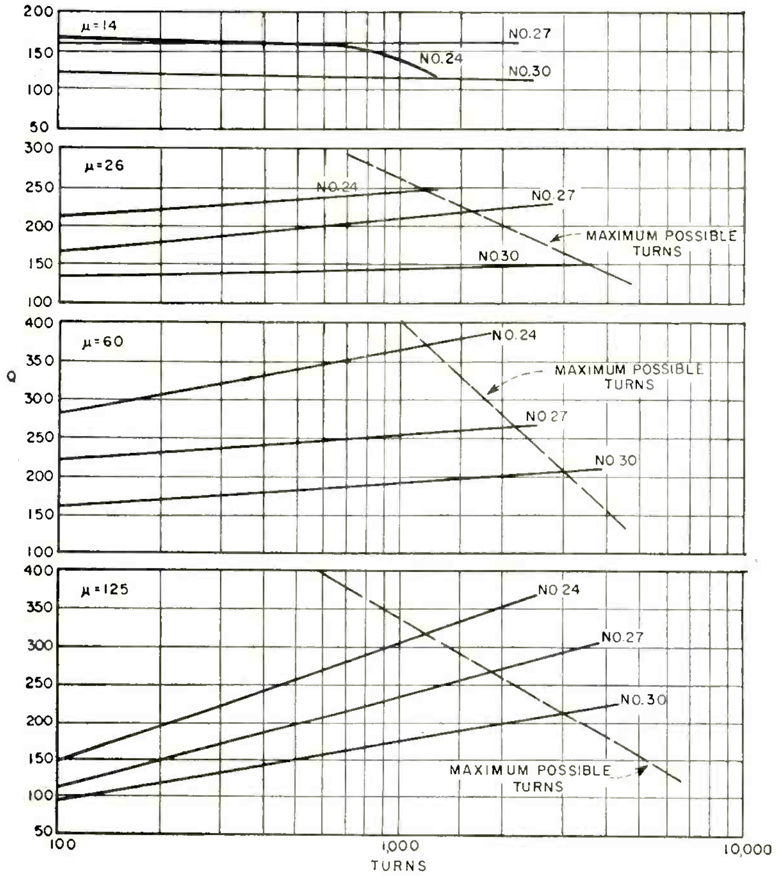


FIG. 4—Auxiliary design chart for toroids using 1.84-in. cores

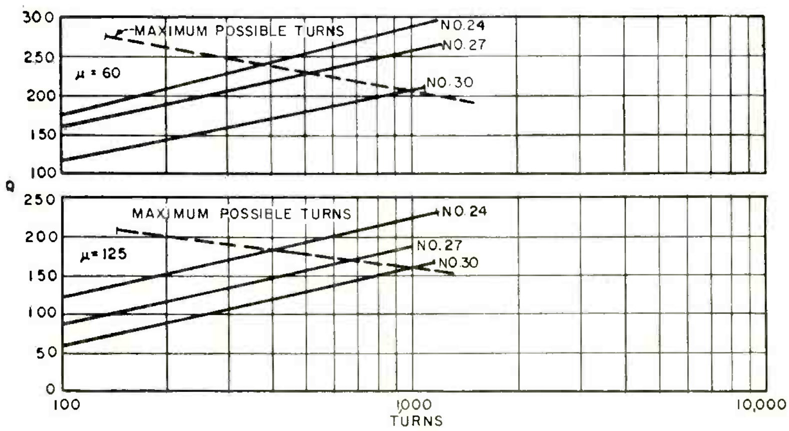


FIG. 5—Auxiliary design chart for toroids using 1.06-in. cores

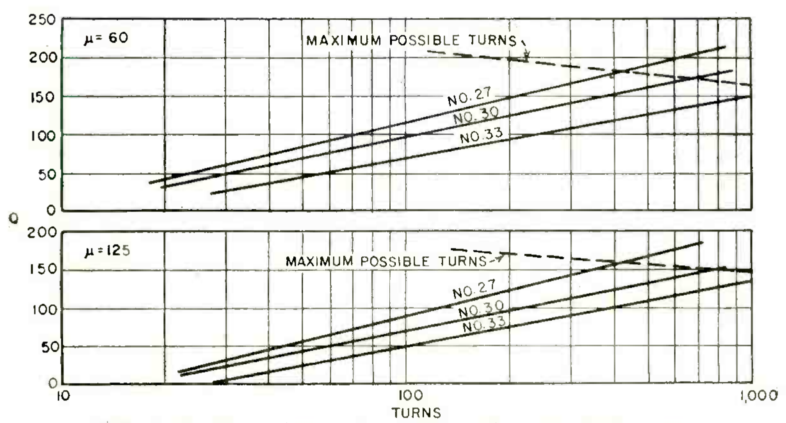


FIG. 6—Auxiliary design chart for toroids using 0.8-in. cores

of No. 24 wire can be wound on a 1.84-in. core. Using two superimposed cores, an inductance of 800 mh can be obtained with only 1,200 turns. Since this is a logarithmic progression, halving the number of turns will not halve the inductance.

Figure 1 is supported by a turns-against-Q chart (Fig. 4.) for each of the four core types. These show the actual Q obtained by winding the specified number of turns. Diagonal Q lines are plotted for each wire size. These are intersected by a dashed line indicating the limit of the number of turns that can be wound on a given core.

Figures 5 and 6 similarly refer to the master charts, Fig. 2 and 3 respectively.

Chokes

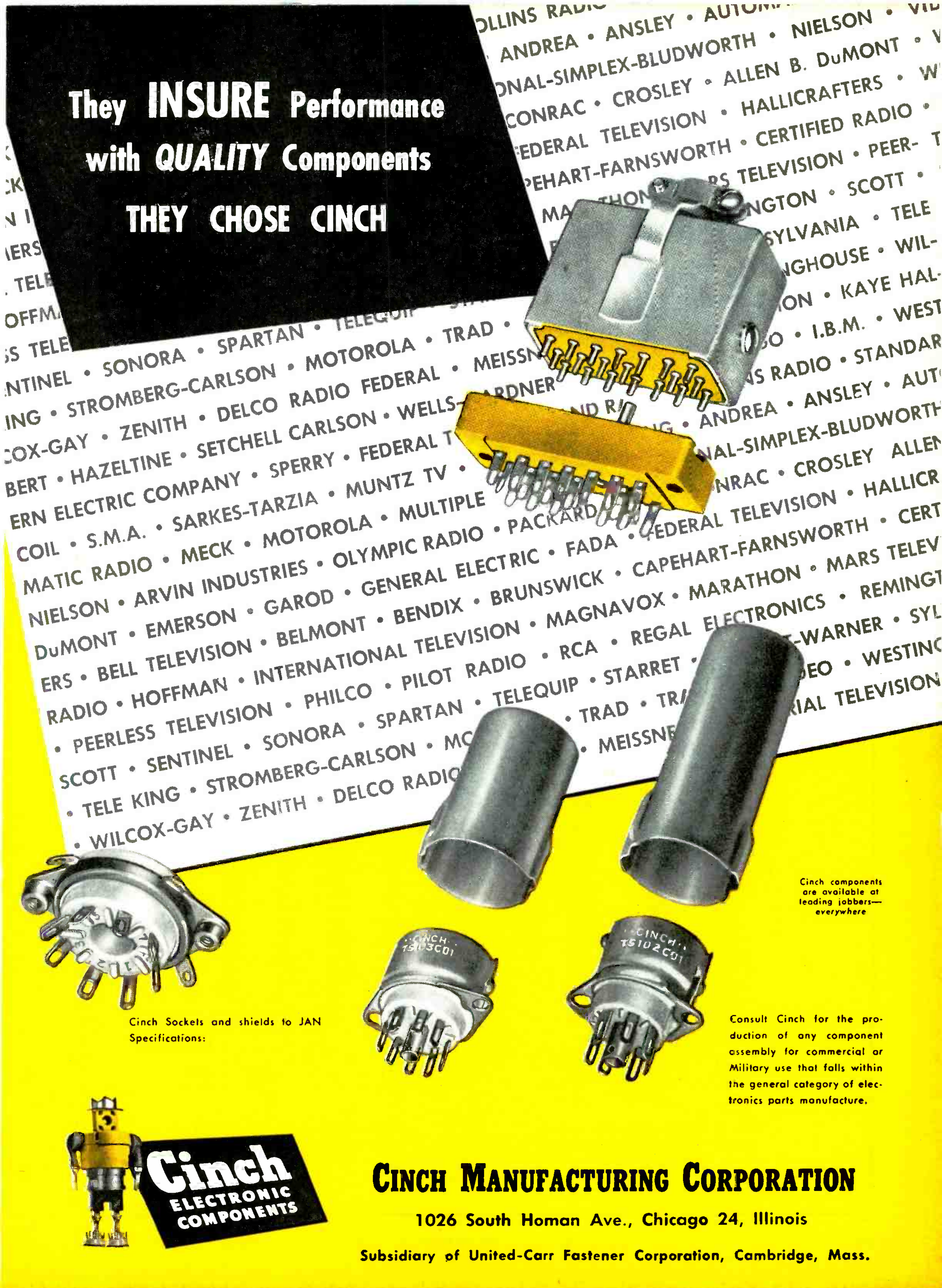
Since a transformer is nothing more than a multiplicity of chokes wound upon a common core, the data is valid for either a choke or transformer. In designing a transformer, the total number of turns of wire (primary and secondary) must be kept in mind. Since maximum efficiency is obtained when the toroidal core is wound fully with wire, the smallest possible core, or the largest possible wire size should always be chosen; Q, of course, holds precedence over other factors. The larger the diameter of wire used, the higher the Q. The choice of core permeability is inversely related to the operating frequency desired. The higher-mu cores operate best at the lower frequencies and conversely.

There is no set rule for using these charts. Some may find it more expedient to look first for the highest obtainable Q at a given frequency, then settle for the core that will provide it. Others may be inductance conscious and settle for the highest obtainable Q at a given inductance.

Figures 7 to 9 give quantitative data on toroids wound by the the author in compiling the accompanying charts.

(continued on p 196)

www.americanradiohistory.com



www.americanradiohistory.com

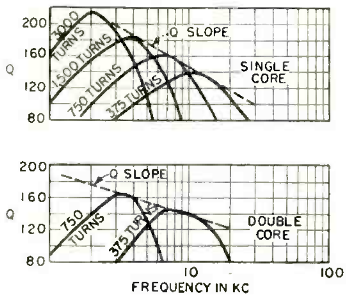
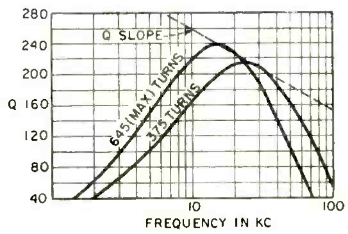


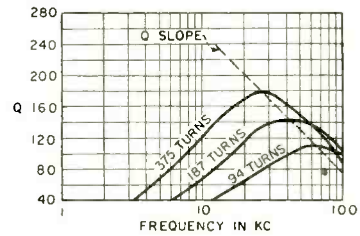
FIG. 7—Design data for toroids wound with No. 30 Formex wire on 1.84-in., 125-mu core.

	Single Core				Double Core	
Freq in kc	375 turns Q	750 turns Q	1,500 turns Q	3,000 turns Q	375 turns Q	750 turns Q
1	25	50	100	162	35	90
2	50	100	158	215	65	140
3						165
4	100	148	185	155	115	160
6	120	160	152	70	140	100
7		162			145	
8	135	158	100		140	43
10	140	138	60		142	
12	138	118	35		135	
15	130	87			117	
18	118	55			100	
20	104	45			82	
22	100				70	
25	94				55	
30	70					
40	45					
50	26					
L(mh)	38.7	154	618	2,530	78	
Q	140	162	185	215	145	
$C(\mu f)$	0.006	0.003	0.0024	0.0025	0.006	
$R_{d\text{-}c}$	7.75	16	33.7	73	12.6	



Freq in kc	375 turns Q	645 (max) turns Q
2	42	65
3	65	100
4	82	125
5	100	150
6	118	170
7	130	185
8	145	200
10	168	215
12	182	230
15	202	238
18	205	232
20	212	228
25	215	210
30	210	190
40	185	138
50	162	100
60	140	68
70	115	
80	90	
90	72	
L (mh)	10.2	30.05
Q	215	238
$C(\mu f)$	0.0039	0.0038
$R_{d\text{-}c}$	2.47	4.6

FIG. 8—Design data for toroids wound with No. 27 Formex wire on 1.06-in., 60-mu core



Freq. in kc	94 turns Q	187 turns Q	375 turns Q
4			55
6		43	80
8		58	100
10	38	68	120
12	43	80	136
15	48	90	152
18	62	109	165
20	65	118	170
30	85	138	176
40	100	142	162
50	102	139	148
60	112	138	138
70	108	132	128
80	106	120	108
90	104	112	98
100	99	104	86
120	92	90	70
150	79	77	
180	64	68	
L(mh)	0.3	1.14	4.68
Q	112	142	176
$C(\mu f)$	0.0177	0.0141	0.0059
$R_{d\text{-}c}$	0.382	0.768	1.71

FIG. 9—Design data for toroids wound with No. 27 Formex wire on 0.8-in., 60-mu core

www.americanradiohistory.com

Get Accuracy . . . Flexibility . . . Reliability . . . with
MALLORY RECTOPOWER® SUPPLIES

√ BROAD DC VOLTAGE ADJUSTMENT RANGE

√ GOOD DC VOLTAGE REGULATION

√ VERSATILE AC INPUT SYSTEM

√ FLEXIBLE DC OUTPUT SYSTEM

√ ADEQUATE DC OUTPUT FILTERING

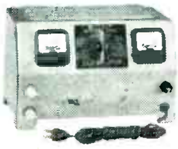
For designing, testing, building and repairing DC electrical and electronic equipment, Mallory Rectopower Supplies provide accurate simulation of actual operating conditions over a wide range of fluctuating DC current requirements.

Check these specifications
See for yourself, the advantages you get with Mallory.

SPECIFICATIONS ON MALLORY RECTOPOWER SUPPLIES

Mallory Rectopower Supply Model No.	DC OUTPUT: DC Volts		DC OUTPUT: DC Amps.		Approx. Output Regulation 0 to Cont. Amps.	RMS Ripple at Cont. Amps. Less than		Output Capacity in MFD	AC INPUT		
	Rating	Range	Continuous	Intermittent		Percent	Erms		Volts ±5%	Phase	Watts
6RS10	6	0-8	10	20	60%	15%	1.0	10,000	115	1	175
6RS25-1	6	0-8	25	40	15%	8%	.5	10,000	115	1	400
12RS5	12	0-16	5	10	55%	12%	1.0	6,000	115	1	135
12RS6D	6 or 12	0-8 or 0-16	10 6	20 14	95% 65%	12% 5%	.8 .6	12,000 12,000	115	1	150
12RS14D	6 or 12	0-8 or 0-16	25 14	40 20	15% 6%	10% 3%	.6 .4	6,000 6,000	115	1	400
28RS15D	14 or 28	0-16 or 0-32	30 15	50 25	8% 5%	1% 1%	.14 .28	12,000 6,000	115	1	800
VA400	6 or 12 or 24	0-8 or 0-16 or 0-32	50 25 12½	64 32 16	15% 15% 15%	2% 2% 2%	.16 .32 .64	40,000 20,000 10,000	115	1	1.2 KW
VA800	6 or 12 or 24	0-8 or 0-16 or 0-32	100 50 25	128 64 32	10% 10% 10%	2% 2% 2%	.16 .32 .64	40,000 20,000 10,000	115/208-230	1	2.4 KW
VA1500	6 or 12 or 24	4-8 or 8-16 or 16-32	200 100 50	250 125 63	25% 25% 25%	2% 2% 2%	.16 .32 .64	None None None	208-230 or 460	3	3.0 KW
VA3000	6 or 12 or 24	4-8 or 8-16 or 16-32	400 200 100	500 250 125	25% 25% 25%	2% 2% 2%	.16 .32 .64	None None None	208-230 or 460	3	6.0 KW
VA4500	6 or 12 or 24	4-8 or 8-16 or 16-32	600 300 150	750 375 187	25% 25% 25%	2% 2% 2%	.16 .32 .64	None None None	208-230 or 460	3	9.0 KW
VA6000	6 or 12 or 24	4-8 or 8-16 or 16-32	800 400 200	1000 500 250	25% 25% 25%	2% 2% 2%	.16 .32 .64	None None None	208-230 or 460	3	12.0 KW

6RS25-1
12RS14D
28RS15D



6RS10
12RS60

12RS5

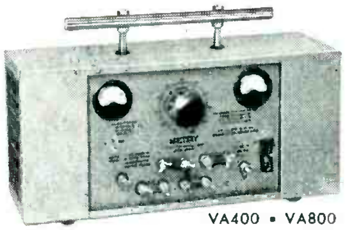
√ *Ample transient power storage capacity.* Mallory Rectopower Supplies are ideal for use with vibrator-powered equipment.

√ *Accurate DC voltmeters and ammeters.* D'arsonval meters with meter range changing switch in VA models. Moving magnet meters in RS models.

√ *Overload protection and "On-Off" switch* in all models. Manual reset AC line overload protection in VA models. Automatic reset overload and reverse battery circuit breakers in RS models.

VA1500
VA3000
VA4500
VA6000

When flexibility, reliability and low cost are important—specify Mallory Rectopower Supplies. They will give you more for your money. For complete information, let us send you a copy of Technical Bulletin 5-27.



VA400 • VA800

Expect more . . . get more from MALLORY

PARTS DISTRIBUTORS IN ALL MAJOR CITIES STOCK MALLORY STANDARD COMPONENTS FOR YOUR CONVENIENCE

P. R. MALLORY & CO. Inc. MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO. INC., INDIANAPOLIS 6, INDIANA

Want more information? Use post card on last page.

www.americanradiohistory.com

ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by ALEXANDER A. McKENZIE

OTHER DEPARTMENTS featured in this issue:

Detector Monitors Vapor Concentration

APPARATUS CONTAMINATION and hazards to personnel from mercury vapor can be held down by control based upon either chemical-absorption or spectrum-absorption detection equipment. Although more expensive, spectrum-absorption devices are more easily calibrated and provide continuous monitoring action. They likewise show when the vicinity is free from contamination.

All substances absorb light at some region of the spectrum. If a spectral region exists where a vapor has a high absorption and the diluent a high transmission, the concentration of the vapor can be measured in terms of light absorbed. The vapor detector to be described is intended for use with vapors having a strong absorption in the 2,537-angstrom region of the spectrum. Designed primarily for the detection of mercury vapor, the instrument gives a quantitative measure of the vapors listed in descending order of magnitude: isopropyl ether, tetraethyl lead, pyridine, benzene, mercury, diethyl acetal, acetone, toluene and illuminating gas. It gives moderate or slight deflection for the vapors of a range of other substances from naptha to turpentine.

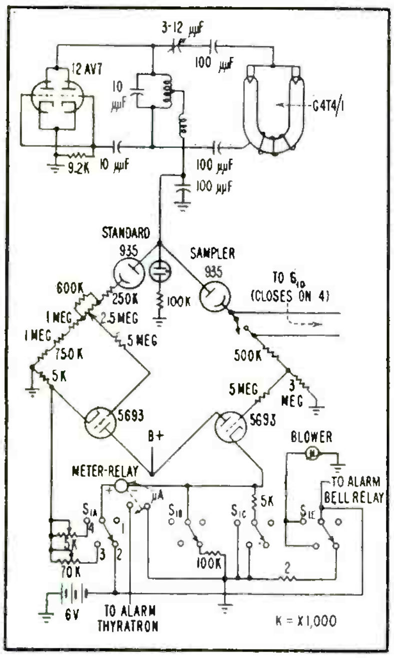
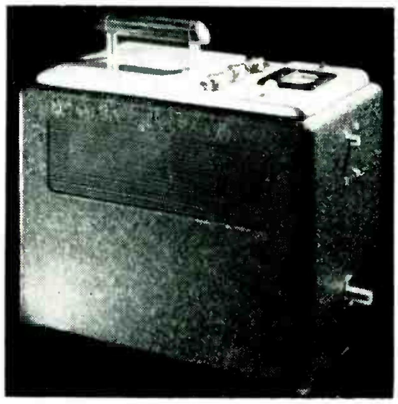


FIG. 1—Circuit diagram of the ultraviolet source and bridge with two phototubes

A schematic diagram of the vapor detector is shown in Fig. 1. Basic operation of the unit centers around a dual-phototube balanced bridge. Two tubes are used because the mercury-arc light source lacks stability. The phototube labeled STANDARD sees the same fluctuations in light intensity as the tube in the vapor sampling leg of the bridge. Being physically closer to the ultraviolet source, the standard is equipped with an iris to attenuate the light to a level similar to that seen by the sampler.



Portable vapor detector powered from wet battery was developed for atomic energy program

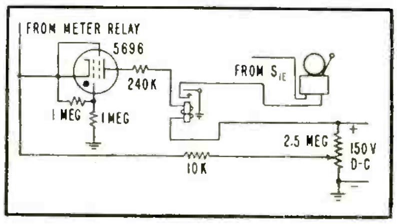


FIG. 2—Audio alarm circuit uses a thyratron to protect contacts of meter-relay shown in Fig. 1

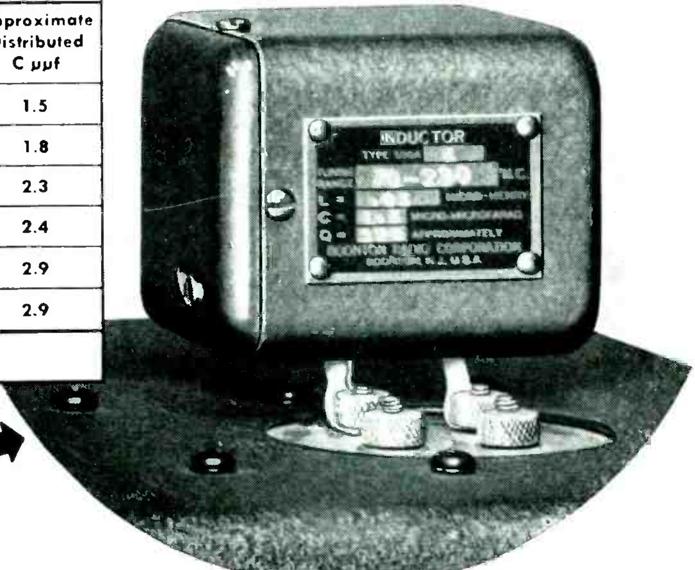
When the bridge is balanced, the flow of an absorption type vapor into the sampling chamber will retard the light sampled and an electrical unbalance in the bridge will then result. Normal sensitivity of the device is 0 to 3.2 milligrams of mercury per cubic meter, but a multiplying position of the range switch allows measurements down to 0.1 milligrams of Hg per cubic meter at full scale deflection

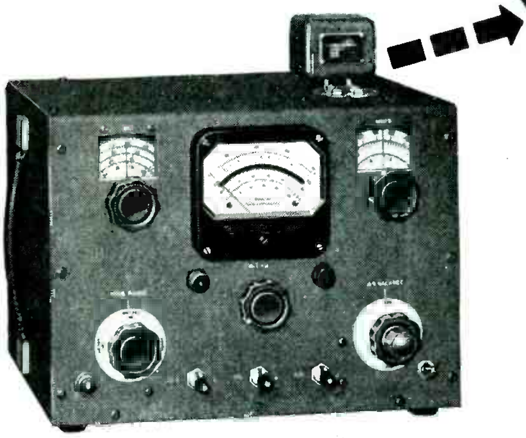
www.americanradiohistory.com

NEW Q Meter Inductors for measurements up to 260 mc!

INDUCTORS Type 590-A— accessories to Q Meter Type 190-A

TYPE 590-A INDUCTORS					
Type	Inductance μh	Capacitance μμf	Approximate Resonant Freq. mc	Approximate Q	Approximate Distributed C μμf
590-A1	0.05	8.0 — 95.0	70 — 230	320	1.5
590-A2	0.1	10 — 100	50 — 160	350	1.8
590-A3	0.25	8.0 — 80.0	30 — 100	310	2.3
590-A4	0.5	7.5 — 80.0	25 — 70	340	2.4
590-A5	1.0	7.5 — 65.0	20 — 50	300	2.9
590-A6	2.5	9.0 — 25.0	20 — 30	300	2.9
PRICE: $10.00 each F.O.B. BOONTON, N. J.					





Q METER Type 190-A

This new 190-A Q Meter measures an essential figure of merit of fundamental components to better overall accuracy than has been previously possible. The VTVM, which measures the Q voltage at resonance, has a higher impedance. Loading of the test component by the Q Meter and the minimum capacitance and inductance have been kept very low.

SPECIFICATIONS—TYPE 190-A

FREQUENCY RANGE: 20 mc. to 260 mc.

RANGE OF Q MEASUREMENT:

Q indicating voltmeter	50 to 400
Low Q scale	10 to 100
Multiply Q scale	0.5 to 3.0
Differential Q scale	0 to 100
Total Q indicating range	5 to 1200

PERFORMANCE CHARACTERISTICS OF INTERNAL RESONATING CAPACITANCE: Range—7.5 mmfd. to 100 mmfd. (direct reading).

POWER SUPPLY: 90-130 volts — 60 cps (internally regulated).

Type 190-A Price: $625.00 F.O.B. Factory

Inductors Type 590-A are designed specifically for use in the Q Circuit of the Q Meters Type 170-A and 190-A for measuring the radio-frequency characteristics of condensers, resistors, and insulating materials. They have general usefulness as reference coils and may also be used for periodic checks to indicate any considerable change in the performance of the Q Meters.

Each inductor Type 590-A consists of a high Q coil mounted in a shield and is provided with spade lugs for connection to the coil terminals of the Q Meters. The shield is connected to the lugs which connect to the Low Coil terminal in order to minimize any changes in characteristics caused by stray coupling to elements or to ground.

BOONTON RADIO *Corporation*
BOONTON · N · J · U · S · A ·

Want more information? Use post card on last page.

www.americanradiohistory.com

of the indicating meter.

To obtain as constant a source of ultraviolet light as possible, the type G4T4/1 ultraviolet tube is excited by the 66-mc oscillator shown.

When used as a warning, rather than simply as a measuring, device, the thyratron-controlled relay shown in Fig. 2 operates a bell for any preset meter reading.

In order to make portable operation possible, a standard synchronous vibrator power supply is used, powered by a 6-v wet battery. A low-frequency filter is not required since this ripple does not interfere with operation of the associated detector circuits. Some slight jitter in the d-c high voltage, probably caused by frequency hunting of the vibrating reed is only in the order of 0.5 percent of the microammeter scale and has no practical bearing on the accuracy of the measurements.

Information on this instrument was abstracted from a University of California Radiation Laboratory report by C. S. Presenz furnished through the United States Atomic Energy Commission.

Multiband Tuner Design Chart

By George J. Maki
Staff Engineer
D & R, Ltd.
Santa Barbara, Calif.

The chart shown in Fig. 1 can be used to determine rapidly the design factors for multiband continuous-coverage tuners. Either the number of bands required, the tuning ratio per band or the frequency limits of the tuner can be found when the other two are known.

The functions are based on the relationship

$$r = \sqrt[n]{f_h/f_l}$$

where r is the tuning ratio per band, n is the number of bands, f_h and f_l thus are the upper and lower frequency limits of the tuner.

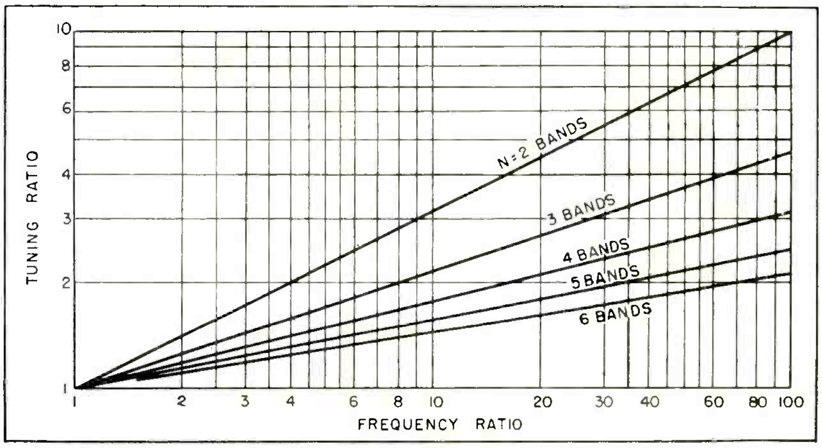
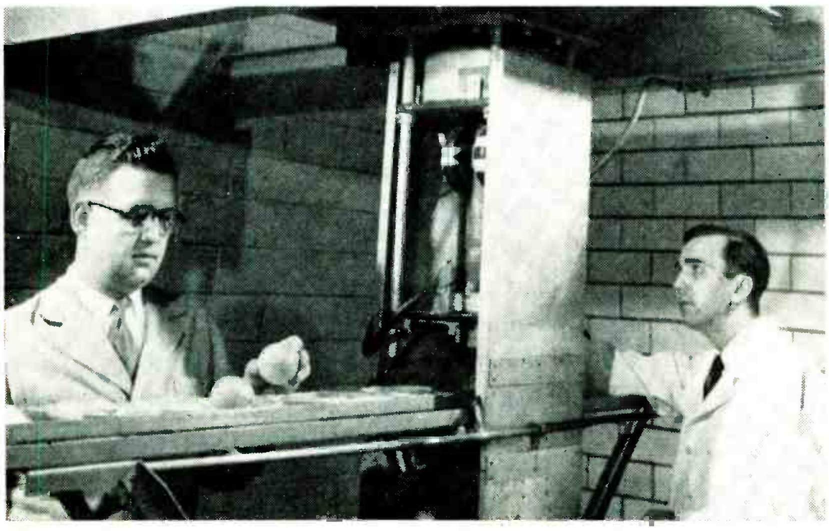


FIG. 1—Chart determines design factors for continuous-coverage tuners having up to six bands

Cathode-Ray Sterilization Preserves Foods and Drugs

According to *Chemical Week*, the electron can be a powerful tool for industry when liberated from the fundamental forces that bind it to the atomic nucleus. "As a free agent it will induce polymerization of monomers, deactivate enzymes, promote a number of chemical reactions, sterilize foods and drugs, depolymerize many substances and often alter the properties of matter in useful ways."



Converted x-ray machine used to produce electron stream. Experiments now in progress show that cold sterilization and prevention of spoilage may be possible by lethal effect of cathode rays on insects, bacteria and mold. Test have already been conducted, with apparently favorable results, on oranges, bread and minute steaks

Experiments to this end were carried out in a recent cathode-ray sterilization symposium held during the opening of GE's Milwaukee laboratory. Equipment used was a modified million-volt x-ray unit. The tungsten target was removed, allowing the stream of electrons to be emitted through a thin metal window. In ordinary use, the electron stream strikes the tungsten target to produce x-rays.

Prime source of power is a synchronous-motor-driven alternator. A 180-cycle resonant transformer has the properties of a high-Q tuned circuit. It is excited at its natural frequency as determined by its inductance and distributed capacitance plus special tuning capacitance to ground. The magnetic core used in conventional construction is eliminated although mag-

www.americanradiohistory.com

Whenever circuits call for precision and high resolution in compact space...

There's a 10-turn Helipot to meet your requirements

With the development of the original HELIPOT—the *first* multi-turn potentiometer—an entirely new principle of potentiometer design was introduced to the electronic industry. It made possible variable resistors combining high resolution and high precision in panel space no greater than that required for conventional single-turn potentiometers.

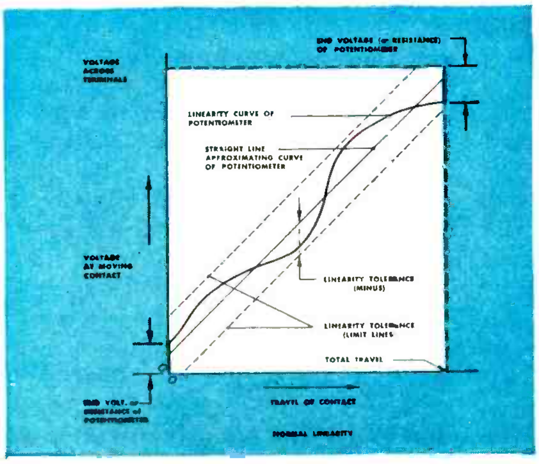
The Helipot Principle... *High resolution and precision settings require a long slide wire. But by coiling a resistance element into a helix, it is possible to gain desired resolution and precision without wasting panel space. This principle is applied in various Helipot models with slide wires ranging from 3 to 40 helical turns.*

Advantages are immediately apparent. In the case of the widely-used 10-turn Model A Helipot, for example, a 45" long slide wire—coiled into ten helical turns—is fitted into a case 1¾" in diameter, and 2" in length. Another advantage of the 10-turn pot is that, when equipped with a turns-indicating RA Precision DUODIAL, slider position can be read directly as a decimal, or percentage, of total coil length traversed.

10-TURN HELIPOT MODELS—CONDENSED SPECIFICATIONS

	Model A	Model AN	Model AJ
No. of turns	10	10	10
Resistance Range	10 ohms to 300,000 ohms	100 ohms to 250,000 ohms	100 ohms to 50,000 ohms
Resistance Tolerance: Standard	±5%	±5%	±5%
Best	±1%	±1%	±3%
*Linearity Tolerance: Standard	±0.5%	±0.5%	±0.5%
Best	±0.05% (1K ohms and above)	±0.025% (5K ohms and above)	±0.1% (above 5K ohms)
Power rating @ 40°C	5 watts	5 watts	2 watts
Mechanical Rotation	3600° +4° −0°	3600° +1° −0°	3600° +12° −0°
Electrical Rotation	3600° +4° −0°	3600° +1° −0°	3600° +12° −0°
Starting Torque	2 oz. in.	1.0±.3 oz. in.	.75 oz. in.
Running Torque	1.5 oz. in.	0.6±.3 oz. in.	.60 oz. in.
Net Weight	4 oz.	4 oz.	1 oz.

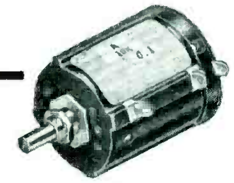
*i.e. INDEPENDENT LINEARITY. The above linearity tolerances are based on the following definition recently proposed to clarify and standardize nomenclature related to precision variable resistors. . . . "Independent linearity is the maximum deviation in percent of the total electrical output of the actual electrical output at any point from the best straight line drawn through the output versus rotation curve. (This line shall be measured through the extent of the effective electrical angle.) The slope and position of the straight line from which the linearity deviations are measured must be so adjusted as to minimize these deviations."



10-Turn Helipot Highlights

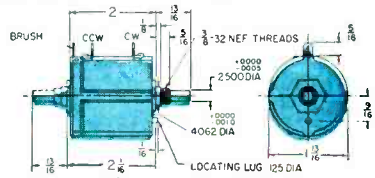
From the basic Helipot principle, model variations have been developed to meet new requirements:

Model A Helipot



the original 10-turn Helipot—provides a resolution from 12 to 14 times that of conventional single-turn potentiometers of same diameter (1¾"), linearities as close as ±0.05% in resistances as low as 1K ohms.

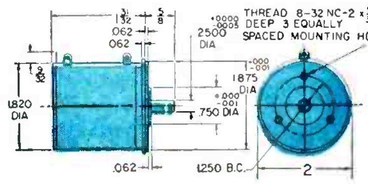
The same multi-turn principle is also available in 3 turn units (Model C), and larger-diameter units of 15 turns (Model B), 25 turns (Model D), and 40 turns (Model E)—a type for every application from 5 ohms to 1 megohm.



Model AN Helipot

an ultra-precision version of the basic 10-turn Helipot. Produced in volume to extremely close electrical and mechanical tolerances, this unit features precision ball bearings (Class 5), servo mounting lid, plus linearity tolerance as close as ±0.025% as low as 5K. A 3-turn unit (Model CN) is also available.

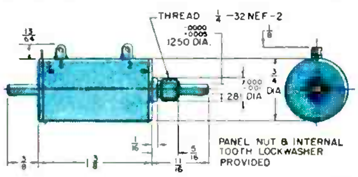
Models AN and CN are particularly recommended for precise servo-mechanism applications and represent the most advanced design and highest quality available today in the field of precision potentiometers.



Model AJ Helipot

a 10-turn *miniature* Helipot only ¾" in diameter, weighs 1 oz., has slide wire 18" long. Also available with servo mounting (Model AJS) and servo mounting with *ball* bearings (Model AJSP). Linearities as close as ±0.1% as low as 5K.

Designed for long life under severe operating conditions, the AJ Series is widely used where small size and weight are vital.



Design details on above units are subject to change without notice. Certified drawings available upon request.

Only Helipot is able to supply—in volume—multi-turn helical potentiometers *with special features to meet your particular needs* . . . Special Shafts, Extra Spot Welded Taps at any position, Ganged Assemblies (except AJ), Special Temperature Coefficients, etc. Send us your requirements!

For complete details contact your nearby Helipot representative. Or write for Data File 106-802

THE Helipot CORPORATION

A subsidiary of Beckman Instruments, Inc.

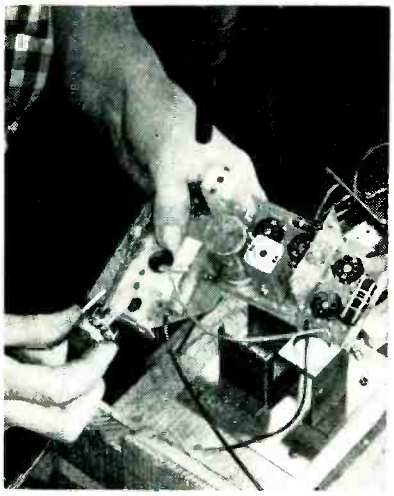
South Pasadena, California

Field Offices: Boston, Rochester, New York, Philadelphia, Cleveland, Detroit, Chicago, St. Louis, Los Angeles, Seattle, Dallas, High Point, N. C. and Fort Myers, Florida. In Canada: J. S. Root, Toronto. Export Agents: Frathom Co., New York 36, New York.

Want more information? Use post card on last page.

www.americanradiohistory.com

THE FRONT COVER



DIP-SOLDER TECHNIQUE completes printed-circuit process used in new Hallicrafters clock radio that will go on the market in October. Copper bonded to insulating board is etched out by acid into circuit configurations laid on from a photographic master negative. Holes for tube sockets and leads are punched out and the small parts dropped into place. Last step is to solder the connections all at once by dipping the sheet into molten solder.

netic shielding of the tank to reduce eddy-current loss is used. Ratio of apparent or circulating kva to the output kw is about 15 to 1. As a consequence, the secondary voltage waveform is nearly sinusoidal and relatively independent of load changes.

A frequently used window structure consists of 0.002-in.-thick type 347 stainless steel supported on the vacuum side by a stainless steel grid consisting of a series of short concentric cylinders held together by radial fins. Windows of this type have lasted over 900 hours at 800 kv peak and beam-out currents ranging up to 1.25 ma continuous duty. Although average power dissipation across the surface of the window is in the order of 20 to 30 watts per sq in., local intensities are higher and high-velocity air cooling is required.

Transistorized Superhet Receiver

THE LOW INPUT impedance and relatively high output impedance of the transistor presents special problems in radio receiver circuits. Resistance-capacitance networks usually cannot be used for interstage coupling in the receiver. Either a matching transformer or a cathode-follower stage must be employed for coupling. The point-contact transistor is unstable in the cathode-follower arrangement and consequently is not a desirable circuit element.

The transistor, in every position in the receiver, must be treated as a power amplifier rather than as a voltage amplifier, since each transistor has to supply considerable power to the low-impedance input of the following transistor stage. Also, because of the low input impedance, the transistor seriously loads tuned circuits associated with it. In a tuned circuit with a Q of 100, for instance, with an L-C ratio that allows it to match the output impedance of the preceding transistor and also to match it to the input impedance of the succeeding transistor by tapping the inductor or otherwise, only ⅓ of the unloaded Q will be left—that is, 33.

For oscillators, the simplest form using the point-contact type, requires base loading. A grounded-base circuit is employed but with the resonant tank circuit in series with the base, so that the base is not grounded at the resonant frequency, and the circuit goes into oscillation there.

Transistor circuits in general, so far as radio applications are concerned, are similar to vacuum-tube circuits. In a receiver using transistors, there is a chain of cascaded power amplifiers, which, except for the mixer, are intended to be linear in terms of input-current control. A selectivity sacrifice is necessary in such a receiver, or more stages are needed for a given selectivity than are required with modern vacuum tubes. Likewise, more transistor stages are needed to provide a given gain. Regulation must be provided for the d-c input-bias current of each stage.

The relatively high power levels available with vacuum tubes are not yet available with present transistors. Therefore, in designing transistor receivers, overload and blocking conditions must be carefully studied in each stage, particularly since the transistors can be permanently damaged by electrical overload. This lack of power-output capability also can result in harmonics of the i-f amplifier frequency appearing in the r-f circuits of the receiver causing birdies. The transistor's noise figure is high and frequency dependent, and the gain of the audio, intermediate,

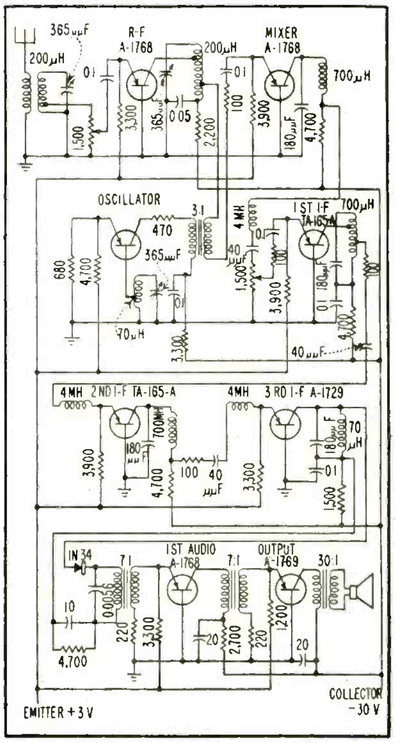
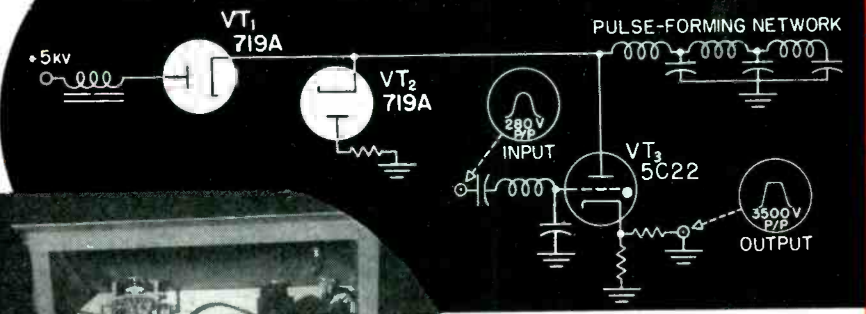
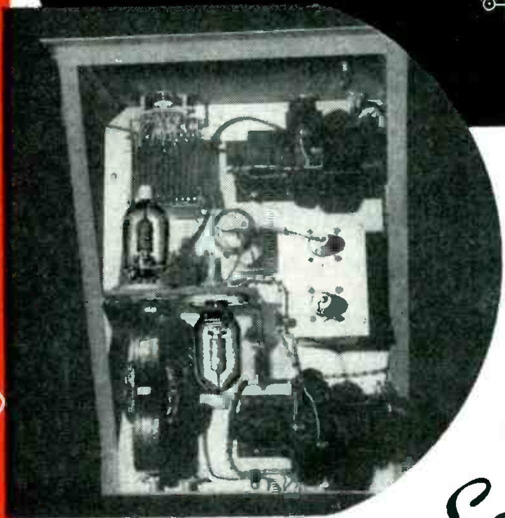


FIG. 1—Circuit of eight-transistor superhet receiver. A 1N34 crystal is used as a detector

www.americanradiohistory.com

MEGAWATT PULSES





and how Los Gatos 719A's shape them for Marchant

In developing a new Signal Corps thyratron-testing unit, engineers of Marchant Research, Inc. (controlled by Marchant Calculators, Inc.) needed a pulse diode combining high average and peak current capabilities with a high inverse voltage rating. Los Gatos 719A diodes were chosen to serve as both the charging diode and the clipper diode, shown in the circuit above.

Tube VT_1 charges the pulse-forming network to 10 kv with 1 megawatt of power, 270 ma average current. Tube VT_2 eliminates overshoot at the bottom of the pulse. The driver unit, as illustrated, supplies accurately controlled pulses to a hydrogen thyratron under test. Facilities are provided, in the balance of the test set, for measuring all parameters of the thyratron. The complete equipment, Mod 20MV Jr3, is part of a Signal Corps program of thyratron development for high-power hydrogen thyratron tubes.

When unusual electron tube problems face you, let Lewis and Kaufman engineers make recommendations. Consult your nearby field representative or write direct to:

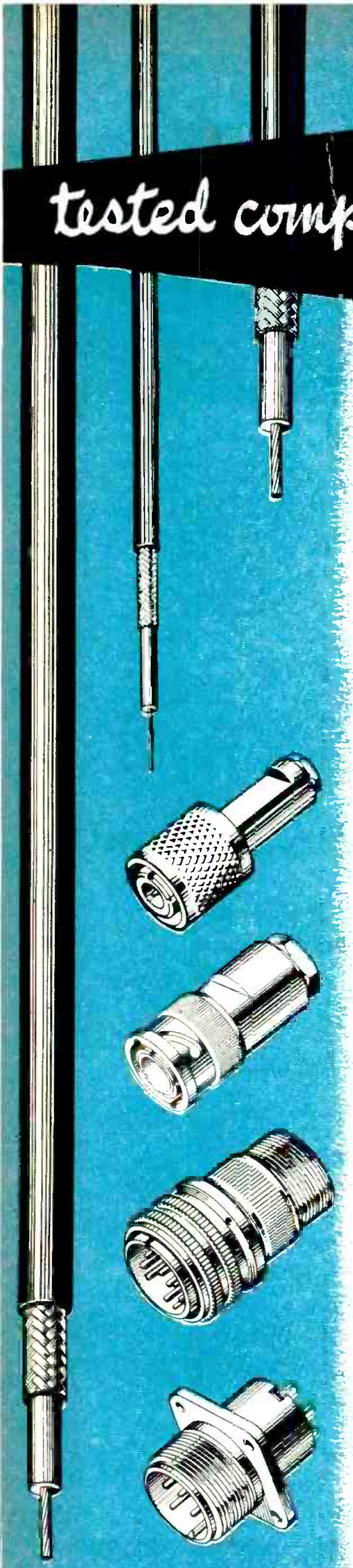
LEWIS and KAUFMAN, Ltd.

LOS GATOS 1 CALIFORNIA

LOS GATOS LONG LIFE

Export Representatives: MINTHORNE INTERNATIONAL CO., INC.
15 Moore Street, New York 4, N. Y. Cable: Address "Minthorne"

www.americanradiohistory.com



tested components

from a single source

In specifying components for electronics use important considerations are twofold: Are the parts the *best* obtainable for the particular application? Can they be purchased economically, from a *single source*? Only AMPHENOL can answer these questions in the affirmative. AMPHENOL quality is a byword in the electronics industry—and we work to keep it that way. Continuous quality control—constant testing of actual production line samples, insure that each and every AMPHENOL component fully measures not only up to but beyond specifications. No part goes out without inspection. No component escapes the rigid testing demanded by AMPHENOL's high standards.

And the double advantage of AMPHENOL is the completeness of the line of components offered. Over 9,000 separate listings are in the catalogs, representing the largest single source available to all who specify electronic components.

AMPHENOL

AMERICAN PHENOLIC CORPORATION

chicago 50, *illinois*

and radio-frequency amplifier sections of the receiver must be carefully proportioned.

Gain control is a big problem with the transistor receiver. The gain of a sharp-cutoff triode cannot be satisfactorily controlled by change of grid bias, because the amplification usually changes comparatively little until either output-current cutoff or saturation begins to occur, at which points the signal becomes seriously distorted. A potential-divider type of control, such as an antenna potentiometer, may be used. It is difficult to obtain a wide range of control with such a device, particularly at radio frequencies, where tapered r-f potentiometers providing constant db change are not available.

Automatic gain control is out of the question. If a variable-mu-tube equivalent in transistor form should become available, agc can be provided, although one other problem may be troublesome. The agc system in a receiver using current-controlled devices must control bias currents, which means that it has to provide control power. In other words, the agc system must be a power system, and it might require a considerable number of additional transistors.

There are some circuits that cannot be put to practical use with transistors as yet, such as high-impedance types of series noise-peak limiters often employed in vacuum-tube communication receivers. In general, high-impedance d-c circuits such as would be normal in vacuum-tube receiver systems cannot be used.

Useful Circuit

The circuit diagram of the superhet receiver, Fig. 1, is similar to one using vacuum-tubes. The receiver has one r-f amplifier stage (550 to 1,550 kc), a mixer, a heterodyne oscillator operating 455 kc above the signal frequency, three 455-kc i-f amplifiers, a diode second detector, one audio interstage amplifier and an audio-output stage. There are eight transistors and one crystal diode in all. This receiver has about 90 db gain with no reserve. The gain-control system comprises two ganged potentiometers, one at

www.americanradiohistory.com

the input to the r-f amplifier and the other at the input to the first i-f amplifier. These provide about 50-db maximum attenuation each, giving 100 db total range. Sensitivity is about 200 microvolts for 6 milliwatts of output at 1,000 cps, with 10-db output signal-to-noise ratio.

Maximum audio power output is in the order of 15 or 20 milliwatts for 5 percent harmonic distortion at 1,000 cycles. The selectivity curve at 6-db down is about 8 kc wide. The 60-db down figure is about 80 kc, giving a selectivity ratio of about 10.

The receiver requires about one watt of d-c power input; 3 volts, 8 milliamperes for the emitter bias circuits; and 30 volts, 30 milliamperes for the collector circuits. This results in an overall power efficiency of about 2 percent, based on the ratio of maximum undistorted audio-output power to the battery power input, which is just about the same as for a typical communication-type vacuum-tube receiver. The sensitivity of such a vacuum-tube receiver, however, would be much better than the 200-microvolt sensitivity of the transistor receiver.

This article has been abstracted from a paper entitled "Application of Transistors to Radio Receiver Circuitry" by Emerick Toth, presented at the Colloquium on Transistors in Theory and Practice, Naval Research Laboratory, Washington, D. C.

Solderless Component Assembly

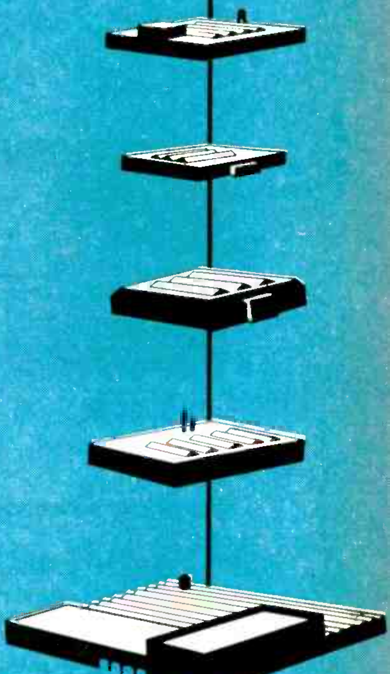
ONE SOLUTION to practical application of mechanized wiring has been suggested by Paul J. Selgin for a Navy project being carried out at the National Bureau of Standards. The system depends upon molding one or two circuit elements into a block containing three contacts. These blocks, about $\frac{7}{8}$ inch high, $\frac{1}{2}$ inch wide by $\frac{1}{4}$ inch thick, fit into a suitable frame fastened to a base plate on which has been printed the desired circuit configuration.

Positive contact is assured, without soldering, by the three-point

... continuous high quality

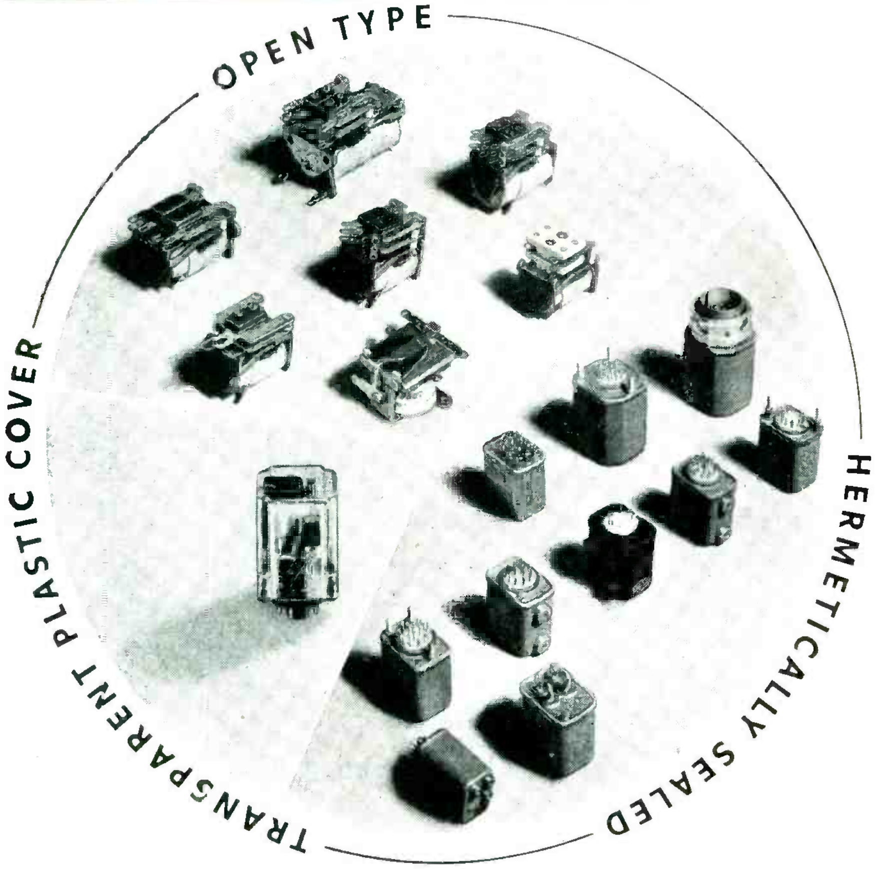
The finest components for electronics use ever available to precision-minded industry now come in profusion from AMPHENOL's five plants. The expanded production of AMPHENOL during the last year plus the continuing high quality of every part supplied recommends AMPHENOL to all who specify components and to all who manufacture equipment. AN connectors, RF connectors, cables, sockets, literally almost everything needed by todays industrial scientists are being supplied from AMPHENOL.

AMPHENOL is always ready to assist in the developement of a new component. If your needs are special, consult with AMPHENOL's engineers upon your problems. That they have come up with solution to tough engineering questions time and again is attested to by the AMPHENOL catalogs— many of the components listed evolved from parts designed first for a special application.



AMPHENOL
AMERICAN PHENOLIC CORPORATION
chicago 50, illinois

www.americanradiohistory.com



R-B-M Relays

FOR EVERY ELECTRONIC APPLICATION

Meeting Commercial and Government Requirements

OPEN TYPE. Circuit switching — power and dynamotor loads — plate circuit — low capacitance.

HERMETICALLY SEALED. Stud or bushing mounting — solder or plug-in headers — circuit switching — power — low loss applications.

TRANSPARENT PLASTIC COVER. Most R-B-M relays now available in low cost transparent plastic cover.

OTHER PRODUCTS: Motor starting relays and overload protectors for refrigeration, appliance and general purpose motors. Industrial contractors and across-the-line starters. NEMA size 1 and smaller. Low cost general purpose relays. Low voltage D.C. manual and magnetic devices.

Let R-B-M engineering and production facilities serve you. Contact us immediately—Phone 5121

Write Dept. B-8 For ASR Bulletin.

R-B-M DIVISION ESSEX WIRE CORP.
Logansport, Indiana

MANUAL AND MAGNETIC ELECTRIC CONTROLS — FOR AUTOMOTIVE, INDUSTRIAL, COMMUNICATION AND ELECTRONIC USE

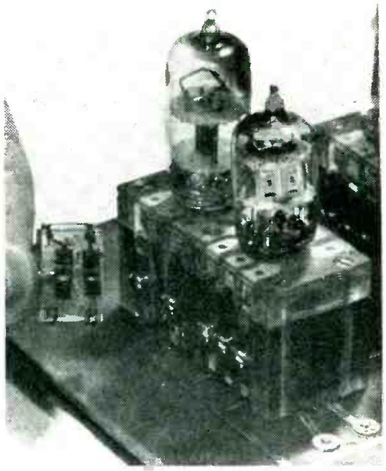


FIG. 1—Cellular technique for mechanized wiring employs three-terminal molded cells that fit into two-tube building block. Printed wiring is used on base plate. Extensions of tube-socket springs make contact and hold blocks in place

mechanical construction of the contact mechanism and the spring loading afforded by contacts extending down from the tube socket assembly atop the frame.

Quick replacement of cells is assured without requiring the use of plugs or connectors. The block framework can be removed from the base plate that contains the printed circuit by removing a few screws. It is believed that the lack of soldering and the simplicity of the fundamental elements will reduce manufacturing cost of equipment employing the system.

In the preliminary units, cells were formed at room temperature using a casting resin. For quantity production, cells could be molded in phenolic resins by a process similar to that now in wide use for making resistors and capacitors.

Foamed Polyethylene Dielectric

ENGINEERS at Anaconda Wire and Cable Co. have produced an ingenious compromise between solid and air insulation by foaming polyethylene with dry nitrogen. The resultant firm mass contains tiny gas-filled cells separated from one another so that internal moisture condensation cannot take place.

First application of the new ma-

4 FINE RHEOSTATS

Announcing 3 new sizes now in production

We have added to our new H-50 rheostat, announced a few months ago—the new H-75, H-100 and H-150 models. These higher wattage rheostats incorporate all the new improved features that have made the H-50 so successful.

- **Unequalled perfection in brush control, which automatically adjusts tension to complete, continuous contact.**
- **Positive, smoothly-controlled spring action which eliminates all strains tending to bind shaft in the bushing.**
- **Greater flexibility—no risk of backlash.**

All models are of course completely bonded with our new high-temperature-enamel;—thermo-shock-proof; more resistant to heat; increased safety factor; higher terminal strength.

And all are designed to comply with current standards of:

(a) Military Specifications JAN-R-22.
(b) Underwriters' Laboratories.
(c) R.T.M.A.
(d) N.E.M.A.

Send today for our new bulletin, containing additional information.

HARDWICK, HINDLE, INC.

Rheostats and Resistors

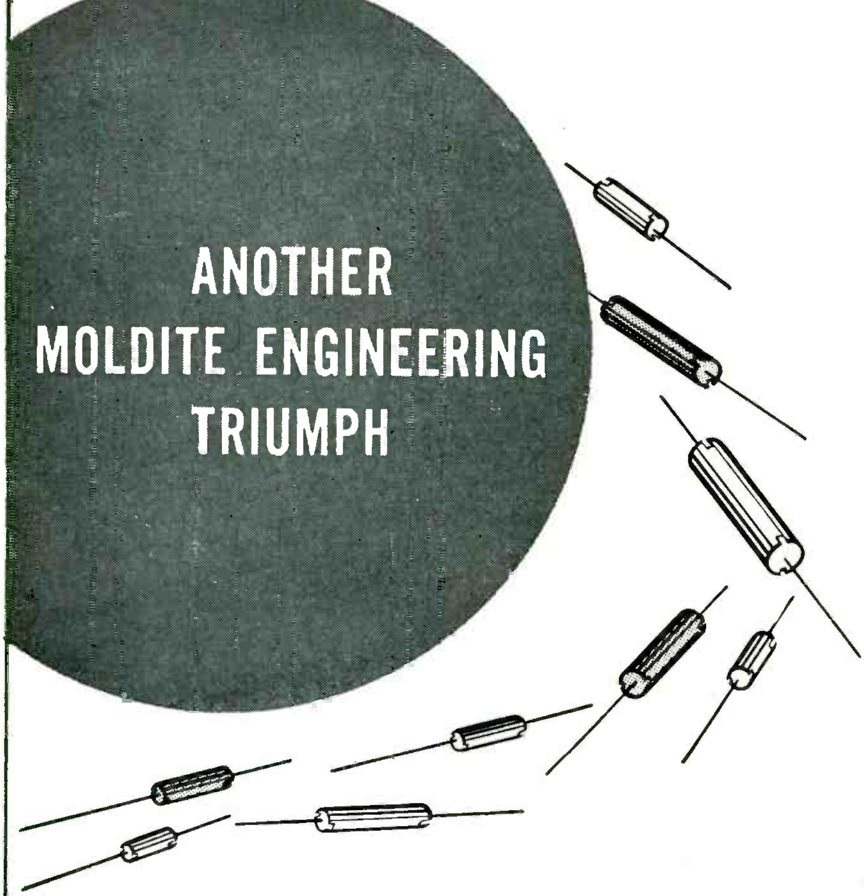
Subsidiary of

THE NATIONAL LOCK WASHER COMPANY

Established 1886 Newark 5, N. J., U. S. A.

The mark of quality for more than a quarter of a century

www.americanradiohistory.com



MOLDED COIL FORMS

After years of development, the NATIONAL MOLDITE COMPANY has engineered and built an automatic machine for making molded coil forms held to the most exact dimensions for length and O.D. This new machine is geared for high speed production, thus providing prompt shipment on most popular sizes.

Here is another example of MOLDITE pioneering in order to provide the radio, television, and communication industries with quality engineered components.

Yes, look to MOLDITE for precision engineered magnetic iron cores, RF filter cores, and now MOLDED COIL FORMS.

MAGNETIC IRON CORES • FILTER CORES • MOLDED COIL FORMS
THREADED CORES • SLEEVE CORES • CUP CORES

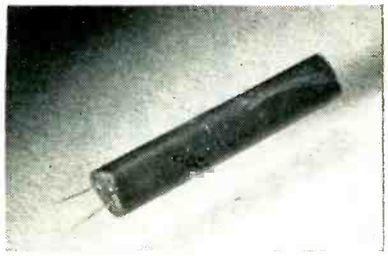
NATIONAL MOLDITE COMPANY

1410 Chestnut Ave., Hillside 5, N. J.

Samples promptly submitted upon request for design, pre-production, and test purposes

SEND FOR CATALOG 110

Robert T. Murray 614 Central Ave. East Orange, N. J.	Jerry Golten Co. 2750 W. North Ave. Chicago 22, Ill.	Martin P. Andrews Mott Road Fayetteville, N. Y.	Perlmuth-Colman & Assoc. 1335 South Flower Los Angeles, Cal.	Jose Luis Pontet Cardoba 1472 Buenos Aires



Polyethylene foam surrounds two copper-clad steel wires. Trapped gas bubbles improve the characteristics of this new uhf-tv leadin that requires no taping or sealing and works equally well in dry or wet weather

terial is for uhf television lead-in, a piece of which is illustrated. A pair of copper-clad steel wires embedded in foamed polyethylene has no higher losses than an air-insulated line (ELECTRONICS, p 18, Nov. 1952). Water, salt spray and dirt on the outside have negligible effect.

Characteristic impedance of the new line is 270 ohms. Dry attenuation is listed below for various frequencies of interest.

100 mc	1.5 db per 100 ft
500 mc	3.6 db per 100 ft
900 mc	5.0 db per 100 ft

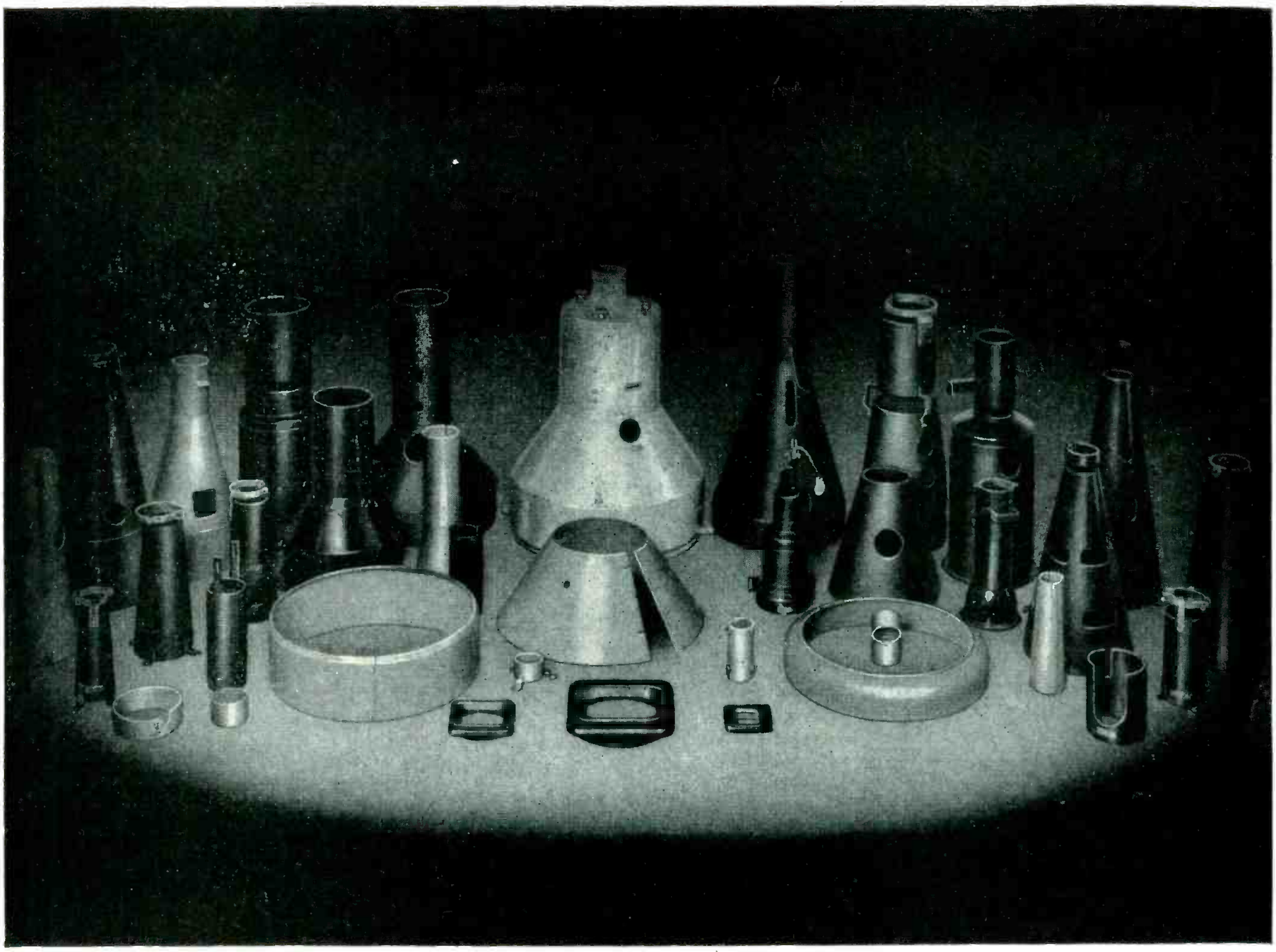
It can be expected that the lower losses in foamed polyethylene will lead to its use in solid dielectric coaxial cables, particularly in military applications and for master antenna systems.

Ultrasonic Porpoise Communications

BY H. N. MORRIS
Air Force Missile Test Center
and
ROBERT KOHLER and W. N. KELLOGG
Oceanographic Institute
Florida State University

A STUDY OF THE hearing and voice of the bottle-nose dolphin or porpoise has been the subject of investigation at the Lerner Marine Laboratory on the Isle of Bimini.

In order to analyze the various sounds emitted by the porpoise, high-fidelity recordings were made with the system shown in Fig. 1. A sensitive underwater microphone or hydrophone was used in conjunction with a preamplifier and high-speed instrumentation-type mag-



Designed for Application

Mu Metal Shields

The James Millen Mfg. Co. Inc. has for many years specialized in the production of magnetic metal cathode ray tube shields for the entire electronics industry, supplying magnetic metal shields to manufacturing companies, laboratories and research organizations. Stock shields are immediately available for all of the more popular sizes and types of cathode ray tubes as well as bezels for 2″, 3″ and 5″ size tubes.

Many production problems, however, make desirable special shields designed in conjunction with the specialized requirement of the basic apparatus. Herewith, are illustrated a number of such custom built shields. Our custom design and fabrication department is at the service of our customers for the development and manufacture of magnetic metal shields of either nicoloi or mumetal for such specialized applications.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY

MALDEN, MASSACHUSETTS, U.S.A.

www.americanradiohistory.com

KLEIN

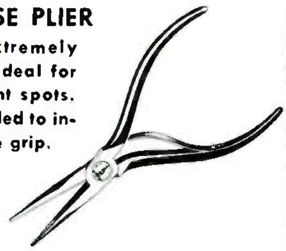
Quality Pliers

SPECIALLY DESIGNED

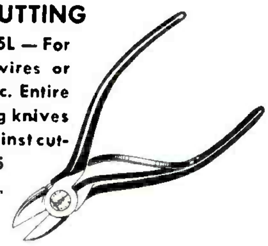
FOR THE ELECTRONICS INDUSTRY

Now, Klein quality pliers are available in new compact patterns for precision wiring and cutting in confined space. Note, too, the replaceable leaf spring that keeps the plier in open position, ready for work. All are hammer forged from high-grade tool steel, individually fitted, tempered, adjusted and tested—made by plier specialists with a reputation for quality "since 1857."

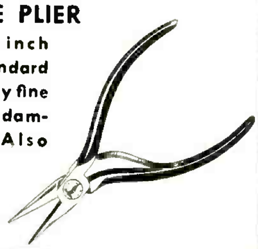
LONG NOSE PLIER
307-5-½L—Extremely slim pattern ideal for the really tight spots. Jaws are knurled to insure a positive grip.



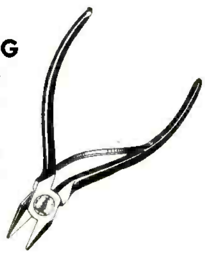
OBLIQUE CUTTING PLIER — **210-5L** — For cutting small wires or trimming plastic. Entire length of cutting knives works flush against cutting surface. 5 or 6-inch sizes.



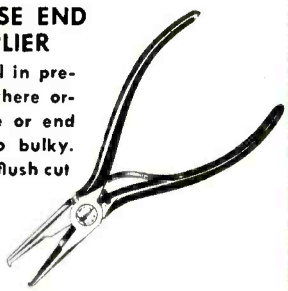
CHAIN NOSE PLIER
317-5L—A full inch smaller than standard pattern. Has a very fine knurl that will not damage soft wire. Also available without knurl.



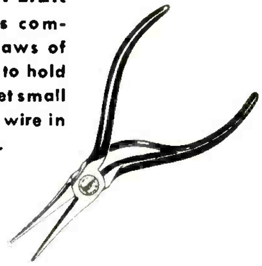
LIGHTWEIGHT OBLIQUE CUTTING PLIER **209-5**—Smaller than 210-5L with an extremely narrow head. Entire length of cutting knives works flush against cutting surface.



TRANSVERSE END CUTTING PLIER
204-6—Useful in precision work where ordinary oblique or end cutters are too bulky. Gives a clean, flush cut



DUCK BILL PLIER
306-5-½—This compact plier has jaws of sufficient width to hold small springs, yet small enough to form wire in confined places.



This Klein Pocket Tool Guide gives full information on all types and sizes of Klein Pliers. A copy will be sent without obligation.

"Since 1857"

ASK YOUR SUPPLIER

Foreign Distributor:
International Standard
Electric Corp.,
New York

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

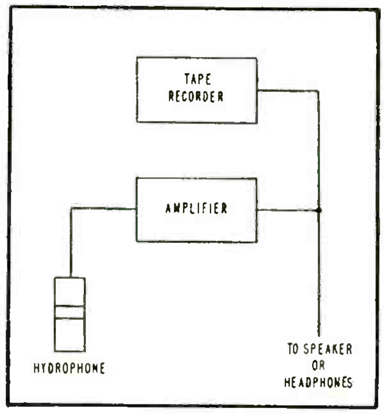


FIG. 1—System used to record porpoise sound on magnetic tape

netic tape recorder.

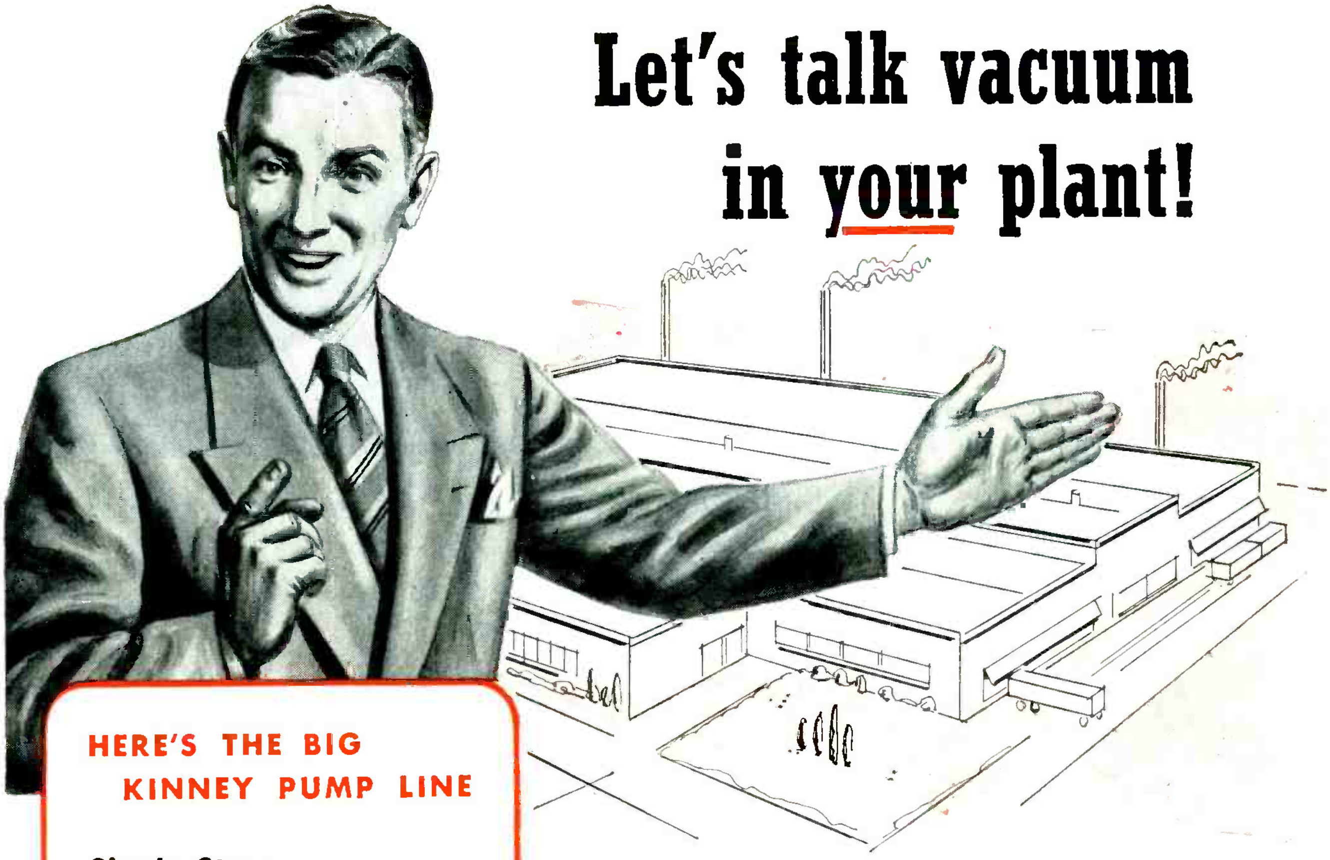
The hydrophone was developed and constructed by the U. S. Navy Mine Countermeasures Station at Panama City, Florida. It consists of four small blocks of Rochelle salt cemented together for maximum output and best frequency response. The crystal structure feeds a twin-triode tube connected as a conventional resistance-coupled amplifier and cathode follower for better impedance matching. The entire unit is potted in plastic for physical protection and to allow immersion in water.

The magnetic-tape recorder has a frequency-response flat within ± 3 db to 80 kc and down only about 10 db at 100 kc. Preselected magnetic tape for telemetering use was employed to obtain as complete a spectrum of the porpoise sounds as possible. These recordings provide a permanent record for analysis in the laboratory, and a signal source for study of the hearing of the porpoise.

The second portion of the experiment was to investigate the hearing of the porpoise. This was accomplished by the use of the test setup shown in Fig. 2.

The signal source was either the recorded voice of the porpoise or a c-w tone from an oscillator. The recorded voice could be fed through a variable-bandpass filter to study the animals' response to different portions of the frequency spectrum. While the slope of the filter was fixed at 18 db per octave, the pass band could be varied to cover any desired number of cycles. The power amplifier used had a uniform

Let's talk vacuum in your plant!



HERE'S THE BIG KINNEY PUMP LINE

Single Stage

Model DVH 27.20.34	1800 CFM
Model DVM 18.14.20	780 CFM
Model DVD 14.14.18	486 CFM
Model DVD 14.9.18	311 CFM
Model DVM 12.8.14	218 CFM
Model DVD 8.8.10	110 CFM
Model VSD 8.8.11	52 CFM
Model VSM 7.7.8	27 CFM
Model VSM 5.5.6	13 CFM

Compound

Model CVM 8.6.10	46 CFM
Model CVM 5.5.6	15 CFM
Model CVM 3534	5 CFM
Model CVM 3153	2 CFM

There's a qualified Kinney Vacuum Engineer in your region, ready to talk vacuum in your plant. Call on him. See how the BIG LINE . . . the *Kinney* line of vacuum pumps can be profitably used in exhausting lamps and tubes, freeze-drying pharmaceuticals and antibiotics, vacuum metallizing, vacuum production of titanium and other miracle metals, vacuum fumigation and impregnation — and in the countless other ways vacuum serves industry today. Kinney Manufacturing Co. — manufacturers of vacuum and liquid pumps. Boston, New York, Chicago, Detroit, Cleveland, Atlanta, Pittsburgh, Philadelphia, Los Angeles, Charleston (W. Va.), Houston, New Orleans, San Francisco, Seattle, and foreign countries.

★ SUBSIDIARY OF THE NEW YORK AIR BRAKE CO. ★

Kinney

SEND COUPON FOR DETAILS!

KINNEY MANUFACTURING COMPANY
3565 Washington Street, Boston 30, Mass.

☐ Please send Bulletin V-51B describing complete line of Kinney Vacuum Pumps.

☐ Please have your Vacuum Engineer call on us.

Name..............................

Company..............................

City.............................. *State*..............................

Want more information? Use post card on last page.

www.americanradiohistory.com

National
PROVEN DEPENDABLE QUALITY
Components


AN


AVD

VELVET VERNIER MECHANISMS

National's famous line of velvet vernier mechanisms has been accepted by well-known commercial users as well as individual builders. Having a standard 5 to 1 ratio, they are available to fit either 3/16″ or 1/4″ shafts. Types are also available with insulated or non-insulated output hubs for connecting to 1/4″ output shafts. Write for drawings and specifications.

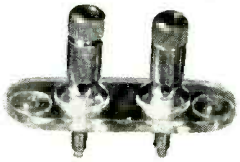
POPULAR TERMINAL ASSEMBLIES

National terminal assemblies have proved extremely popular because of extremely low-loss characteristics, their rugged construction and practical design.

Type FWG is a Victron terminal strip for high frequency use. Binding posts take banana plugs at top, grip wires through a hole at bottom.

Type FWH — the insulators of this terminal assembly are moulded bakelite. Binding posts same as FWG.

Type FWJ utilizes same insulators as FWH, but has jacks.


FWG


FWH


FWJ

Write for drawings

National
EST. 1914
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

Microphone lowered into tank picks up high frequency sounds emitted by porpoise

response ±2 db from 20 to 100,000 cycles and furnished up to 20 watts of power to an underwater sound projector.

The projector was a U. S. Navy Underwater Sound Research Laboratory Type 1-K. Its power output is dependent upon frequency but above 1,000 cycles it can handle 10 to 15 watts. The frequency response is linear to 20 kc and has response, with peaks, to 200 kc. The radiation angle of the projector is 75 degrees.

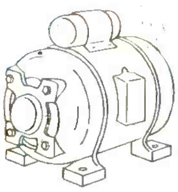
Preliminary results of these experiments indicate that porpoises emit sounds with energy in the frequency spectrum up to the limit of the available recording equipment. A complete analysis of these results will be released at a later date.

Some observations were made directly on correlating the porpoise sounds with physical movements. A man, equipped with diving gear and underwater headphones, descended into the pen and watched the animals while listening to their sounds.

The porpoises react to strange sounds in their hearing range by sudden accelerated movements and jumping from the water. Since the porpoises make sounds almost continuously, a random portion of the recorded tape was played through the bandpass filter and projected into the water. A short burst was sent and three observers checked the reactions of the animals.

A series of tests was made with this setup and then the audio oscillator was substituted for the tape

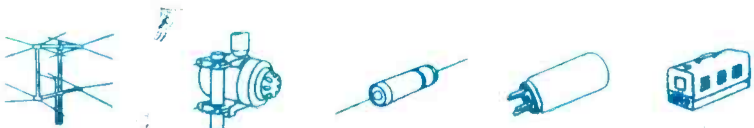
Want more information? Use post card on last page.



C-D probably has the answer to your electrolytic problem! Is it for a motor? TV circuit? Photoflash? Micro-wave communications? If anybody has the answer to your electrolytic problem, it's likely to be Cornell-Dubilier, the greatest name in capacitors. Write for the complete catalog to: Dept. K-83, Cornell-Dubilier Electric Corp., General Offices, South Plainfield, New Jersey.

CORNELL-DUBILIER

world's largest manufacturers of capacitors

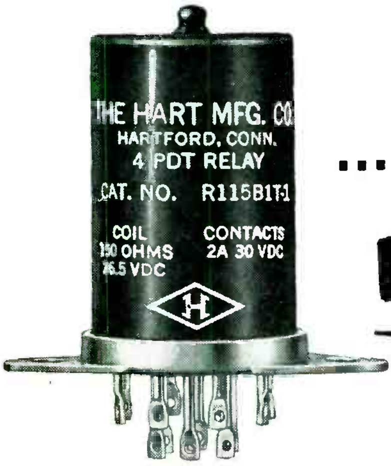


SOUTH PLAINFIELD, N. J. · NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS. · PROVIDENCE, R. I. · INDIANAPOLIS, IND. · FUQUAY SPRINGS, N. C. · SUBSIDIARY, THE RADIART CORP., CLEVELAND, O.

Want more information? Use post card on last page.

www.americanradiohistory.com

'DIAMOND H' RELAYS



Shown Actual Size

...now even **mightier** midgets

NEW CHARACTERISTICS engineered into famous "Diamond H" Series R Relays have now broadened their adaptability for such applications as guided missiles, jet aircraft, fire control and fire detection, radar, communication, high speed camera, geophysical and computer apparatus . . . wherever positive operation is demanded under critical conditions.

A 4PDT hermetically sealed, miniature aircraft relay basically, they are now also available DPDT with two independent coils, either or both of which will operate the units.

In their field still the smallest and lightest, (1.6 cu. in. 3.76 oz.) combining highest operating shock resistance (to 50 "G" and higher), widest temperature range (−65° to + 200° C.) and greatest ability to break high currents and high voltages, Series R Relays consistently operate over 400,000 cycles without failure at 5 A. and go 3,500 or more under 30 A. at 30 V., D.C., resistive. They carry voltages up to 300 D.C. at 4/10 A. for more than 400,000 cycles. With low contact loading, life expectancy is 10 million cycles or better.

Operating time is 10 ms. or less; drop out time 3 ms. or less. Coil resistances up to 35,000 ohms are standard; to 50,000 ohms available for special units. Sensitivity approaches 100 mw. at 30 "G" operational shock resistance. Inter-electrode capacitance is less than 5 mmf. contacts to case—less than 2½ mmf. between contacts, even with plug-in type relay and socket. Vibration range is from 0 to 500 cycles per second and upward at 15 "G" without chatter.

All standard mounting arrangements, including ceramic socket, are available. Uniquely simple design permits compact grouping . . . and a firm bond between relay and chassis.

Designed to meet all requirements of USAF Spec. MIL-R-5757B, they far surpass many. Bulletin R-150, giving basic performance data under varying conditions, is yours on request. Our engineers are prepared to work with you to develop variations to meet your specific requirements. Tell us your needs.

THE HART MANUFACTURING COMPANY

202 Bartholomew Avenue • Hartford, Connecticut

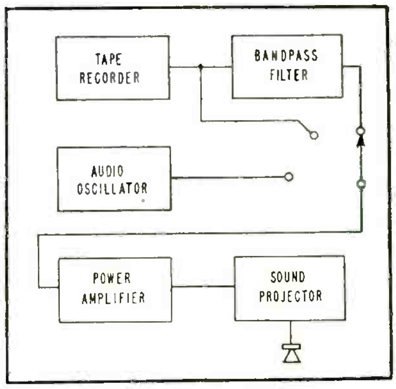


FIG. 2—Porpoise reaction tested with recorded sounds and single tone from audio oscillator

recorder and filter. Use of the oscillator enabled a more accurate indication of frequency response since only a fundamental signal was transmitted. A definite response by the animals was indicated at frequencies to 80,000 cycles. There is a good possibility that the porpoise uses this extended-range hearing and voice as a means of locating objects in a manner similar to that of sonar. The only other animal known to emit these high-frequency sounds is the bat.

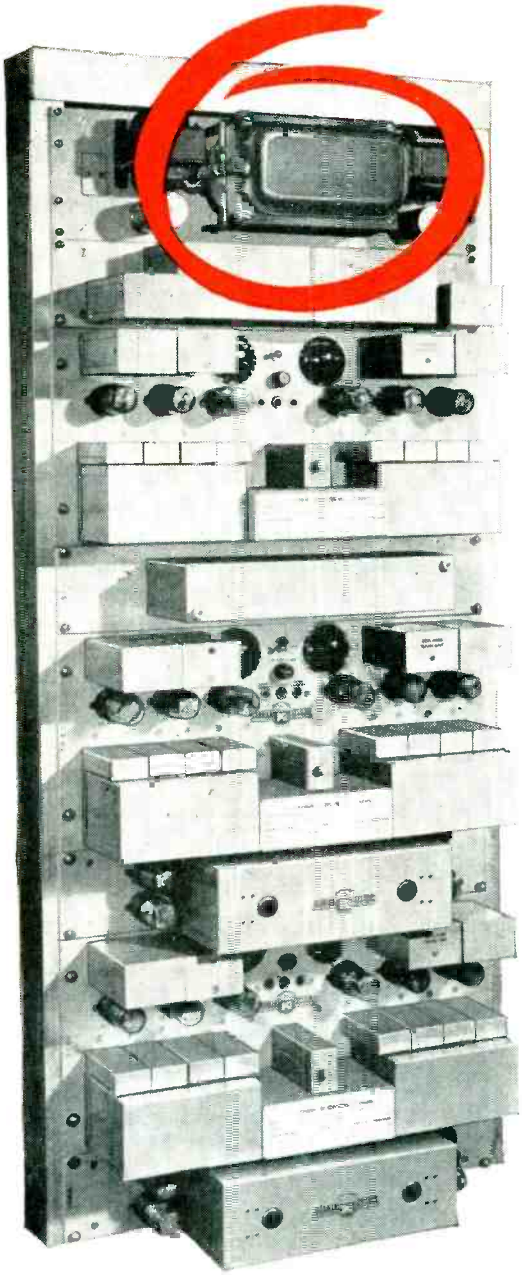
The porpoise is a fast swimmer and seems to travel day or night with equal ease. His vision alone could not enable him to avoid objects in dark and murky waters, especially at night. While this assumption has not been proved conclusively, all test results point towards it.

Magnetic Shaft-Position Digitizer

By ARTHUR J. WINTER
Telecomputing Corporation
Burbank, California

OUTPUTS OF MANY PRECISION DEVICES occur as shaft rotations. When the position of such a shaft must be determined to an accuracy beyond the reach of analog instruments, or when the data must be processed by digital equipment, an analog-to-digital conversion must be made. It is often essential that the digitizer present no appreciable mechanical load to the shaft under measurement. A further requirement that often must be met is that readings be taken while the shaft is in motion at speeds varying from

BUILT-IN SOLA REGULATED POWER TRANSFORMER



Assures Positive Signalling and Protects Components

ON KELLOGG NO. 5 TRANSMITTED CARRIER TELEPHONE SYSTEM

Low voltages cause disconnects and false signalling on telephone carrier systems. Abnormally high voltages can result in damage to components and premature filament failure of electronic tubes.

The Kellogg Switchboard and Supply Company provides dependable performance, positive signalling and satisfactory transmission by building in a Sola Constant Voltage Transformer as an integral component of their system's power supply. The custom Sola unit they employed automatically maintains voltage constant within ±3% with line voltage variations from 95 to 125 volts.

Like Kellogg Switchboard, you can assure reliable performance of your electronic equipment. Make sure of the proper input voltage with a Sola Constant Voltage Transformer. Any reasonable combination of plate and filament voltages can be provided to meet your specifications.

Sola stabilizers are static magnetic regulators . . . regulation is continuous and automatic . . . response time is 1.5 cycles or less.

There are no moving parts, no tubes, no manual adjustments. The cost is reasonable. Regulation within ±1% with line voltage fluctuations as great as 30% can be provided. Your inquiry will receive prompt attention.

The photograph above shows a complete Type No. 5 three channel Transmitted Carrier Telephone Terminal made by Kellogg (an Associate of International Telephone and Telegraph Corp.) The Sola Constant Voltage Transformer is a standard component of the power supply chassis at the top of the rack.

BUILD-IN AUTOMATIC VOLTAGE STABILIZATION WITH

SOLA *Constant Voltage* TRANSFORMERS

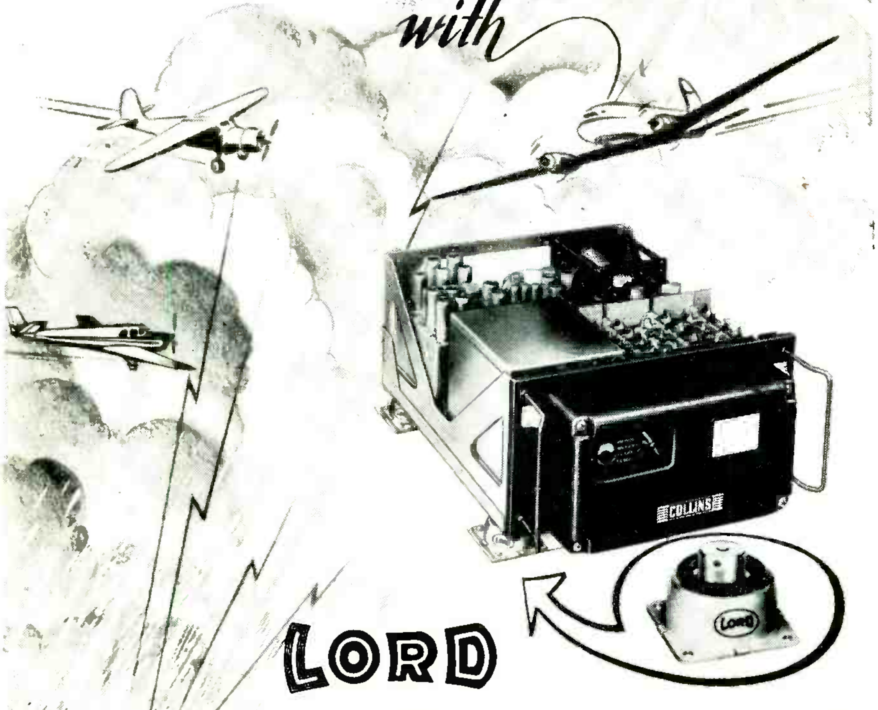
COMPLETE CATALOG AVAILABLE. Write for Bulletin DCV-142

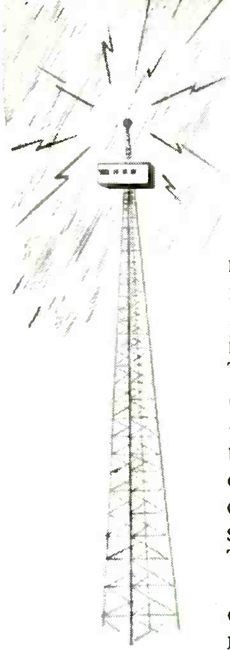
Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Mercury Vapor Lighting • Luminous Tube Signs
SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois, Bishop 2-1414 • NEW YORK 35: 103 E. 125th St., TRafalgar 6-6464
PHILADELPHIA: Commercial Trust Bldg., Rittenhouse 6-4988 • BOSTON: 272 Centre St., Newton 58, Mass., Bigelow 4-3354
CLEVELAND 15: 1836 Euclid Ave., PRospect 1-6400 • KANSAS CITY 2, MO., 406 W. 34th St., Jefferson 4382 • Representatives in Principal Cities

Want more information? Use post card on last page.

Maximum Electronic Performance in any WEATHER

with





LORD TEMPROOF MOUNTINGS ON COLLINS 618S-1 TRANSCEIVER

SENSITIVE electronic equipment for airline transmitting and receiving must give continuously accurate results. For instance, note this "inside" view of the Collins Transceiver, mounted on Lord Temproof Mountings which isolate it from vibration and shock. Lord Temproof Mountings function efficiently throughout operational ranges of temperature from —80° to +250°F. The Collins Transceiver with automatically tuned elements for maximum flexibility and high power output delivers maximum performance in any weather, completely protected from vibration, shock and excessive equipment motion at resonant frequencies by Lord Temproof Mountings.

May we give you further details on this Lord application or help you solve your specific mounting requirement?

BURBANK, CALIFORNIA 233 South Third Street
DALLAS, TEXAS 413 Fidelity Union Life Building
PHILADELPHIA 7, PENNSYLVANIA 725 Widener Building
DAYTON 2, OHIO 410 West First Street
DETROIT 2, MICHIGAN 311 Curtis Bldg.
NEW YORK 16, NEW YORK 280 Madison Avenue
CHICAGO 11, ILLINOIS 520 N. Michigan Ave.
CLEVELAND 15, OHIO Room 811 Hanna Building

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL**

zero to many hundreds of rpm.

This paper deals with a recently developed shaft-position digitizer designed more nearly to satisfy these requirements. Two previous types that led to its development will be discussed first.

An early type of digitizer uses a rotating slotted disk to interrupt a light beam. A photoelectric tube pickup and d-c amplifier produce an output signal of varying amplitude. If this signal is fed through a d-c operated trigger into a counter, the counter will accumulate angular increments by counting the number of slots. By using another phototube angularly separated from the first by an amount equal to one-half of a slot, an additional signal is derived 90 deg out of phase with the first. Since the phase relationship will change with direction of rotation, the second signal may be used to prepare gates in the accumulator

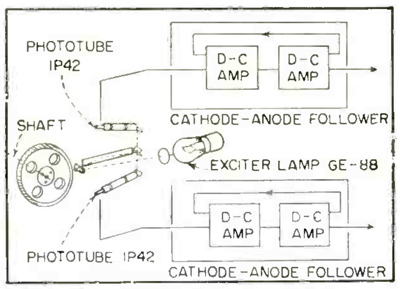


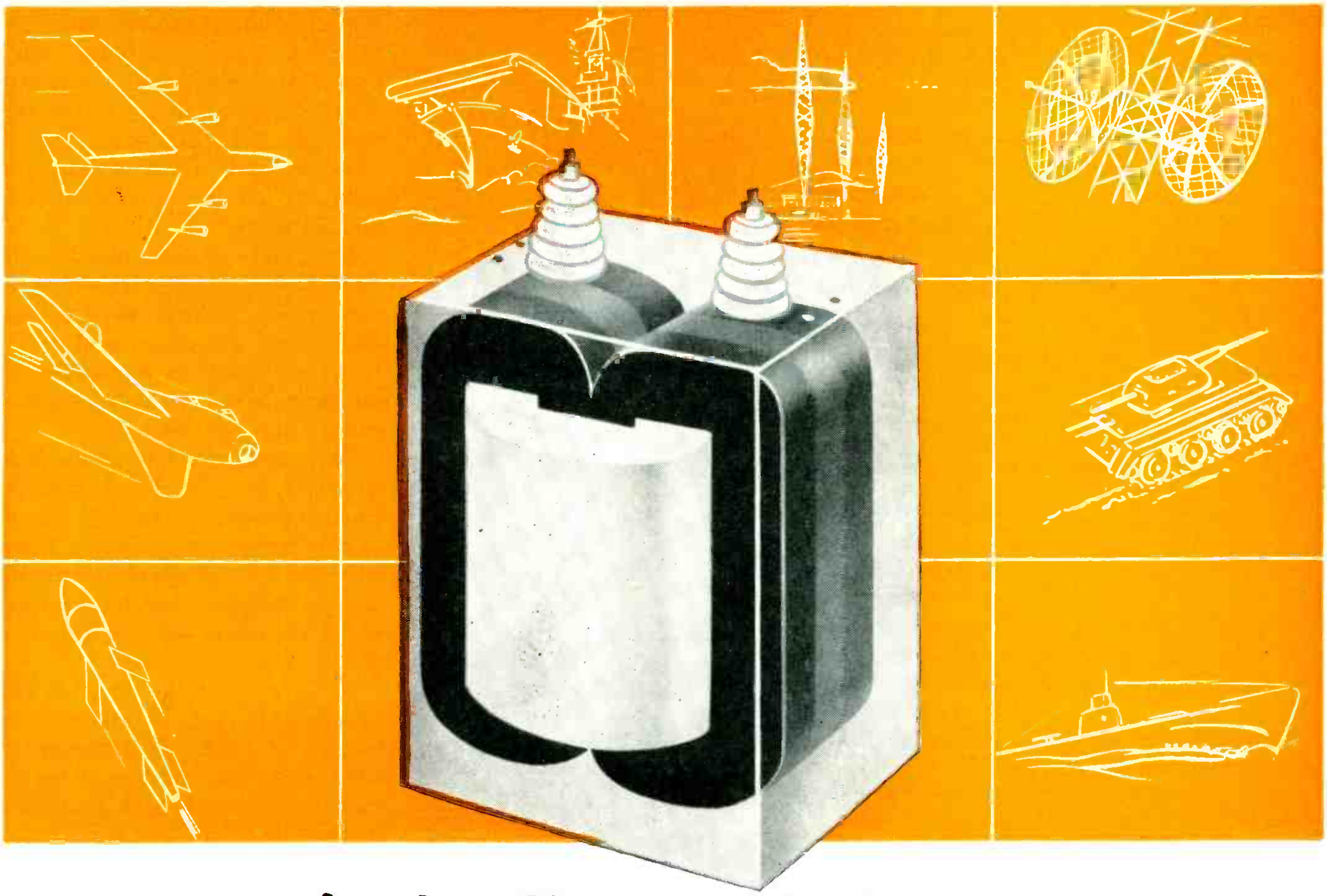
FIG. 1—Shaft position digitizer using serrated drum and phototubes to measure shaft rotation

causing the counters to subtract when the digitizer reverses direction. In this way the digitizer can be used on a shaft which may hunt, oscillate, or reverse direction, without introducing errors. Readouts may be obtained without stopping the digitizer or losing the count in the accumulator.

The slotted disk digitizer is limited in resolution by the number of slots that it is possible to cut in any given diameter disk, and has been used only for applications requiring resolution of about 200 counts per revolution or less.

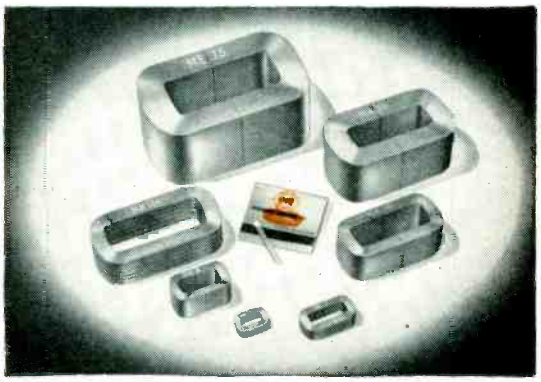
The next to be developed was a serrated-drum digitizer. In this type the slotted disk is replaced by a drum with many serrations on its surface. The serrations act as concave mirrors reflecting light into two phototubes, as shown in Fig. 1. The output from the phototubes is

MOLONEY *HiperCore* ELECTRONIC CORES



...for Any Electronic Application

Moloney HiperCore Electronic Cores assure better transformer performance because of their advanced wound core design. These wound cores have greater flux carrying capacity and lower losses than other types of cores of comparable sizes. In addition to better performance, a smaller, lighter core is obtained. In electronic applications, where size and weight are critical, Moloney HiperCore Electronic Cores are particularly desireable. Because they are wound cores, savings in assembly time can be favorably reflected in accelerated production. Rigid production control assures cores that test well within industry standards. More than 1000 standard sizes are available and special sizes can be made for specific applications, if desired.



Moloney HiperCore Electronic Cores are wound with grain oriented silicon steel of 1, 2, 4 or 12 mil thicknesses.

Write today for bulletin SR-205 containing specifications, performance data and prices on over 300 stock sizes.

ME 53-17

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers Step Voltage Regulators • Unit Substations

MOLONEY ELECTRIC = BETTER PERFORMANCE, GREATER RELIABILITY, LESS MAINTENANCE

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

Want more information? Use post card on last page.

www.americanradiohistory.com

ENGINEERS AND PHYSICISTS

Attending the

WESTERN ELECTRONIC SHOW AND CONVENTION

San Francisco
August 19-21, 1953

Inquiries are invited regarding openings on our Staff.

HUGHES research in the fields of Radar, Guided Missiles, Semiconductor Products, Electronic Computers, Microwave Devices and Electron Tubes is creating new openings for those qualified in these fields.

IN RESEARCH AND DEVELOPMENT the problems are concerned with the physical design of electronic equipment involving Servo Mechanisms, Computers, Pulse Circuitry, Miniaturization, Hydraulics-Gyros, Test Equipment, Subminiaturization, Stress Analysis, Instrumentation, Structures and Precision Production Problems.

ELECTRONIC MANUFACTURING includes the fields of Microwave Test Equipment Design, Production Testing and Quality Control.

COMMERCIAL PRODUCTS activities have to do with Semiconductor Products Applications Engineering, Test Equipment Design, Semiconductor Components Engineering and Technical Writing.

FIELD SERVICE AND SUPPORT consists of Field Engineering, Technical Writing, Field Modifications and Personnel Instruction.

For the convenience of those attending the Western Electronic Show and Convention, members of our Technical Staff will be available for interviews at Hotel Whitcomb. For appointment telephone DOuglas 2-6535.

Assurance is required that relocation of the applicant won't cause disruption of an urgent military project.

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES
ELECTRONIC MANUFACTURING DIVISION
COMMERCIAL PRODUCTS DIVISION
FIELD SERVICE AND SUPPORT

Culver City
Los Angeles County
California

amplified and handled in the same way as in the case of the slotted disk digitizer. The advantage of the serrated drum over the slotted disk is that more serrations can be machined in a given diameter drum than slots could be cut in the same diameter disk. However, since the light output is not as great, phototube and amplifier drifts are more of a problem.

The magnetic shaft-position digitizer designed to overcome disadvantages in the two previous types, has higher resolution and is free from drift due to phototubes and d-c amplifiers. It is much more rugged and reliable.

The basic principle of operation is shown in Fig. 2. A high-frequency generator causes a current to flow through a conductor shaped so that at any instant the current flow in adjacent parallel segments of the conductor are 180 deg out of phase.

The arrows in the diagram indicate polarity of current flow at some instant of time. If a pickup coil were placed over any one of the conducting segments, such as *A* or *C*, it could be used to measure the intensity of the field near that segment; and if the coil were placed halfway between two adjacent segments, position *B*, its output would be essentially zero. If the output of the pickup is amplified and demodulated, the resultant d-c output signal will fluctuate from maximum to null as the pickup coil is moved across conductor segments. Fluctuations in these signals can be used to count the number of segments. To obtain two outputs for direction sensing as in the previous digitizer, two pickups must be used, spaced one-quarter of a segment apart.

In order to adapt this principle

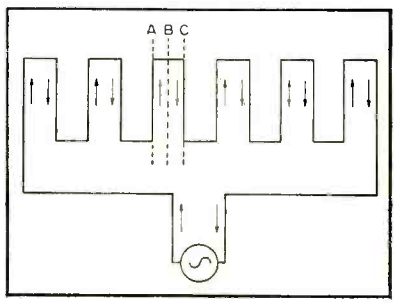
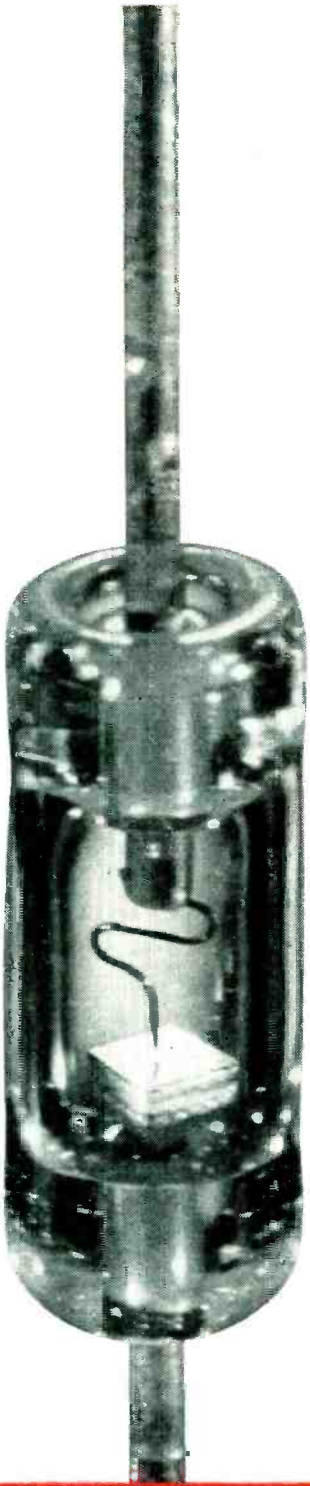


FIG. 2—Adjacent conductors are 180 deg out of phase causing null point to occur at *B*

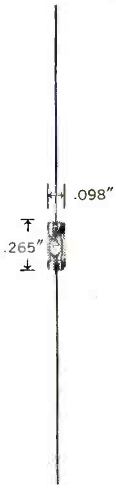
Why Hughes Diodes have set

A NEW STANDARD OF RELIABILITY

Reliability in a germanium diode is determined principally by permanent freedom from the two major causes of diode failure—moisture penetration of the diode envelope, and electrical instability under extreme operating conditions.



Fusion sealed in glass *for electrical stability*



actual size

HUGHES GERMANIUM DIODES are designed to prevent such failures through two exclusive features:

1. **Fusion Sealing**—The glass-to-metal seal, proved in billions of vacuum tubes, is incorporated to full advantage in diode manufacture by the Hughes-developed process of fusion sealing at high temperature. The result is a rigid *one-piece* glass envelope making moisture penetration impossible.

2. **100% Testing**—One hundred per cent testing insures the satisfactory operation of **HUGHES DIODES** under adverse conditions of moisture, temperature, vibration and severe shock. Hughes testing procedures *invite* instabilities to occur prior to shipment and assure rejection of every defective diode. *Each* **HUGHES DIODE** is humidity-cycled, temperature-cycled, JAN shock-tested, and electrically tested under vibration.

Reliability of **HUGHES DIODES** has been proved in airborne military electronic equipment for navigation, fire control and guided missiles. The same high standard required for these uses is your insurance against costly shutdowns, high maintenance expense and time losses.

Specify **HUGHES DIODES** wherever reliability is essential.

HUGHES GERMANIUM DIODE ELECTRICAL SPECIFICATIONS AT 25° C.

Description	RTMA Type	Test Peak Inverse Voltage* (volts)	Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1 v (ma)	Maximum Inverse Current (ma)
High Peak	1N55B	190	150	5.0	0.500 @ −150 v
	1N68A	130	100	3.0	0.625 @ −100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ −5 v; 0.050 @ −50 v
	1N99	100	80	10.0	0.005 @ −5 v; 0.050 @ −50 v
	1N100	100	80	20.0	0.005 @ −5 v; 0.050 @ −50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ −5 v; 0.100 @ −50 v
	1N97	100	80	10.0	0.008 @ −5 v; 0.100 @ −50 v
	1N98	100	80	20.0	0.008 @ −5 v; 0.100 @ −50 v
High Back Resistance	1N116	75	60	5.0	0.100 @ −50 v
	1N117	75	60	10.0	0.100 @ −50 v
	1N118	75	60	20.0	0.100 @ −50 v
General Purpose	1N90	75	60	5.0	0.800 @ −50 v
	1N95	75	60	10.0	0.800 @ −50 v
	1N96	75	60	20.0	0.800 @ −50 v
JAN Types	1N126**	75	60	5.0	0.050 @ −10 v; 0.850 @ −50 v
	1N127†	125	100	3.0	0.025 @ −10 v; 0.300 @ −50 v
	1N128‡	50	40	3.0	0.010 @ −10 v

*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.
**Formerly 1N69A. †Formerly 1N70A. ‡Formerly 1N81A.

© 1953, H. A. C.

In addition to RTMA *types,* HUGHES DIODES *are also supplied 100 per cent factory-tested to special customer specifications.*

Semiconductor Sales Department

Hughes

AIRCRAFT COMPANY
CULVER CITY CALIFORNIA
Chicago New York City

Address inquiries to Dept. E

Want more information? Use post card on last page.

www.americanradiohistory.com

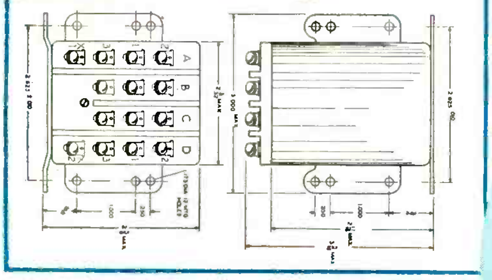
Leach CONTROL RELAYS

FOR *UNEXCELLED* PERFORMANCE

Furnishing Relays that excel in performance is a *Leach* specialty. Their rugged strength and smooth endurance provide uniform control, protection and dependability.

No matter what your Relay application, we invite you to share our nearly four decades of experience and facilities as designers, engineers and manufacturers of a complete line of relays.

DIMENSIONS

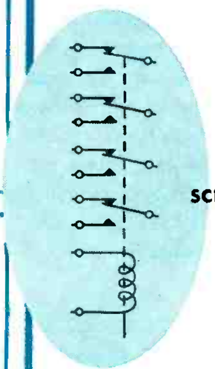


CHARACTERISTICS

Leach Part No. 9072 Hermetically Sealed, Screw Terminals.

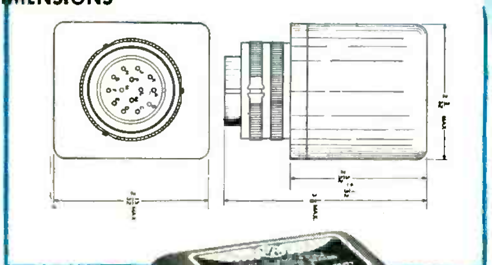
CONTACTS:
Arrangement—4 Pole, Double Throw. Rating—10 amps resistive and inductive at 29 v d-c, 6 amps motor load at 29 v d-c, 10 amps resistive at 115 v a-c, 400 cps.
COIL: 135 ohms, 28 v d-c.
WEIGHT: .70 lb.

Also available with Solder Terminals—Leach Part No. 9039SS.



SCHEMATIC

DIMENSIONS



Leach Part No. 9039 Sealed AN Connector Mounting.
Same Characteristics as above.
APPROVED:
AN3310-1 part per spec. MIL-R-6106
WEIGHT:
.57 lb.

Hermetically Sealed and Sealed — Midgets — Circuit Controls — Aircraft Relays & Contactors — Special Purpose — Radio & High Frequency — Keying

For your specific requirements and for BETTER CONTROLS THROUGH BETTER RELAYS—*Contact Leach*

LEACH RELAY CO.

5915 AVALON BOULEVARD • LOS ANGELES 3, CALIFORNIA
Representatives in Principal Cities of U.S. and Canada

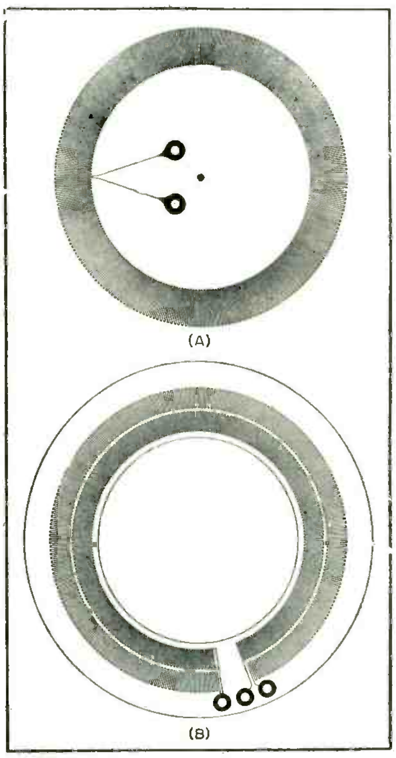


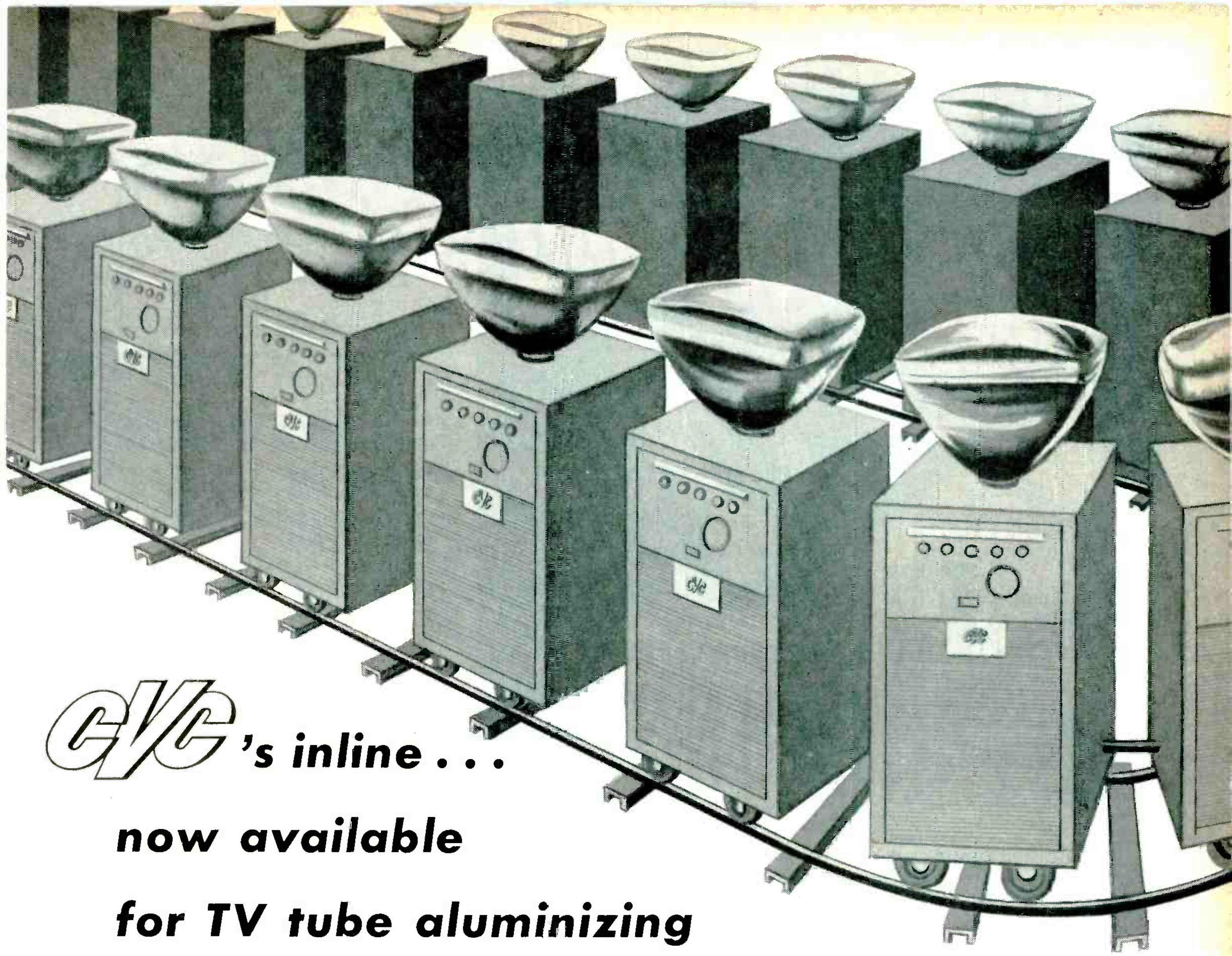
FIG. 3—Rotor (A) and stator (B) patterns for magnetic shaft-position digitizer

to shaft digitizing, the circuit of Fig. 2 was arranged in the circular pattern shown in Fig. 3A. This is a reduced negative of a 500-segment pattern photoetched onto a 2½ inch disk and used as the rotating element of a shaft-position digitizer. The connections at the center are for injection of the high frequency carrier current. To avoid using slip rings the carrier current is coupled to the rotor by means of a small air core transformer whose secondary is mounted on the rotor.

The arrangement in Fig. 3B is used as a pickup device. This pickup pattern functions in the same way as a pickup coil would except that there is coupling to every segment in the rotor, and the output signal is a much more accurate indication of position, since each null and each maximum results from an average of all of the conducting segments. The pickup pattern is also photoetched on a disk and consists of two conductors displaced angularly one-quarter of a segment space, Connections for two amplifiers and a common ground are at the outer edge of the disk.

Figure 4 shows the arrangement of the assembled digitizer. The

www.americanradiohistory.com



CVC's inline . . . now available for TV tube aluminizing

Here is an inline system capable of aluminizing TV tubes with the same efficiency and high production rates as the famous inline exhaust systems pioneered by *CVC*.

Similar to the exhaust system, individual aluminizing units move around an oval track, one revolution completing the aluminizing cycle. Each cart is completely self-contained with mechanical and diffusion pumps, valves, power pickups, and controls for automatic operation. The operator need only load and unload tubes and replenish the aluminum on the filaments.

This new *CVC* system can handle any size TV tube currently produced. Interchangeable diffusion pump jet assemblies permit easy adaptation of the system to the higher vacuums probably required for color TV tube aluminizing.

For smaller scale operations, CVC offers an integrated system of one to six individual pumping units with common roughing and holding pumps. Timing devices control cycling automatically and permit one operator to handle all systems.

CVC's vast experience in designing inline exhaust systems makes these units trouble-free and economical in operation. We will be pleased to give you the details on specifications, costs, and deliveries. *Consolidated Vacuum Corporation, Rochester 3, N. Y.* (a subsidiary of Consolidated Engineering Corporation, Pasadena, California).

CVC

Consolidated Vacuum Corporation

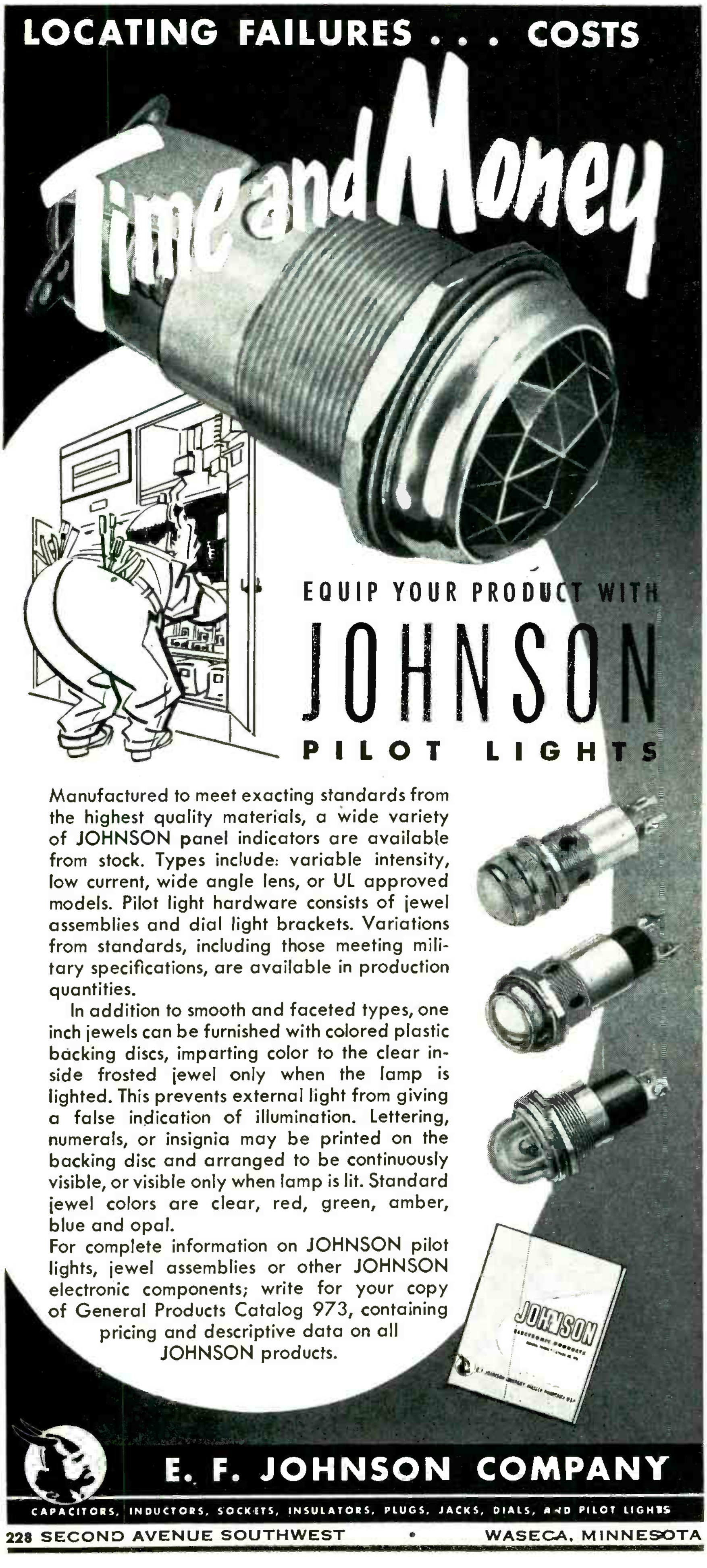
Rochester 3, N. Y.

formerly DPi Vacuum Equipment Dept.

designers and manufacturers of high vacuum equipment

SALES OFFICES: MENLO PARK, CALIF. • CHICAGO, ILL. • CAMDEN, N. J. • NEW YORK, N. Y.

www.americanradiohistory.com



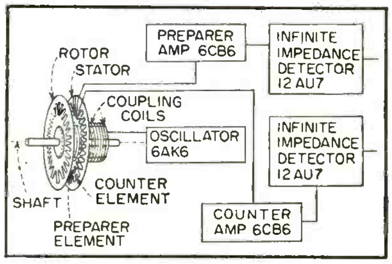


FIG. 4—Diagram of magnetic digitizer

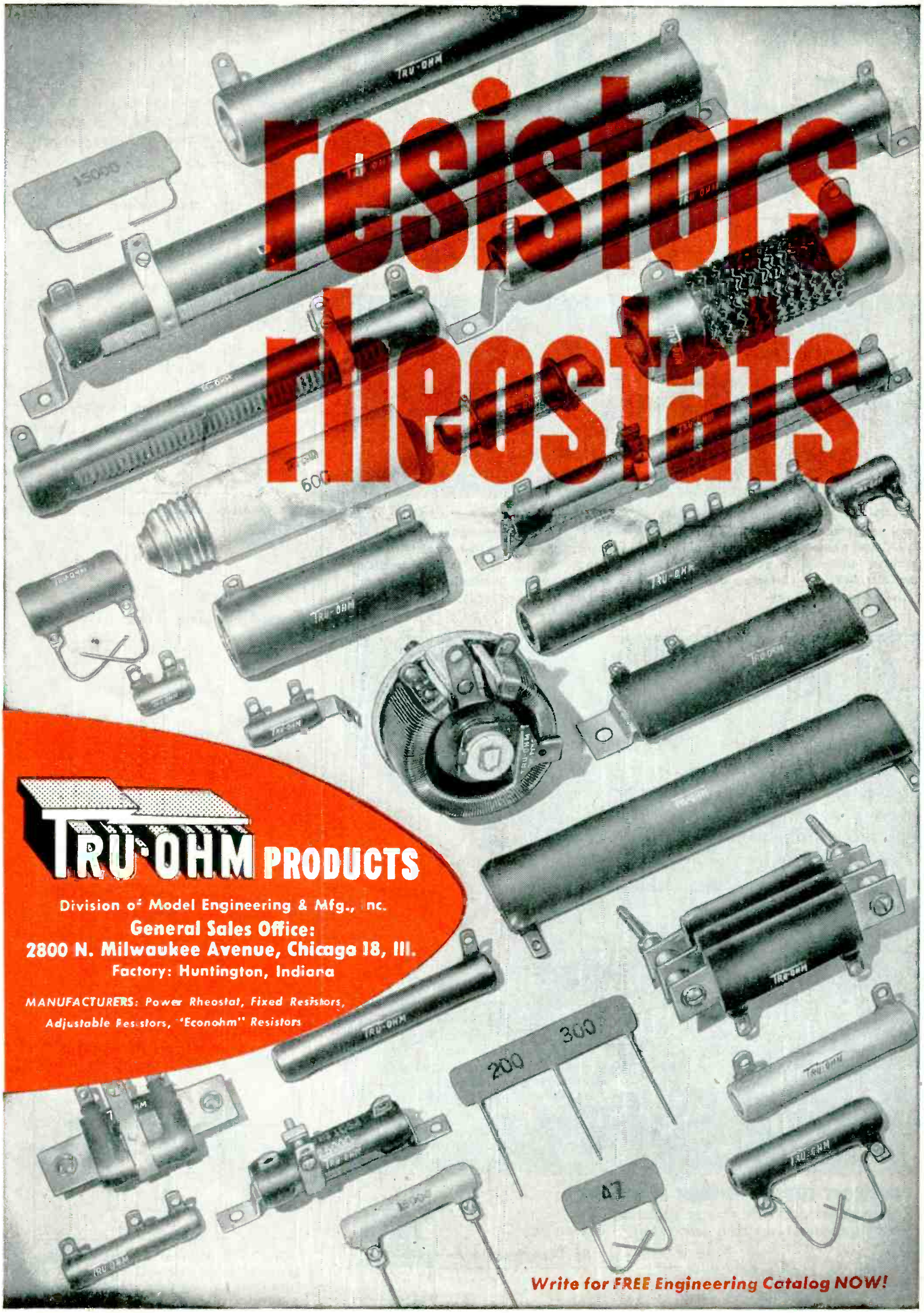
rotor and the transformer secondary spin with the shaft. The transformer primary is fed by a 1.6-megacycle oscillator. The pickup, or stator, supplies signals to two tuned amplifiers.

This type of shaft-position digitizer has a permissible shaft speed of from zero to 1,800 rpm; and since its output contains directional information, it can reverse direction or hunt without introducing errors. Use of the photoetching process has made it possible to obtain high resolution. Digitizers of 1,000 and 2,000 counts per revolution have been built. It is electrically more stable and not subject to drifts since it is an a-c carrier operated nulling device. Low impedance and tuned circuits make the unit less subject to stray electrical pickups. The smaller rotor disk presents less of an inertial load to the shaft.

Another advantage of the magnetic digitizer is the averaging effect of the pickup element. The position of the exact point on the circle at which the output goes through any given null is at least an order of magnitude more accurate than it would be if the signal were derived from a pickup over only one rotor segment. Development is now under way to take advantage of this potentially high accuracy by electrically dividing the increments between nulls so that the number of counts per revolution may be multiplied many times.

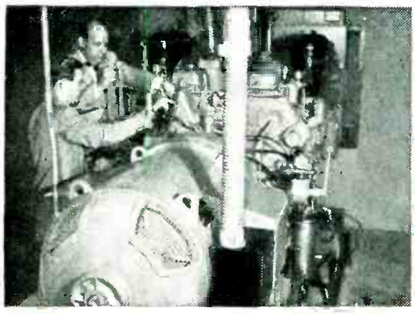
Magnetic Material from Aluminum and Iron

DEVELOPMENT of techniques for rolling have made available a new magnetically soft material known as 16-Alfenol, composed of 16 percent aluminum and 84 percent iron. Although the alloy has been known

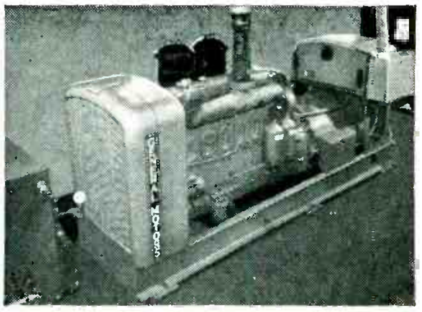


www.americanradiohistory.com

GM DIESEL *Stand-by* GENERATOR SETS



WJR—Detroit, Michigan, uses 200 kw. GM Diesel generator set as stand-by power for 50,000-watt transmitter. Compactness of unit permitted installation in garage adjoining transmitter building—eliminating cost of a specially designed building.



WKTV—UTICA, N. Y., uses a 100 kw. General Motors Diesel generator set for stand-by power. Set can be started remotely from the control room. Low vibration characteristic of engine permitted installation in room adjacent to transmitter and within 30 feet of studio.

If you are planning stand-by power, be sure to check the advantages of General Motors Diesel generator sets, listed briefly below. GM Diesel generators are meeting the exacting requirements of military service in all parts of the world. They supply emergency power for more than 1100 telephone and telegraph exchanges—for microwave relay stations, for hospitals, government buildings, banks, airports. There is a GM Diesel distributor near you who will analyze your power requirements and make his recommendations without obligation. Look in the yellow pages of your phone book for his listing, or write direct to us.

- Wide range of models—12½ to 200 kw., 220 or 440 volts, single or three-phase current.
- Excellent frequency and voltage regulation for the most exacting requirements.
- Powered by General Motors Diesel engines—dependable, smooth 2-cycle operation—low cost maintenance—easy to service.
- Built by one manufacturer—one warranty, one responsibility for both engine and power generator.
- Instant push-button power starting on safe Diesel fuel—or fully automatic starting. Immediate power, no "warm-up" period.
- Dependable starting—no spark-ignition system to fail because of dampness or corrosion—always ready to start.
- Easy to install—compact—lightweight—requires no special building, no special base. Complete instrumentation provided.
- Distributors and Dealers throughout the country.

DETROIT DIESEL ENGINE DIVISION

GENERAL MOTORS • DETROIT 28, MICHIGAN

SINGLE ENGINES . . . 16 to 275 H.P. MULTIPLE UNITS . . . Up to 840 H.P.

It pays to Standardize on

GM GENERAL MOTORS DIESEL POWER

Write for Generator Set Catalog 6 SA 20.

for some time and was used by the Japanese during the war, the extreme hardness and brittleness of the material restricted its use and prevented efficient rolling of sheets.

Metallurgists at the U. S. Naval Ordnance Laboratory developed a method of cold rolling and discovered that the metal could be formed into thin tapes with desirable magnetic properties.

The metal tapes show isotropic magnetic properties and high bulk resistivity that prevents electrical losses. In rolling, it develops its own insulating layer. For transformer cores, like those used at high frequencies, the new material shows properties superior to those of silicon iron that is now widely used.

A comprehensive technical report is now in process of preparation by NOL.

Zero-Crossing Detector Using Gated-Beam Tube

By PAUL ROSEN

Lincoln Laboratory
Massachusetts Institute of Technology
Cambridge, Mass.

THE 6BN6 GATED-BEAM tube as applied here makes a simple zero-crossing detector, providing 100-volt negative spikes at the zero crossing on both positive and negative slopes of a sine wave.

The 6BN6 has two control grids, both having nearly the same control characteristics. If the two grids are connected in push-pull as shown

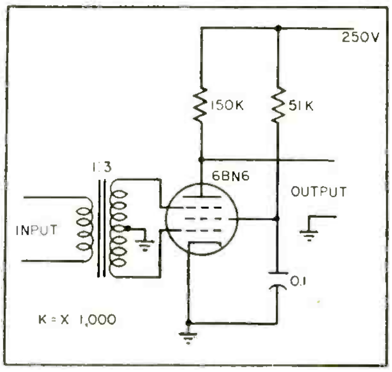


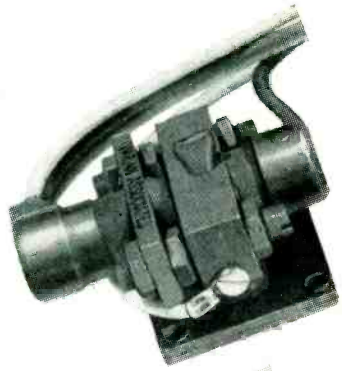
FIG. 1—Gated-beam tube zero-crossing detector uses push-pull connection on two grids to keep tube cut off except in zero-voltage region

www.americanradiohistory.com

VARIAN* associates

LOCKNUT TUNERS
for extreme ruggedness

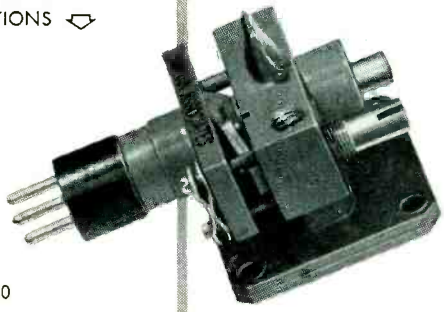
VA-6313/V-280



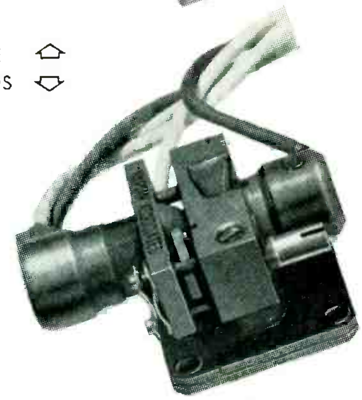
VA-6314/V-290

CONVENTIONAL
CONNECTIONS

HIGH-ALTITUDE
INSULATED LEADS



VA-6310/V-260



VA-6312/V-270

SHAFT TUNERS
smooth, chatter-free

X-BAND KLYSTRONS in QUANTITY

rugged local oscillators for radar and beacon services

full production

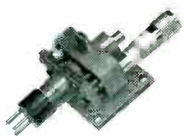
quantity prices

firm basis for new equipment design

READY NOW for your specification into production equipment. This comprehensive series of Varian X-Band Klystrons includes the type variations illustrated—all having these outstanding features:

- Non-microphonic characteristic
- Negligible barometric-frequency coefficient
- Rapid warmup—on frequency in 30 seconds
- Low-voltage operation—see data below
- Production tested—under high-amplitude vibration

		V-260, V-270		V-280, V-290		X-13	
GENERAL DATA	Frequency Range, kmc	8.5-10.0		8.5-10.5		8.2-12.4	
	Heater Voltage, v	6.3		6.3		6.3	
	Heater Current, amp.	1.2		1.2		1.2	
	Tuner	slotted shaft		locknut		micrometer	
MAXIMUM RATINGS	Resonator Voltage, v	350		385		500	
	Resonator Current, ma	42		74		65	
	Reflector Voltage, v	0 to -1000		0 to -1000		0 to -1000	
TYPICAL OPERATION	Resonator Voltage, v	200	300	200	300	300	500
	Frequency, kmc	9.3	9.3	9.3	9.3	10	10
	Resonator Current, ma	17	28	23	42	28	58
	Power Output, mw	20	70	15	48	90	560
	Electronic Tuning Range, mc	30	48	50	82	46	43
	Temperature Coefficient, kc/°C	60	60	60	60	100	100
	Reflector Voltage, v	-120	-160	-80	-100	-230	-600
	Load VSWR, less than	1.1	1.1	1.1	1.1		
	Warm-up Time, sec to oscillation	15	15	15	15	15	15



FOR LABORATORY x-band measurement—the basic Varian X-13 Klystron general-purpose signal source is now available for early shipment in production quantities.

* Trademark

Field representatives in 21 Cities.

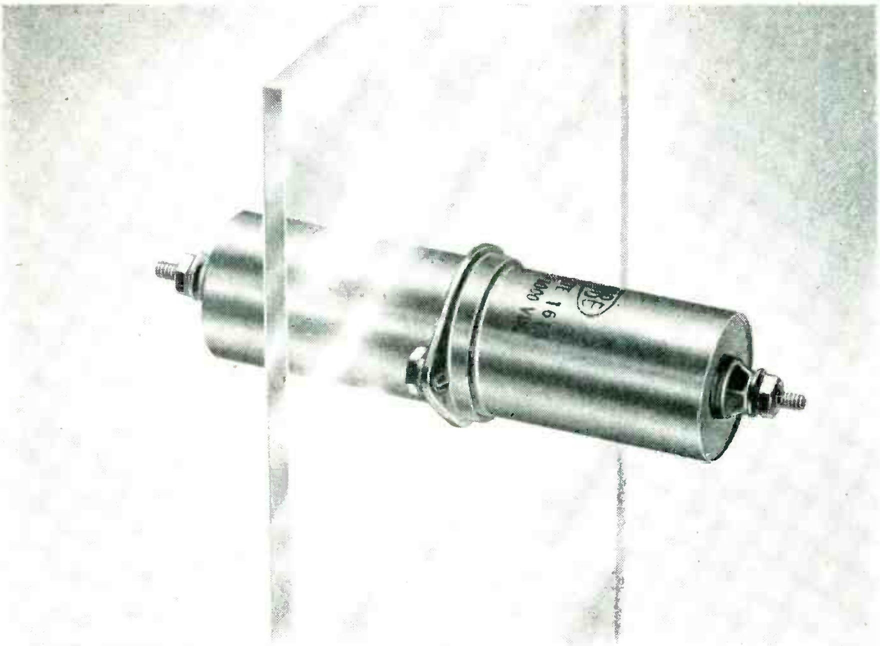
VARIAN associates
PALO ALTO 1, CALIFORNIA

www.americanradiohistory.com

RADIO-NOISE FILTER

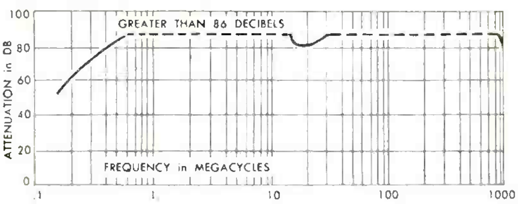
for Bulkhead Mounting

Filterette No. 1613 1000 volts DC 5 amperes

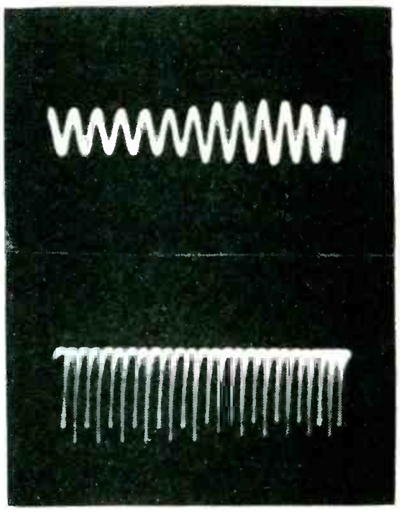


TOBE FILTERETTE SERIES 1613

This wide-band radio-noise filter is designed for connection in series with any single line that may be carrying radio interference. Hermetically sealed in a metal case, it is built to make use of the shielding afforded by metal bulkheads or firewalls. Installed in a 1-5/32" hole in the bulkhead, Filterette 1613 has a mounting flange that completes the filter circuit to ground. External-tooth lockwashers are recommended between the mounting flange and the metal bulkhead to maintain low-resistance contact. This unit conforms to applicable military specifications, and is suitable for use at high altitudes. Its attenuation characteristics are shown below.



TOBE DEUTSCHMANN CORPORATION
NORWOOD, MASSACHUSETTS



Sine-wave input at top, results in series of sharp negative peaks in the output

in Fig. 1, the tube is cut off by the negative excursion of one of the grids during most of the cycle. For a short period, however, when both grids are around zero, the tube conducts heavily. The result is a sharp spike appearing at the plate.

The input sine wave and the output pulses are shown in the photograph. For best results the input amplitude should be at least fifty volts peak-to-peak.

High-Voltage Power Supply

By William C. Davidon

Director of Research
Nuclear Instrument and Chemical Corp.
Chicago, Ill.

The variable-voltage, electronically-regulated, high-voltage power supply shown in Fig. 1 has the advantage of having high voltage impressed across only one tube, regardless of the high voltage output. No high voltage surge above the desired value occurs during the initial warmup time, eliminating the need for a time delay circuit. Filaments of all tubes except the high voltage rectifier, can be operated at low potentials with respect to ground, for a negative high voltage supply.

Current through the high-voltage bleeder is equal to the current through the amplifier tubes. The high-voltage output assumes a value such that the bias on the 6AH6 is the correct value to provide

www.americanradiohistory.com

In photo-electronics

. . . it's RCA Phototubes for your needs

RCA—pre-eminent in the design and development of phototubes—offers a full line of high-quality phototubes to meet your needs in designing light-actuated devices. This line of phototubes includes a wide selection of gas types (for sound-on-film and relay work)—vacuum types (for high-speed work and precision measurements)—and multiplier types (for applications where extremely high sensitivity is important).

RCA phototubes are available in a variety of spectral responses, physical shapes, and sizes. For help on phototube equipment design problems—write RCA Commercial Engineering, Section 42HR, Harrison, N. J. Or call the RCA Field Office nearest you:

(EAST) Humboldt 5-3900
415 S. 5th St., Harrison, N. J.
(MIDWEST) Whitehall 4-2900
589 E. Illinois St., Chicago, Ill.
(WEST) Madison 9-3671
420 S. San Pedro St., Los Angeles, Cal.

Check your application—select your phototube

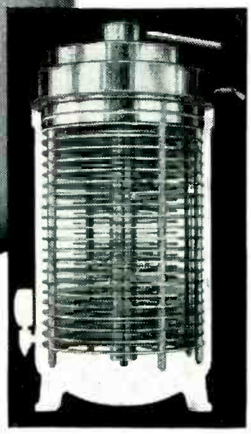
Application	RCA Phototube Types
Sound Reproduction	1P40, 920, 927
Light and Color Measurements	1P21, 1P22, 1P28, 1P29, 1P39 917, 919, 926, 931-A, 935, 6217
Relay Applications	1P39, 1P40, 1P41, 1P42, 917 919, 921, 922, 925, 931-A
Scintillation Counting	1P21, 931-A, 5819, 6199
Facsimile	934, 5652

Visit the RCA Exhibit at the Western Electronic Show and Convention, San Francisco—August 19-20-21

RADIO CORPORATION of AMERICA
ELECTRON TUBES **HARRISON, N. J.**

Want more information? Use post card on last page.

www.americanradiohistory.com



The

Lapp

GAS-FILLED CONDENSER

... the "no trouble" capacitor for high voltage, high current duty

● For duty at high voltage and high current, the Lapp Gas-Filled Condenser offers a combination of characteristics not available in any other type of capacitor . . . extreme compactness . . . low loss . . . high safety factors . . . puncture-proof operation . . . constant capacitance under temperature variation . . . and reliability of performance assured by a 15-year service record.

In construction, the Lapp Gas-Filled Condenser assembly is supported on a top aluminum ring, the steel tank serving only as a support and as a leak-proof gas container. High-potential plates are stationary, carried on a rigid aluminum center stud, supported by a ceramic bowl. Rotor plates are grounded, carried on ball-bearings in a race almost the full diameter of the tank. This construction provides a grounded tuning shaft on variable models, makes possible efficient and complete water cooling for high current operation, and results in direct and short current paths to condenser plates.

Units available in 5 tank diameters, 7″ to 24″, for duties at capacitances up to 60,000 mmf; current ratings to 525 amps at 1 mc; voltages to 100 Kv peak. Write for Bulletin 302, with complete description and characteristics data. Lapp Insulator Co., Inc., Radio Specialties Division, 104 Sumner St., Le Roy, N. Y.

Lapp

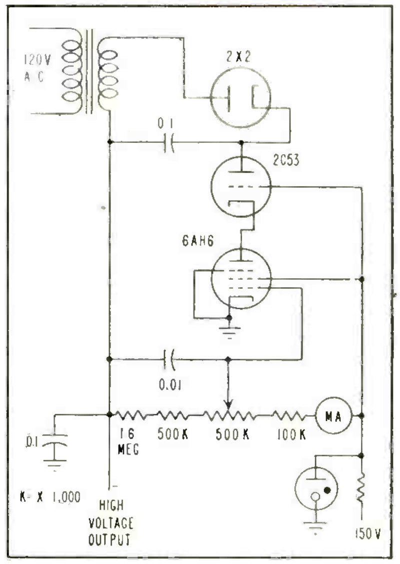


FIG. 1—Circuit of high-voltage power supply

the required output current. To the first approximation, therefore, the output voltage can be obtained by considering that the 6AH6 grid is at ground potential and that the output voltage bears the same relation to 105 volts as the corresponding resistors in the bleeder. If for any reason the output of the rectifier should increase, the 6AH6 will be biased more negatively, increasing the voltage drop across the 6AH6 and 2C53 combination and maintaining constant output voltage. If the high-voltage load is increased, the bias is reduced resulting in decreased impedance of the tube combinations and maintaining the output voltage relatively constant.

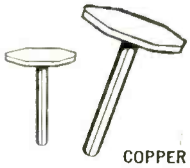
At a 2,500-volt output a one-milliampere bleeder gave better regulation, stability and reduced ripple than the same circuit using a 100-microampere bleeder. Voltage measurements made throughout the circuit are listed in Table I. The measurements were taken with 120 volts a-c input and the output voltage set at 2,000 volts. The output voltage could be varied with the components as indicated from less than 500 volts to over 2,500 volts.

Regulation and stability measurements were made by comparison between a high-voltage battery and the high-voltage output of the power supply. At 2,000 volts output, a line voltage change of 120 to 130 volts increased the output by 1.5

www.americanradiohistory.com

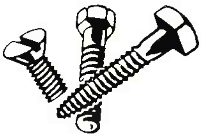
Items like these available QUICKLY at CHASE® warehouses

COPPER NAILS and TACKS



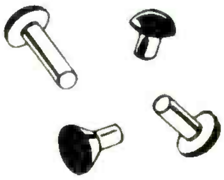
COPPER STORM NAILS

BRASS and BRONZE BOLTS and NUTS

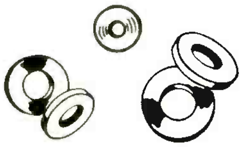


BRASS and BRONZE CAP, MACHINE and LAG SCREWS

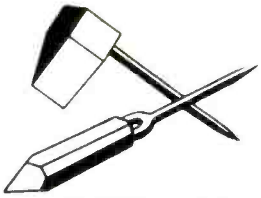
BRASS COTTER PINS
BRASS ESCUTCHEON PINS



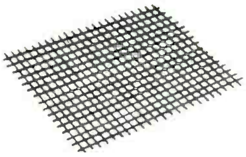
BRASS and COPPER RIVETS, BURS



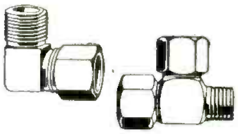
BRASS, BRONZE and COPPER WASHERS



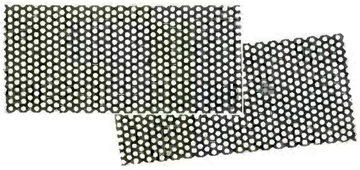
SOLDERING COPPERS



INDUSTRIAL WIRE CLOTH and BRASS STRAINER CLOTH



INDUSTRIAL and AUTOMOTIVE FITTINGS



PERFORATED METAL IN BRASS, BRONZE and COPPER

BEARING BRONZE BARS

CALL US FOR ANYTHING from Bearing Bronze Bars to Brass or Bronze Bolts . . . or any other brass or copper item for maintenance, repair, operating or production.

Twenty-four Chase warehouses are located in major industrial centers from coast to coast. Phone the one nearest you. We can usually fill your orders from stock.

Chase® BRASS & COPPER

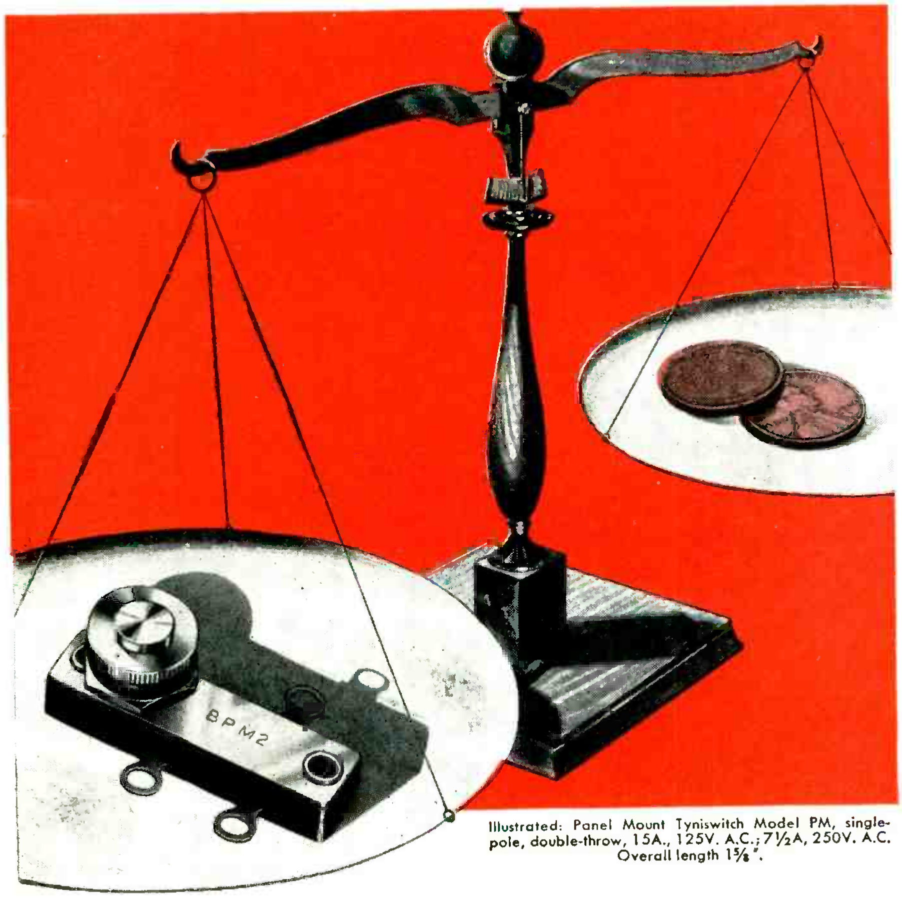
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

Want more information? Use post card on last page.

www.americanradiohistory.com



Illustrated: Panel Mount Tyniswitch Model PM, single-pole, double-throw, 15A., 125V. A.C.; 7½A, 250V. A.C. Overall length 1⅝".

The only miniature snap switch

where size and high rating come to terms with cost

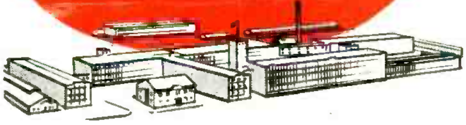
Repeat: *where size and high rating come to terms with cost.* Consider this in terms of engineering that seeks to increase product efficiency while holding costs at a minimum. Then base your snap switch specifications on the following facts.

TYNISWITCH is a low cost, compact snap-action unit based on simplified construction principles. It permits high-load switching in a minimum amount of space. It eliminates costly, non-functional bulk in new or redesigned products. No other model or make — of comparable size and rating — can match its high-standard performance. Its action is flawlessly smooth and dependable. Moreover, it has been conclusively proven by approved laboratory tests that TYNISWITCH is completely reliable . . . for over millions of cycles!

Investigate these and many other TYNISWITCH advantages today. New models can be developed economically to fit your specifications — or you can select conventional circuit arrangements from a variety of standard units. Write for details. TYNISWITCH Division, The Sessions Clock Company, 103 East Main Street, Forestville, Connecticut.

TyniSwitch

A DIVISION OF THE SESSIONS CLOCK COMPANY, FORESTVILLE, CONNECTICUT



volts. A line voltage change from 110 to 120 volts increase the output by approximately 2 volts. A one-ma additional load reduced the high voltage by 11 volts, a two-ma additional load reduced the high voltage by 17 volts.

The circuit as constructed, supplies a negative high-voltage output. To supply a positive output, a small low-voltage supply isolated from the line and from the chassis should be used for the VR105.

Table I—High Voltage Supply Operating Data

Rectifier output.......	3,500 volts
Voltage on VR105.....	107 volts
VR105 current........	9 ma
6AH6 screen current...	0.3 ma
Meter current.........	0.8 ma
Grid to cathode 2C53..	2.5 volts
Grid cathode 6AH6,	2.3 volts

Spring Mounting for Phonograph Chassis

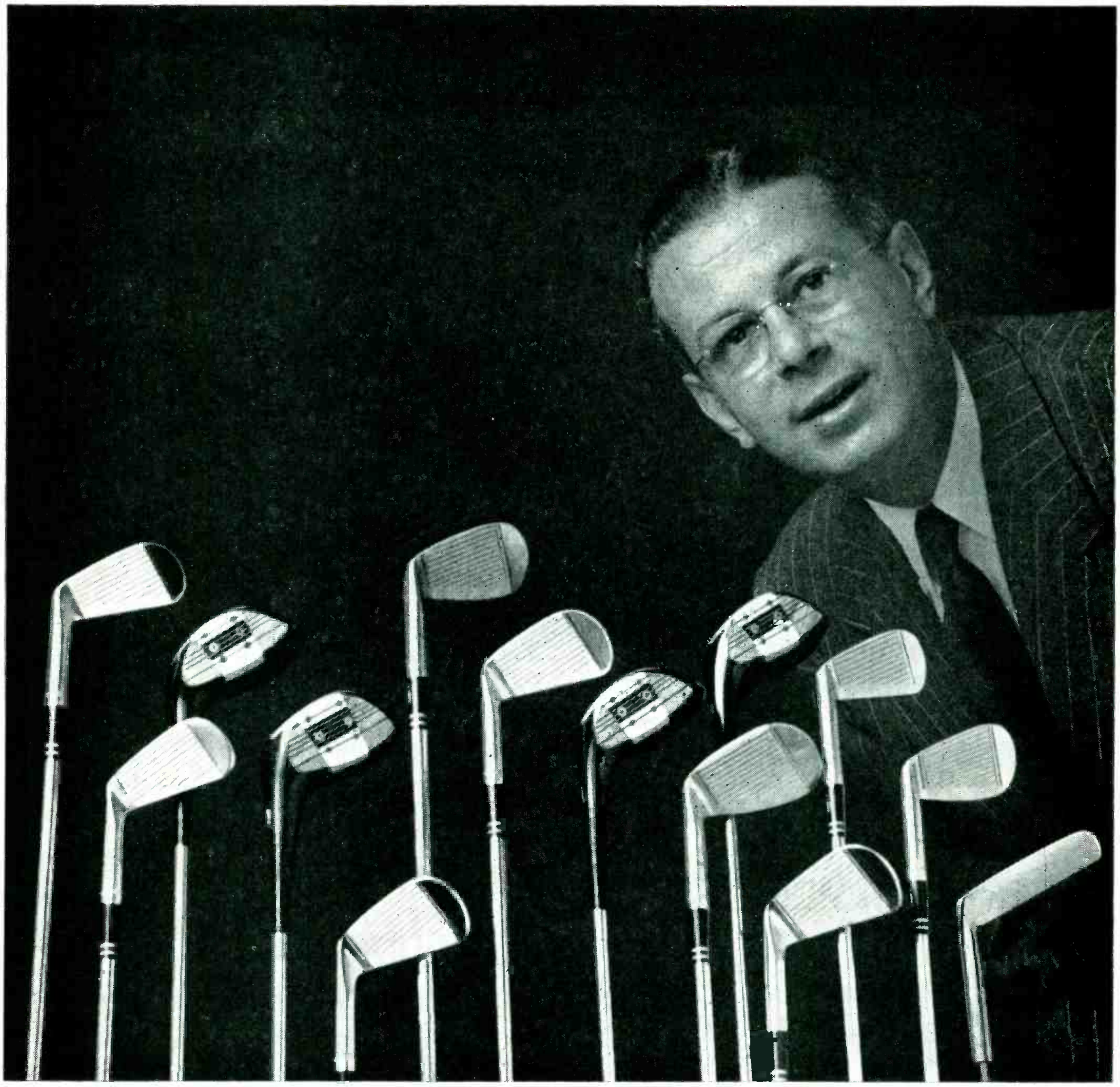
By KJ Prytz
Sonofon Radiofabrik
Gentofte, Denmark

To prevent feedback caused by loudspeaker vibrations returning to the phonograph pickup, the phonograph chassis must be isolated from the speaker. When spring mountings are used it is important that the spring compliance be adjusted so that frequencies in the amplification range are transferred only in a negligible degree. The resonance frequency of the suspended chassis has to be well below the lowest amplified frequency not more than 5 to 10 cps. As there normally are 3 or 4 springs, many resonance frequencies are possible, but we restrict our considerations to the simple case where all the springs are operating in equal phase as one single spring.

In fig 1 the chassis is concentrated in the mass m, grams, and the springs in one single spring which is compressed x cm from the unloaded position. Movement of m up and down, attenuation being neglected, can be expressed by the differential equation:

$$m \frac{d^2x}{dt^2} = mg - kx \qquad (1)$$

www.americanradiohistory.com



Henry P. Cowen, President of MacGregor Golf Co., Cincinnati, Ohio, asks an unusual question:

"Which club is worth $8,000?"

"Jack Burke was teed off!

"He was leading the Texas Open after two red-hot rounds. Then a souvenir-hound stole a custom-made 11-iron from his bag. Without that MacGregor 'Double Duty' iron, he was in trouble!

"He sent us a desperate telegram at Cincinnati. We called Air Express — and a duplicate club was in his hands the next morning!

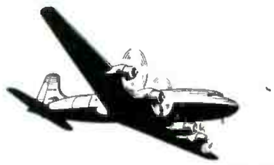
"He went on to win the Texas Open and three more tournaments in quick succession. His new MacGregor 11-iron (6th from the right) was worth $8,000 in prize money — thanks to Air Express!

"Jack and our other staff professionals are the 'proving ground' for MacGregor golf equipment. Keeping these famous players supplied as they move from tournament to tournament could be a tough job. But Air Express reaches them quickly—wherever they are.

"Demands of tournament committees, pro shops and retailers keep us calling on Air Express day in and day out. Air Express has never failed us. Yet costs on most of our shipments are actually *lower* than other air services.

"We save money by specifying the fastest service — Air Express!"

It pays to express yourself clearly. Say Air Express! Division of Railway Express Agency.



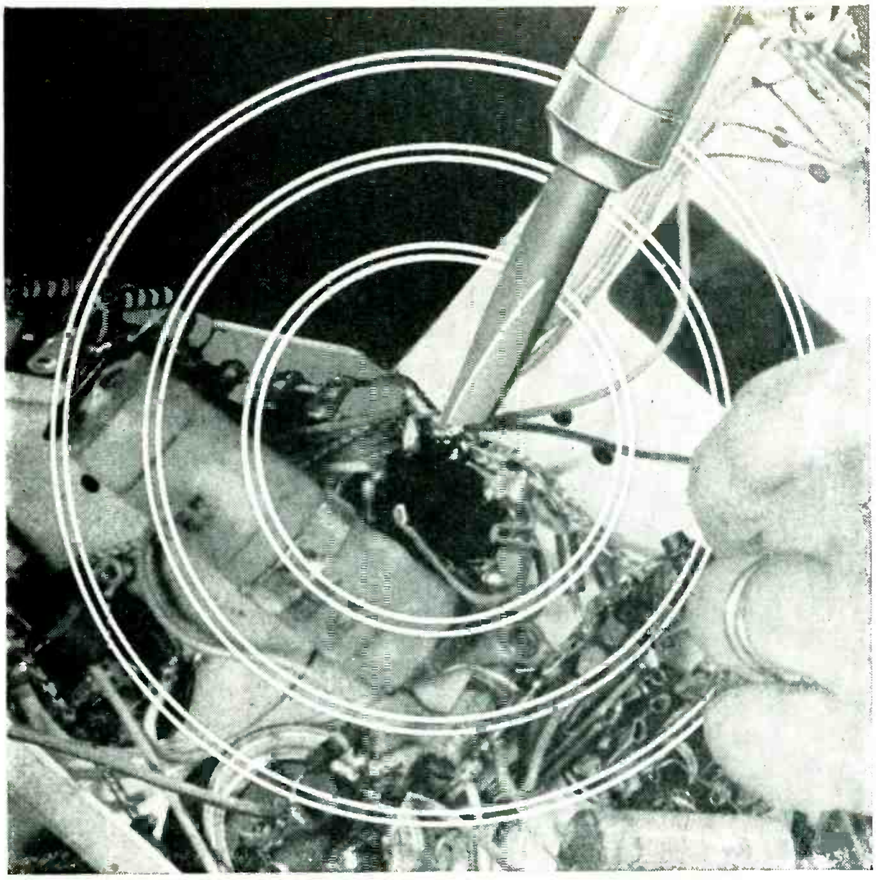
AIR EXPRESS

GETS THERE FIRST

via U. S. Scheduled Airlines

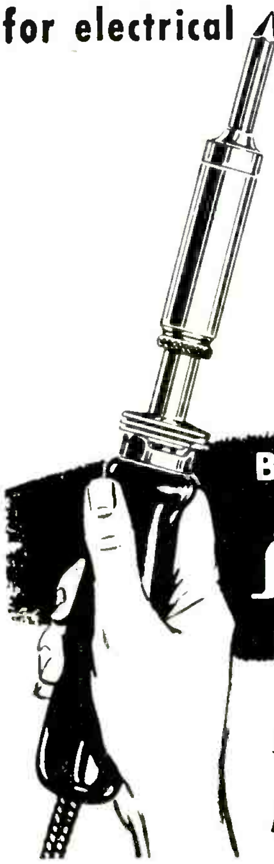
Want more information? Use post card on last page.

www.americanradiohistory.com



You can't beat a soldered connection

for electrical conductivity and permanence!



SOLDERED connections eliminate loss of current, fire hazard, radio interference and excess heat which result from loose, corroded, arcing NON-SOLDERED connections.

For over 50 years experts have specified American Beauty Electric Soldering Irons. They know American Beauty Irons are built to LAST LONGER, OPERATE DEPENDABLY and BE SERVICED QUICKLY.

Build better with solder . . .
Solder better with
American Beauty
SOLDERING IRONS

WRITE FOR FREE LITERATURE

Dependable • Durable • Efficient

SINCE 1894

AMERICAN ELECTRICAL HEATER COMPANY
DETROIT 2, MICHIGAN A-100

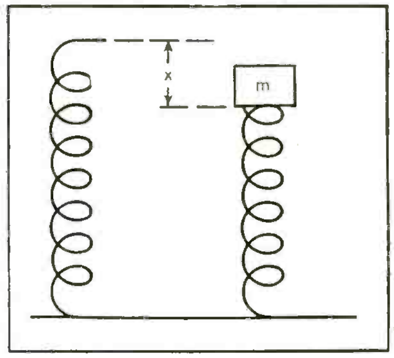


FIG. 1—Simplified concept of chassis and springing used in setting up equation for finding resonance of mounting springs

where g is the acceleration due to gravity 981 cm per sec$^{\text{per sec}}$ and k the stiffness of the spring in dyn per cm. This equation has a solution

$$x = x_o + \alpha \sin 2\pi ft$$

where x_o cm is the spring compression at rest, α cm the amplitude of the oscillating movement of the mass m, and f the oscillating frequency in cps. Differentiating twice and substituting in Eq. 1 we find the frequency

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{x_o}} \cong \frac{5}{\sqrt{x_o}}$$

This equation displays a simple correlation between the resonance frequency f and the spring compression (or elongation) at rest x_o when the mass is suspended against force of gravity. The resonance frequency is inversely proportional to the square root of the spring compression at rest without regard to the mass. If the spring compression is 1 cm the resonance frequency will be 5 cps.

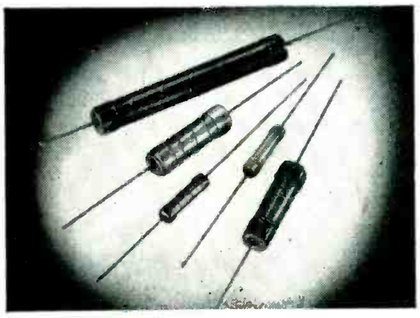
An easy way to determine the spring compression at rest for a gramophone chassis is to measure the distance from chassis to base in normal working position and the same distance with chassis turned upside down. The difference is then $2x_o$.

Radioelectrophysiologograph

ELECTROCARDIOGRAMS have recently been made with subects in motion, according to the London *Times*. Changes in potential indicating heart action as well as those norm-

www.americanradiohistory.com

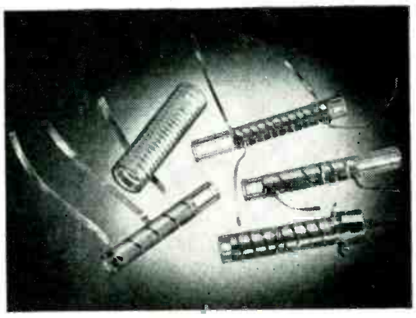
Where **stability** is important



Corning Film-Type Resistors

With a film material that is entirely new for resistors, CORNING Film-Type Resistors afford a rugged unit with exceptional stability and capable of withstanding high ambient, high operating temperatures. (The film material is fired in at red heat to make integral contact with the heat-resistant glass base, forming a tough bond.)

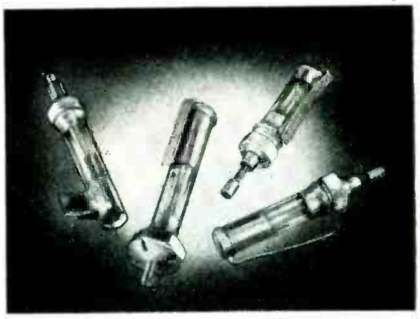
CORNING Film-Type Resistors are available in two types: Type N with a resistance tolerance of 1% and capable of operating at ambient temperatures up to 140°C.; Type S with a normal resistance tolerance of 2% and capable of operating at ambient temperatures up to 200°C.



Corning Metallized Glass Inductances

The exceptionally high electrical stability and low temperature coefficient of CORNING Metallized Glass Inductances are the result of the integral contact of the fired-on metallizing with dimensionally stable glass coil forms. Drift is negligible, even under unusually variable ambient temperatures. High Q is inherent.

Whether you require uniform, variable or double pitch windings—fixed tuned, permeability tuned or permeability tuned inductance-trimmer combinations—we can meet your requirements exactly and to close tolerances.



Corning Metallized Glass Midget Trimmer Capacitors

Since these components are produced by permanently bonding metal to tubes made of glass with practically zero temperature coefficients in the VHF range, capacity shift is negligible even with widely variable ambient temperatures.

CORNING Metallized Glass Midget Trimmer Capacitors are available in standard types from .3 to 12 u.u.f., or can be designed to meet your own particular needs. They are simple to solder, rugged and easy to tune critically. With direct traverse trimming, there is negligible capacity shift under vibration, and an absolutely smooth capacity curve.

▶ ***Corning inductances,*** *capacitors and resistors are mass produced on automatic machinery to close tolerances consistently duplicated from piece to piece. Our engineers will be glad to work with you on whatever design assistance you need. For complete information, use the coupon below.*

Corning Glass Works

New Products Division

Corning means research in Glass

CORNING GLASS WORKS, Dept. EL-8, Corning, N. Y.

Please send me information on:

☐ CORNING Metallized Glass Inductances, ☐ CORNING Film-Type Resistors

☐ CORNING Metallized Glass Trimmer Capacitors

Name.. Title..................................

Company..

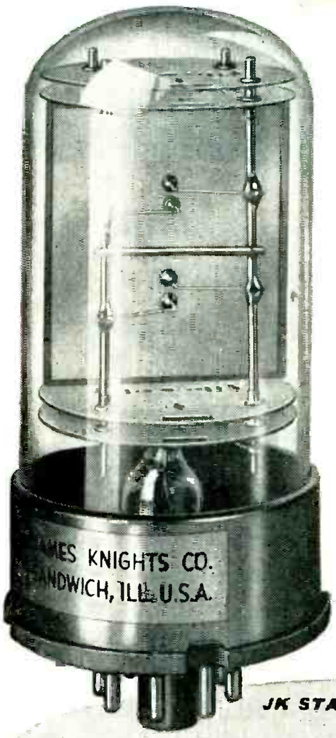
Address..

City.. Zone.............. State..............

www.americanradiohistory.com

PRODUCTS

Speeding Electronic Progress through crystal research



The JK G-12 is a precision 100 kc G-T cut crystal intended for operation in Meacham Bridge and similar oscillators. Available for operation at series resonance or into large load capacities. Resistance approximately that of usual lamp used for amplitude stabilization, simplifying bridge circuit design. The JK G-12 is vacuum sealed. Equipped with octal base it is more convenient than usual "soldered-in" type of precision standard crystal. Suitable for transistor oscillators. Will fit JK 07EH temperature control unit. Consult us on specific applications.

JK STABILIZED G-12 CRYSTAL

Did you know? Surgical cleanliness during manufacture is an important reason for the unequalled stability of JK Crystals. In an airconditioned, dust-free plant crystal blanks are repeatedly cleaned with chemicals, washed in distilled water and spun dry — plain tap water or even a fingerprint would impair stability. The final crystal, vacuum sealed in a glass holder, provides stability equal to a watch that would remain accurate to within three seconds over a year's time. Creative research combined with today's most modern production facilities brings you today's finest — JK "Crystals for the Critical".

THE JAMES KNIGHTS COMPANY, SANDWICH 3, ILLINOIS

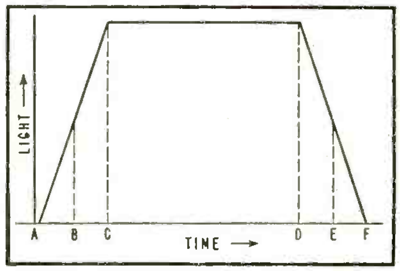


FIG. 2—Light passes through camera shutter during exposure. Slopes *AC* and *DF* are values during the opening and closing of the shutter

admitted during the time that the shutter is opening and closing. This interval from *B* to *E* is the average open-time interval that will be measured in determining the time of the shutter exposure.

Test Procedure

To make the test, the shutter mechanism is placed between the light source and the phototube and the shutter is operated. The output of the phototube is applied to the vertical deflecting plates of the crt.

The internal sweep of the oscilloscope is adjusted until its time interval agrees with the average time interval of the shutter. To obtain this adjustment the shutter is repeatedly opened and closed and the sweep is varied until the pattern overlaps as shown in Fig. 3 at points *B* and *E*, which are one-half the maximum amplitude. At this point the frequency of the internal sweep is equal to the shutter speed. To determine the time interval of the sweep the output of the audio oscillator is applied to the vertical plates of the oscilloscope and the oscillator frequency is varied until one complete cycle is obtained on the screen. The time interval rep-

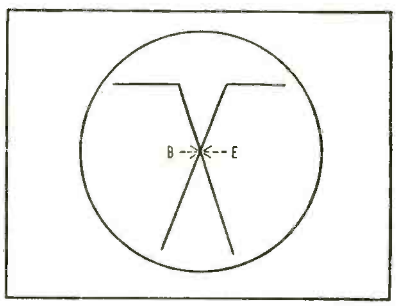
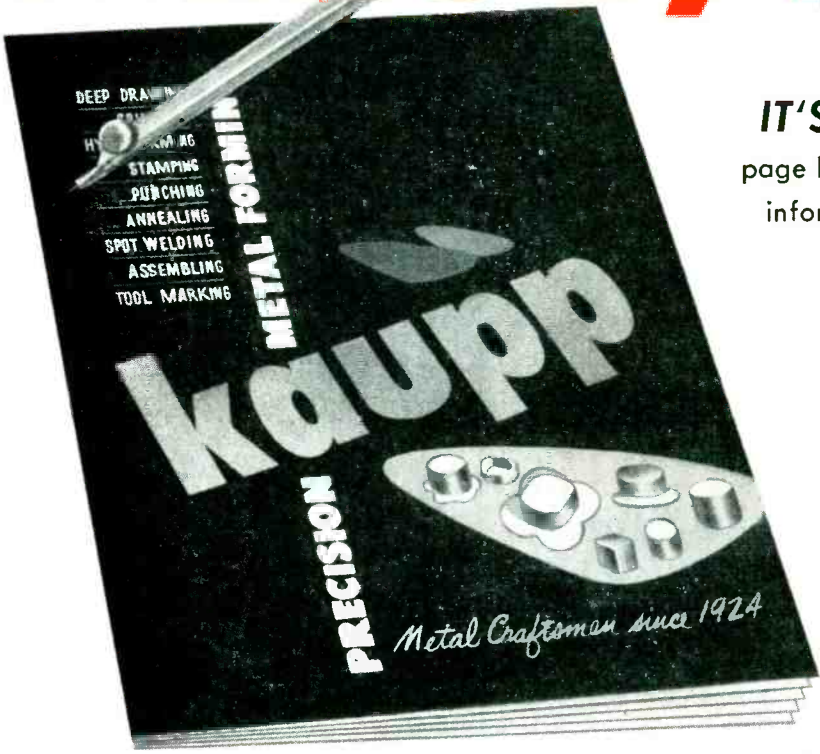


FIG. 3—Oscilloscope sweep is adjusted so points *B* and *E* on light curve will overlap

www.americanradiohistory.com

Here's your COMPLETE GUIDE to –

PRECISION METAL PARTS by KAUPP



IT'S FREE! The new sixteen page brochure containing helpful information covering all phases of precision metal forming and sub-assembly work.

SPINNING

STAMPING

PUNCHING

DEEP DRAWING

HYDROFORMING

ANNEALING

SPOT WELDING

ASSEMBLING

TOOL MAKING

Designers, production engineers and purchasing staffs are invited to request their copies, now!

New! For Experimental and development engineers—
HYDROFORMING
reduces costs, saves time on short runs and development components

New process sharply reduces tooling time and tool costs. Punch and nest ring are the only tool requirements as hydraulic oil functions as the die member. Send drawings for quotations and information.

COMPLETE FACILITIES and over a quarter century of metal forming to close tolerances assure precision components for the most critical applications. Kaupp experience includes forming and drawing of intricate shapes in stainless, inconel, aluminum, cold rolled steel, brass and other alloys. Gauges from .002 to ⅜ stock. For full details ask for your copy of the new brochure.

PRODUCTION AND DEVELOPMENT FACILITIES FOR THE ELECTRONICS, AVIATION, MARINE INDUSTRIES

C. B. KAUPP & SONS
NEWARK WAY • MAPLEWOOD • NEW JERSEY

www.americanradiohistory.com

ally recorded on a electroencephalograph are sent out by a small f-m radio transmitter to the receiver and recorder nearby.

States of anxiety have been noted when the subject is in a situation fraught with danger, such as looking down from the top of a ladder. With the new method, it is possible to record reactions standing still, marking time or walking up stairs.

Some difficulty is reported having been encountered with static electricity but attempts are being made to eliminate this source of interference, not to the radio signal, but to the brain impulses.

Electronic Measurement of Camera Shutter Speeds

By A. V. Donnelly
Dept. of Electrical Engineering State University of Iowa Iowa City, Iowa

A simple and effective method of calibrating camera shutter speeds uses the internal sweep of an oscilloscope to compare the shutter timing with the frequency of an audio oscillator.

In operation, a source of illumination, which may be a 25 or 60-watt lamp in a reflector, passes light through the camera shutter to a phototube (Fig. 1). The output of the phototube is displayed on a cathode-ray oscilloscope. An audio oscillator is then used as a variable-frequency generator for comparison purposes.

A curve showing the amount of light that passes through the camera shutter during one operation of the shutter is indicated in Fig. 2. The steep curves from *A* to *C* and *D* to *F* indicate the amount of light

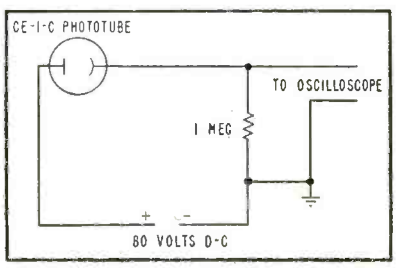


FIG. 1—Phototube circuit used to measure camera shutter speed

are rated and matched EXACTLY to guard against OVERLOADING-OVERHEATING

Rectifiers in your equipment are as dependable as their weakest cells. With rectifiers operating at rated load, *over-rated* cells tend to *over-load* . . . over-heat and age excessively. If one cell fails, the entire rectifier—*and your equipment*—may fail.

In Vickers rectifiers, each cell is accurately rated, its performance carefully matched with every other cell. Load is evenly distributed, cell temperatures are safe. There's protective margin for brief circuit overload. Vickers rectifiers, with performance-matched cells, are dependable in your equipment.

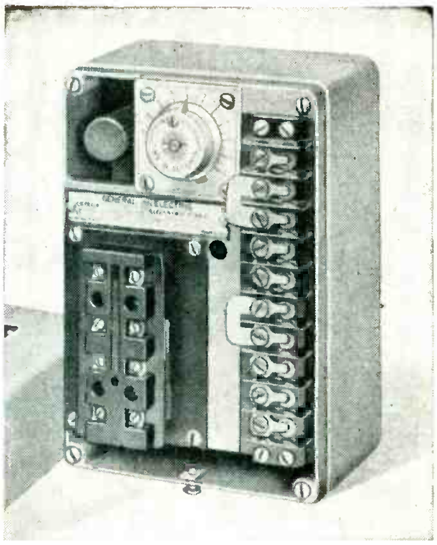
more reasons why Vickers makes a better rectifier

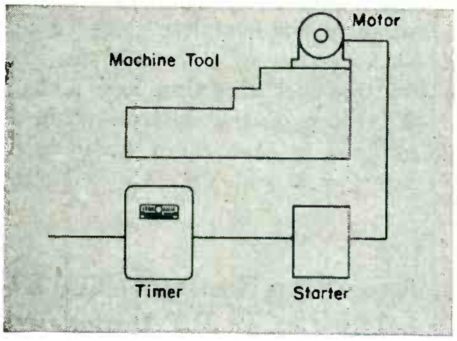
- **Automatic electroforming "pre-stresses" cells**
- **Hydraulic assembly assures mechanical strength and dimension**
- **Rectifiers shock and vibration tested to military specifications**
- **255 tests and inspections guard quality from start to finish**

Write for Bulletin 3000. Vickers engineering service is available without obligation.

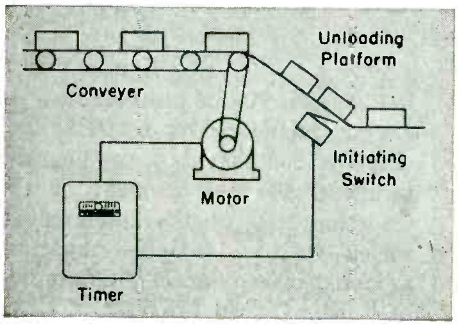
VICKERS ELECTRIC DIVISION
VICKERS Inc.
A UNIT OF THE SPERRY CORPORATION
1801 LOCUST STREET • SAINT LOUIS, MISSOURI

G-E Electronic Timer Has High Repetitive Accuracy



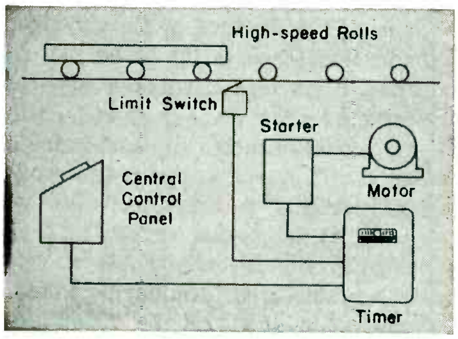


General Electric Electronic Timers assure precise timing of repetitive operations. One manufacturer reports the use of G-E timers on bearing grinding machines where they control cutting time and drift time. Here, G-E timers perform over 500 repetitive time cycles per hour. Where you require a uniform product turned out at high speed, put the accuracy of the General Electric Electronic Timer to work for you.



Controls F-hp Motor Directly

Here, a G-E Electronic Timer controls directly the small motor of a box conveyor. The timer tells the motor when enough boxes have been delivered to the gravity conveyor. A limit switch, actuated by the first box, tells the timer when to start. You can get a G-E Electronic Timer to start fractional-horsepower motors directly or handle motor starters up to NEMA Size 3.



Can Be Remotely Adjusted

Here a steel company, through a furnace control desk, controls the time cycle of high-speed rolls even though the timer is inaccessible. A limit switch actuated by the steel slab starts the electronic timer. Your G-E Electronic Timer can be located wherever necessary and remotely adjusted from a convenient location.

SPECIFICATIONS

EXCELLENT REPETITIVE ACCURACY
High-quality capacitors permit errors no greater than $\pm 2\%$ of dial setting, independent of normal temperature changes.

THREE TIME RANGES AVAILABLE
.06-1.2, .6-12, 6-120 seconds, each continuously adjustable through a 20:1 range.

TWO TYPES OF OPERATION
Can be set for immediate or delayed start.

HIGH CONTACT RATING
One million operations at full-load, up to ten million at less load. Handles motor starters to NEMA Size 3, starts f-hp motors directly.

REMOTE CONTROL
Timing potentiometer and dial assembly may be located where most convenient.

CONSTRUCTION
High quality components, conservatively rated for top performance and long life.

PHOTOELECTRIC RELAY CR7505-K100

One of a complete line of devices for all photoelectric applications. This model is inexpensive, has broad application. Bulletin GEA-3533D.

Send to Section E 785-1, General Electric Company, Schenectady 5, New York

Please send me the following bulletins:

☐ Electronic Timer, GEA-5255B

☐ Photoelectric Relay, GEA-3533D

NAME .... TITLE ....

COMPANY ....

ADDRESS ....

CITY .... STATE ....

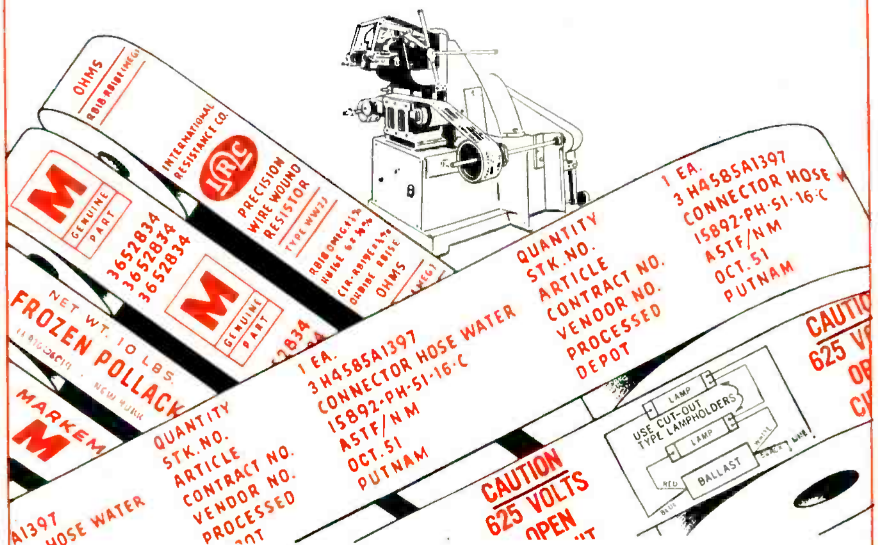
ELECTRONIC DEVICES

GENERAL ELECTRIC

www.americanradiohistory.com

MARKEM SOLVED THIS MARKING PROBLEM

PRINTING LABELS ON PRESSURE SENSITIVE TAPE



The introduction of pressure sensitive tape for industrial uses offered many advantages if *label* data could be printed on the tape *in the plant itself when needed*. Markem developed methods that permit printing of stock number, part number, trade mark or other designation on this tape. Label inventory problems are thus eliminated. Manufacturers can now print the exact number of labels required . . . readily changing variable information or color of ink when desired. The Markem method used includes a Markem machine which makes up to 85 imprints per minute, rewinds the roll of tape automatically, and shuts itself off after a selected number of imprints. Thus Markem has provided industries of all types with a more modern, more attractive and less expensive means of labeling.

MARKEM® MARKS THEM ALL

CAN MARKEM HELP YOU? Printing labels on pressure sensitive tape is but an example of how Markem solves industry's marking problems. Markem has been providing industry with production techniques and equipment to identify, decorate or designate its products, parts and packages since 1911. Markem also provides technically trained men who are available in your area to assure *continued* satisfaction with Markem methods and equipment.

When *you* have a marking problem, tell us about it and send a sample of the item to be marked. Perhaps a complete Markem method has already been developed to solve your problem. If not, Markem will work out a practical solution.

Markem Machine Company, Keene 5, N. H., U.S.A.

MARKEM ... TO MAKE YOUR MARK

resented by one cycle of the sine-wave output of the oscillator is the same as the time interval of the shutter opening. The frequency of the audio oscillator corresponds to the reciprocal of the time interval representing the average shutter opening time. For example, if the oscillator setting required to produce one complete cycle on the cathode-ray tube is 32 cps, the shutter operating time is $\frac{1}{32}$ second. Accuracy of the determination is as good as that of the audio oscillator.

Measuring Resistance and Reactance of an R-F Impedance

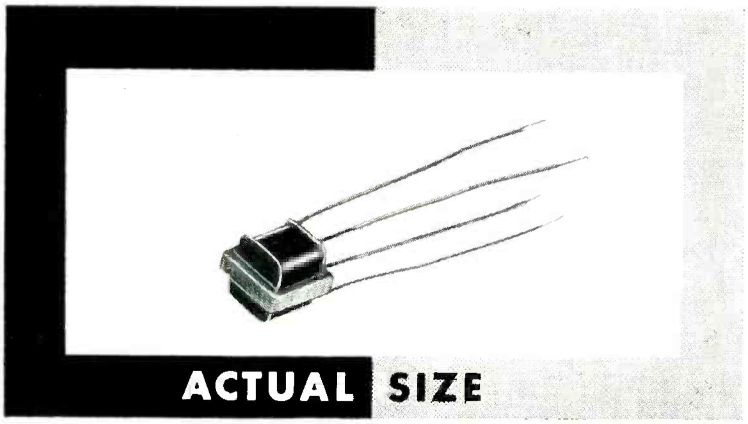
By Scott L. Shive
Signal Corps Engineering Laboratory Fort Monmouth, N. J.

R-F IMPEDANCE of an unknown inductor, including its resistive and reactive components, may be determined by measurement of the insertion loss of the inductor in series with a variable capacitor adjusted to resonance. This method has been used successfully to measure the resistance and reactance of inductors with air, iron, and ferrite cores up to 30 mc. Although no measurements were attempted above that frequency, with reasonable caution in observance of good uhf practices the method could undoubtedly be extended into the hundred-megacycle region.

Accuracy is comparable to that obtainable with standard commercial r-f bridges and the upper limit of the frequency range is substantially higher. The measurement procedure is relatively simple and the instrumentation required is commonly available. The range of impedance measurement depends on the maximum output of the signal source and sensitivity of the detector, but a range of 10^{-2} to 10^{6} ohms is easily obtainable with the usual laboratory signal generators and receivers.

The voltage insertion loss ratio, or merely the insertion loss, of a network inserted into a transmission system between a source and a load may be defined either as the ratio of load voltage, for a constant source voltage, before and

www.americanradiohistory.com



the most efficient and smallest

TRANSISTOR TRANSFORMER

7 *types*

available for immediate delivery!

"TINYFORMERS"

by

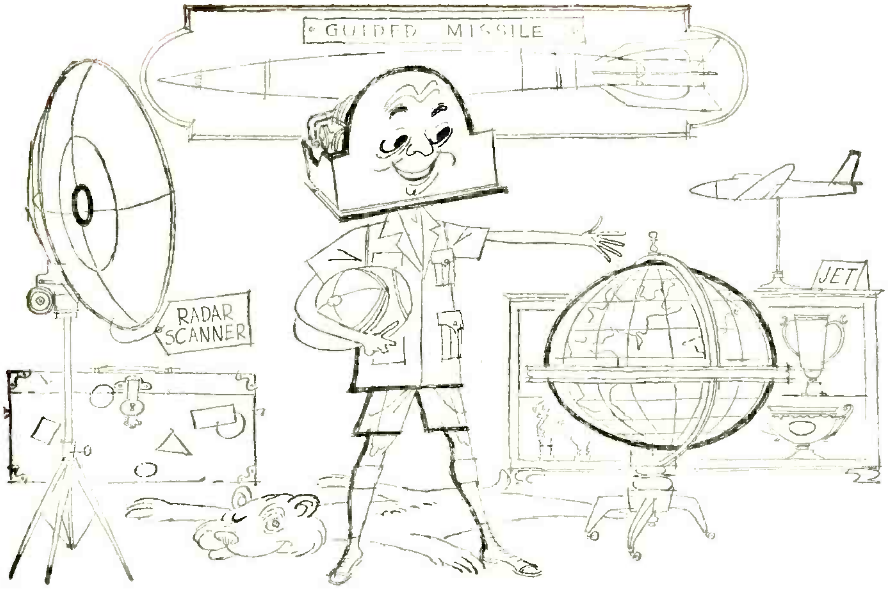
GRAMER

TRANSFORMER CORPORATION

2734 NORTH PULASKI ROAD · CHICAGO 39, ILLINOIS

Want more information? Use post card on last page.

www.americanradiohistory.com



GYRO LOOKING FOR NEW WORLDS TO CONQUER

We're mighty happy with the performance of our Cageable Vertical Gyro as an autopilot component in fighters and guided missiles—and in radar stabilization systems.

But we feel that this gyro—which can be caged in under ten seconds, uncaged in only three seconds—has a lot of undeveloped possibilities for our armed services.

Some of them we know. But you may have problems and applications of which we are not aware.

So if you get any ideas from the specs below, drop us a line.

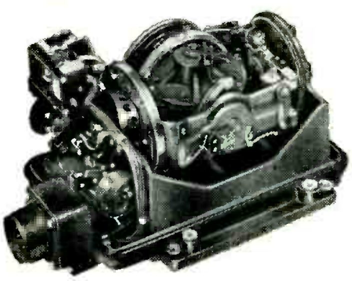
And remember, here at Honeywell we're specialists in gyros, have become one of the leaders in the field. Our gyro "family"—which includes other vertical, rate and the extremely sensitive Hermetic Integrating Gyros—is now available to manufacturers who require *precision* performance.

If you'd like to know more about any of the products in our gyro line, we'd be pleased to send details. The address is Honeywell Aero Division, Dept. 401 (E), Minneapolis 13, Minnesota.

Cageable Vertical Gyro JG 7044A Specifications

Power Requirements: Gyro motor: 115 volts, 400 cps ± 10%, single-phase. Erection motors: 30 volts, 400 cps, single-phase. Caging circuit: 28 volts dc.

Power Load: Gyro motor: 50 watts max. (starting); 20 watts max. (running).



Erection motors: 5 watts (each). Caging operation: 12 watts (operating); 6 watts (standby).

Gyro Speed: 22,000 rpm. (minimum).

Angular Momentum: 4.75×10^6 gm-cm^2/sec.

Roll Axis Freedom: 360°.

Pitch Axis Freedom: ± 85°.

Caging Time: 10 seconds. (max.).

Gyro Run-down Time: 8 min. (min.).

Erection Rate: 2° to 6° per minute (factory adjustment).

Drift Rate: 30° per hour (maximum).

Accuracy: 0.15° of true vertical in each axis.

Resolution: 1/13° each axis.

Environment: Designed to meet AAF Spec. 27500D.

Weight: 5 lbs.

MINNEAPOLIS
Honeywell

H HONEYWELL

Aeronautical Controls

after insertion, or, as the ratio of source voltages, for a constant load voltage, after and before insertion of the network. Insertion loss is a function of the source and load impedances of the transmission system and of the characteristics of the inserted network. For a two-terminal network, critical characteristics are the effective series resistance and reactance, which may be calculated directly from insertion loss measurements and knowledge of the source and load impedances.

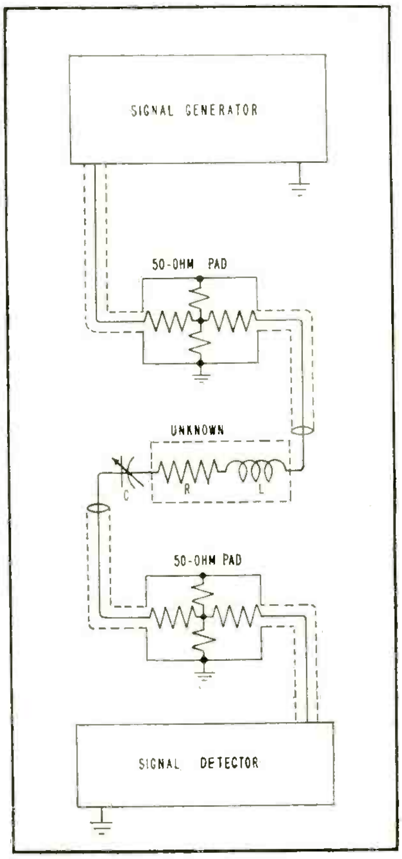
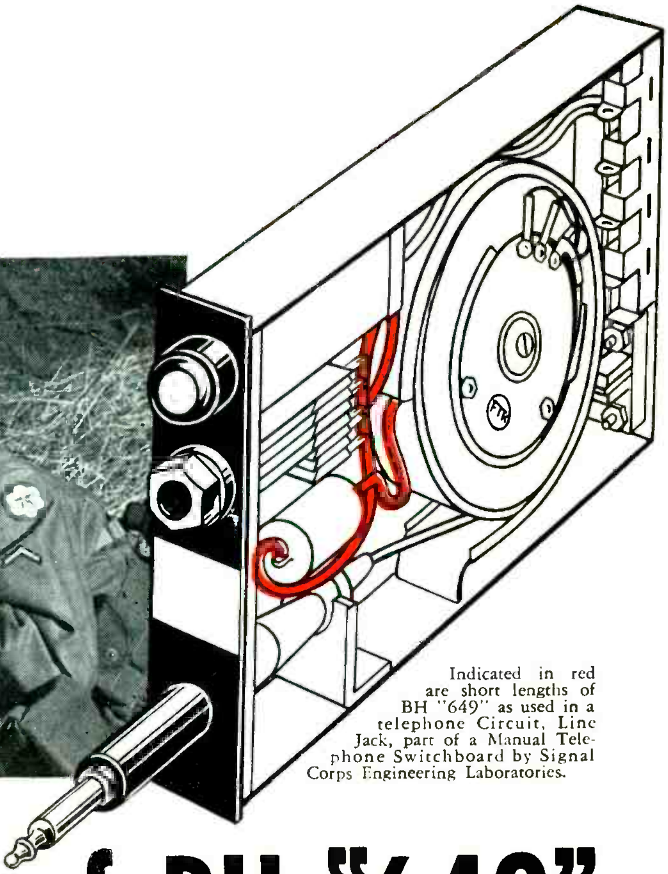


FIG. 1—Insertion-loss measuring circuit used when resistance of the unknown impedance is large compared to the 50-ohm attenuation pads

The insertion-loss measuring circuit, shown in Fig. 1 and 2, consists of a 50-ohm source provided by the attenuator pad connected to the output of the signal generator, and a 50-ohm load provided by a similar pad connected to the detector input. The impedance to be measured is connected into the transmission system between source and load.

The series connection of Fig. 1,



Indicated in red are short lengths of BH "649" as used in a telephone Circuit, Line Jack, part of a Manual Telephone Switchboard by Signal Corps Engineering Laboratories.

1/2¢ *lengths* of BH "649" help shrink a telephone

New Army field telephones manufactured by Federal Telephone & Radio Corporation are only one-third the size of previous equipment. "Electrical insulation that withstands high and low temperatures, and vibration is a must in this application. BH "649" vinyl coated Fiberglas Tubing meets all specifications", say Federal engineers.

Resistance to high and low temperatures is a permanent feature of BH "649". It keeps its flexibility and dielectric strength from −50°F. to 266°F. Remains unchanged during processing temperatures up to 500°F.

Vibration and shock resistance are additional advantages of BH "649". It is permanently flexible with infinite shelf-life. Can be knotted, twisted and given a sharp bend without cracking. It helps speed assembly, too.

Rated up to 7,000 volts, BH "649" has excellent chemical and oil resistance. Also available with fungus inhibitors.

BH "649" is just one of a large family of tubings and sleevings that have solved many electrical insulation problems. If you'll send facts on your requirements — voltages — temperatures — unusual conditions — we'll make recommendations and send you samples for testing.

Address Dept. E-8
Bentley, Harris Manufacturing Co.
Conshohocken, Pa.

BH FIRST IN

- use of Fiberglas
- heat-treated Fiberglas
- true high temperature flexibility
- vinyl-coated Fiberglas
- silicone rubber coating
- colors in silicone rubber
- true Class B (130°C.) protection

BH *Fiberglas** SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

Want more information? Use post card on last page.

www.americanradiohistory.com

The new Bendix-Pacific TOR-6 Oscillator gives improved performance with resistance type strain gages and variable resistance type temperature pickups. The unit operates with unusual stability under extreme conditions of environment.

Unbalance of the resistance bridge provides a voltage which is used to change the frequency of the oscillator. The magnitude and direction of the frequency change is proportional to the magnitude and phase of the bridge output.

SPECIFICATIONS

Bridge Impedance: 120 ohm*
Sensitivity: ±7.5% change of f_0 for 0.125% change in resistance in each of four active arms*. (This is RDB specified subcarrier bandwidth)
Frequency Response: Flat within ±2.0% from DC to 10% of bandwidth.
Linearity: Within 1.0% of best straight line.
Stability: Drift less than 0.5% of bandwidth (0.07% of f_0) for 8 hours at 25° C. after 15 minute warmup.
Temperature Effect: f_0 changes less than 0.08% of bandwidth per degree centigrade.
Vibration Effect: 1.0% maximum noise at 10 g, 20 to 1000 cps.
Supply Voltage Effect:
Plate Supply: Drift does not exceed 1.0% of bandwidth for ±10% change of plate supply voltage.
Heater Supply: Drift does not exceed 1.0% of bandwidth for ±10% change of heater voltage.
Output: 1.5 volts rms into 100 kilohms resistive load. Generator impedance 750 kilohms.
Harmonic Distortion: 2.0% maximum.
Power Requirements:
0.015 A at 108 volts DC
0.800 A at 6.0 volts DC or rms AC.
Bands of Operation: Standard RDB bands 1.7 through 14.5 kc*.
Size: 4.5" long x 1.45" wide x 1.35" high; occupies 2 sections of Bendix TJS Component Mounting Assembly.
Weight: 0.4 pounds.

*Available for other bridge impedances, sensitivities, and bands of operation on special order. For temperature measurement, ±0.5% change of resistance in one arm produces ±7.5% change of f_0.

Write for complete information.

Pacific Division
Bendix Aviation Corporation
NORTH HOLLYWOOD, CALIF.
Bendix

EAST COAST OFFICE: 475 FIFTH AVE., NEW YORK 17, N.Y.
EXPORT DIVISION: BENDIX INTERNATIONAL, 72 FIFTH AVE., NEW YORK 11 N.Y.

where the unknown impedance and a resonating capacitor are placed in series with the source and load impedances, is applicable when the unknown resistance component R is large compared to 50 ohms. The desired insertion loss voltage ratio is E_2/E_1 where E_1 is the signal generator output voltage required to provide a convenient detector indication when the unknown impedance and resonating capacitor

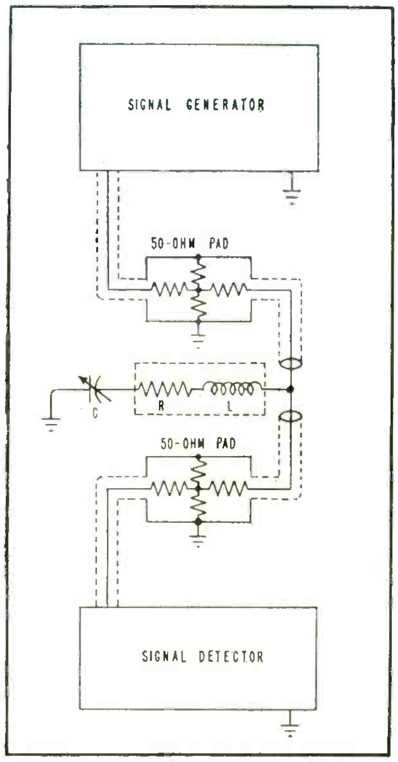


FIG. 2—Parallel connection of the measuring circuit used when unknown resistance is small compared to the 50-ohm pads

are removed from the measuring circuit, and E_2 is the signal generator output voltage required to produce the same detector reading when the unknown impedance and resonating capacitor are inserted between source and load. Resonance is indicated by a maximum in detector output as the capacitance C is varied.

At resonance, the reactances cancel leaving only the unknown resistance component R to produce the observed insertion loss P. The value of R is then given by the expression $R = 100\ (P - 1)$ where

Want more information? Use post card on last page.

Andrew

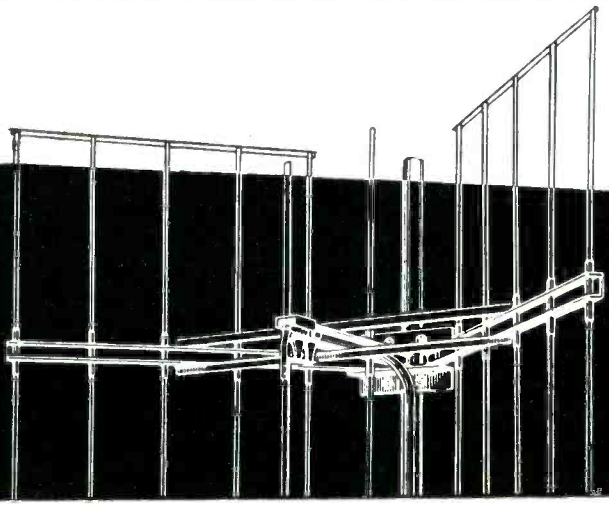
CORPORATION

363 EAST 75TH STREET, CHICAGO 19

ANDREW CORNER REFLECTOR ANTENNA

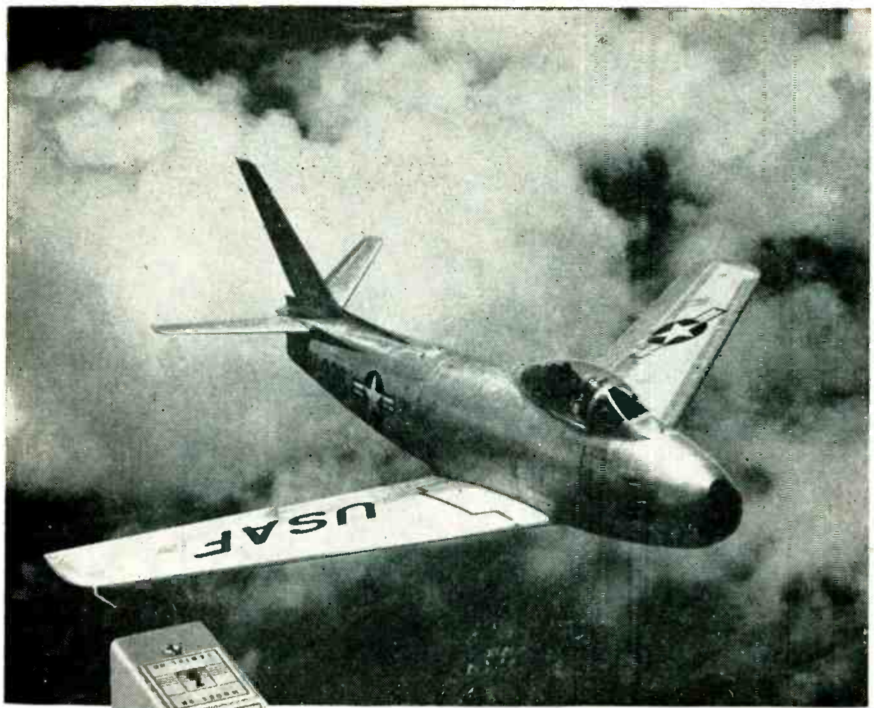
Puts New Power in Two-Way Radio Communications!

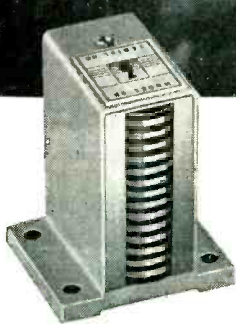
Stronger signals at greater distances are **BUILT-IN** this new narrow-angle antenna. Ideal for serving long stretches of highway, rail or pipe lines, it is equally effective for point-to-point communications, or back-to-back with other services. Gains up to 12 DB can be achieved by stacking. Vertically polarized, uni-directional, Andrew Corner reflector antennas are available in all mobile communications bands. Put them to work for you to INCREASE and IMPROVE your radio coverage. For more information, write us today.



Want more information? Use post card on last page.

www.americanradiohistory.com


North American F-86F Sabre Jet

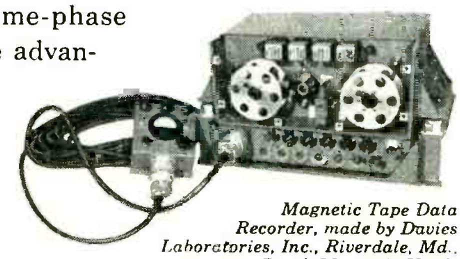


VIBRATION DATA
recorded by
14-channel Brush Magnetic Head

A precision Brush multichannel head assures faithful reproduction in the Davies magnetic tape data recorder, used to record vibration in jet aircraft and shock waves in seismic and oil field exploration.

This head has one synchronizing channel and 13 data channels, all of which record on a single tape 1¾″ wide. *Precision gap alignment* permits recording on one machine and playback on another machine with all signals in perfect time-phase relationship—an exclusive advantage of Brush multichannel heads.

For complete information, write Brush Electronics Company, Dept. K-8, 3405 Perkins Ave., Cleveland 14, Ohio.


Magnetic Tape Data Recorder, made by Davies Laboratories, Inc., Riverdale, Md., uses Brush Magnetic Heads for Accurate Recording

BRUSH ELECTRONICS COMPANY

INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZO-ELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT
ULTRASONIC EQUIPMENT

formerly The Brush Development Co. Brush Electronics Company is an operating unit of Clevite Corporation.

P is the voltage insertion loss ratio at resonance.

The inductance component L of the unknown impedance is derived directly from the value of the resonating capacitor

$$L = \frac{1}{w^2C}$$

If the variable capacitor C is not calibrated and no convenient means are at hand for determining its capacitance at resonance, the reactance X_L of the unknown inductive component may then be determined from two insertion loss measurements as follows

$$X_L = 100\sqrt{P_1^2 - P^2}$$

where P_1 is the insertion loss of the unknown impedance alone, with the resonating capacitor C removed from the circuit, and P is the previously measured insertion loss of the unknown impedance at resonance with the capacitor C.

The parallel connection, shown in Fig. 2, is applicable when the resistance component R of the unknown impedance is small compared to 50 ohms. The measurement procedure is similar to that described for Fig. 1 except that the unknown impedance and series resonating capacitor are inserted, for the E_2 determination, between line and ground in parallel with the source and load. Resonance in this case is indicated by a minimum in detector output as the capacitor C is varied.

For the parallel connection, the resistance component R is related to the insertion loss ratio P at resonance by the expression

$$R = \frac{25}{P - 1}$$

also, as before,

$$L = \frac{1}{w^2C}$$

Here too, the unknown inductive reactance X_L may be derived from two insertion loss measurements, one with and the other without the resonating capacitor C in the circuit. For the parallel connection, the following formula applies

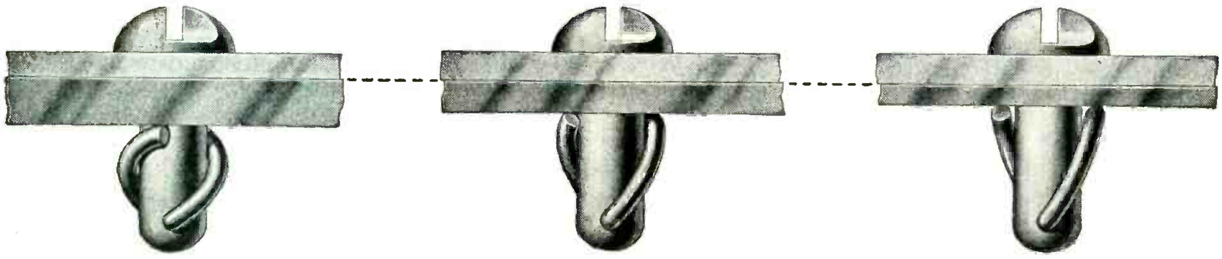
$$X_L = \frac{25}{(P - 1)}\sqrt{\frac{P^2 - P_1^2}{P_1^2 - 1}}$$

in which P_1 is the insertion loss of

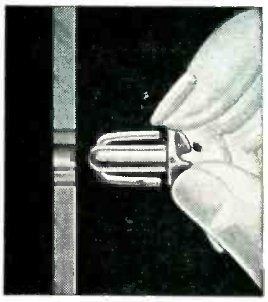
Want more information? Use post card on last page.

www.americanradiohistory.com

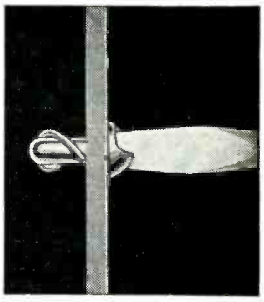
This fastener works through thick and thin!



HERE'S HOW SPRING-LOCK WORKS



1. *Insert fastener.*



2. *Half-turn locks it in place.*

Spring-Lock—the easy-to-use removable fastener for modern designs—works whether panel thicknesses run over or under specifications! Spring wire deflects automatically to handle greater or lesser thicknesses. Spring-Lock's design flexibility makes it more than a fastener: it can be adapted as a shelf support, door strike, knob or any similar panel-mounted device. Many standard shapes and sizes of Simmons Spring-Locks are available from stock.

SIMMONS FASTENER CORPORATION

1750 North Broadway, Albany 1, New York

Simmons

QUICK-LOCK
SPRING-LOCK
ROTO-LOCK
LINK-LOCK
DUAL-LOCK

JUST OUT!
NEW 36-PAGE CATALOG WITH APPLICATIONS
SEND FOR IT!

With production costs on the uptrend, you can figure on Spring-Lock as an assembly time and money-saver, because:

- **Installation is BLIND**
- **Installation is EASY: no special tools are needed**
- **Installation is QUICK: a half-turn locks it in place**
- **Installation is SECURE: the *spring* steel *locks* the fastener, resists vibration**

Send for details and samples, or write us about *your* fastening problem.

Want more information? Use post card on last page.

www.americanradiohistory.com

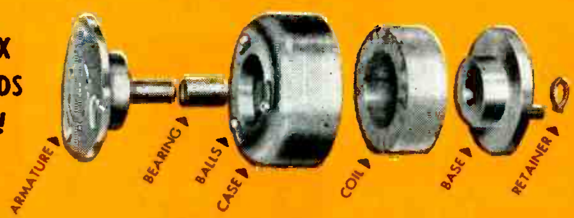
LEDEX ROTARY SOLENOIDS

...give positive, powerful snap action!

here's how a
LEDEX ROTARY SOLENOID
operates...

The magnetic pull moves the armature along the Solenoid axis. This action is efficiently converted into a rotary motion by means of ball bearings on inclined races. The inclined ball races are made to compensate for the magnetic pull increase as the Solenoid air gap closes, thereby providing substantially constant torque throughout the Solenoid stroke. The rotary snap-action power of the Ledex can be efficiently harnessed with a minimum of linkages, through the use of one or more standard features available on all models.

here's why **LEDEX ROTARY SOLENOIDS** *are dependable!*



As can be seen from the exploded view, Ledex Rotary Solenoids are simply constructed with few moving parts. All parts are manufactured to exacting tolerances and are carefully inspected and assembled.

The copper wire coil, the heart of the Solenoid, was developed especially for this product. It is wound by a precision winding process that puts a maximum amount of magnet wire into available space . . . giving tremendous power to compact Ledex Rotary Solenoids.

six basic **LEDEX ROTARY SOLENOIDS** *to choose from!*

Model Number	2	3	5	6	7	8
Diameter	1⅛"	1 5/16"	1⅞"	2¼"	2¾"	3⅜"
Torque lb.-in.*	¼	1	5	10	25	50
Weight lbs.	⅛	¼	½	1	2¼	4¼

*45° stroke intermittent duty.

Engineering data is available upon request. Write for descriptive literature today!

G. H. Leland INC.

123 WEBSTER STREET, DAYTON 2, OHIO

the unknown impedance, and P is the insertion loss of the unknown impedance at resonance.

Aluminum Antimony Semiconductors

INVESTIGATIONS at Battelle Memorial Institute by R. K. Willardson, A. C. Beer, H. Goering and A. E. Middelton indicate that electrical properties of aluminum antimony compounds may compete with those of germanium and silicon.

Aluminum antimony has two kinds of atoms in its lattice. Either p or n type aluminum antimony can be produced. Room-temperature electrical resistivity has been varied by a factor of more than 500,000 through controlled processing.

Because the intrinsic energy gap of aluminum antimony is larger than that for silicon, the former may have advantages over germanium and silicon for high-temperature applications.

Diode rectifiers made with the newly investigated material have rectification ratios close to 10,000. Since the material is photosensitive, it may have further interesting applications.

The cost of constituent materials is less than fifty cents a pound.

Pertinent Patents

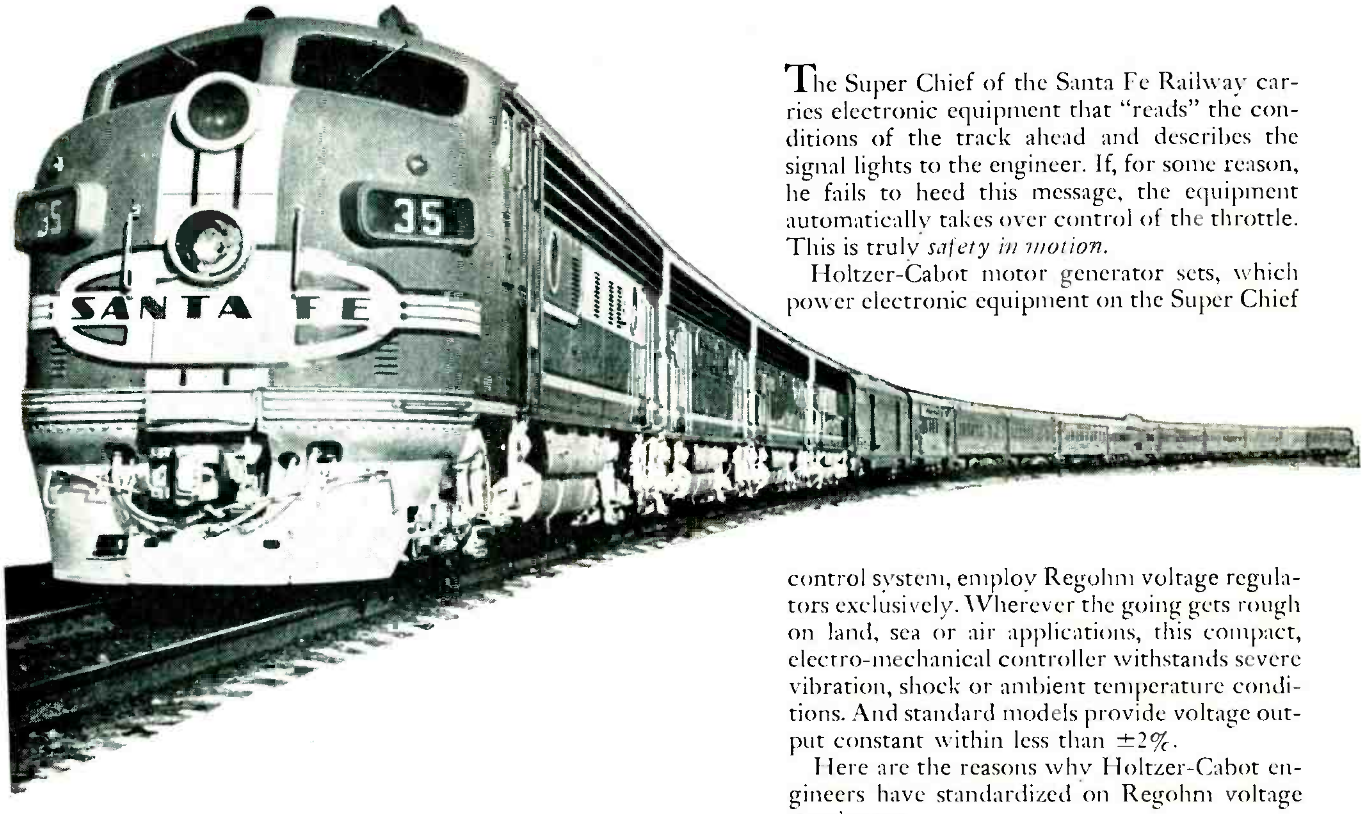
W. M. Gottschalk of Watertown, Massachusetts is the inventor of a "Microwave Energy Amplifier" that was granted U. S. patent 2,627,586. The patent is assigned to the Raytheon Manufacturing Co.

The invention consists of an evacuated envelope such as that of the familiar cathode-ray tube. The structure within the envelope is illustrated in Fig. 1. An electron gun projects a beam of electrons toward a collector anode along a path A that is centrally positioned in the tube and within a resonant Lecher-wire fork, a half wavelength long and forming a half-wave parallel line shorted at one end. This forms the input electrode.

A pair of full-wave lines similar to the input electrode form output electrodes. The output electrodes

www.americanradiohistory.com

The Iron Horse that **reads** and **heeds** with Electronic Eyes



The Super Chief of the Santa Fe Railway carries electronic equipment that "reads" the conditions of the track ahead and describes the signal lights to the engineer. If, for some reason, he fails to heed this message, the equipment automatically takes over control of the throttle. This is truly *safety in motion.*

Holtzer-Cabot motor generator sets, which power electronic equipment on the Super Chief control system, employ Regohm voltage regulators exclusively. Wherever the going gets rough on land, sea or air applications, this compact, electro-mechanical controller withstands severe vibration, shock or ambient temperature conditions. And standard models provide voltage output constant within less than ±2%.

Here are the reasons why Holtzer-Cabot engineers have standardized on Regohm voltage regulators:

1. Low Cost—Regohm costs less, does more, than the complex equipment that once was the only available solution to control problems.

2. Ruggedness—Upgrade, downgrade, working on a railroad demands the ability to "take it." Regohm has it, is sturdy and reliable.

3. Long Life—In properly engineered installations, Regohm's life is measured in years. This means low maintenance cost. Shelf-life is substantially unlimited.

4. Simplified Maintenance—Regohm's plug-in feature simplifies replacement and maintenance by unskilled crews. There are no parts to renew or lubricate.

5. Good Regulation—Regohm insures continuous control and will stabilize control systems with widely varying characteristics.

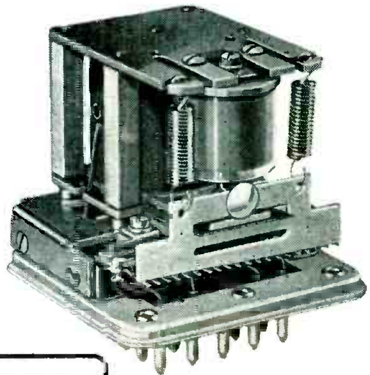
Our engineering and research staff can help you develop optimum design for your equipment and system. Learn how Regohm can help you with your regulation problem. Write for Bulletin 505.00. The address: Department E., Electric Regulator Corp., Norwalk, Conn.

Powered by Holtzer-Cabot Generators

Controlled by

Regohm

Voltage Regulators



REGOHM

CONTROL COMPONENT IN: Servo systems · battery chargers · airborne controls · portable and stationary generators · marine radar · inverters · locomotive braking systems · mobile telephones · guided missiles · signal and alarm systems · telephone central station equipment · magnetic clutches · railroad communication systems.

Want more information? Use post card on last page.

www.americanradiohistory.com

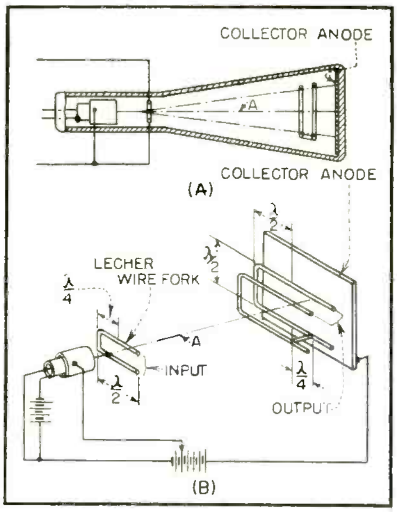


FIG. 1—Microwave energy amplifier tube (A) and circuit detail (B)

are a quarter wave apart. As the beam of electrons passes through the input fork, it is modulated by the microwave energy impressed on the input. As a result, the electron beam is scattered. The scattered microwave-modulated electron beam passes through the output fork elements from which is extracted an amplified counterpart of the input wave.

The inventor claims a gain of 5 for his microwave amplifier and a high operating efficiency.

Transitron Sweep

The invention of a "Sweep Generator" was awarded patent 2,627,-025. This was issued to G. C. Trembly and assigned to the United State of America as represented by the Secretary of the Navy.

In this invention a transitron-oscillator sweep generator is disclosed. In Fig. 2 the circuit of the generator is shown. The oscillator is triggered by a positive pulse from a gas tube. The gas tube operation is initiated by external positive trigger pulses. The output pulse of the gas trigger tube is applied to the suppressor grid of the transitron oscillator tube.

In the steady state the control grid of the transitron oscillator pentode is drawing current through the grid resistor, returned to a positive voltage point in the circuit. The pentode is now conducting heavily through its screen grid. At the same time the suppressor grid

www.americanradiohistory.com

Names that mean outstanding quality

Capehart

SYLVANIA

Motorola

Sentinel

RAYTHEON

. . . RELY ON Midland CRYSTALS

Manufacturers with front-rank reputations make sure of every component that goes into their products. Such reputations can be maintained only through constant vigilance and selection of suppliers who also have proud reputations to uphold.

Names of distinction in every field of communications depend on Midland Crystals for reliable frequency control in their products. That's tribute enough to the kind of performance Midland Quality Control has built into millions of crystals faithfully doing a first-class job on land, sea, and in the air.

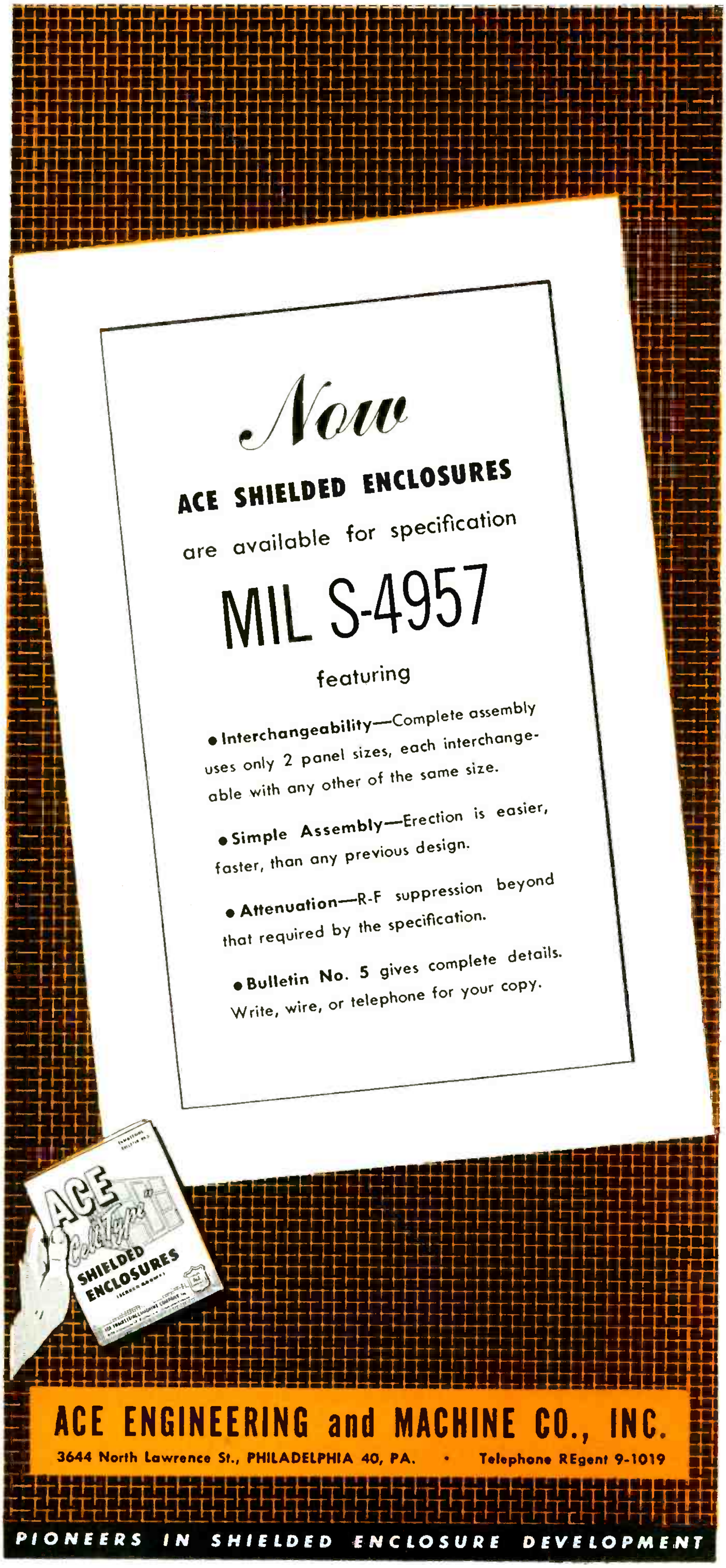
Whatever your Crystal need, conventional or highly specialized
When it has to be exactly right, contact

Midland MANUFACTURING COMPANY, INC.
3155 Fiberglas Road, Kansas City, Kansas

WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

Want more information? Use post card on last page.

www.americanradiohistory.com



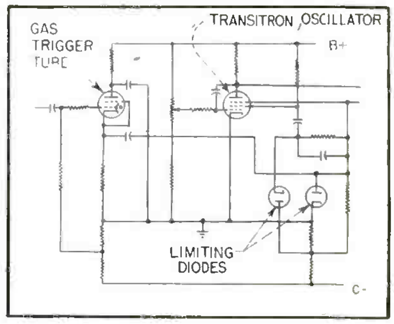


FIG. 2—Transitron oscillator sweep generator

is at a negative potential. The screen is at a somewhat lower positive potential than the plate. When the positive trigger pulse is applied to the suppressor grid it is driven to ground potential. Conduction is thereby shifted from screen to plate in the pentode. The shift is graphically illustrated in Fig. 3.

The suppressor is held at ground potential by the circuit elements until the screen is again able to conduct. The resulting drop in plate voltage as conduction shifts to plate is applied to the control grid through the coupling capacitor between control grid and plate. The grid voltage is forced down to the point at which the plate current will be supported. At this point a degenerative action starts a linear sweep.

The drop in plate current is maintained linearly now by the discharge of the grid-to-plate coupling capacitor. When the plate current has reached a certain limiting value the screen begins to conduct again and screen and suppressor voltages go down. The grid quickly goes positive and plate current is cut off. The grid current recharges the grid-plate coupling capacitor. One of the limiting diodes quickly removes any charge remaining on the capacitors coupling suppressor and

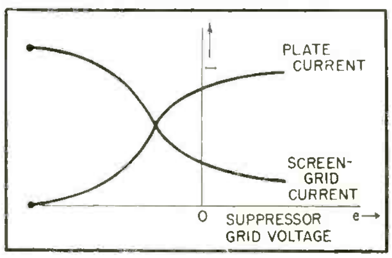


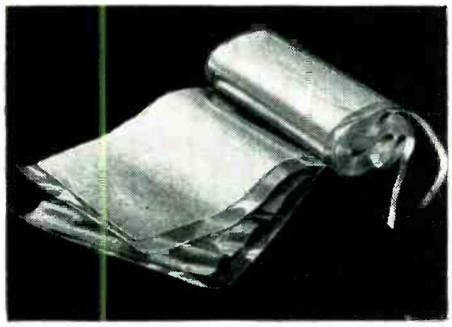
FIG. 3—Conduction shifts from screen to plate in pentode

Want more information? Use post card on last page.

www.americanradiohistory.com

Now a new synthetic helps dial telephone service

In a large, modern telephone office, two million relay contacts await the orders of your dial to clear a path for your voice. They open and close a billion times a day.



Unrolled view (one-third size) of capacitor unit wound with "Mylar." The transparent film is only 0.0005" thick yet stands handling without breaking.

AMONG the elements that guard your dial telephone service are electrical capacitors. They help prevent the formation of arcs that pit and may eventually destroy relay contacts. But millions more of these capacitors are needed each year. How could they be made less costly?

Bell Laboratories engineers, on the lookout for new materials, became alert to the possibilities of the new "Mylar" polyester film. A product of the Du Pont Company, "Mylar" is chemically the same as Du Pont's "Dacron" polyester fiber used to make fabrics. Bell engineers discovered that it also had remarkable dielectric properties—of just the right kind to help their capacitor problem.

The film takes the place of impregnated paper formerly used to separate the metal foil electrodes. It is tougher, stands more voltage and needs no impregnation. The new capacitors require no protective housing and are *much* smaller and less costly.

Here is another example of the way America's technology advances through the sharing of knowledge. Just as Bell Telephone Laboratories makes many of its discoveries—the Transistor, for example—available to other companies, so does it adapt the inventiveness of others when it can help your telephone service.

BELL TELEPHONE LABORATORIES

There are many opportunities for creative scientists and engineers at Bell Telephone Laboratories. For details see our advertisement on page 410

Want more information? Use post card on last page.

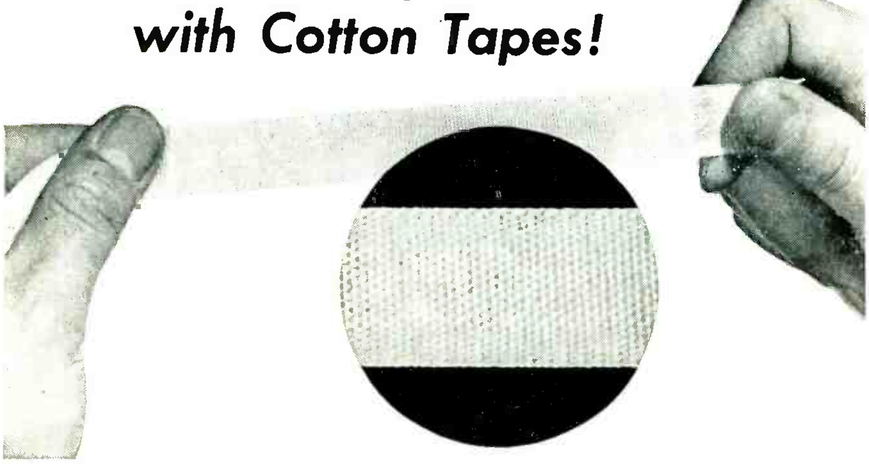
www.americanradiohistory.com

What you have waited for —

IMCOR®

CX WOVEN GLASS TAPE

Priced to Compete with Cotton Tapes!



AT LAST! . . . a woven glass electrical insulating tape developed to compete with cotton tapes in performance and price. Now, cost-conscious manufacturers of low temperature apparatus can gain the benefits of glass tape . . . including resistance to moisture, dirt, and acid; high strength; space-saving thinness; and speedy heat conduction away from "hot spots."

INTENDED only for Class A insulation work, you may be able to use .004 inch Imcor Type CX glass tape to replace both .005 inch and .007 inch cotton tapes for permanent or sacrifice work. It is designed for tying, filling, and wrapping of coils and conductors in motors, armatures, transformers, controls, and other electrical units.

ECONOMICAL, continuous-filament glass yarns, which are treated to permit machine or hand winding of the tape, are used in Imcor CX glass tapes. Standard widths are ½, ¾, 1, 1¼, and 1½ inches.

PLAN NOW to test Imcor CX woven glass tape on a trial basis to determine its possibilities for your application. Ask your nearest IMC office for prices, samples, and specifications.

INSULATION MANUFACTURERS CORPORATION

ELECTRICAL INSULATION

*CHICAGO 6 — 565 W. Washington Blvd. — Phone CEntral 6-7320
*CLEVELAND 14 — 1231 Superior Ave., N. E. — Phone SUperior 1-2310
DAYTON 2 — 120 W. Second St. — Phone Michigan 1391
MILWAUKEE 2 — 312 E. Wisconsin Ave. — Phone DAly 8-5359
PITTSBURGH 22 — 535 Smithfield Street — Phone GRant 1-7100

— AUTHORIZED REPRESENTATIVES —

*CHICAGO 6 — Complete-Reading Elec. Co. Inc. — 100 S. Jefferson St. — Phone CEntral 6-5390
DETROIT 2 — Harry R. Brethen — 15 Lawrence Ave. — Phone TOwnsend 8-2577
*MINNEAPOLIS 3 — H. A. Holden, Inc. — 1208 Harmon Place — Phone Geneva 5353
PEORIA — W. C. Johnson — 101 Heinz Court — Phone 2-7786

*LOCAL STOCKS AVAILABLE AT THESE LOCATIONS

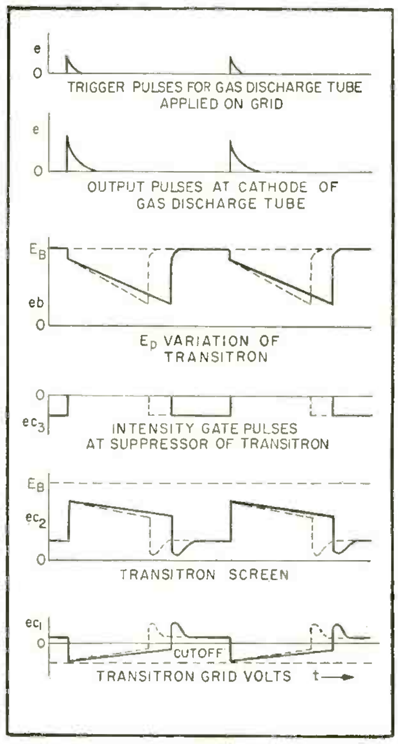


FIG. 4—Waveforms encountered in transitron sweep circuit

screen. The sweep thus terminates abruptly until a new trigger pulse appears.

The waveforms illustrated in Fig. 4 show the operation of the circuit at various points.

Tone Generator

Patent 2,627,413 for a "Method and Means for Producing Simple and Composite Notes or Tones" was granted to A. H. Frisch and A. Silverberg of New York, N. Y.

This invention, while not specifically an electronic circuit application as such, has potential applicability in electronic systems that makes it interesting.

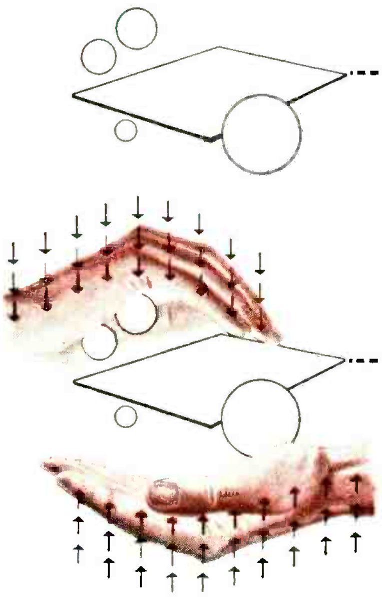
The inventors disclose a method whereby magnetic tapes may be printed with magnetic fields corresponding to musical sounds.

The illustration of Fig. 5 shows the structure of one of the printing dies. A magnetic path is formed between a toroidal magnet and an iron base through the magnetic tape and a preformed die. The tape becomes magnetized in the degree of contact or separation of undulations in the bottom of the die structure proximate to the magnetic tape. The tape thus will bear a magnetic pattern such that when pulled

Selenium available today is remarkably free of unwanted impurities. Bradley controls it still further through an exclusive vacuum process. This laboratory control method, applied at Bradley on a production line basis, is further assurance of uniform quality and more stable rectifier performance. You pay no more for this extra quality — frequently, less.

Vacuum Processed Bradley Rectifiers

a plus in your circuit but not in your cost



Plates for Bradley rectifiers — from miniature types to large power stacks — have selenium applied under vacuum. Vacuum processing removes undesirable impurities and permits closely controlled modification of selenium with desired "impurities".

Vacuum processing also prevents entry of atmospheric impurities during the crystallization of selenium on the plate — a most critical period. Better crystallization results and this, in turn, means a better rectifier.

RECTIFIER STABILITY, longevity and uniformity are the sum of many things. One determining factor is the quality of the selenium crystalline structure. The better or more closely controlled this structure, the better the rectifier.

Bradley, through its unique vacuum process, uses the most advanced safeguards to assure excellent crystalline structure. It's one big reason why we can rate our rectifiers conservatively, why you can be sure of Bradley stability and long life under operating conditions. Vacuum processing is coupled at Bradley with engineer inspection at all points of production. This laboratory control saves time and materials, which are translated into low unit cost to you. For a plus in your circuit but not in your cost, specify Bradley rectifiers.

For further information or consultation, write or phone our sales engineering department. Special problems are welcomed.

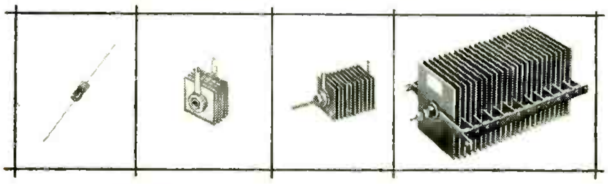
SELENIUM AND COPPER OXIDE RECTIFIERS

SELF-GENERATING PHOTOELECTRIC CELLS

VACUUM PROCESSED for PERFORMANCE AS RATED

Bradley
LABORATORIES, INC.

The complete selenium rectifier line — from microamperes to thousands of amperes

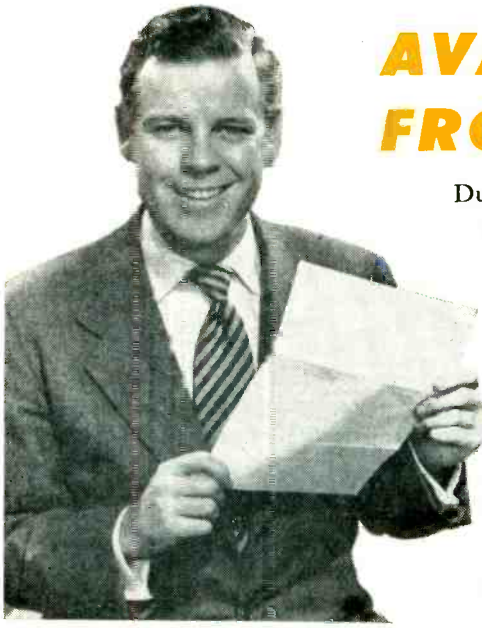


BRADLEY LABORATORIES, INC., 168E Columbus Avenue, New Haven 11, Conn.

Want more information? Use post card on last page.

www.americanradiohistory.com

NOW for the first time in *Over 10 Years* BOGUE 400 CYCLE GENERATORS



AVAILABLE FROM STOCK!

Due to the extremely high production at our newly enlarged plant, we are able to offer for immediate shipment from stock "World Famous" Bogue Hi-Cycle Generators in the following sizes:

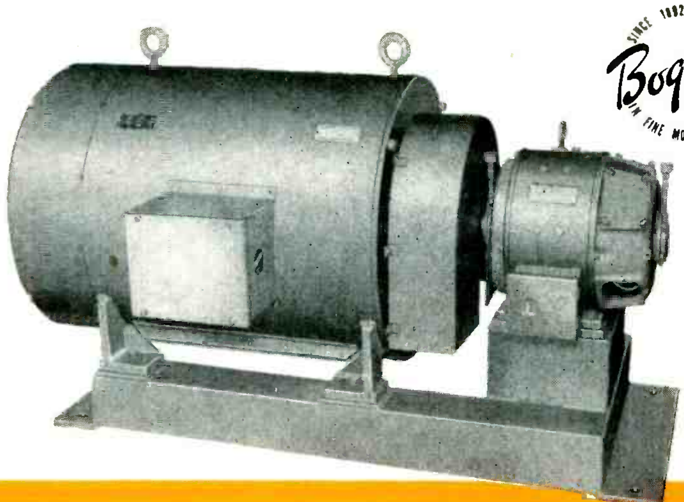
5, 10, 20 and 50 KVA
Single Phase & Three Phase Output
220/440 Volt Input

Deliver 400 cycles regardless of load and input variations

LOW HARMONICS
CLOSE VOLTAGE REGULATION

Our engineering department will be glad to supply full specifications on stock units as well as on special units to meet all Hi-Cycle requirements.

SINCE 1892 SPECIALISTS IN FINE MOTORS & GENERATORS
Bogue



BOGUE ELECTRIC
The Authority on High Cycle Power
52 IOWA AVENUE • PATERSON 3, NEW JERSEY

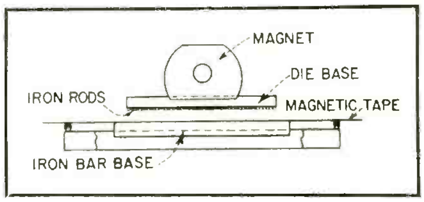


FIG. 5—Printing die for impressing magnetic pattern on tape

through a magnetic-tape reproducing head a tone will be produced that will have a frequency determined by the tape speed and the separation between the elements in the formation of the die base.

While the inventors only claim their invention's usefulness in respect to the generation of musical tones, and foresee the preprinting of simple tonal effects on magnetic tape, incorporation of devices and the method disclosed in this invention in computing devices can be foreseen.

Any fixed signal pattern can be imparted to the die base as shown in Fig. 6. It is certainly a reasonable extension of this idea to set up predetermined signal code patterns that can be printed on magnetic tape information storage devices in electronic computing systems. When in the programming of the computer device the information code must be struck onto the tape, it may be done as described by the inventors in their patent and drawn off or read out at the appropriate time in the computing sequence by a magnetic-tape reproducing head.

Telephone Amplifier

People who use telephones over extended periods, and acquire sore ears in the process, should find patent 2,632,811 of interest. The patent was granted to M. L. M. Souget and N. L. Chalfin for "Telephone Amplifying Apparatus".

The circuit of the telephone am-

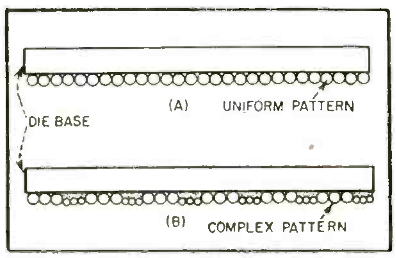


FIG. 6—Uniform (A) or complex (B) pattern depends on die base

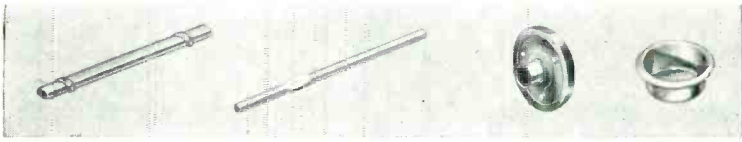
Behind the radar curtain that guards our shores

Magnetron illustrations courtesy of Raytheon Manufacturing Company

Source of UHF waves that make possible the radar screen guarding our continental perimeter is the magnetron.

Essential elements of the magnetron, and the anodes and cathodes of the companion direct-reading oscilloscope are produced by Superior Tube Company. For example, in the Raytheon magnetron above, Superior furnishes: A. The cathode (heart of the magnetron); B. The anode; C. The sleeve on the wave trap (or choke) assembly.

All of these parts are made from Superior seamless nickel tubing. As a matter of fact, there is Superior tubing *in every one* of the 400 different types of Raytheon magnetrons—a record possible only because of great satisfaction with Superior alloys, fabrication, deliveries and service. Put *your* chief dependence upon Superior. Superior Tube Company, 2500 Germantown Ave., Norristown, Pa.



Superior
THE BIG NAME IN SMALL TUBING

All analyses .010″ to ⅝″ OD.

Certain analyses in Light Walls up to 2$\frac{1}{16}$″ OD.

Seamless Nickel Cathode. Oval, double bead, .025″ x .048″ x .003″ Wall. 12mm long.

Lockseam* Nickel Cathode Round, vertical emboss, .045″ OD x .0021″ Wall. 26.5 mm long

Disc Cathode* .121″ OD, .312″ long.

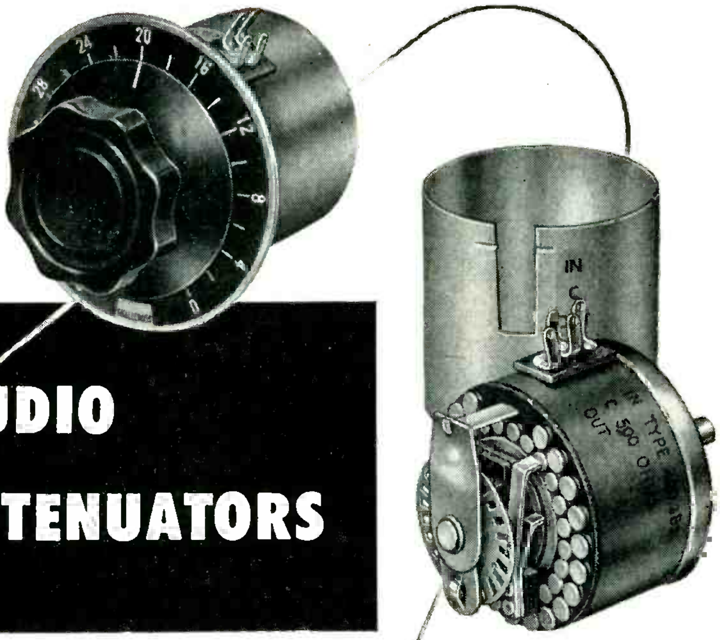
No. 2 Grid Cup, 305 Stainless Steel, Rolled edge. .499″ OD x .010″ Wall x .262″ long.

Many other types of nickel cathodes—such as Lockseam*, made from nickel strip, disc cathodes, and a wide variety of stainless anodes, grid cups and other tubular fabricated parts are available from Superior. For information and free literature on these products as well as Cathaloy A-30, A-31**, our latest Cathode Alloys, address Superior Tube Company, Electronics Division, 2500 Germantown Avenue, Norristown, Pa.

*Manufactured under U.S. Patents
**U.S. Trademark applied for

Want more information? Use post card on last page.

www.americanradiohistory.com



AUDIO ATTENUATORS

OVER 200 BASIC TYPES TO CHOOSE FROM

Do audio attenuator problems cost you money? Chances are Shallcross has a model to match your specifications exactly—and at moderate cost.

Shallcross attenuators are made in over 200 basic types. Each type can be supplied with a choice of attenuation characteristics . . . with a positive detent mechanism . . . and in numerous input and output impedances. Where calibration must be extremely accurate, Shallcross precision wire-wound resistors are used. For less critical applications, models with high grade composition resistors can be supplied—often at lower cost.

A complete description of all Shallcross attenuators — mountings, characteristics, and circuits is yours for the asking in Bulletin L-4A. SHALLCROSS MFG. CO., 522 Pusey Avenue, Collingdale, Penna.

QUICK DELIVERIES! Small quantities of popular 20 step Shallcross composition resistor potentiometers and wire-wound ladders without detents are immediately available.

Shallcross

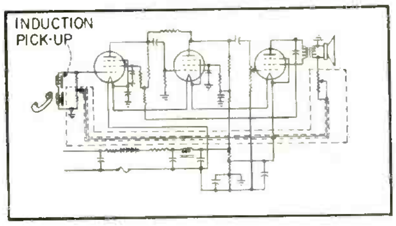


FIG. 7—Telephone amplifier features feedback

plifier is shown in Fig. 7. The particular novelty of the telephone amplifier is illustrated in the feedback path. While overall degenerative feedback in a three-stage audio amplifier is by no means novel, in this case it was the solution to a problem of feedback familiar to many unsuccessful attempts to provide a telephone-amplifying device. The general purpose of such amplifiers is to free telephone users' hands—particularly where the calling party must wait for the called party, or listen to a long recital of figures or names. Another important use is for conference calls to a large group.

The induction pickup unit of the telephone amplifier is employed as illustrated in Fig. 8. Magnetic leakage currents from the receiver of the telephone handset induce signal voltages in this pickup, which is mounted beneath a depression in the top of the telephone amplifier cabinet. The top of the cabinet is contoured to fit most currently used telephone handsets. The telephone, using the induction device of this invention, delivers an incoming call at loudspeaker volume without any

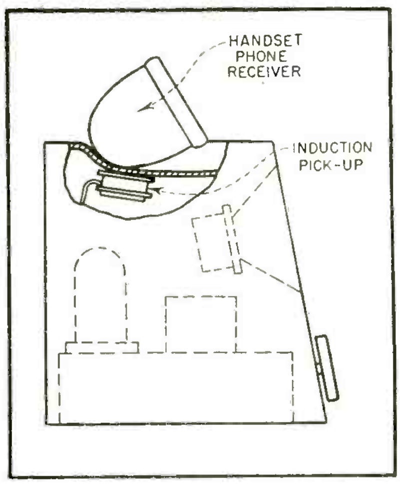
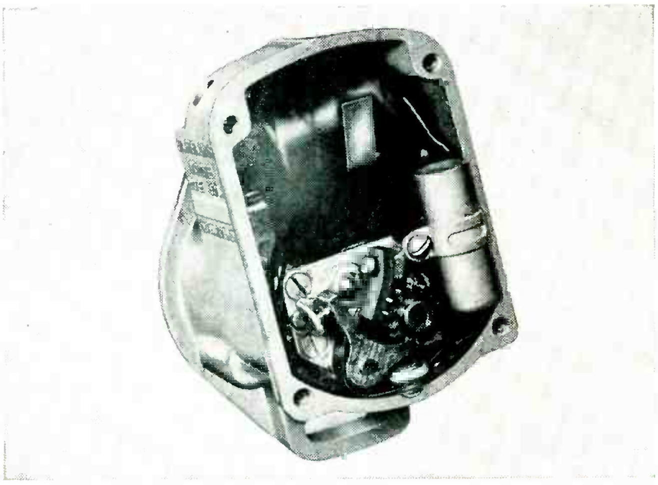
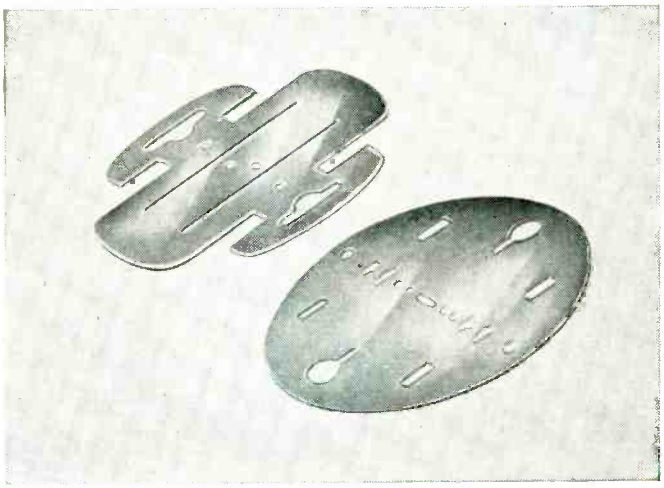


FIG. 8—Induction pickup obviates need for direct connection to telephone

How many of these electrical insulation problems do you have?

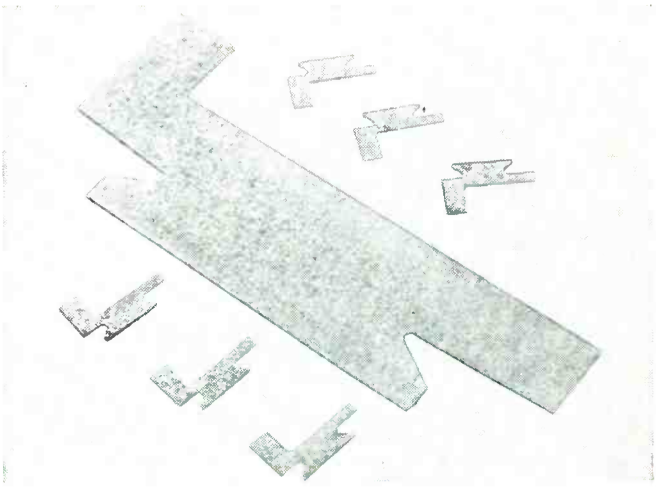


1. Looking for an efficient coil wrapping for small spaces? EMPIRE® varnished bias-cut nylon tape is highly flexible, strong and efficient . . . makes a thin insulation of unusually high dielectric strength with good resistance to oil and water.



2. Need accurately punched mica stampings for filament, grid and plate supports? MICO produces mica stampings to extremely fine tolerances. Whenever you need precision-fabricated mica parts of the highest quality, call on MICO.

3. Looking for a better material for wiring diagrams, controls, instruments, dials and nameplates? DECORATIVE LAMICOID® resists wear, aging, weathering, oils, corrosive vapors, moisture and temperature extremes. Won't warp, check or chip. Good electrical properties. Wipes clean with a damp cloth.



4. Need a class H segment plate that's easy to work with? ISOMICA* Segment Plate — made of built-up continuous mica sheet — shows no tendency to split or flake. Small segments of heavy thickness may be punched, and larger segments can be accurately sawed, milled, punched, etc.

Whatever electrical insulation material you need — standard or special — class A to class H — MICO makes it best. We manufacture it, cut it to size, or fabricate it to your specification. Send us your blueprints or problems today.

*Trade-mark

1893-1953 60 Years of Leadership in Electrical Insulation

MICO ELECTRICAL INSULATION ®

MICA *Insulator* COMPANY

Schenectady 1, New York

Offices in Principal Cities

LAMICOID ® (Laminated Plastic) • MICANITE ® (Built-up Mica) • EMPIRE ® (Varnished Fabrics and Paper) • FABRICATED MICA • ISOMICA *

Want more information? Use post card on last page.

www.americanradiohistory.com

physical electrical connection of the invention to the telephone instrument.

Impedance Measurement

The design of impedance-measuring devices has always presented difficulty. The problems are most notable in designing instruments for measuring the extremes because stable standards of admittance or impedance are difficult to construct. It is also difficult to avoid error due to the large bridge ratios necessary in measuring extremes. Likewise, the stray impedances of uncertain value become part of the measured element and constitute an undeterminate error.

The invention of Ben Secker, of London, England, patent 2,617,857, recently issued for an "Impedance Measuring Device", proposes to overcome these difficulties. The patent is assigned to International Standard Electric Corp. of New York.

The impedance-measuring device provides an electrical admittance or impedance bridge comprising two equal ratio arms formed by two equal, balanced, and closely coupled inductive windings. One of the windings is coupled to the impedance to be measured, or to one or more standards, at least one of which is connected to the other winding through an attenuator. A test voltage, or test current, is applied to the impedance or admittance under test, and to all standards. A meter indicates when the algebraic sum of all the voltages or currents in the impedances or admittances is zero.

The circuit of the impedance measuring device of Secker's inven-

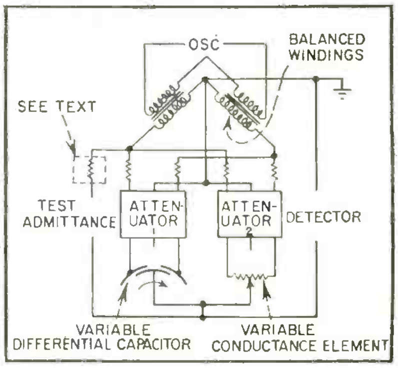


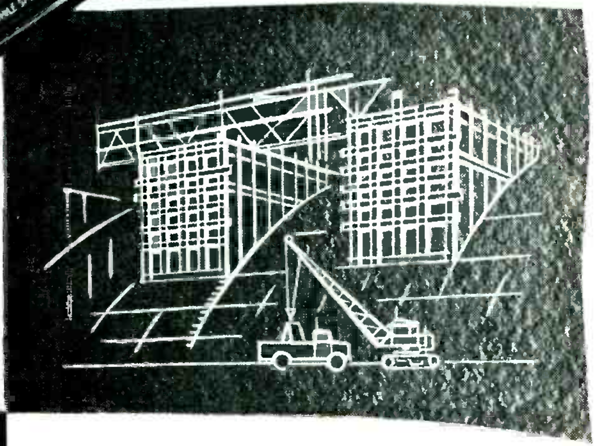
FIG. 9—Impedance measurements depend upon bridge circuit

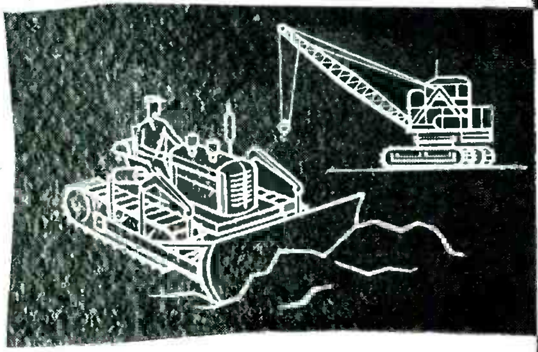
Want more information? Use post card on last page.

www.americanradiohistory.com

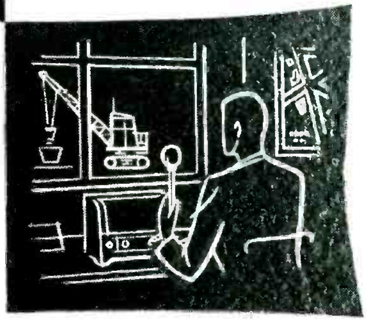
"REPORTER" PTC 116/117
MOBILE RADIO-TELEPHONE FOR ENGINEERING COMMUNICATIONS

Ranking high among the benefits derived from V.H.F. radio-telephone communication is the control of mobile vehicles and personnel. The Pye "Reporter" fulfils this function in admirable and versatile fashions.





A compact and economical equipment, it is designed to fit neatly under vehicle dashboards but is also available in transportable form. Reason enough that it should feature so prominently in over two-thirds of the V.H.F. schemes in the United Kingdom.



PYE Telecommunications

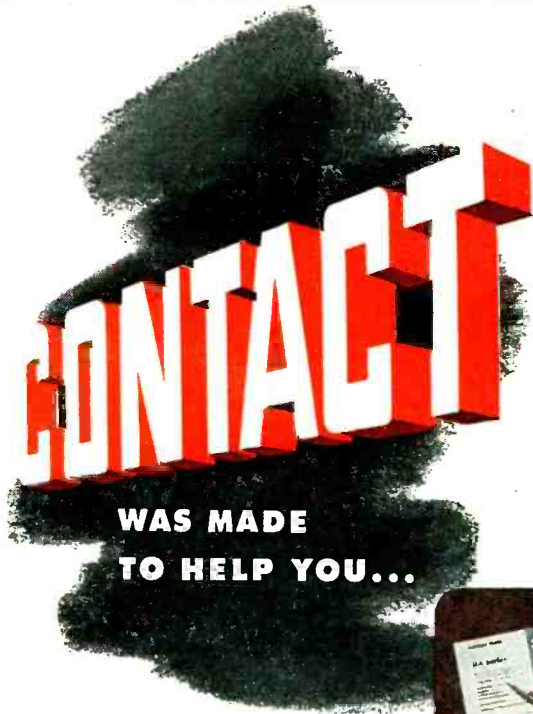
PYE LIMITED · CAMBRIDGE ENGLAND

5B/4/5/6/7

Want more information? Use post card on last page.

www.americanradiohistory.com

IF YOU WORK WITH ELECTRICAL OR ELECTRONIC CIRCUITS...



A color film with schematic animation and supporting narration... to help you select connectors engineered to your requirements and operating conditions. Disconnect system? Number of contacts? Voltage? Amperage? These and other factors are covered in this helpful film. In addition you'll learn how the printed Cannon Plug Guide (below) leads you to the *right* connector for any job. Request your free showing today.

CANNON PLUG GUIDE
... An easy-to-follow graphic aid.

CURRENT CAPACITY
and its relation to contact spacing.

SPACING AND NUMBER
of contacts involves many factors.

CANNON ELECTRIC

since 1915

Main office and plant, Cannon Electric Company, Los Angeles 31, California. Factories in Los Angeles, New Haven, Toronto. Representatives in principal cities.

"Contact", a 30-minute, 16mm Kodachrome sound picture, costs you nothing except 2-way transportation charges. You furnish sound projector. 24-page printed Plug Guide will be furnished for each person viewing film. To avoid delay request your booking for the film on coupon today.

MODERN TALKING PICTURE SERVICE, INC. 234
45 Rockefeller Plaza, New York 20, N. Y.

NAME__________
FIRM__________
DATE TO BE SHOWN__________
ALTERNATE DATES__________
ADDRESS__________
CITY______ ZONE___ STATE______

tion is shown in Fig. 9. In Fig. 10A, the left side of the bridge is shown in equivalent-circuit form including attenuator 1. Figure 10B shows the circuit without attenuation so that the voltage is reduced to E/K where K is the attenuation factor of attenuator 1.

The entire bridge of Fig. 9 will be equivalent to the circuit of Fig. 10C. Here, Y_x is the unknown admittance. Symbols G_a and G_c are conductances in both sides of the circuit through adjustment of the variable conductance element. Capacitances C_a and C_c are those introduced by the variable differential capacitor. Values K_1 and K_2 are the attenuation factors introduced by attenuators 1 and 2, respectively. The emf's on the C side of the bridge will be opposite in sign to those on the A side.

Zero current in the detector will be found when

$$\frac{E}{Z+\frac{1}{Y_x}} + \frac{E}{K_1\left(Z+\frac{1}{j\omega C_a}\right)} + \frac{E}{K_2\left(Z+\frac{1}{G_a}\right)} = \frac{E}{K_2\left(Z+\frac{1}{j\omega C_c}\right)} + \frac{E}{K_2\left(Z+\frac{1}{G_c}\right)}$$

which reduces to

$$Y_x = \frac{(G_c - G_a)}{K_2 + \frac{j\,(C_c - C_a)}{K_1}}$$

The inventor points out the series impedance element in the test admittance input circuit (dashed in Fig. 9) may be omitted for small values of Y_x but that the others are necessary for properly terminating the input circuits of the attenuators. Other details may be obtained by reference to the patent.

For those who may desire copies

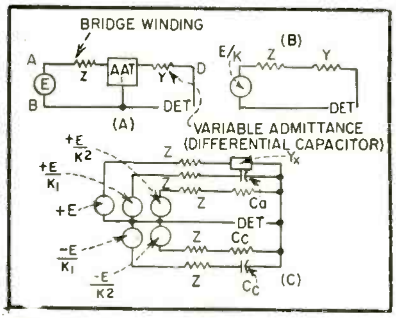


FIG. 10—Equivalent circuit (A) of left side, circuit with attenuator removed (B) and equivalent circuit of entire bridge (C)

Want more information? Use post card on last page.

Cramer TIMING DEVICES

NEW TIME TOTALIZER

MODEL ET

better than

0.02 of 1%

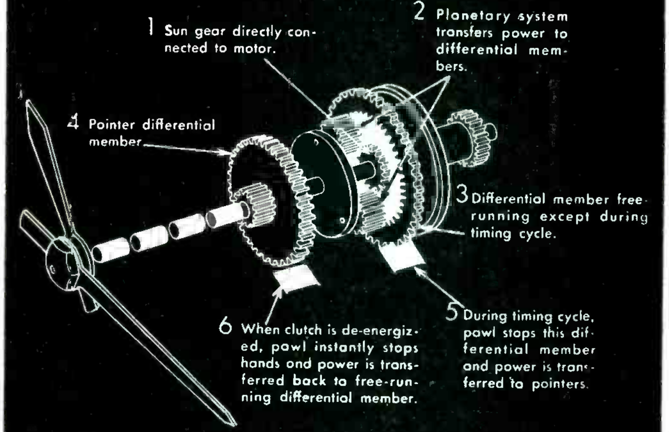
accuracy

Designed to the most exacting specifications for such applications as timing operations in industrial laboratories or for measurement processes in the chemical and metals industries. Incorporates new principle of differential clutching that prevents slippage and overrun and insures unusually high accuracy and dependable performance.

FEATURES

- *High Accuracy*... Better than 0.02 of 1% of full scale reading.
- *Positive Clutching*... Differential gear clutch provides positive action. No friction element to slip or wear. Accuracy further improved by clutching at a high-speed part of the gear train.
- *Extra Strength Motor*... High torque motor insures adequate reserve for adverse operating conditions.
- *Easy-to-Read Dial*... Large sweep hand permits extremely precise readings.
- *Compact Size*... Takes up minimum space on crowded panels... ideal for portable or airborne equipment.
- *Military Specifications*... Models available to meet exacting specifications as to shock, vibration, temperature, etc.

POSITIVE ACTION CLUTCH WITH DIFFERENTIAL GEAR PREVENTS SLIPPING OR OVERRUN



In this unique clutch mechanism, the motor is permanently connected to the sun gear of a differential gear system. A solenoid pawl moves between the two differential members so that only one is free to rotate at one time. Starts and stops are thus effected by positive engagement of pawl with gear. There can be none of the slippage or overrun associated with friction clutches, nor can characteristics change with age.

the R. W. CRAMER CO., INC.
Box No. 3, Centerbrook, Conn.

Please send complete information about the ET Time Totalizer. (Please check) ☐
Send copy of General Bulletin on Synchronous Timing Motors and Electric Timers. ☐
NAME: ______________________
Address: ______________________
____

6CR53R

Want more information? Use post card on last page.

www.americanradiohistory.com

Sensitive DC-VTVM Furthers Electronic Research and Production

Progress in electronic engineering, as in other fields of engineering, is closely linked with the development of more sensitive measuring instruments. During the past 4 years our MV-17B DC Vacuum Tube Millivoltmeter has helped substantially to advance both research and production throughout the entire electronic field. Crystal diodes and transistors for instance have benefited from it due to its ability to measure small DC voltages with minimum circuit loading (1 mV full scale, 6 megohms input impedance). As a null detector, in bridges, the MV-17B can be overloaded up to 100,000 times, thereby eliminating suspension-galvanometer trouble and increasing measuring ranges and sensitivity. Grid current measurements, small voltage drops in regulated power supplies, delicate temperature measurements, insulation material research are but a few other applications which have made this instrument a reliable stand-by in nearly all leading laboratories in America and abroad.

MV-17B
DC-Millivoltmeter

•

"It Measures Where Others Fail"

Other Millivac Meters, Similar to MV-17B.

- MV-17BX DC Millivolt meter, identical with MV-17B but equipped with external output terminals. Used as a high-gain DC amplifier or to operate external indicating and recording instruments.
- MR-67B DC Millivolt Recorder, sensitivity 200 microvolts per centimeter. Uses Sanborn heat-writing unit.
- MV-18B High Frequency Voltmeter. Has MV-17B DC measuring circuit and external crystal probes. Covers 1 MC to 2,500 MC, lowest reading 1 mV. Measures also 100 microvolts to 10 mV DC.

MILLIVAC INSTRUMENT CORPORATION
P.O. BOX 997, Schenectady, N.Y.

of the patents reviewed in these pages, they may be obtained by writing Commissioner of Patents, Washington 25, D. C. Each patent is available at a cost of 25 cents and should be ordered by patent number.

Radar Photography

A method of producing visual images of objects by their reflection of radio waves is the subject matter of U. S. Patent 2,627,600 granted to R. H. Rines of Brookline, Mass.

The basic concept of Rines' invention is illustrated in Fig. 11. An object irradiated with radio-frequency energy in the manner of a radar system normally reradiates the energy. By means of a radio-wave-refracting lens, such as one of polystyrene, the reradiated energy from the object may be focused onto a film. The film is a mosaic of minute silicon detectors on a heat-sensitive surface. The sides of the mosaic are dimensioned to act as quarter-wave resonators.

The heat-sensitive layer may be composed of acid salts readily decomposable on the application of heat along with a basic salt that decomposes only slowly under heat. A decomposable acid salt suggested is barium acetate. Secondary ammonium phosphate is suggested as the basic salt. Other combinations are disclosed in the patent. The reradiated energy from the object in the radiated beam, when focused on the heat-sensitive layer disposed at the focal point of the lens, will produce differing amounts of energy on the film, depending on the field strength magnitudes reflected from

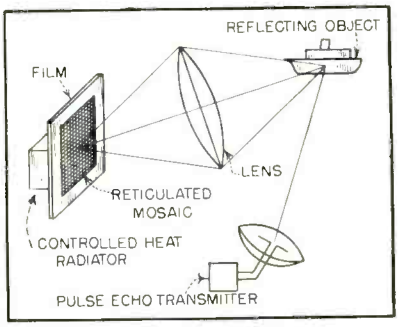
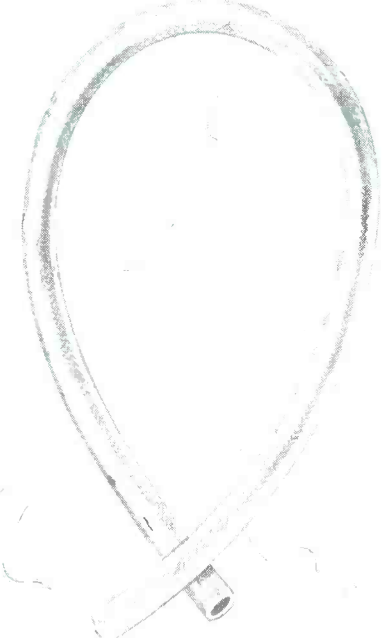


FIG. 11—Basic concept of radar photographic method by r-f reflection

Flexible

Improved New VARGLAS SILICONE Tubing and Sleeving



Now Varglas Silicone has been made more flexible. Sharp turns and 90° bends cause no cracking or peeling — no loss of dielectric strength.

As pioneers in the manufacture of silicone sleeving and tubing, we know this is the greatest improvement made during the past ten years. Unexcelled where high temperatures must be withstood for several hours — not just for 15 minutes. You need not sacrifice abrasion resistance and toughness to get flexibility. The new Varglas Silicone sleeving and tubing will pass cold bend tests at 35° to 40° LOWER temperature than formerly.

The only Class H insulation with all these features:

Efficient from 500° F. to — 85° F.
Moisture and Fungus Resistant
Flame Resistant — Self extinguishing
Abrasion Resistant
Dielectrically Strong with average readings up to 7,000 volts.
Available in 10 colors — at no extra cost.

Samples of Varglas Silicone products as well as samples of our complete line of tubing and sleeving are available in a convenient sample folder. Just drop us a line telling us your problem and its peculiarities.

Varflex CORPORATION

Makers of Electrical Insulating Tubing and Sleeving

VARFLEX *Sales Co., Inc.*
308 N. Jay St., Rome, N. Y.

Want more information? Use post card on last page.

www.americanradiohistory.com

TRIAD

SUB-MINIATURE HERMETICALLY SEALED

transistor transformers

- standard MIL cases
- hermetically sealed
- magnetically shielded

Triad offers Transistor Transformers, both cased and uncased, for all applications in connection with both NPN and PNP type of transistors. Cased types are listed below. Dimensions, ¾"x ¾"x 1⅛".

Type No.	Impedance Winding #1	Impedance Winding #2	Max. Level-VU	Shielding db.
JAF-1	50000	600/250/50	10	45
JAF-2	250000	600/250/50	10	45
JAF-5	50000	30/12/4	10	45
JAF-11	50000	15000	10	45
JAF-21	15000	600/250/50	10	45
JAF-23	20000 C.T.	600/250/50	10	45
JAF-31	600/250/50	600/250/50	10	45
RS-71	10000	600/150	33	0

Triad's new 1953 catalog lists other transformers which can be adapted to transistor circuits.

Write for Catalog TR-53G

TRIAD TRANSFORMER CORP.

4055 Redwood Ave. • Venice, Calif.

Want more information? Use post card on last page.

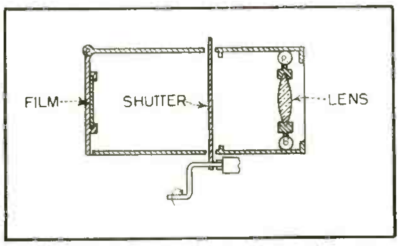


FIG. 12—Arrangement of camera for radar photography

the object itself.

The silicon particles rectify the energy impinging on them. The heat generated from the rectifying action will amount only to microjoules of energy, but this will be sufficient to decompose the film coatings in varying amounts thereby changing the pH concentration of the acid-basic-salt mixture in varying amounts depending on the radio frequency energy imported to the resonant mosaic silicon surfaces.

Developing of the film is accomplished by dipping it in a litmus, or phenolphthalein solution. Thus, the image of the reradiating object will appear in degrees of red under a litmus development, corresponding to the volatile-acid or volatile-base pH concentration.

If the radio-photographic technique described in the Rines invention works as claimed, it seems reasonable to project into the future the possibility of identification of distant objects in a radar beam by more detailed, instantaneous observation than is now possible on the conventional radar scope where considerable time intervals elapse between one scanning sweep over an area and a succeeding sweep.

One point that seems logically made in the specification of this invention is that the greater the range of the objects being observed, the longer the exposure required.

By including a litmus solution in the film surface, the inventor claims to be able to make the object visible without development.

In Fig. 12 there is shown a box-camera representation of the technique proposed in this invention.

Unusual Klystron

An unusual approach to the design of velocity-modulated tubes of the type generally known as

NEW!

AN EXCLUSIVE **C-A-C** DEVELOPMENT

COMPRESSION MOLDED *Plastic Toroids*

***Meet JAN temperature and humidity requirements**

We consider this development as revolutionary as the development of the molded mica capacitor. The bothersome mounting problems and fragility of the uncased toroid have been entirely eliminated. Complete uniformity of dimensions are maintained by precision molds. To keep mounting pressure off the plastic, a bushing of brass is molded into the center. Type "A" provides a center hole to clear a 6-32 screw. Type "B" is threaded for a 6-32 screw. Tooling is complete for molding any of the .90 x .40 coils. The complete unit is compact, measuring only 1 1/16" by ½" thick.

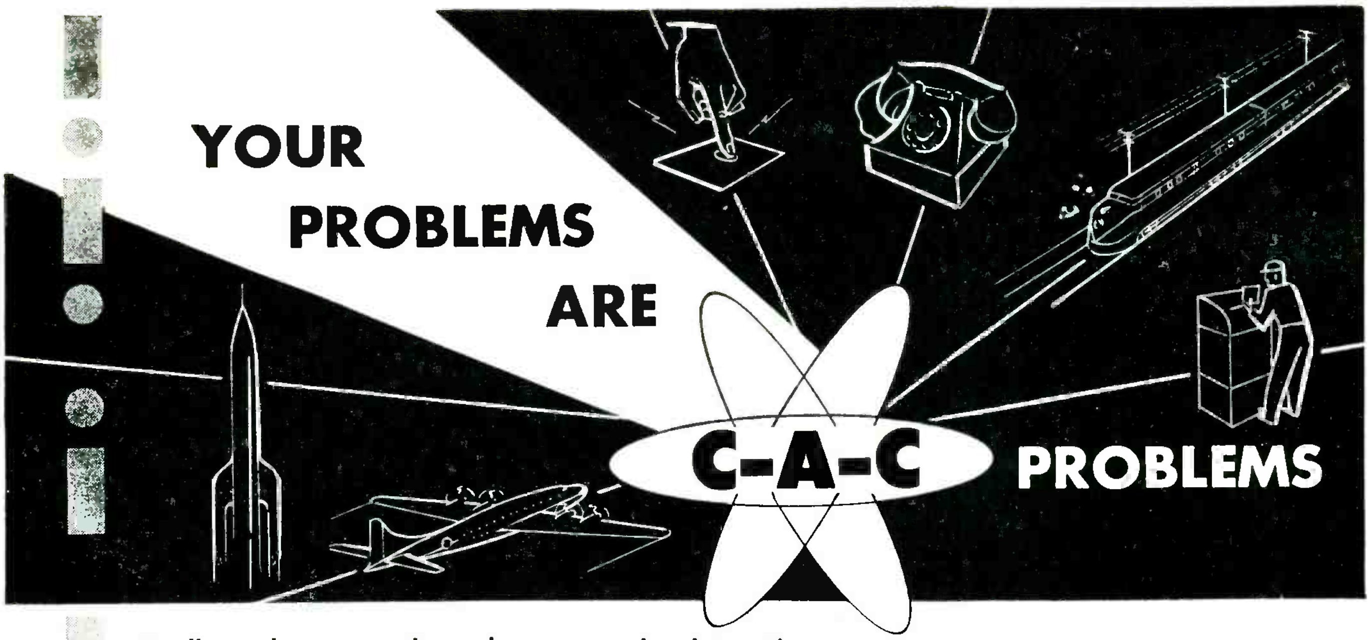
Complete data available on request; samples will be furnished for your evaluation.

COMMUNICATION ACCESSORIES Company

HICKMAN MILLS, MISSOURI

Want more information? Use post card on last page.

www.americanradiohistory.com



Hardly a day passes but what we receive interesting research problems on the application of toroids.

CAC engineers welcome the opportunity to consider your specific requirements in frequency selective networks—

For your convenience use our specification list (below) which covers most filter requirements:

FILTER SPECIFICATIONS

1. Pass Band
   a) Frequency limits: ________ to ________
   b) Max. insertion loss at min. point: ________ db
   c) Required flatness: ± ________ db
2. Attenuation Band
   a) Frequency limits & relative attenuation required:
      1) ________ to ________; ________ db
      2) ________ to ________; ________ db
      etc
3. Terminations *
   a) Input
      1) impedance in pass band: ________ ohms
      2) impedance beyond pass band: ☐ increase ☐ decrease ☐ not important
      3) ☐ balanced, ☐ unbalanced
   b) Output
      1) impedance in pass band: ________ ohms
      2) impedance beyond pass band: ☐ increase ☐ decrease ☐ not important
      3) ☐ balanced, ☐ unbalanced
4. Operating Conditions
   a) Power level ________ DBM
   b) Temperature range ________° to ________° F or C
   c) Vibration requirements ________________.
5. Case Requirements
   a) Max. dimension: ______ in. x ______ in. x ______ in.
   b) Mounting by No. ______ - ______ (thread) x ______ in. ☐ studs ☐ tapped inserts.
   c) Location of terminals and mounting provisions: on ______ in. x ______ in. surface.
   d) Hermetic Seal: ☐ yes ☐ no.
   e) Finish Color; ☐ dark gray ☐ light gray ☐ black ☐ Special (Specify)
6. Other Requirements
   a) Military specifications applicable: ☐ MIL-T-27 ☐ ________ ☐ none
   b) Special Requirements: ________________

*NOTE: If low frequency limit of pass band is d.c., input and output impedances are usually equal and must both be either balanced or unbalanced.

TOROIDAL INDUCTORS
Data For Standard Types

Type	Normal Lmax.	Appr. Size O.D. x H	Useful Freq. Range	Qmax @ Freq.	T.C.	Iac-ma
206	3.0 Hy	.90x .40	Up to 15 KC	140 @ 9 KC	1	23
930	17.5 Hy	1.20x .60	Up to 15 KC	170 @ 7.5 KC	1	42
254	35 Hy	1.85x .85	Up to 15 KC	220 @ 5 KC	1	67
466	60 Hy	2.15x1.00	Up to 15 KC	260 @ 5 KC	3	95
848	1.4 Hy	.90x .40	10- 50 KC	170 @ 20 KC	1	33
395	8.0 Hy	1.20x .60	10- 50 KC	220 @ 20 KC	1	61
381	17.0 Hy	1.55x .65	10- 50 KC	250 @ 17.5 KC	3	71
608	600 Mh	.90x .40	30- 75 KC	165 @ 60 KC	3	50
579	7.5 Hy	1.55x .65	30- 75 KC	18[illegible] @ 30 KC	2	110
041	320 Mh	.90x .40	50-200 KC	115 @ 120 KC	3	68
013	4.0 Hy	1.55x .65	50-200 KC	145 @ 70 KC	3	150

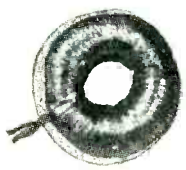
REMARKS

Qmax—Values taken at approx. .01 Iac. Q decreases with increasing current to about .50 Qmax at 1.0 Iac—higher inductance values have lower Qmax at lower frequency due to dielectric losses of winding distributed capacity. All values are for inductors wound with Heavy Formex wire.

T.C.—Temperature characteristics as follows:
1—approx. 100 ppm/°F
2— ± .1% 55 to 90°F
3— ± .1% 30 to 130°F
(most types with temp. characteristic 1 are available with characteristic 3 at no sacrifice in performance)

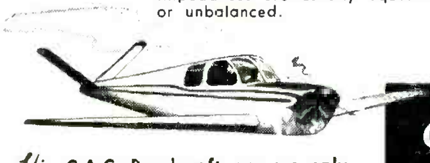
Iac—r.m.s. current which raises 0.1 Hy inductor to max. (2% above initial) inductance — (1% increase occurs at approx 0.35 Iac.

Custom miniaturization of filters is achieved through use of miniaturized components and advanced design techniques.



Uncased coils adjusted to your specifications.

Moistureproof Plastic Coated Toroids available in all types.



Via C.A.C. Beechcraft, we are only hours away from you—we solicit the invitation to discuss your problems across your own desk.

COMMUNICATION ACCESSORIES
Company
HICKMAN MILLS, MISSOURI

Want more information? Use post card on last page.

www.americanradiohistory.com

Keeps

DESTRUCTIVE OLD AGE

away from your drawings

BY the time you discover old age has attacked your important drawings — it's too late. By then, the damage has been done. The time to effectively block old age is NOW — while tomorrow's drawings are still in the preparatory stage.

The way to do it? Specify Arkwright Tracing Cloth. Arkwright checks the destructive effects of old age. Arkwright won't fray at the edges, turn brittle or opaque. You are assured perfect transparency, regardless of age.

There are other reasons why it pays to work with Arkwright. This superior tracing cloth can "take" all the erasing you're likely to give it in a month of Sundays — and still provide sharp, clear lines. You need never worry about "feathering" or "blobbing" or imperfect blueprints.

So insist on quality. You'll get it with Arkwright . . . America's Standard for over 32 years. Arkwright Finishing Co., Industrial Trust Bldg., Providence, R. I.

ARKWRIGHT

Tracing Cloths

AMERICA'S STANDARD FOR OVER 32 YEARS

klystrons is the subject matter of patent 2,603,764 issued to Ernest Rostas of Paris, France, and assigned to the International Standard Electric Co., of New York.

In the inventor's statement of objects he proposes that his system provide means whereby the electron streams of the velocity-modulated tube may be separated into two groups of mean transversal velocities. Transversal velocity is understood to mean the velocity component of the electron stream perpendicular to the magnetic field used around the tube.

The two electron streams are controlled by the magnetic field established along the general axis of the electron-beam path and a high-frequency electric field that is perpendicular with the axis of the beam. The electron beam does not consist substantially of the electrons whose displacement is perpendicular to the axis of the beam. Means are provided to eliminate the electrons having a certain mean transversal velocity after the electrons have been divided into two groups of differing transversal velocities by a circle that envelops the orbits of the electrons of accelerated transversal velocities or according to their absolute tangential velocity. Reflection electrodes are employed to accomplish the encirclement.

A magnetic field and a high-frequency electric field are made to pass two or more distinct regions of the tube that are traversed in succession by a single electron beam. The two fields are perpendicular to the beam axis. Electrons that are shifted along the beam axis at the entry to the first region, where a parallel magnetic field and a perpendicular high-frequency electric field is provided, are not included.

Various other combinations of magnetic and electric fields are employed to generate the characteristics sought by the inventor. In one of these, illustrated in Fig. 13, a

FIG. 13—Combination of magnetic and electric fields in mass spectrometer

magnetic field of cone shape, parallel with beam direction, creates a conic beam of electrons converging toward the input of a region where a magnetic field is provided in the axis of the beam and an electric field perpendicular to it.

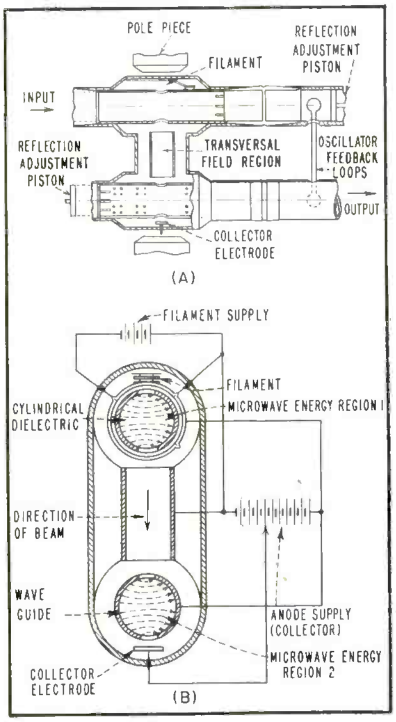
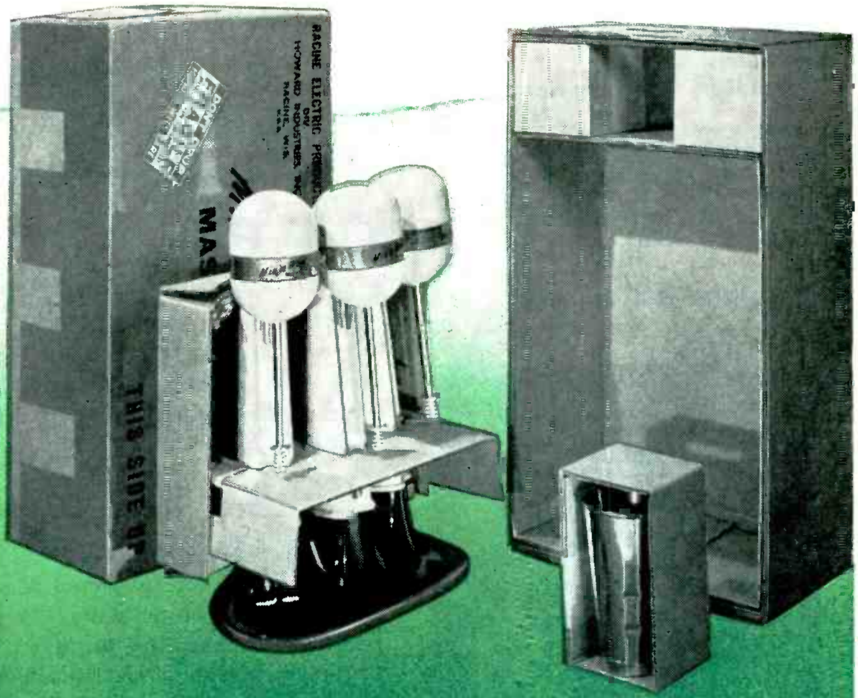


FIG. 14—Physical structure (A) and field regions (B) of special klystron

Meanwhile, another beam is permitted to pass on through the structure where at a further point in the path another field acts upon it. The second beam of greater mean diameter takes on a conical shape and is collected at an anode structure in the tube. In the invention many structures are shown that generate two beams of different characteristics, one of which is eliminated insofar as it is used within the tube (although some undisclosed external use is made of the energy) and the other is passed on to a final collector electrode after an oscillatory energy is first imparted and then lost. The velocity at which electrons finally strike the collector electrode is retarded with a view to reducing the power consumption of the device.

In Fig. 14 the physical structure embodying the invention is shown together with the various magnetic and electric field regions and tube components.

An H&D idea for you



This Huski-Duty shipping box means lower freight cost, minimized damage claims and excellent dealer relations. Get all three in your shipping box—send for booklet "How To Pack It." Hinde & Dauch, Sandusky 10, OHIO.

H&D®

HINDE & DAUCH

17 MILLS AND FACTORIES • 40 SALES OFFICES

Our 65th Year

Want more information? Use post card on last page.

Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Air Cylinder Replaces Drill-Press Feed

Foot-controlled air cylinder, replacing feed handle of drill press, leaves both hands of operator free for holding and indexing meter cases being drilled

AN AIR CYLINDER mounted on a standard drill press and controlled by a foot-operated valve leaves both hands of the operator free for holding and indexing the work in the Bayamon, Puerto Rico plant of Triplett Electric Co. of P. R. Inc.

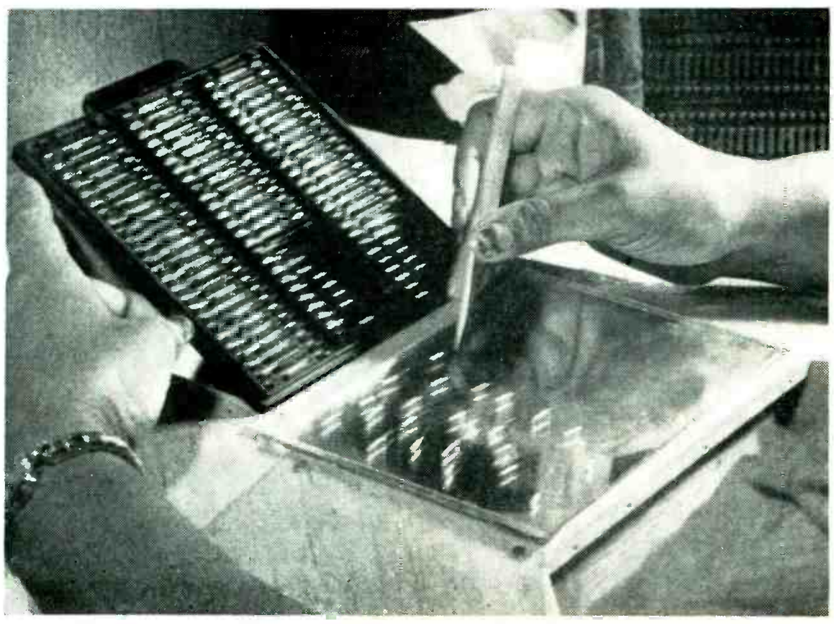
The operation involved is drilling holes in plastic meter cases at precisely the correct positions. The operator holds the case against the side of a drilling jig with her right hand and operates the indexing lever of the jig with her left hand to obtain precise positioning. The air cylinder is mounted in such a way that it brings the drill slowly down through the guide bushing and through the work at constant pressure when the foot valve is actuated.

Mirror Table Speeds Small-Parts Inspection

BOTH SIDES OF SHAVED cathodes for vacuum tubes are inspected at the same time for chips and other defects by placing the parts on an ordinary mirror in the Bloomfield, N. J. plant of Tung-Sol Electric Inc.

The mirror is a conventional type with silvered back surface. It is mounted in a wood box that supports it just high enough above the bench surface to give a clear separation between each tiny cathode and its mirror image when the operator is seated at the bench.

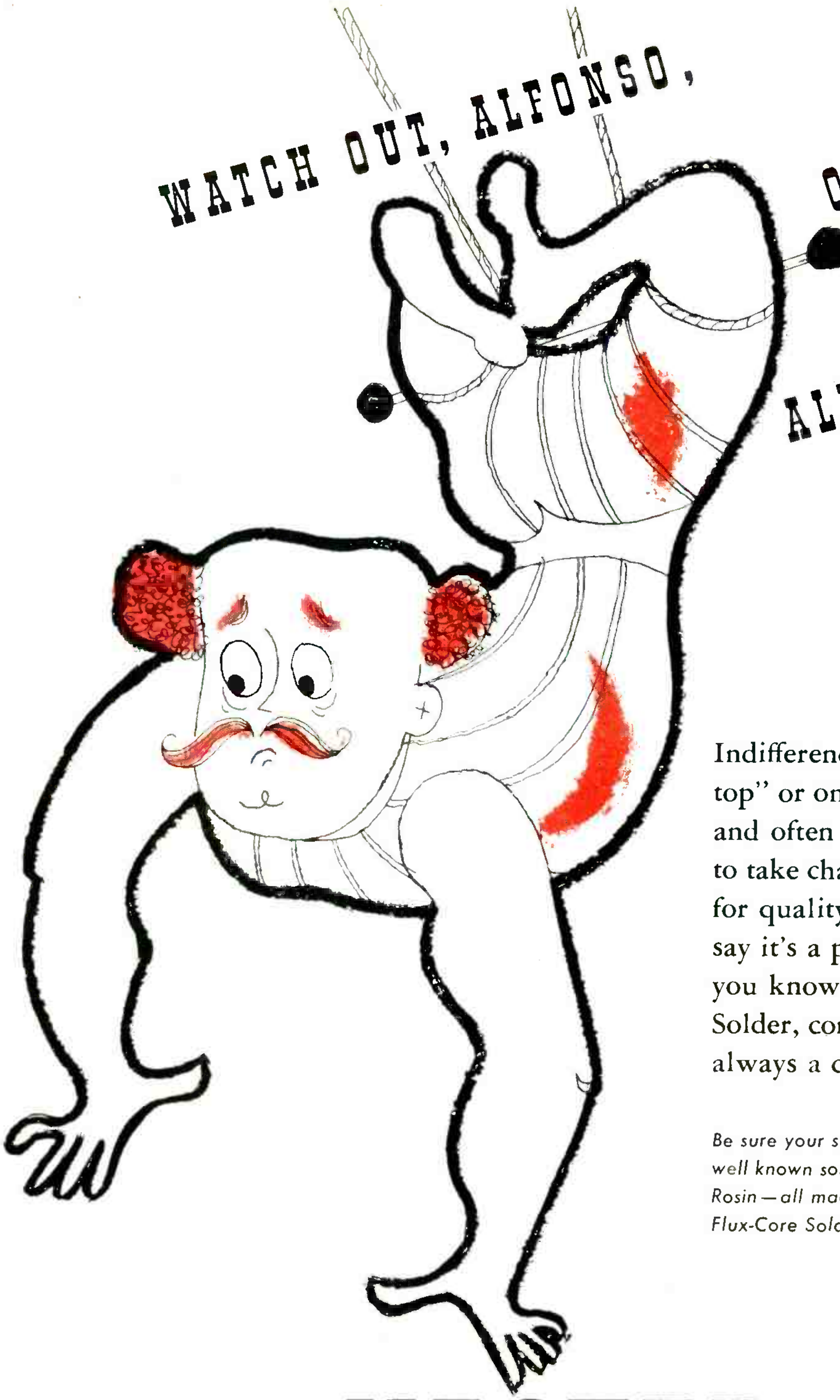
Sloping plastic-covered wing boards go downward from the box to the bench on either side to pro-



Mirror setup used for inspecting both sides of small parts simultaneously

www.americanradiohistory.com

WATCH OUT, ALFONSO, ONE TUMBLE'S ALL IT TAKES...



Indifference—whether it's under the "big top" or on the production line—is inexcusable and often fatal. You simply can't afford to take chances with a hard won reputation for quality performance. That's why we say it's a pretty good rule to stick to a solder you know and trust . . . time-proved Kester Solder, constant in solder alloy and always a consistent flux formula.

Be sure your soldering is satisfactory with one of these well known solder products: "44" Resin, "Resin-Five" and Plastic Rosin—all made only by KESTER . . . Key Name in Flux-Core Solder for More Than 50 Years.

KESTER

SOLDER COMPANY

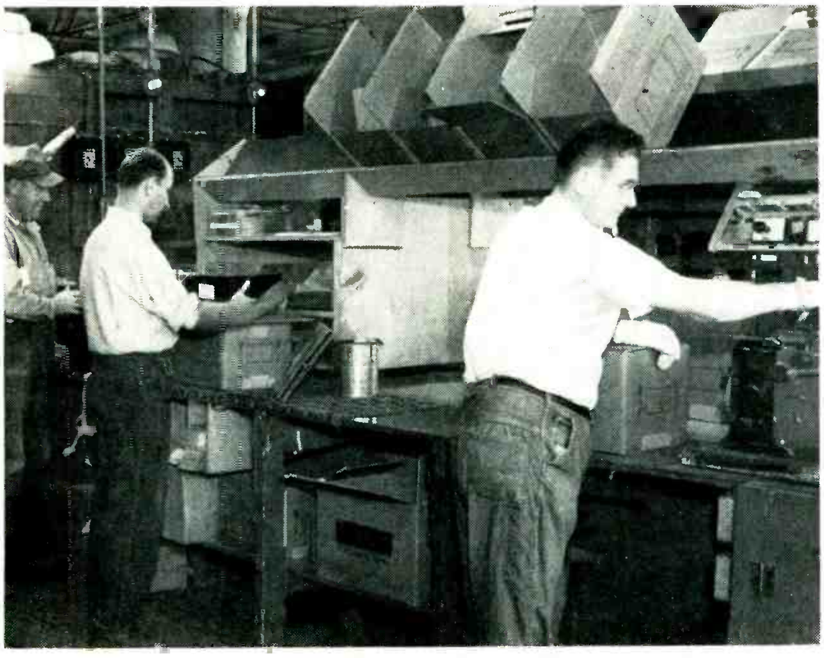
4204 WRIGHTWOOD AVENUE, CHICAGO 39, ILLINOIS
NEWARK 5, NEW JERSEY • BRANTFORD, CANADA

Want more information? Use post card on last page.

www.americanradiohistory.com

vide comfortable arm rests for the operator. A wood rack at the rear of the box supports the special molded plastic trays used for handling and storing the cathodes. Individual cathodes are handled only with tweezers to prevent contamination of the emissive surface.

Empty-Carton Slide Aids Packing of Radios

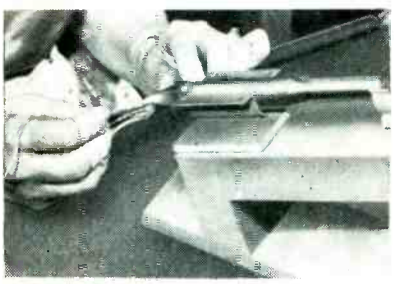


Final packing bench for radio sets. Conveyor line is within easy reach of operator at right, who unloads empty cartons and loads full cartons after sealing them

AN OVERHEAD empty-carton slide is combined with an efficient bench arrangement to simplify the procedure for packing radio sets in shipping cartons at Crosley's Cincinnati plant. The conveyor line that brings empty cartons to this position and takes away filled cartons dips down to loading level at the right-hand end of the bench. The man at this position picks empty cartons off the conveyor pans as needed to keep the overhead slide almost full, pushing the cartons to the left each time so that the empties are within reach of the other two men at this final packing station.

At the carton-loading position, the bench is covered with carpet to prevent scratching of the radio cabinets. The support for the overhead slide contains shelves for holding instruction books and slips.

Soldering Iron Holders Free Both Hands



Method of using soldering iron in holder for fastening ferrules to end of shielding braid on cable

IN THE OPERATION of soldering together the inner and outer ferrules that capture the shielding braid at the termination of a multiple-conductor cable, the procedure recommended by Amphenol involves bringing the work up to a rigidly mounted soldering iron and rotating it while applying solder. The accompanying illustration shows one satisfactory method of supporting the soldering iron while performing this operation.

Vertical support for soldering iron used in soldering ferrules of cable shield to shell of connector plug

First, blocks of wood are assembled to form a mounting platform that slopes toward the operator. At the lower end of this platform, a square of hard-pressed asbestos board and a U-shaped metal piece are mounted to serve as a holder for the heated part of the soldering iron.

Farther up, an ordinary toolholding clip is fastened to the platform to serve as a tight-gripping holder for the soldering-iron handle. This arrangement holds the iron with adequate rigidity yet permits easy removal for other uses.

A modification of this holder, involving use of two clamps for holding the soldering iron vertically, is used later for soldering the ferrules to the shell of the connecting plug, for giving a watertight seal.

Glass Windows on Bench

TO MINIMIZE PICKUP of dust during assembly of delicate meter movements, a tunnel is built on top of the assembly bench to protect the units as they are moved down the production line in the Bayamon, Puerto Rico plant of Triplett Electric Co. of P. R. Inc.

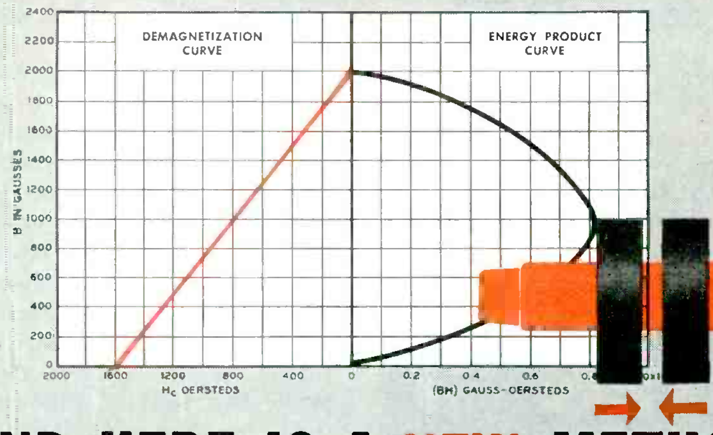
The tunnel has a sliding glass

www.americanradiohistory.com

NEW!

MAGNADUR

A NEW PERMANENT MAGNET MATERIAL...



...AND HERE IS A NEW METHOD OF FOCUSING CATHODE RAY TUBES

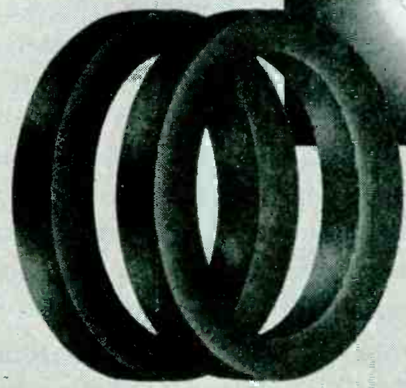
Here is another Ferroxcube "first": a permanent magnet material with outstanding magnetic characteristics—*and no critical materials are involved in its manufacture.* Magnadur's extremely high coercive force and unusually high resistance to demagnetization permit entirely new magnet designs.

Magnadur will be produced in a variety of shapes. Production for the current year is concentrated on Magnadur toroids—developed specifically for TV focusing ring magnets.

Magnadur focus rings provide a real answer to TV focus problems. The double lens system, which is focussed by adjusting the relative position of two toroidal magnets, reduces stray fields to a minimum and provides a highly symmetrical field. Maximum sharpness and spot symmetry are assured.

Technical information will be sent upon request. Ferroxcube engineers are at your service for consultation. We'll be pleased to have you call or write.

SEND FOR BULLETIN



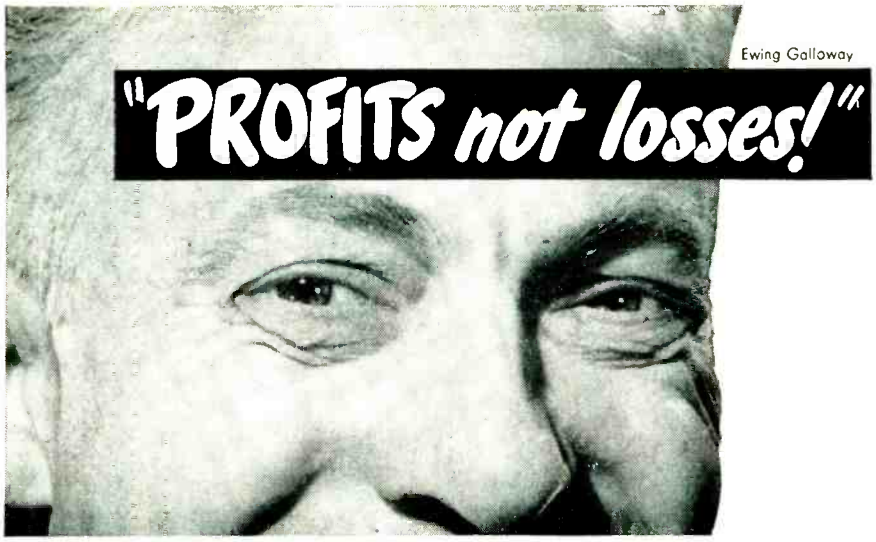
EXAMPLE OF A COMPACT TV FOCUSING DEVICE USING MAGNADUR RINGS

FERROXCUBE CORPORATION OF AMERICA

• *A Joint Affiliate of Sprague Electric Co. and Philips Industries, Managed by Sprague* •

35 EAST BRIDGE STREET • SAUGERTIES, NEW YORK

www.americanradiohistory.com



"We minimized scrap loss...

...cut fabricating costs 23.9%

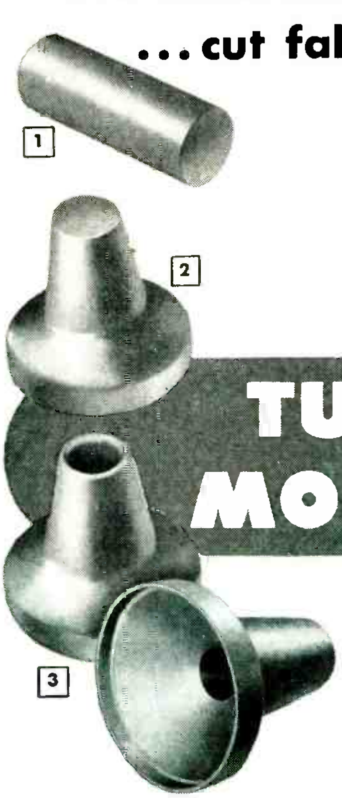
by letting

Fansteel

fabricate our

TUNGSTEN and MOLYBDENUM

COMPONENTS



A short molybdenum rod (1) was hot forged to form basic cone (2), and the part (3) was finished by machining and drilling.

More and more tungsten and molybdenum users are finding Fansteel fabrication the answer to complicated and costly production problems. Fansteel's long-experienced engineers and technicians not only recommend the material to be used but also the shape best adapted to solve a specific problem. Why not use Fansteel fabrication to your advantage, too? Fansteel will help you effect important cost savings by eliminating the scrap and reject problem, minimizing inspection costs, and releasing equipment and personnel for other work.

FANSTEEL WORLD'S LARGEST PRODUCER OF REFRACTORY METALS

Write for the informative booklet: "FANSTEEL TUNGSTEN AND MOLYBDENUM"

TUNGSTEN & MOLYBDENUM

22503C

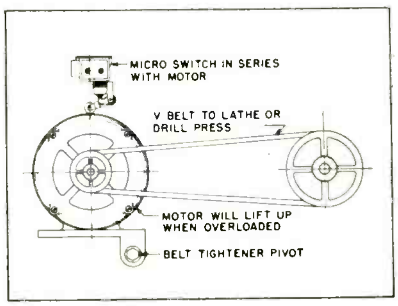
Fansteel Metallurgical Corporation NORTH CHICAGO, ILLINOIS, U.S.A.

Bench arrangement incorporating transfer and storage tunnel at rear, with sliding glass windows for access, to minimize contamination of meter movements during assembly. All parts are stored in the tunnel. Windows are closed at the end of the working shift

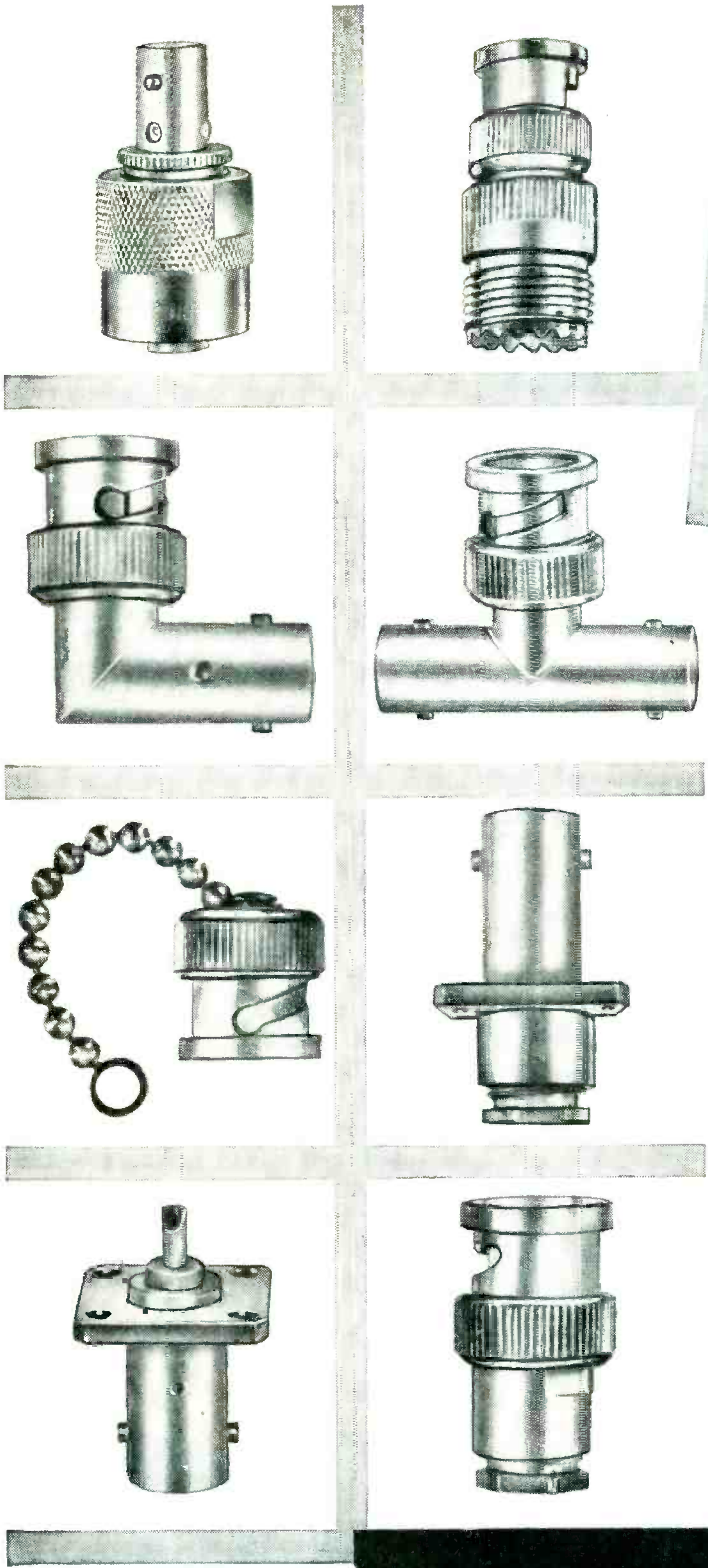
window in front of each operator. During working hours, operators leave their windows open far enough so they can conveniently reach in. Each finished part is placed on a slide in the tunnel, from which it travels downward by gravity to the open window in front of the next operator. Similarly, the next part to be worked on is taken from the bottom of the slide of the preceding operator. Parts thus move down the assembly line by way of the tunnel step by step, with much less risk of contamination than was formerly obtained when passing parts directly down the work bench from operator to operator.

Switch Used for Motor Protection

ON MOTORS which are mounted in such a way that the weight of the motor keeps the belt tight, a micro switch mounted just above the motor can serve in place of a fuse for opening the circuit and stopping the motor in the event of stalling or overloading. The normally-closed



Method of using switch in place of fuse to break circuit when fractional-horsepower electric motor stalls



BNC CONNECTORS BY KINGS

The B N C Connectors shown are small, lightweight Connectors designed for use with small cables such as RG-58/u, RG-59/u and RG-71/u. Widely used for video and aircraft test equipment, they are recommended for frequencies as high as 3000 M.C., where impedance matching is important. The B N C series is used successfully in the region of microwave frequencies.

Whether your connector requirements call for the B N C series, N series, the new C series or special adaptations of standard connectors, you can rely on Kings. Our staff of highly specialized engineers invite your inquiries.

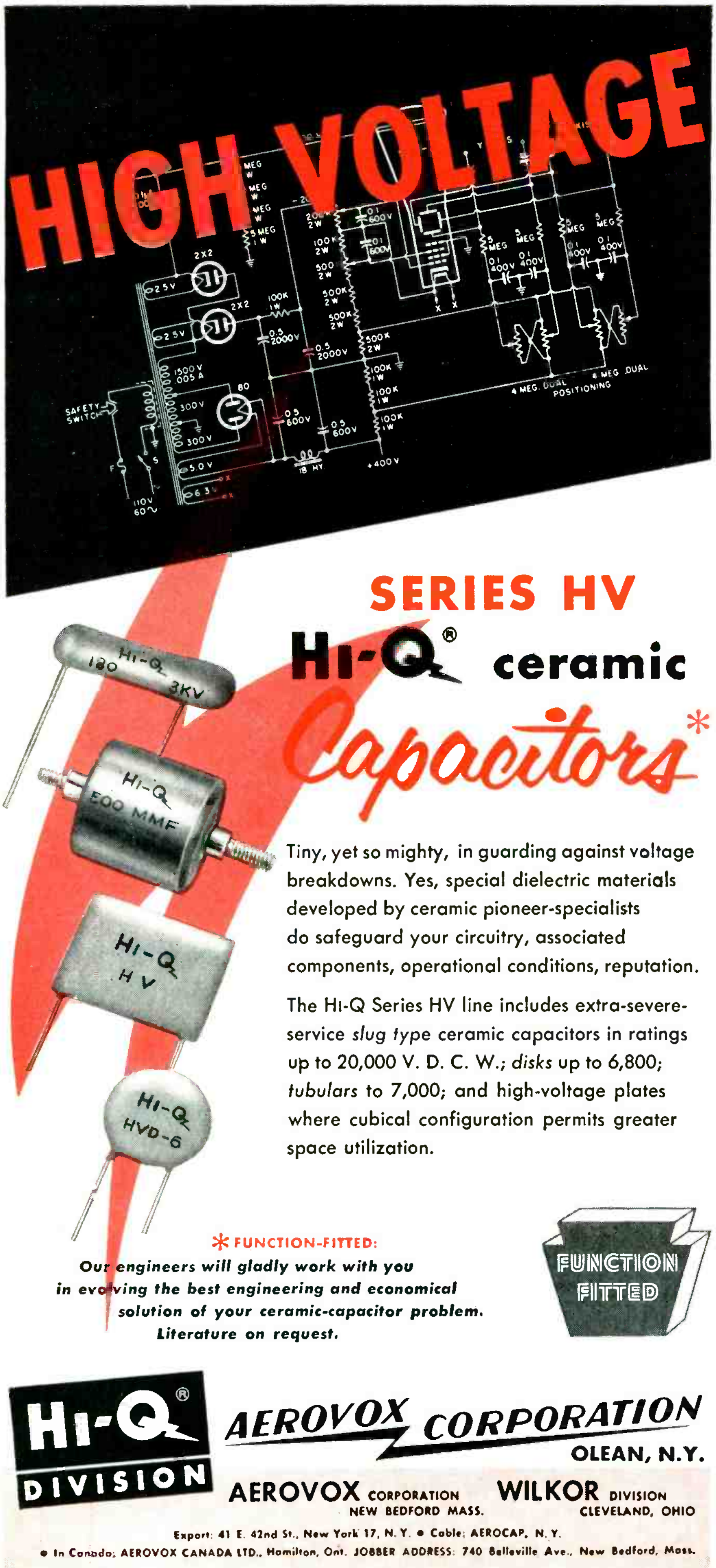
KINGS *Electronics* CO., INC.

40 MARBLEDALE ROAD, TUCKAHOE, N. Y.

IN CANADA: ATLAS RADIO CORP., LTD., TORONTO

Want more information? Use post card on last page.

www.americanradiohistory.com



snap-action switch is wired in series with the motor circuit. Best results are obtained with a switch mounting having a lever with a roller on the end for actuating the switch button.

When the motor stalls or overloads, tightening of the belt causes the motor to rise and actuate the switch. This opens the circuit and stops the motor, thereby eliminating blown fuses or the possibility of burning out the motor. This switch arrangement also acts as a safety feature in the event that the operator's clothing gets caught in the equipment.

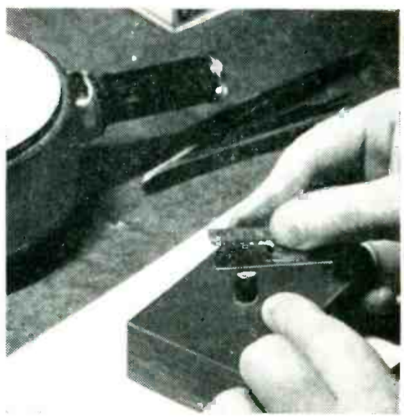
This production safety idea was suggested by Walter G. Wilson of Maywood, Illinois in a letter to the Idea Exchange Department of Microtips, a publication of Minneapolis-Honeywell Regulator Co., Freeport, Illinois.

Potting Transistors

AN EXPERIMENTAL PILOT production setup for potting small batches of point-contact transistors in Tung-Sol's Bloomfield, N. J. plant requires only easily available tools and supplies.

The first step in potting is cutting the tops off No. 1 Lilly gelatin capsules with a heated razor blade. A single-edge blade is heated by placing it on an ordinary electric warming plate. The longer end of the capsule is placed over a brass rod projecting out of a block the desired distance for the encapsulating tube, and the heated razor blade is moved across the top of the rod to slice off the closed end.

Next, the cut sleeve is pushed

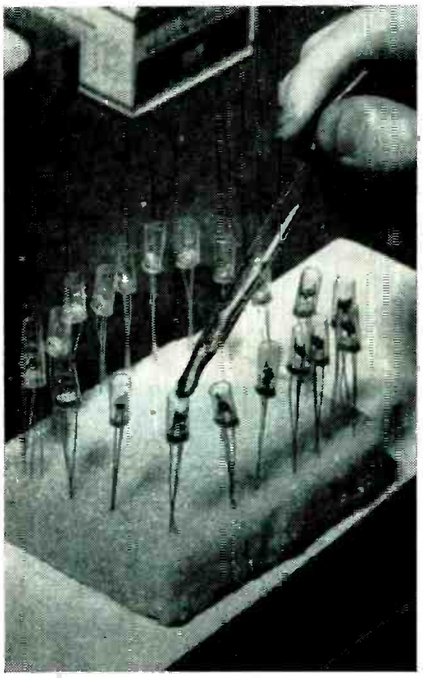


Preparing transistor - encapsulating sleeve by slicing top off pharmaceutical capsule with heated razor blade

Placing sleeve over transistor. Units are stored in foam polystyrene block between operations

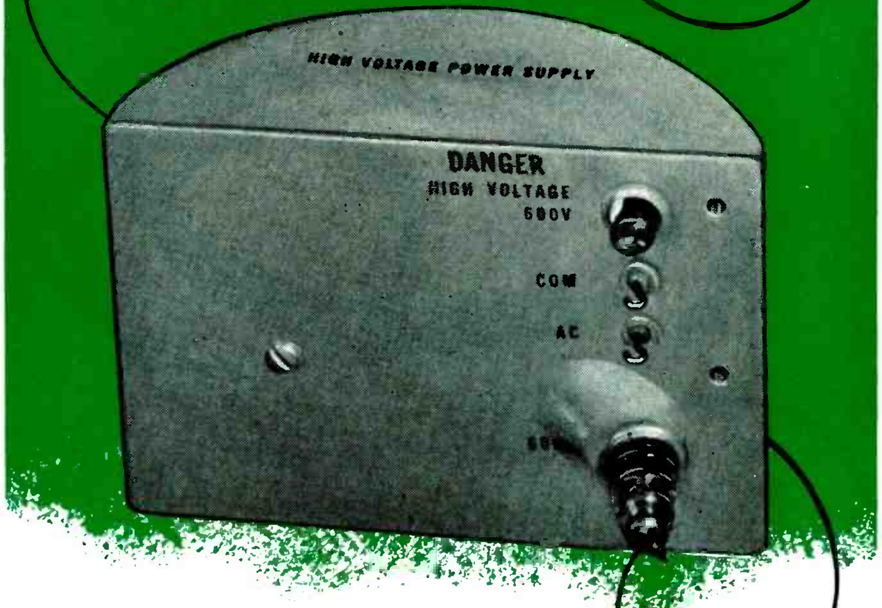
down over the base of the assembled transistor. Styrofoam foam polystyrene blocks are used in place of trays as supports for the transistors before and after this operation. The somewhat flexible transistor leads are easily inserted in this block for holding the units upright and for transporting them.

As the final operation, a medicine dropper is used to fill the sleeves of the transistors with Araldite resin



Using medicine dropper to fill each transistor sleeve with potting resin

FUNCTION-FITTED*
High Voltage



POWER SUPPLY

Eliminating all vacuum tubes, Acme Regulated Power Supplies provide extremely dependable, trouble-free, accurate, most economical service for industrial and laboratory purposes. Regulated by magnetic amplifiers. Such units will give a minimum of 20,000 hours' continuous service. Available in variety of voltages and frequencies. Typical:

Here shown is Type S-730. *Input:* 100-120 v. AC; 380 to 420 cps. *Output:* 6000 v. DC ± 5%, with 100 microampere load; 600 v. DC tap; ripple voltage less than 120 v. peak-to-peak at 100 microampere load. *Temperature Range:* Designed to operate from —55°C to +85° C, and at —55° C at 50,000 ft. altitude. *Potted Unit* which elminates altitude problems inherent in oil-filled designs. This particular unit does not include magnetic amplifier.

* FUNCTION-FITTED TO YOUR NEEDS
Send us your power supply requirements. Acme either has a standard unit that will do, or will design and build a special unit for you. Literature on request.

FUNCTION FITTED

acme ELECTRONICS, INC.
AEROVOX CORPORATION
300 N. Lake Avenue, Pasadena 4, Calif.

HI-Q DIVISION OLEAN, N. Y. | AEROVOX CORPORATION NEW BEDFORD MASS. | WILKOR DIVISION CLEVELAND, OHIO

In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.
Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y. •

Want more information? Use post card on last page.

www.americanradiohistory.com

Cable assemblies?

HHB

CAN MAKE THEM FOR YOU!

Whatever the design, or requirement . . . standard and special, HHB can provide skill and facilities to make cable assemblies to your exact specifications.

Or, if you are a user of connectors and components, including AN Types, RF Types, Rack and Panel Types, and special items, we can help you with your requirements.

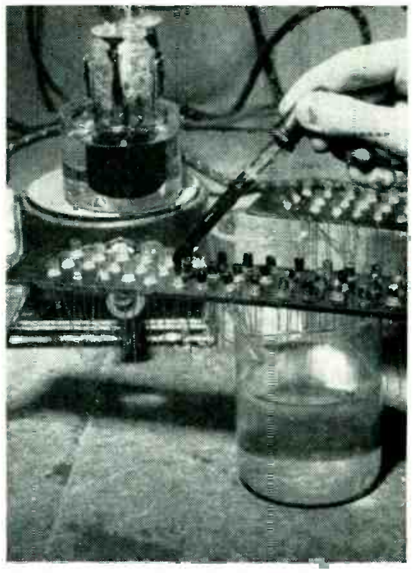
A new HHB catalog is available illustrating many of these outstanding products of HHB craftsmanship. A copy will be mailed to you if requested on your business letterhead.

H. H. BUGGIE And Company

TOLEDO 4, OHIO

Sales Engineers in All Principal Cities

Skilled in Electronic Component Parts
RESEARCH · DESIGN
ENGINEERING
MANUFACTURING



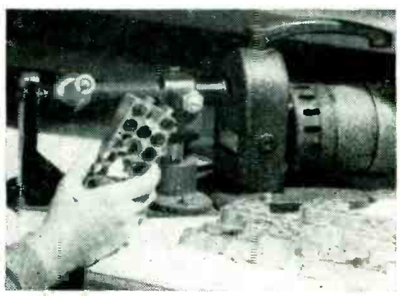
Potting germanium diodes with mixture of resin and lampblack, kept at 120 C with an oil bath on hot plate in background. Beaker in foreground merely serves as support for plastic strip holding diodes

that has been warmed to about 120 C. The sleeve acts as a shell, without dissolving or fusing. The resin is later cured in an oven for about 24 hours at 110 C.

A similar procedure is used for potting special uhf germanium diodes for use up to 1,000 mc as uhf mixers. Coil dope is used here to fasten the sleeve to the glass base, and carbon black is used in the resin. The diodes rest in drilled holes in a strip of sheet plastic for this potting operation.

Checking Threaded Holes

A POWER-DRIVEN thread gage speeds inspection of the magnesium castings that make up the chassis of Raytheon's PRC-6 hand-held f-m transmitter-receiver. Each one of the 36 blind precision-tapped holes



Setup for checking threaded holes in magnesium chassis castings

www.americanradiohistory.com

for 2-56 screws and studs is checked at high speed on this machine. This preliminary inspection minimizes cross threading or jamming and insures that each screw and stud will hold its share of tension.

The operator holds each hole in the chassis in turn against the master screw. This is turned rapidly into the hole by the motor until the screw strikes bottom. Rotation is then automatically reversed and the screw comes out.

Cable Test Sets

ASSEMBLY PROCEDURES recommended by Amphenol for attaching power plugs to multiple-conductor cables involve the use of five different test sets. Two are used for checking insulation resistance on different types of cables, two for applying high-voltage breakdown tests and one for making the final electrical inspection to detect possible short-circuits.

The first insulation resistance checker handles one cable at a time, but has front-panel fittings for three different types of male power

Using insulation resistance test set directly for checking one cable at a time. Operator's hand is on zero-adjust knob. Metal strip at left on panel prevents operator from moving one of the toggle switches accidentally

THE RELIABLE ELECTRONIC MEMORY

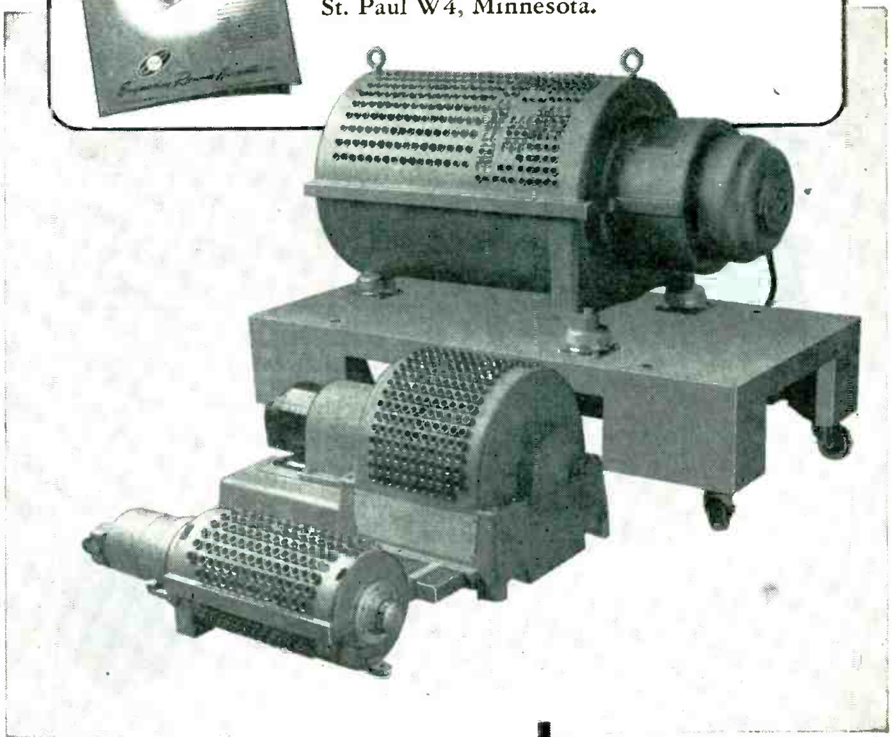
ERA

MAGNETIC DRUM STORAGE SYSTEMS
for Rapid-Access Data Storage

The Magnetic Storage Drum has proved to be the most versatile rapid-access electronic memory yet developed. ERA pioneered the development of these systems. Today, you can select from the family of ERA Magnetic Storage Drums, a model with characteristics best suited to your requirements—without the necessity of costly special development. ERA Magnetic Drum Memory Systems provide *all* of these features:

- **LARGE STORAGE CAPACITY** allows a recorded density as high as 2200 binary digits per square inch.
- **HIGH SPEED** of associated equipment permits storage or reading of data at rates up to 125,000 digit-groups per second.
- **CONTINUED RE-USE** of recording surface—recording heads are not in contact with drum surface and no wear occurs.
- **NON-VOLATILE STORAGE** means stored information is unaffected in the event of power failure.

Send us your requirement. Write on your business letterhead to: Engineering Research Associates Division of Remington Rand Inc., 1902 West Minnehaha Avenue, St. Paul W4, Minnesota.



Engineering Research Associates | Division of Remington Rand INC

1902 West Minnehaha Avenue, Dept. E-14, St. Paul W4, Minnesota

DIGITAL COMPUTERS . . . DATA-HANDLING SYSTEMS . . . MAGNETIC STORAGE SYSTEMS . . . INSTRUMENTS . . . ANALOG MAGNETIC RECORDING SYSTEMS . . . COMPUTING SERVICE

www.americanradiohistory.com

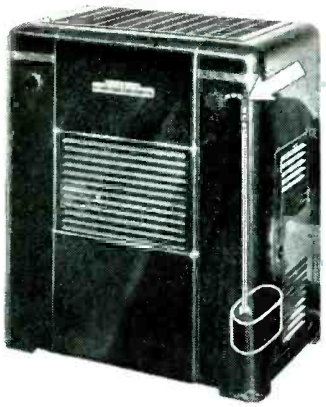
THE PROBLEM

TO PROVIDE A CONVENIENTLY OPERATED CONTROL

The designer of a cabinet type oil heater had to provide a manual control for an oil and air metering valve which was placed at the bottom of the unit. He wanted to place the control knob on the front of the heater where it could be easily seen and operated. To do this meant bringing the control linkage around a 90° turn. To solve the problem, he chose

THE LOW-COST SOLUTION

AN S.S.WHITE REMOTE CONTROL FLEXIBLE SHAFT



In this way he was able to connect the control dial to a rod running to the valve with a single part which did not require alignment and could be installed in a minimum amount of time. **The net result was impressive savings in assembly and manufacturing costs,** advantages that most designers gain when they use S.S.White flexible shafts to solve their remote control problems.

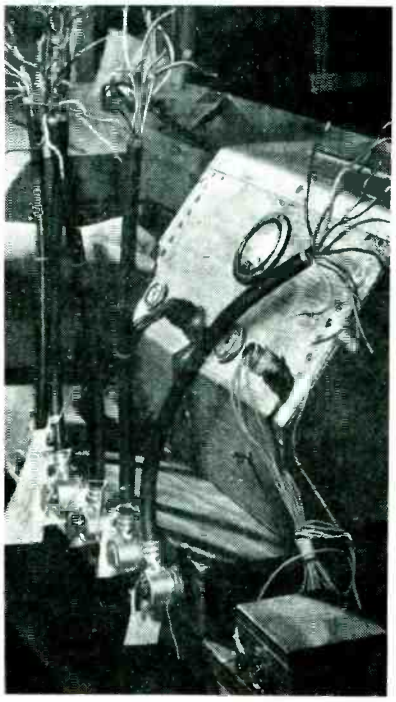
Get These Flexible Shaft Facts

This 256-page flexible shaft handbook, containing full facts on flexible shaft selection and application will be sent free if you write us direct on your business letterhead.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. E, 10 East 40th St.
NEW YORK 16, N. Y.
Western District Office • Times Building, Long Beach, California

Method of using insulation resistance test set with adapter (in box underneath) for checking five cables at a time

plugs and one female connector. The test set is essentially a high-range ohmmeter with the meter scale calibrated to read from 0 to 5,000 megohms. A zero-adjust switch on the right side of the panel is readjusted for each cable to compensate for drift in the test circuit. The test here is made between the outer metal housing of the plug and all cable leads shorted together; this reveals in one measurement the lowest leakage resistance value between any of the conductors and



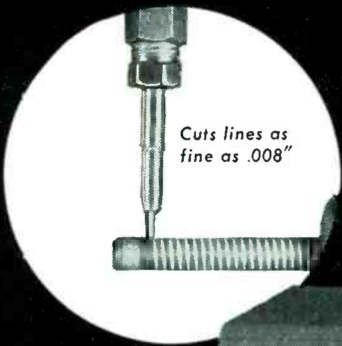
High-voltage cable breakdown test set employing snap-action switches as conductor selectors. Operator is pressing the tiny projecting button that actuates one of these switches the plug housing. Shorting of leads is done by the sockets mounted on the front panel of the test set.

Another type of insulation resistance set uses the same basic ohmmeter in combination with an adapter for checking five paralleled cables simultaneously. Sockets for these cables are mounted on the front of the adapter and the measurement is made between the five paralleled plug housings and the five sets of paralleled conductors. A special cable, fitting into the male socket on the test set, makes connections to the adapter. A logarithmic meter scale reading from 0.1 to 10,000 megohms is used on this test set.

Five identical cables can be checked simultaneously on each of the high-voltage breakdown test sets. Here again, standardized test sets are employed in conjunction with easily interchangeable adapter boxes, each of which accommodates a different type of cable plug.

The first type of high-voltage test set has fourteen tiny buttons projecting through holes in its panel. Each button actuates a snap-action switch for applying the test voltage between one individual conductor and the plug housing. After this, the operator presses different combinations of two buttons at a time, in an attempt to break down the cable between different pairs of conductors. The operator watches the meter as she manipulates the switches; any lowering of the meter reading indicates a defect in the cable. The operator then has to pull out the cable plugs one at a

Improved version of high-voltage test set, having ten circuit-switching buttons and hence less flexibility



IT MAKES THE IMPOSSIBLE JOBS ...easy!

It has been demonstrated that the "Airbrasive" Unit will do jobs that are impossible to accomplish by previously known methods. What is your problem?

THE S.S.White INDUSTRIAL "AIRBRASIVE" UNIT

THE S.S.WHITE Industrial "Airbrasive" Unit provides a fast, accurate and low-cost way to handle those tough, high precision jobs that are either impossible or impractical to do by conventional methods. For instance, it will:

- Cut germanium or other hard, brittle materials.
- Cut and shape fragile crystals.
- "Trim" surface coatings on printed circuits without harming the base material.
- Remove oxidation from circuits printed by the copper etch method.
- Produce fine matte finishes on metal and glass.
- Cut calibration marks on precision glassware.
- Do light deburring.
- Drill thin sections of glass and other material.
- Cut spiral bands on deposited carbon resistors.

The secret of the "Airbrasive" Unit's amazing precision and versatility is its unique principle of cutting by means of a high speed gas propelled stream of abrasive particles. The stream, which is directed at the work through a tiny orifice, produces a cool, shockless and controllable cutting effect which can be held to extremely close tolerances.

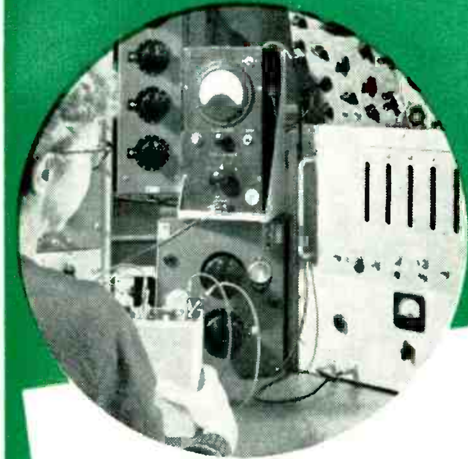
We'll be glad to conduct tests on samples of any material or parts you have and advise you as to the suitability of the "Airbrasive" cutting process for your needs. Write today. For full details...

WRITE FOR BULLETIN 5307. *It provides a comprehensive outline of the many ways in which the Industrial "Airbrasive" Unit can be used. Send for a copy.*

THE S.S.White DENTAL MFG. CO. INDUSTRIAL DIVISION
Dept. EB 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.

FILTERS



to assure your product's performance Lenkurt tests them mesh by mesh

When you guarantee your product's performance—you are guaranteeing the components it contains. That's why the confidence you can have in LENKURT FILTERS is so important. Lenkurt uses laboratory care even in mass production quantities.

Typical of Lenkurt's extra care is the well engineered procedure for testing both filter meshes and final assemblies. Each mesh of a Lenkurt filter is tested for frequency response, effective a.c. resistance and other significant requirements. The frequency sources used are accurate within ±1 cycle. Lenkurt's testing techniques are direct reading to cut testing time and eliminate sources of human error. Their efficiency makes possible the uniform adherence to any feasible specification you request.

Lenkurt's efficient testing techniques were the subject of an article in Electronics Magazine, April 1953. Reprint copies are furnished on request. Write today for further information.

Lenkurt

LENKURT ELECTRIC SALES CO.
SAN CARLOS 1, CALIFORNIA

Operator matches corresponding pairs of conductors with this test set to check for short-circuits in cables at final electrical inspection station

time to determine which one is guilty, since the high voltage is applied to corresponding leads of all five cables simultaneously.

A more modern version of this test set employs ten conventional pushbuttons of the doorbell type, with a 500-volt full-scale meter and a neon lamp above the meter to provide additional visual indication. A batch of five cables can be tested in about two minutes with this test set, including the time for attaching and removing the five plugs.

Even though cables pass the insulation resistance and breakdown tests, they can still have shorts between wires. These shorts are revealed in the final electrical tests, using a test set that checks two cables at a time. The cable plugs are attached to the sockets at the front of the test set. The operator then matches corresponding colors of leads at the other ends of the cables and touches the strip ends together momentarily. A buzzer sounds to indicate a short.

The foregoing procedure is abstracted from a booklet, "OK Methods", available from American Phenolic Corp., Chicago 50, Ill.

Soldering Flexible Braid

IN ORDER TO SOLDER a highly flexible metal conductor to the moving armature of an aircraft relay without having the solder creep up into the braid and stiffen it, a soldering technique involving the use of a

Method of using resistance-soldering unit to heat relay armature terminal for critical soldering operation

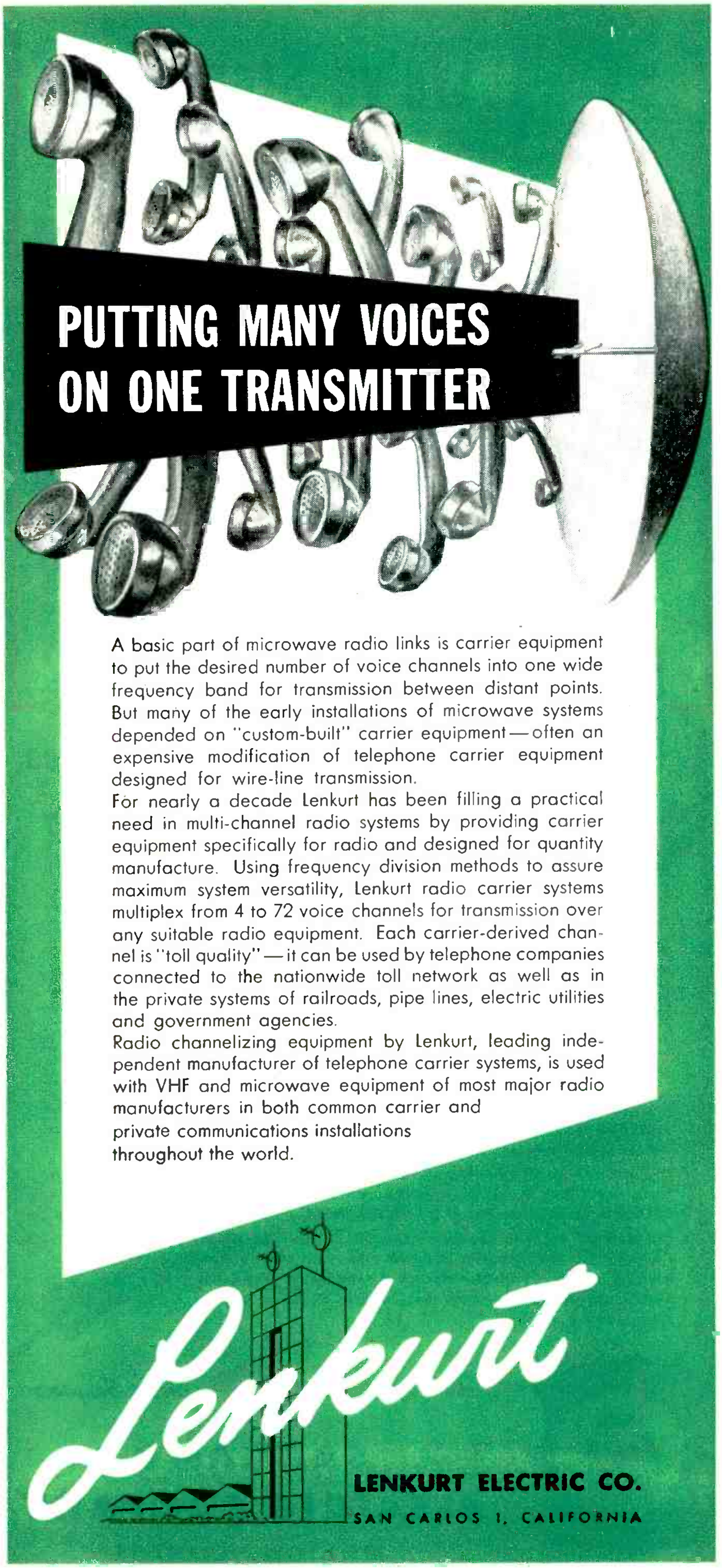
Wassco 450-watt Glo-Melt soldering unit was developed by Phillips Control Corp., San Juan, Puerto Rico.

The metal braid is looped through the terminal hole in the armature and then crimped around the opposite side of this terminal, so that the end of the braid is distinctly separate from the point where the braid enters the terminal.

The operator next holds the armature terminal against the carbon electrodes of the soldering unit to heat it up, then applies 0.020-inch diameter 60/40 rosin-core solder carefully to the end of the braid. This gives a good joint without impairing the flexibility of the connection and minimizes breakage at the solder joint.

The soldering unit uses carbon electrodes having copper shells. Strapping on the front panel under the electrodes is used in conjunction with an output voltage control on the front panel to give three different electrode voltage ranges: 0.1–1.5 v; 1.8–4 v; 2.5–5.4 v.

The same setup is used for soldering silver contacts to the relay

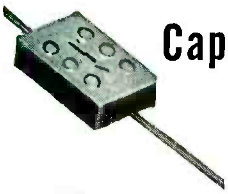


Want more information? Use post card on last page.

www.americanradiohistory.com

We've Stepped-up Production!

NOW Sangamo HUMIDITITE* Mica Capacitors are available in Quantity



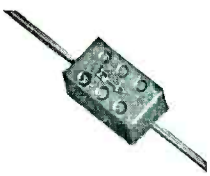
When Sangamo HUMIDITITE Molded Mica Capacitors were first put on the market, the great interest shown in these remarkably moisture resistant capacitors far exceeded our expectations. We have increased our manufacturing facilities and our production capacity . . . initial demands have been met . . . and we can now handle quantity orders for Humiditite Micas with full assurance that delivery requirements will be met.

*what is HUMIDITITE?

Humiditite is the very effective new plastic molding compound, developed by Sangamo, that gives Sangamo Mica Capacitors moisture resistance properties far superior to any others on the market.

Sangamo Humiditite Micas, under the standard moisture resistance tests described in MIL-C-5A (proposed) Specification, tested in excess of 50,000 megohms—more than 500 times the specification requirements.

Humiditite is just another example of the advanced engineering that enables Sangamo to meet the existing and future needs of the electronic industry. For additional information about HUMIDITITE, write for Engineering Bulletin No. TS-111.



Those who know... SANGAMO choose Sangamo

The Little Indian

SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

SC 53-9

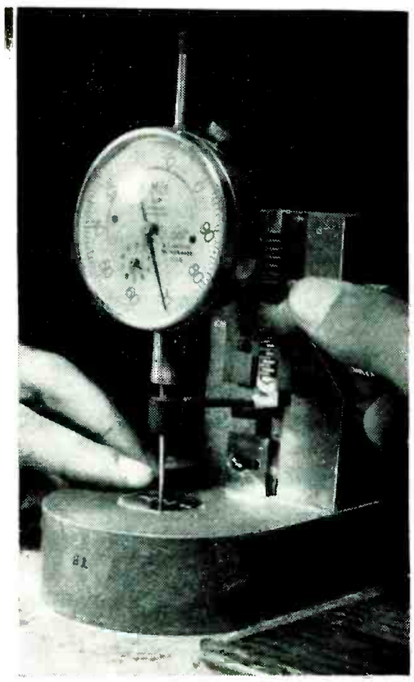
contact blades, except that here solder preforms are used in place of spooled solder.

Checking Hole Diameters in Mica Punchings

SAMPLING INSPECTION of punched mica spacers for vacuum tubes is facilitated through use of a rack and gear arrangement for quickly raising the spindle of the micrometer. The operator first sets the gage to zero when the spindle is resting on the unpunched surface, then allows the precisely tapered spindle to drop into the hole being gaged. Readings of tolerance limits are expressed in terms of dial readings on this setup, so that pieces outside of tolerance are detected directly.

The micrometer gage employed, made by B. C. Ames Co., Waltham, Mass., serves to check hole sizes to tenths of thousandths of an inch when used in this manner in the Rio Piedras, Puerto Rico plant of Sylvania Electric of P. R. Inc. The indicator is rigidly attached to the upright part of the metal fixture.

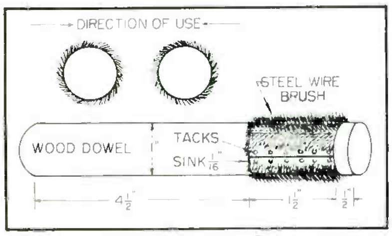
Also on this upright part is mounted a small gear and a slide for a corresponding rack. Turning



Operator here is rotating knurled knob clockwise with right hand to lower spindle, for gaging diameter of center hole in mica spacer a knurled knob counterclockwise moves the rack up, thereby raising the spindle for shifting the mica to a new hole or for testing the next piece. Rotating the knob clockwise allows the spindle to drop by gravity for gaging a hole. The lowering arm clears the spindle as soon as the spindle encounters resistance, hence does not affect the accuracy of readings.

Comb for Braided Shield

A USEFUL tool for combing out the braided strands of shielded cable, suggested by engineers at Navy



Suggested tool for combing metal braid into parallel strands

Yard Norfolk, is easily made from a strip of steel wire brush taken from a file brush. This brush is wrapped around a 6-inch length of 1-inch wood dowel, then glued and tacked in position as shown in the diagram.

The steel wire strip should be wrapped so that the direction of the wire ends is in the direction of the expected use. This is essential so the teeth of the comb will dig into and pull out the strands on the braided shields, in preparation for making a connection to the braid.

Heat Treatment for Nylon Molded Parts

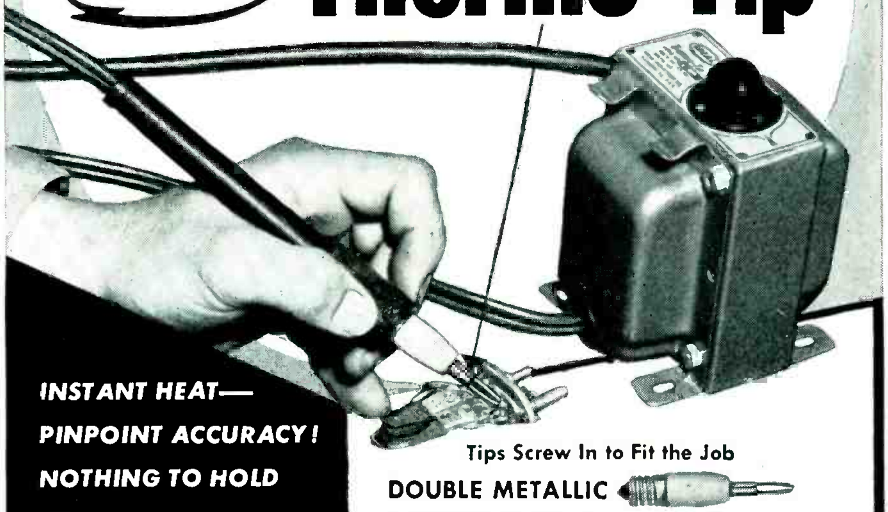
DIMENSIONAL changes subsequent to the molding of electronic components from nylon can be prevented by heat-treating soon after molding, to relieve residual stresses. The process involves immersion in a heat-transfer medium at 350 F. A suitable medium for the purpose is Glycowax S-932, made by Glyco Products Co., 26 Court St., Brooklyn 2, N. Y. This is available in convenient flake form, melts at about 150 F, and has the required high

Now a NEW

"Pencil Point" SOLDERING TOOL

FOR SMALL OR MINIATURE WORK

IDEAL Thermo-Tip



INSTANT HEAT—
PINPOINT ACCURACY!
NOTHING TO HOLD
BUT AN ELECTRODE
"PENCIL"

Tips Screw In to Fit the Job

DOUBLE METALLIC
DOUBLE CARBON

Other Tips Available

Pencil-Thin

FOR EASIER, FASTER SOLDERING OF:

- Electronic Circuits and Parts
- Aircraft Connectors
- Pin Type Plugs
- Wire-to-Wire
- Terminals
- Radio and TV Chassis
- Instruments
- Printed Circuits

Here is an all-new production tool expressly designed to make small and miniature soldering simpler and surer than ever before. It is so fast that some joints can now be soldered in less than 1 second! . . . so much lighter and easier to handle than soldering irons or guns that a woman can use it all day long without fatigue! Check this unique combination of features against your job requirements:

GETS INTO SMALL, TIGHT SPOTS because of smaller electrode pencil.

NO HEAT DAMAGE—instant resistance heating makes sound joints before resistors, condensers, printed circuits, terminal fibre, etc., can be damaged. Pinpoints the heat!

NO "COLD FLOW JOINTS"—resistance principle *requires* that metal be heated before the solder will flow. Tap switch adjust heat as needed.
SAFE—soldering pencil uses harmless (6v) voltage and high amperage from separate step-down transformer.

LESS FIRE HAZARD—electrodes are hot only when in use.

LESS REPLACEMENT COST—only low cost electrodes to buy.

SOLD THROUGH LEADING DISTRIBUTORS

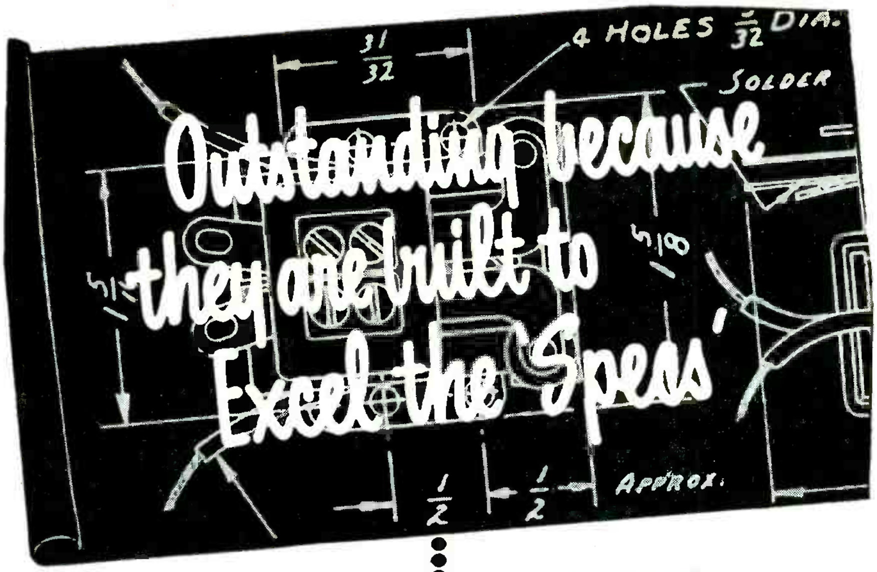
TIPS FOR EVERY SMALL JOB —2 sizes of double carbon, single carbon with ground clamp, double metallic. May also BE USED AS SOLDERING IRON —two sizes of chisel tip irons.

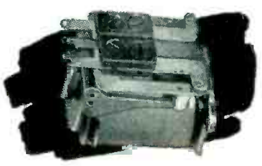
MAIL FOR FURTHER DATA

IDEAL INDUSTRIES, Inc.
1055 Park Avenue, Sycamore, Illinois
Please send catalog data on NEW IDEAL THERMO-TIP.
NAME..........
COMPANY..........
CITY.......... ZONE.... STATE..........
ADDRESS..........

Want more information? Use post card on last page.

www.americanradiohistory.com





R 45 SERIES—Small telephone type relay with pin hinge construction. Available with multiple contact springs up to six pole double-throw. Capacities: 1 amp., 3 amp., or 5 amp. Normally supplied for D.C. operation. Hermetically sealed or open. 1-13/32x1-1/4x1-7/32 to 1-5/8 high.

R 83 SERIES—Available with A.C. or D.C. coils. Contact ratings up to 30 amperes continuous, 150 amperes inrush with single pole double-break arrangement. Multiple contact springs with proportionately lower ratings also available. Size: 1-7/8x1-5/16x1-5/8 high.

R 94 SERIES—Hermetically sealed small telephone type relay with pin hinge construction for long life. Available in D.C. only with contact springs up to 4 pole double-throw. In 1 amp., 3 amp., or 5 amp. capacity. Plug-in or solder terminals. Overall size 1-5/8 x 1-1/32 x 2-1/4 D.

RB 45 SERIES—Similar to R 45 with the exception that it is designed to fit the hermetically sealed enclosure shown. Three stud mounting; solder terminals. Available up to 4 pole double-throw. Widely used in aircraft and ground communication equipment. Size: 1-5/8 x 1-7/16x2-1/32 D.

"Diamond Quality" TIME SWITCHES...

Automatic Electric also produces a complete line of Time Switches and Timers, both manual and automatic reset. Write for information.

AEMCO

Automatic Electric MFG. CO.

62 STATE STREET MANKATO, MINN.

smoke point of about 500 F. Standard immersion time is 30 minutes. Small items can be treated in wire baskets fitted with lids to prevent the nylon parts from floating to the surface. Where wall thickness is under ⅛ inch, ten minutes are adequate for immersion.

After immersion, the basket is removed and allowed to drain. The wax gives good run-off so that only a very thin film remains on the nylon parts. Parts are then placed in a corrugated cardboard box away from a draft for cooling.

Although removal of the residual wax is usually unnecessary, it can be done easily by placing the cool parts in the basket again and immersing for one minute in boiling water. The wax then floats to the surface and can be skimmed or drawn off.

Simple Chassis Support for Radar Subassembly

Inspection of finished unit supported in simple chassis holder

AN INEXPENSIVE adjustable chassis support made entirely from wood is used throughout the Coamo, Puerto Rico plant of the Caribe Aircraft Radio Corp. for supporting the chassis of a military radar subassembly during assembly of parts, soldering and inspection. End supports cut from ¾-inch plywood are nailed to wood spreader strips to form the base, and similar wood strips form the frame in which the chassis is placed.

Preliminary routing of frame strips on a circular saw before cutting and nailing gives a recess in which the chassis rests without dropping through the frame. Wood

Want more information? Use post card on last page.

www.americanradiohistory.com

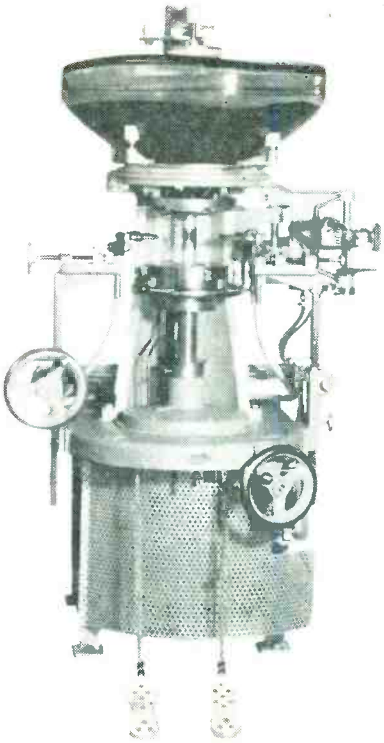
dowels set into the ends of the frames serve as pivots. A bolt through one of the vertical side supports serves to lock the frame in the optimum position for convenient work.

Neck Cutter and Slicer Salvages Picture Tubes

A SINGLE combination neck cutting and neck splicing machine developed by Kahle Engineering Co. of North Bergen, N. J., will salvage 24-inch, 27-inch, 30-inch, 33-inch and larger cathode-ray picture tubes with one handling of the bulb. Rejected tubes can then be easily repaired and returned to the assembly line.

Neck cutting is performed by the hot-chill method, producing a clean, square cut. The cutoff mechanism is adjustable up and down.

Neck splicing incorporates an upper centering chuck which automatically lines up the bulb if part of the neck remains. The lower centering chuck moves up and down as required for splicing on a new length of neck. The splicing fires are likewise movable up and down as well as in and out under control of a foot pedal. A special hold-down



Machine for putting new neck on rejected picture tubes ranging up to 33 inch in size and even larger

rugged

Under all conditions, the delicate mechanisms of Kollsman products must function with accuracy and rugged dependability.

- AIRCRAFT INSTRUMENTS AND CONTROLS
- OPTICAL PARTS AND DEVICES
- MINIATURE AC MOTORS
- RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT

Current production is largely destined for our defense forces; but our research facilities, our skills and talents, are available to scientists seeking solutions to instrumentation and control problems.

kollsman INSTRUMENT CORP.

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA • SUBSIDIARY OF Standard COIL PRODUCTS CO., INC.

Want more information? Use post card on last page.

www.americanradiohistory.com

Users and prospective buyers of Magnet Wire may expect from Wheeler a technical service that gets right to the heart of their problems . . . for radio, electronics, television or other applications. Since 1909, we've accumulated a wealth of practical experience that has been of considerable value to manufacturers in these fields.

From our initial operation of drawing electrolytic copper "rod" down to finished wire in sizes from AWG #22 to #50 . . . through our automatic Formvar and other insulating machines . . . high speed enameling production lines . . . or textile yarn wire covering machines . . . there's no let-up on testing and inspection to insure top quality of product.

Wheeler engineers and representatives are competent, friendly and willing cooperators.

THESE DATA SHEETS
SHOULD SOLVE YOUR PROBLEM!

Tell us about your Magnet Wire problem. Wheeler engineers will send you this file folder (which tells you about our plant and its facilities) and include data referring to your inquiry. No charge, of course.

SERVICE QUALITY WHEELER DEPENDABILITY

WHEELER

MAGNET WIRE
COILS
COMMUNICATIONS EQUIPMENT
TRANSFORMERS

MAKES THESE PRODUCTS A *Specialty*

THE WHEELER INSULATED WIRE COMPANY, INC.
Division of The Sperry Corp. • 1101 EAST AURORA ST., WATERBURY 20, CONN.

attachment is provided for use when the neck is gone entirely.

Gun sealing may be accomplished with a special gun-mount pin available for this purpose with the machine.

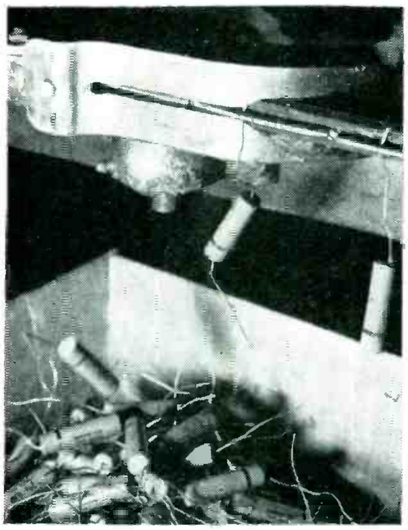
Dipping Capacitors in Wax

A SPIRAL spring fastened to a conventional flanged-pulley drive belt serves as the conveyor line for giving finished paper capacitors their final sealing bath in molten beeswax, in one production setup used at Pyramid Electric Co. Two operators load the belt by pushing capacitor leads between the turns of the spring. The spring is fastened to the belt approximately every four inches with wood screws to keep the turns sufficiently tight so units do not fall off as they go around the bend and into the tank.

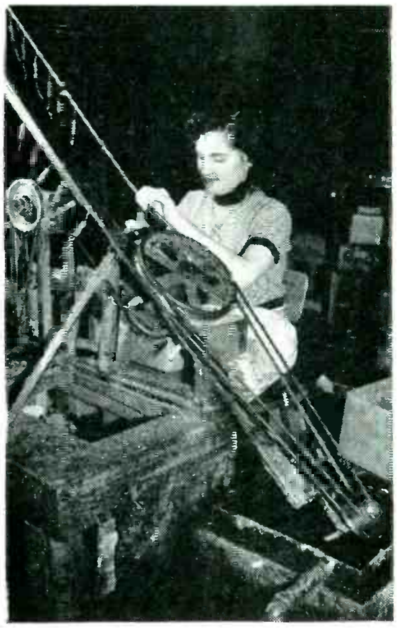
Just before the first loading position is an automatic unloader resembling the claws of a carpenter's hammer. This pushes the leads out from between the turns as the spring travels through the slot, allowing the waxed units to drop into a carton below.

Another type of machine used for the same purpose in this plant has solid round leather belts in place of springs. Loading is done by bending one lead of each capacitor in turn around the leather belt. Unloading simply involves pulling the

Wax-dipping machine using coil spring attached to rubber V-belt. Operators are loading belt by pressing one lead of each capacitor between turns of the spring. Length of belt is sufficient for wax to harden before units are knocked off automatically units off individually or in handfuls. Though equally effective, this machine involves placing one additional bend in leads that are already badly out of shape.



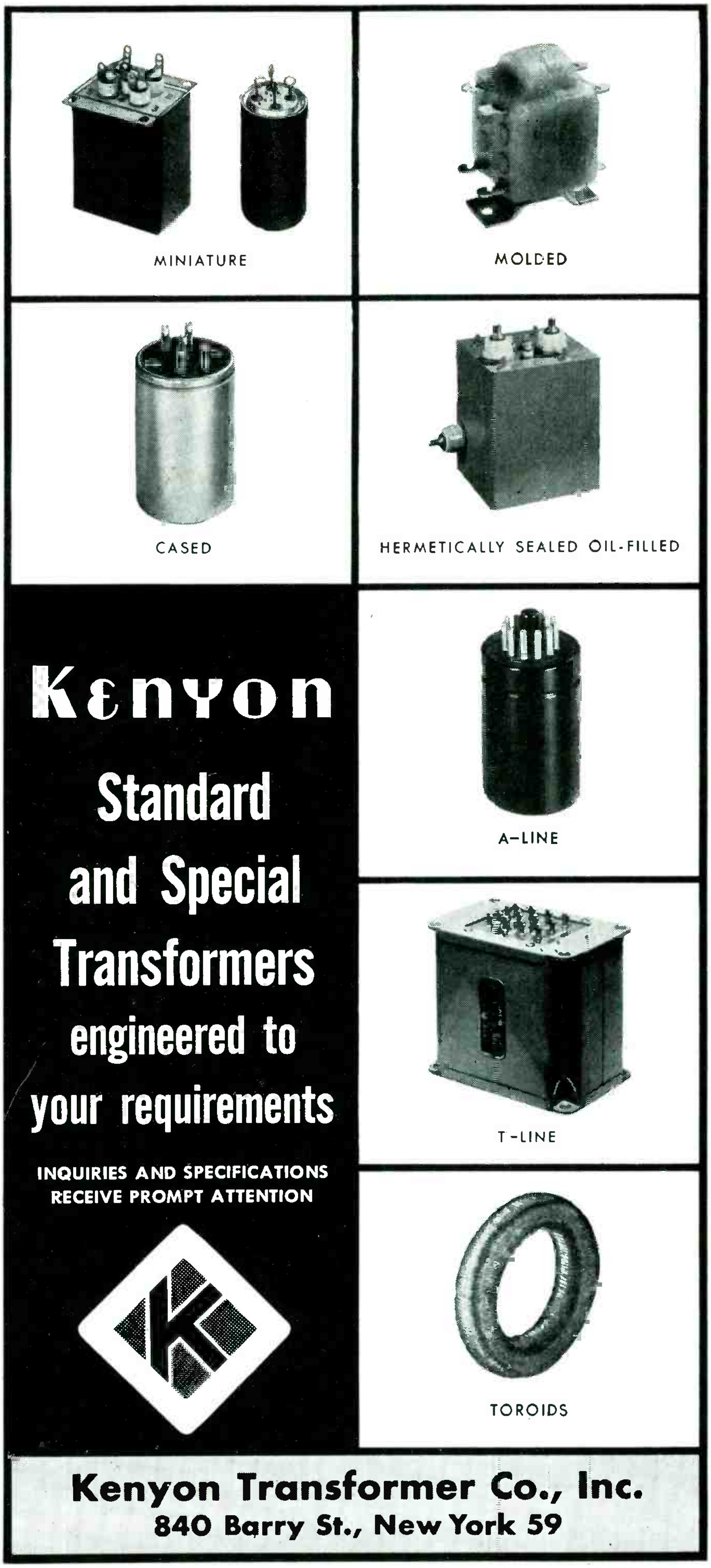
Claw-type device for removing dipped capacitors from coil spring as the spring moves from right to left through the claws



Leather-belt conveyor arrangement for dipping paper capacitors into beeswax in heated tank at lower right

Surge Comparison Tester

TURNS ratios and other characteristics of magnetic-amplifier coils and windings of rotating machines are checked precisely with a cathode-ray instrument known as the Westinghouse surge comparison tester, in the Paterson, N. J., plant

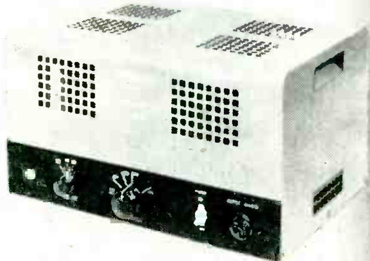


www.americanradiohistory.com

ADVANCED ELECTRONIC DESIGNS . . . by AVION

FREQUENCY CONVERTER—MODEL 400

A 400-CYCLE POWER SUPPLY BENCH SIZE



- Plugs into 60-cycle line
- Delivers 100 volt-amperes
- Output frequency and amplitude adjustable through entire AN-E-19 Range: 380-420 cps 105-130 volts

Frequency Regulation: Better than ±1 cps
Voltage Regulation: Better than ±1%
Harmonic Distortion: Total better than 3%
Independent of power factor

The small size (17″ long x 11½″ wide x 9″ high), power output (100 V-A), and low cost afford the convenience of using one converter for each bench set-up. Four hundred cycle power handling capacity need be paid for only as required.

PRECISION VOLTAGE REGULATOR—MODEL 116
400-CYCLE

- Regulation: ±0.01% for 0 to 50 VA load variation
  ±0.02% for 0 to 100 VA load variation
  (When output set to center of ±10% input voltage variation)
- Developed harmonics: better than 1%
- Transient time constant: better than 0.01 seconds

Low harmonic distortion and low transient time constant result from the use of a push-pull feedback amplifier in the output. These features, together with the unusually high regulation, suggest the superiority of the Model 116 as compared with ordinary 400-cycle regulators.

Send for complete data on these Avion products

OTHER AVION PRODUCTS
Altitude & Air Speed Control Units • Electronic Choppers • Electronic Inverters
Magnetic Memory Systems • Miniature Plug-In Amplifier Units • Miniature Precision Potentiometers
Multron • Power Supplies • Replaceable Subminiature Amplifier Assemblies • Signal Generators

AVION INSTRUMENT CORP.
Division of American Car and Foundry Company
299 Highway No. 17 • Paramus, New Jersey

EXPORT REPRESENTATIVE: Rocke International Corp., 13 E. 40th Street, New York 16, N. Y.
Cables: "ARLAB" New York • All Codes
CANADIAN REPRESENTATIVE: Aeromotive Engineering Products,
5257 Queen Mary Road, Montreal, Que.

Checking windings with surge comparison tester. Similar setup is used for magnetic amplifiers

of Bogue Electric Mfg. Co.

One method of use involves applying a voltage stress between turns of a coil, between phases, between two electrically similar windings or between a winding and ground. The windings are stressed by the application of a repetitive surge voltage in opposite directions. If a short-circuit, an improper connection, a reversed coil or a ground exists in one half of the centertapped winding but not in the other half, the difference in impedance in the windings causes two different traces to be observed on the oscilloscope. If the windings are identical, the resulting traces will coincide.

Tests are made quickly and easily on singe-phase or polyphase stator or rotor windings as well as on coils and transformers.

Cabinet Inspection

A 90-percent reduction in the number of rejected units out of television cabinet and paint shops followed the introduction of female inspectors in this department of

Want more information? Use post card on last page.

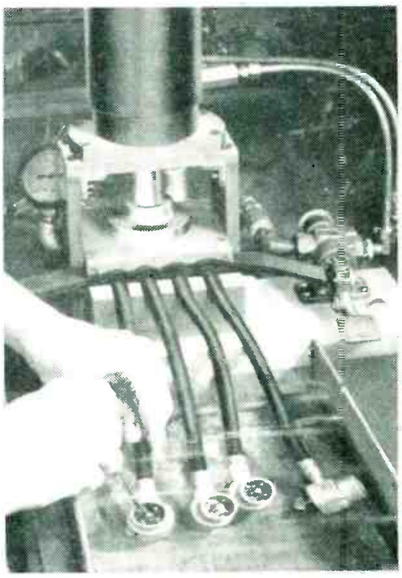
National Electronics Mfg. Co., makers of Natalie Kalmus tv sets. The women proved to have a finer eye for the detection of minute flaws and blemishes.

Water Test for Cables

AFTER ASSEMBLY of Amphenol power plugs on the ends of multiple-conductor cables, it is often essential to test the water-tight seal by actual immersion.

One recommended procedure involves submerging the connector along with the length of cable in a trough of water. The open ends of the cable are fastened to an air fixture that permits applying 30 pounds of pressure. Bubbles emerging from the connector or cable under water reveal the location of a leak that must be eliminated.

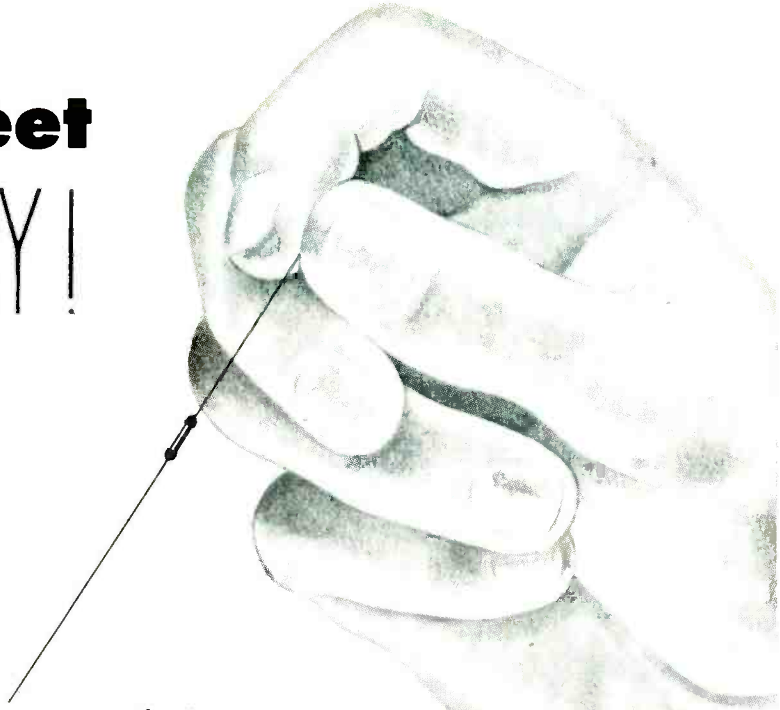
In one test setup, an air cylinder is used to press sponge rubber strips over the tops of the cables, so as to press the cables tightly against the walls of the metal grooves in which they have been placed. The arrangement is such that cables project into an airtight chamber when the cylinder is down. Operation of the hand valve that brings the cylinder down also serves to admit air into this chamber, from which it is forced out between the conductors of the cable. A pressure gage is attached to read the pressure in the chamber; a



Setup for using single air cylinder to check power plugs on cables at air pressures up to 30 lb per sq in. while plugs are under water

meet

TINY!



the *Electra* deposited carbon "TRANSISTOR" RESISTOR

- Wattage—1/8
- Length of body—9/32″
- Diameter of body—5/64″
- Resistance Range 4 ohms—250K ohms
- Accuracy ±1%
- Maximum Rated Voltage—250

These are the key specifications of "TINY" the No. DC-1/8 Deposited Carbon Resistor *made only by* Electra. It is especially adapted to all miniature requirements and like all Electra resistors, offers these advantages:

STABILITY! You can depend on Electra Carbon-Coat Resistors. You get maximum stability regardless of resistance value tolerance. Order ±1%, ±5% or ±10% — all are equally stable.

ECONOMY! When you specify stability, accuracy and small physical size, Electra Carbon-Coat Resistors are your most economical buy.

Electra Deposited Carbon Resistors are available in nine sizes from 1/8 watt to 2 watts; in resistance ranges from 2 ohms to 50 Megohms; in resistance value tolerances of ±1%, ±2%, ±5%, ±10%; in hermetically sealed types as well as standard.

For complete data write us today.

MAIL THIS COUPON TODAY!

Electra carbon-coat PRECISION RESISTORS

ELECTRA MFG. COMPANY
2537 Madison • Kansas City 8, Mo.
Please send Bulletin E-4 giving complete specifications and characteristics of Electra Carbon-Coat Resistors.

NAME ....

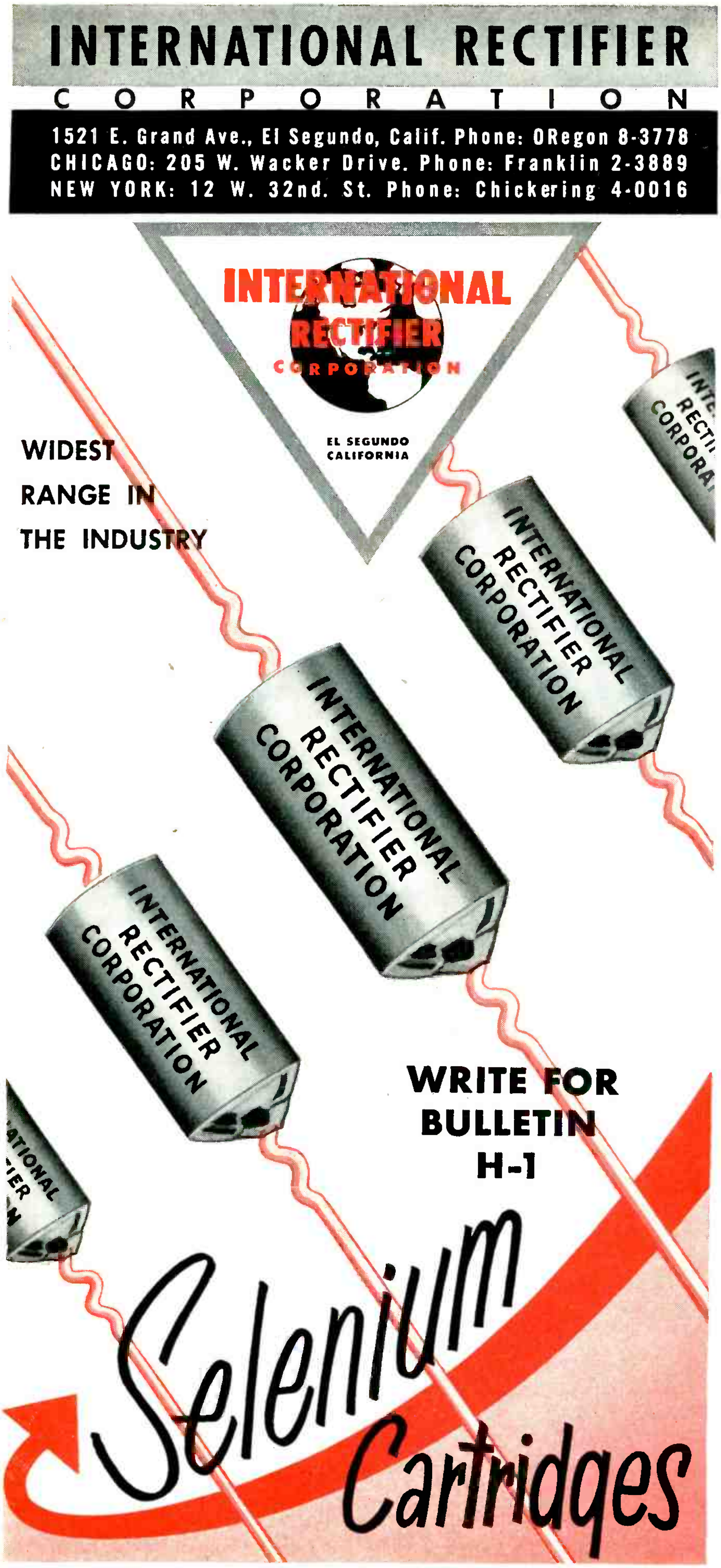
COMPANY ....

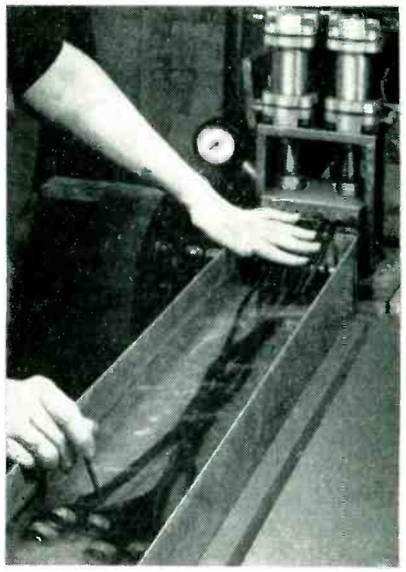
ADDRESS ....

CITY .... STATE ....

Want more information? Use post card on last page.

www.americanradiohistory.com





Setup using two air cylinders and longer trough for checking submerged cables for air leaks

typical test pressure is 30 lb per sq in.

In another setup, used for testing six smaller but longer cables simultaneously for leaks, two air cylinders are arranged to act on opposite ends of the same trough. Again, sponge rubber is used to eliminate air leaks from the chamber.

Inspecting and Vacuum-Cleaning Punched Mica Parts

TINY PUNCHED MICA insulators and spacers for subminiature tubes are automatically fed through a vacuum-cleaning arrangement and spread out so they slide down a glossy white table for inspection, in an arrangement recently installed in the Rio Piedras, Puerto Rico plant of Sylvania Electric of P. R. Inc.

Boxes of punched parts coming from the punchpress department are dumped into the bowl of a Syntron Vibra-Flow feeder, the speed of which is controlled with a knob on an associated Syntron electric controller. The feeder produces a steady flow of punchings down a metal slide and then across a wire mesh positioned under the mouth of a vacuum-cleaner pipe. Loose flakes of mica are sucked up the pipe by the vacuum, and small particles drop through the screen.

Complete punched parts travel

down the screen onto a smooth white slide mounted on a Peeco vibrator feeder. An operator watches the parts as they slide down, and with her fingers pushes off any that are incomplete or otherwise defective. The cleaning screen is attached to the vibrating inspection table to provide vibration needed to make the parts slide down the screen at the slight angle employed. The vacuum source for cleaning is an ordinary Lewyt vacuum cleaner.

Arrangement used for cleaning and inspecting tiny punched mica parts. Vacuum cleaner under bench is connected to flared metal outlet over screen with thin metal tubing

Fabricating Technique for Foil-Clad Laminates

FABRICATION of the metal-clad plastic sheets employed in printed or etched circuits can generally be done with the same machinery and methods used for plastic sheets without foil. Shearing and sawing offer no additional complications. With progressive piercing and blanking dies, special care must be taken in die design, so that the stripper plate will prevent any lifting of the foil as punches are withdrawn.

When drilling a foil-clad laminate, drills should be sharpened with a negative rake similar to that used when drilling aluminum. This rake prevents the drill from catching the foil and lifting it away from the laminate when holes are drilled through a narrow line of metal or at the termination of a line.

The toughest production problem is rapid punching in exact register

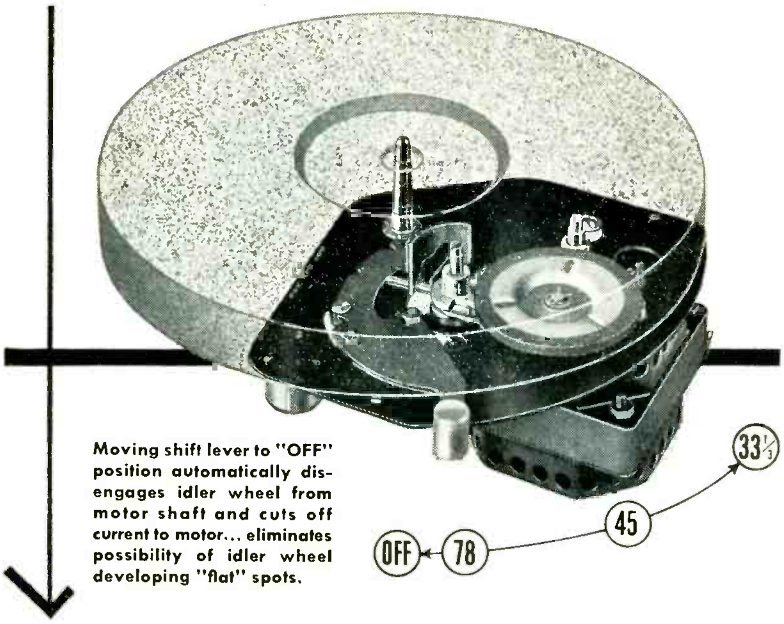
Want more information? Use post card on last page.

www.americanradiohistory.com

NOW...

a three-speed phonomotor designed for

HIGH-FIDELITY REPRODUCTION...



General Industries

MODEL DSS (4-pole) PHONOMOTOR

Here's a three-speed phonomotor that was designed expressly to meet the requirements of high-fidelity reproduction. From its dependable, heavy-duty 4-pole motor to its unique step-shaft speed change mechanism, this new GI Model DSS Phonomotor represents the ultimate in phonomotor engineering, design and construction.

Specifications, quantity price quotations on this or its companion, the new Model SS, with 2-pole motor, will be furnished promptly upon request.

50th ANNIVERSARY 1903-1953

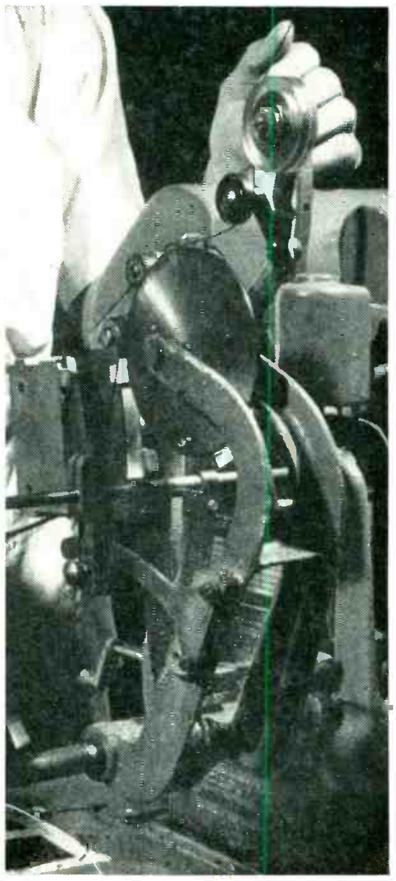
THE GENERAL INDUSTRIES CO.
DEPARTMENT MA • ELYRIA, OHIO

with the etched pattern. No general solution exists, however, since each printed circuit is of a different size and shape. The method of handling will depend on the type of tools required, the length of the strip and a number of other factors, according to Norman A. Skow, director of research for Synthane Corp.

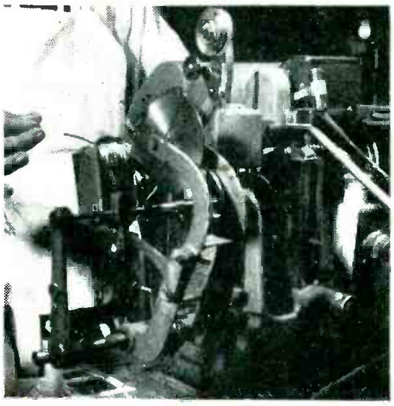
Winding Primary Coil for Soldering Gun

A CAREFULLY PLANNED combination of split bobbins, preformed insulating sheets and a modified winding machine serve to produce primary windings for soldering guns at a high production rate despite the irregular shape of the coil, in the Bayamon, Puerto Rico plant of Weller Mfg. Co.

After unloading a finished coil by taking apart the bobbin, the parts of the bobbin are put together again and locked with a thumb screw, after which preformed fiber insulating sheets are slipped under holding tabs on the



Start of primary winding on bobbin



End of primary winding. Winding machine is made by Universal Winding Co. Operator has just finished putting spaghetti on ends of leads

bobbin. Preforming is done beforehand by dipping punched fiber sheets in water, then forming to shape in a press having heated dies.

After the bobbin has been placed on the arbor of the winding machine, a few turns of insulated wire are wrapped around the bobbin to serve as the low-voltage winding for energizing the spotlights of the soldering gun. An insulating sheet is wrapped over this and fastened with Scotch tape, after which the large primary winding is started and run. While one coil is being wound, the operator is unloading, reassembling and preparing the other bobbin for the next winding.

Mercury-Contact Unit Checks Coil Continuity

A SIMPLE continuity tester speeds checking of stators for B-50 aircraft tachometers at Bogue Electric Mfg. Co. The jig is made from two transparent plastic blocks, hollowed out for a neon indicating lamp and associated connections. Test leads go to two countersunk half-inch holes about ½ inch deep in the top surface. The holes are filled with mercury. An extension cord bringing in the test voltage enters the block from the rear through a tight-fitting hole. Use of mercury contacts eliminates the need for removing the insulating coating from fine wires to make quality tests in between production operations.

The operator merely grips the leads of a coil by their insulation

Stycast
Customized Casting Resins

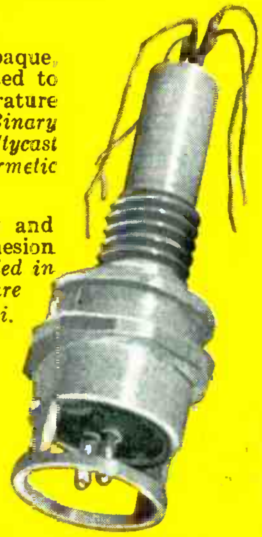
Electronic Embedment techniques, as you may have discovered, have distinct advantages—and hidden pitfalls. Emerson & Cuming know-how can show you how to build-in the specific qualities you need with one of its standard resins — or a plastic specially formulated for your particular use.

Stycast resins are simple to use. They are manufactured for but one purpose: To make superior electrical embedments.

Stycast 40 A clear, transparent, casting resin used for preliminary embedments of electronic circuits or components, and permanent castings where visual inspection is required. Temperature range: −10°C to +150°C. *Coil assembly used in high speed photographic equipment operating at 22,000 volts.*

Stycast 1030 CM A tough, black, rubbery material with high impact strength for embedments used over a temperature range from −90°C. to +170°C. *Monopole transformer at left sealed in Stycast 1030 CM.*

Stycast 4030 CM A black, opaque, quick-curing material, well adapted to production applications. Temperature range: −65°C. to +200°C. *G-E Binary Scaler; entire circuit potted in Stycast 4030 CM for stabilization and hermetic sealing.*



Stycast 5050 CM Combines good low and high temperature characteristics with excellent adhesion and high insulation qualities. *Glass thermister sealed in aluminum housing to withstand underwater pressure of 300 psi.*

Stycast 35 Polystyrene casting resin with excellent electrical qualities. Dielectric constant 2.6; dissipation factor below 0.0009 from 60 to 10^{10} cycles. *Well adapted to this Waveguide Plug and to many RF applications.*

Stycast TP A material which combines excellent electrical and physical qualities over a wide temperature range: −65°C. to 135°C. Dielectric constant 2.6; dissipation factor below 0.002 from 60 to 10^{10} cycles.

Write for data on Stycast Resins and brochure of recent applications. Let's discuss your problem.

Emerson & Cuming, Inc.
Engineering Plastics for Electronics Production
869 Washington Street, Canton, Mass.

BOSTON	BUFFALO	CHICAGO
R. W. Gray, Inc.	L. E. Markle, Jr.	Crane Sales Company
572 Washington Street	235 Hopkins Road	3020 N. Cicero Avenue
Wellesley, Massachusetts	Williamsville 21, N. Y.	Chicago 41, Illinois
Wellesley 5-5296	Plaza 4592	Spring 7-4022

Want more information? Use post card on last page.

www.americanradiohistory.com

Help for DESIGNERS who can use these properties of POLYPENCO® TEFLON*

To any man wanting to gain the full benefits of Teflon, Polymer offers this complete service . . .

1. **Technical Help in Application:** Polymer controlled quality Teflon is the result of Polymer Corporation's early pioneering in the field of extruded specialty industrial plastics. At your request, Polymer engineers will work with you on the newest ideas and techniques to apply and fabricate POLYPENCO Teflon easily, economically.

2. **Dependable delivery of shapes and parts to meet your specifications:** Polymer offers complete stocks of POLYPENCO Teflon rod, tape, tubing and slab. In addition, you can also get quick delivery of controlled quality Teflon parts *fabricated* to your individual specifications.

Excellent Stability
•
Water Repellent
•
Chemically Inert
•
Excellent Electrical Insulation Properties at High Temperatures and High Frequencies
•
Low Dielectric Loss
•
Low Temperature Impact Strength

For the kind of "shirt sleeve" help that goes right to work in helping you apply and use POLYPENCO Teflon, take this step now: Drop us a line on your company letterhead for full details. No obligation, of course.

Ask for these quick facts on Teflon — how it is applied and prices on shapes available.

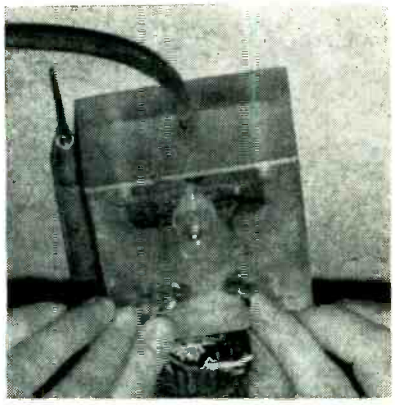
POLYPENCO® TEFLON

nylon and teflon* / and other industrial non-metallics *stock shapes, finished parts*

also available to your specifications

The POLYMER CORPORATION of Penna. • Reading, Penna.
In Canada: C-H Engineering Company • Montreal • Toronto

*registered trademark of the Du Pont Company

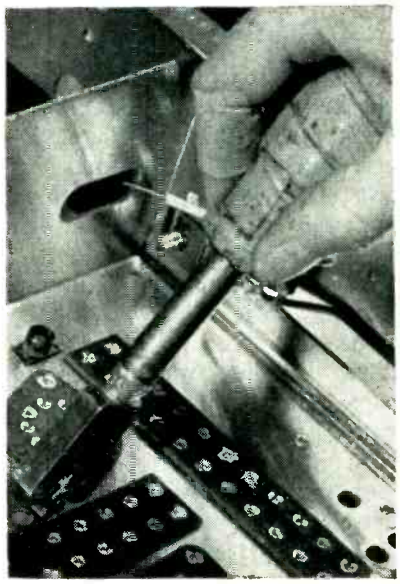


Holding leads of stator in mercury pools of continuity tester for coils of tachometers and miniature a-c and d-c motors and generators

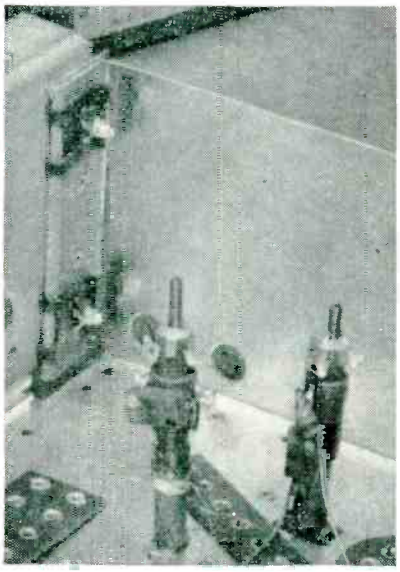
and inserts them in the mercury pools while watching the neon lamp inside the transparent plastic jig. Use of the mercury contacts with a completely enclosed housing of plastic also permits safe testing at high voltages when necessary. The tester can also be used in conjunction with a vacuum-tube voltmeter for checking turns by the comparison method.

Coil-Installing Tool

INSERTION of a Tinnerman Speed Nut coil support in chassis slots is facilitated through use of a special pushing tool. The operator places a clip in the recesses of the tool, uses the tool to insert the clip in its in-



Method of installing coil-mounting clips in chassis of GE dip-soldered television receiver. Mounted clip can be seen just above head of tool



Appearance of mounted coils. Note use of captive speed nuts and self-tapping screws for fastening insulated side plate to chassis

tended holes in the chassis, then pushes gently on the handle of the tool to lock the clip in position.

In a subsequent operation, the fiber coil forms are easily pushed over the mounted clips to complete the coil assembly operation.

Testing Plug-In Capacitors

DUAL-SECTION plug-in electrolytic capacitors having octal bases are quickly tested for leakage with a setup devised by Pyramid engineers. The operator places each unit in turn between two horizontal rods on a jig and rotates the unit until the aligning key drops into the socket mounted at the rear of the jig. She then pushes in the unit

Jig on bench speeds testing of plug-in electrolytics for leakage

Visit us at Booth 1004, Western Electronic Show—San Francisco

TIC-TALKS FEATURE

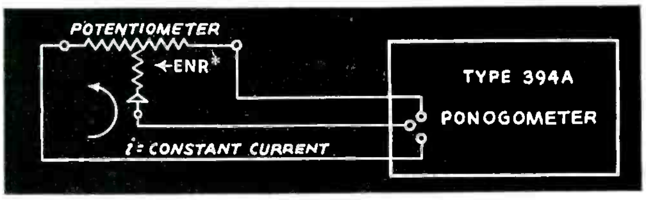
Type 394-A PONOGOMETER

Precision Potentiometer Noise Tester

Designed as a production and laboratory test instrument by the Technology Instrument Corporation for quality control in the manufacture of their precision potentiometers, the Type 394-A Ponogometer is now available for such uses as:

1. Incoming inspection of single or multi-turn potentiometers.
2. To establish noise-performance criteria for precision potentiometers in servo, control, or instrumentation applications.
3. For laboratory investigations and/or quality control in single or multi-turn potentiometer manufacturing.

Working to a definition‡ of noise covering, in part, the voltages created by the equivalent, transient contact noise resistance appearing between the wiper and resistance element of a precision potentiometer, the 394-A Ponogometer monitors this contact resistance, providing an audible and visual indication when a prescribed threshold level is exceeded.



SPECIFICATIONS

Range: Equivalent Noise Resistance*—threshold level adjustable from 10 to 5000 ohms. Lower levels can be set up by means of accessory amplifiers.

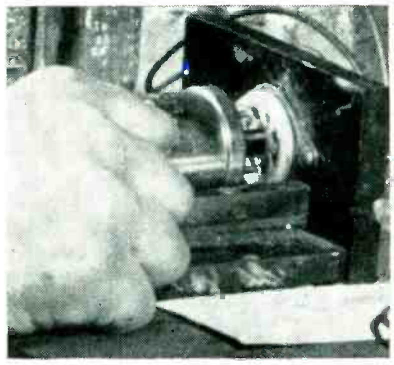
Wiper Exciting Current: Constant 1 milliampere. Other values can be set up by means of accessory current sources.

Type Indication: Audible tone and a neon light, essentially independent of speed of operation of total resistance, and resistance function of potentiometer.

Write for specifications and further details in ‡Laboratory Report No. 6

TECHNOLOGY INSTRUMENT CORP.

533 Main Street, Acton, Massachusetts, Telephone: Acton 600



Details of capacitor-testing jig

and glances up at the meters to note the speed at which the needle drops. If the unit is excessively leaky, the pointer stays upscale as an indication of high leakage current.

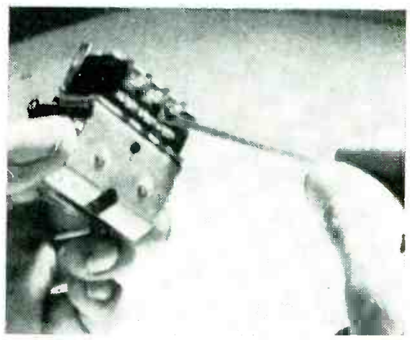
A somewhat similar setup is used at another position for checking capacitance.

Centering Relay Contacts

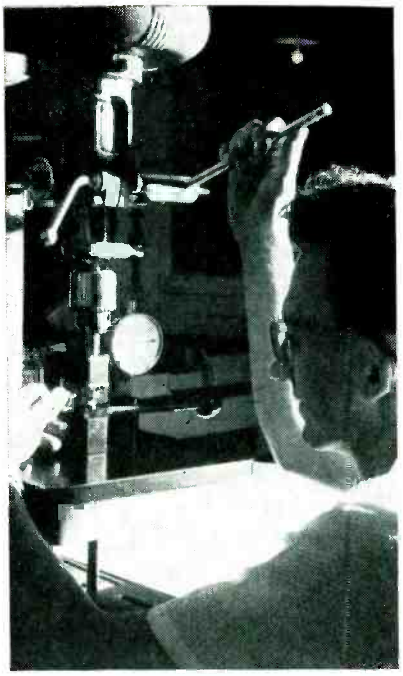
To obtain precise centering of moving-armature contacts between the two sets of fixed contacts on aircraft relays, gaging and contact-spinning operations are combined ingeniously in the San Juan, Puerto Rico, plant of Phillips Control Corp.

The relay is assembled completely, including the moving armature. The two gaps for each of the three pairs of fixed contacts are next measured with a square rod-type step gage and each reading noted. This gives gap spacings in steps of 0.002 inch per gage.

Next, the three-blade armature for this relay is taken out and placed on a modified Delta drill press having in its chuck a spinning tool. A Starrett dial indicator is mounted alongside the drill press



Using step gage to measure contact gap in aircraft relay



Reducing thickness of moving contact, after removing armature temporarily from relay, by applying pressure with spinning tool while watching resulting change in thickness on dial indicator

in such a way that it reads changes in contact thickness. From the readings of the step gage the operator knows how much each contact must be flattened by spinning so that the sums of the two gaps will be the same for each armature. He then brings down the drill press lever until the dial indicates that the desired change in contact thickness has been obtained, for each contact in turn.

The spinning tool is a metal roll mounted horizontally, with the diameter of the roll reducing gradually from the ends to the center so that no flat spots will develop as the shaft of this roll is rotated in a horizontal plane by the drill press.

Parts Mounted on Prints Aid TV Inspectors

FINAL INSPECTION of each dip-soldered television chassis is expedited in the Syracuse plant of General Electric Co. by placing in front of each inspector a mounted parts layout print on which have been placed all of the parts that are her responsibility.

To prepare the sample board, small holes are drilled in it at the

Visit us at Booth 1004, Western Electronic Show—San Francisco.

Measurement of

Impedance
Inductance
Capacitance
Resistance
Dissipation Factor (D)
Storage Coefficient (Q)
Plot Impedance Functions

310A *Z-Angle Meter*

The type 310A Z-Angle Meter measures impedance directly in polar coordinates as an impedance magnitude in ohms and phase angle in degrees: $Z \angle \theta$

Impedance Range: .5 to 100,000 ohms, covered by a single dial and a four position range switch.

Accuracy: ± 1%

Frequency Range: 30 cycles to 20 kc. for impedances below 5000 ohms, measurements can be made up to 40 kc. For frequencies from 100 kc. to 2 mc., write for specifications for the type 311A-RF Z-Angle Meter.

Phase Angle Range: 0° to 90° Direct reading on panel meter. Meter is also Calibrated in D and Q.

Phase Angle Accuracy: Within 2° of meter indication.

Internal Oscillator: 60 cycles and 400 cycles. Terminals are provided for an external, variable frequency signal generator for measurements at other frequencies.

In the field, the laboratory, the production test floor or the class room, the extreme accuracy and the simplicity of operation has proved the type 310A Z-Angle Meter to be a superb and reliable instrument.

Write now for more detailed information.

ENGINEERING REPRESENTATIVES

Chicago, Ill. — UPtown 8-1141
Cleveland, Ohio — PRospect 1-6171
Waltham, Mass. — WAltham 5-6900
Boonton, N. J. — Boonton 8-3097
Dayton, Ohio — Michigan-8721
Arnprior, Ont., Can. — Arnprior 400
Hollywood, Cal. — HOllywood 9-6305
Dallas, Texas — DIxon 9918
Roseland, New Jersey — Caldwell 6-4545
Wyncote, Pa. — Ogontz 8805
Silver Spring, Md. — Sligo 7-550

TECHNOLOGY INSTRUMENT CORP.

533 Main Street · Acton, Massachusetts · Tel. ACton 3-7711

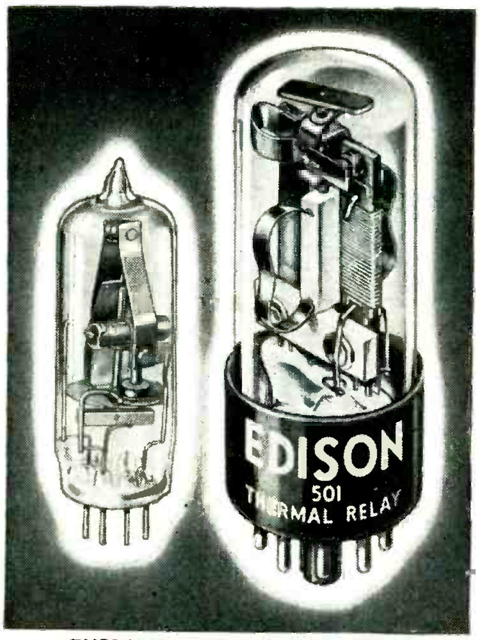
YOU CAN ALWAYS RELY ON EDISON COMPONENTS

for Electronic and Communications Equipment Because of:

HERMETICAL SEALING in rigid glass.

TAMPER-PROOF stability that defies time and abuse.

ACCURACY. Patented feature permits calibration *after* sealing.



THERMAL TIME DELAY RELAYS

Cathode and filament protection • Gyro Erection • Prevent surges and false starts in sensitive auxiliary equipment • Miscellaneous circuit switching

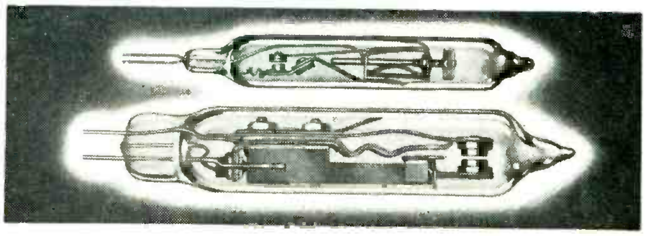
SPECIFICATIONS

Standard Octal Base

Delays . . . 2 seconds to 5 minutes
Heater . . . 5 watts nominal, continuous operation Voltages: 6.3, 26.5 and 117
Contacts . . . 6 amps maximum, 3 amps to 450 volts a.c. or d.c.
Vibration . . . 1/16" amplitude at 55 cps. 50g shock.
Ambient . . . −60 to +85°C **Seated Height** . . . 3¼ max.

Miniature 7-Pin Base

Delays . . . 5 seconds to 75 seconds
Heater . . . 2.5 watts nominal, continuous operation Voltages: 6.3 and 27.5
Contacts . . . 2.5 amps max. 1 amp at 125 volts d.c.
Vibration . . . 1/16" amplitude at 55 cps. 50g shock.
Ambient . . . −60 to +85°C **Seated Height** . . . 2¼ max.



SEALED THERMOSTATS

Ambient protection for frequency standards • Precision heat control for electronic laboratory instruments • Overheat detection and fire alarm

SPECIFICATIONS

Heavy duty—type D8

Max. temp. . . . 320°C
Max. watts . . . 1000
Max. amps. . . . 8.0 d.c.
Calibration tolerance . . . ±2.5°C
Length, 2¾"; **dia.,** 9/16" (approx.)

Precision control—type S1

Max. temp. . . . 190°C
Max. watts . . . 150
Max. amps . . . 1.0
Control differential at ¼ amp = 0.1°F
Length, 2½"; **dia.,** ⅜" (approx.)

Write for free bulletins and application data to:

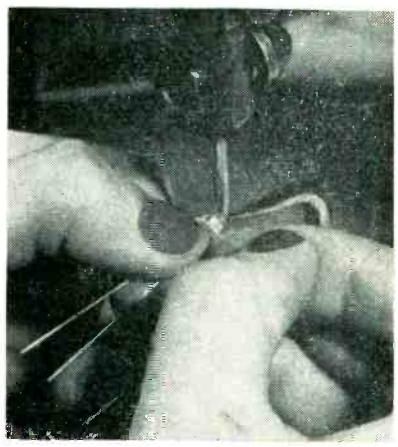
Thomas A. Edison
INCORPORATED
Instrument Division
DEPT. 54, WEST ORANGE, NEW JERSEY

YOU CAN ALWAYS RELY ON EDISON

Inspection position on chain-conveyor assembly line, showing method of mounting layout print. All parts and leads assigned to this operator have been mounted on this print in their correct positions

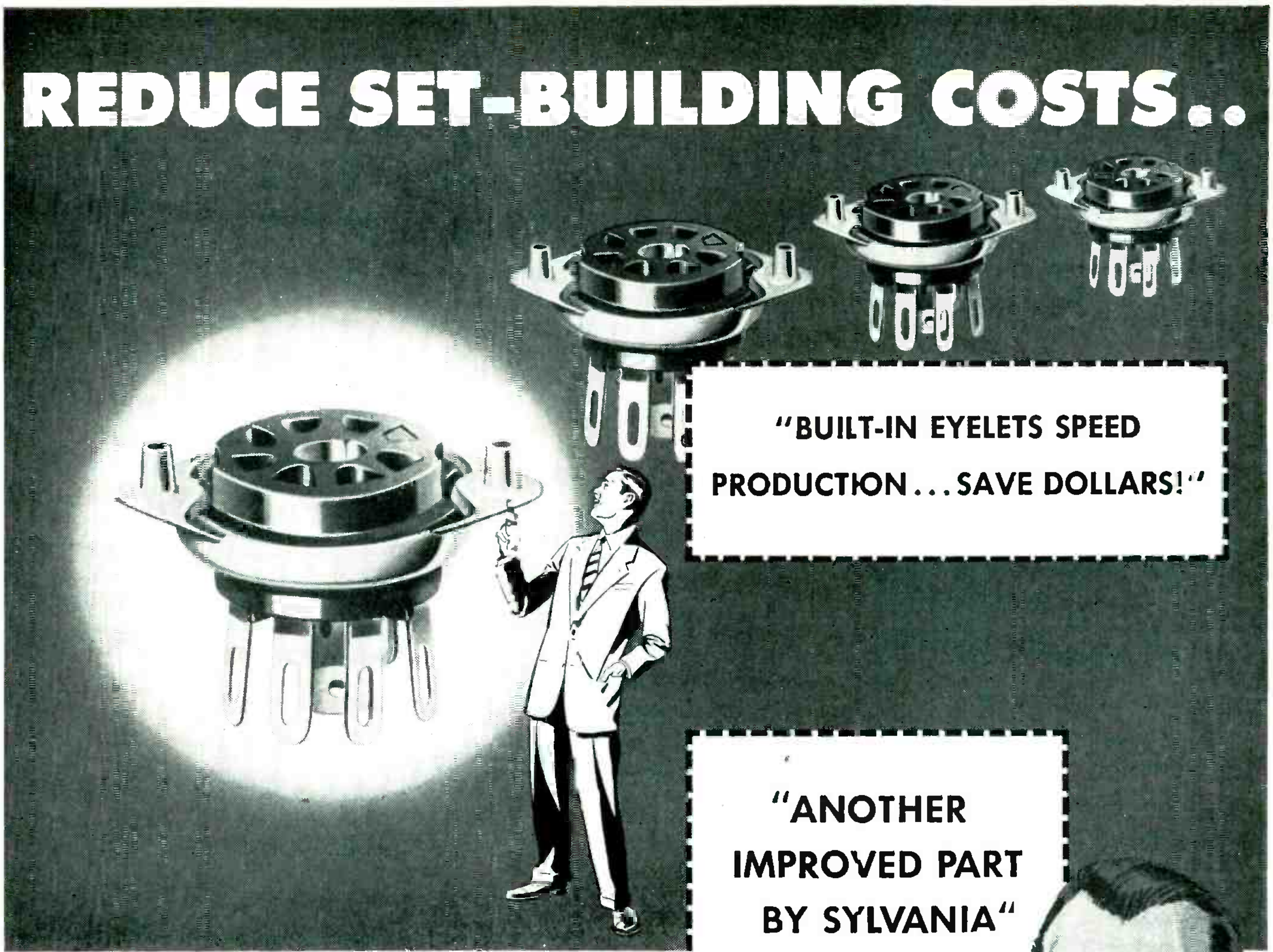
exact positions corresponding to the chassis terminal pins for the parts and leads to be inspected. These parts and leads are then inserted in the holes, and the projecting ends are bent over on the backside for anchoring. Two wood blocks with grooves sawed at an angle support the sample board on the shelf over the operator at the most convenient position for quick reference.

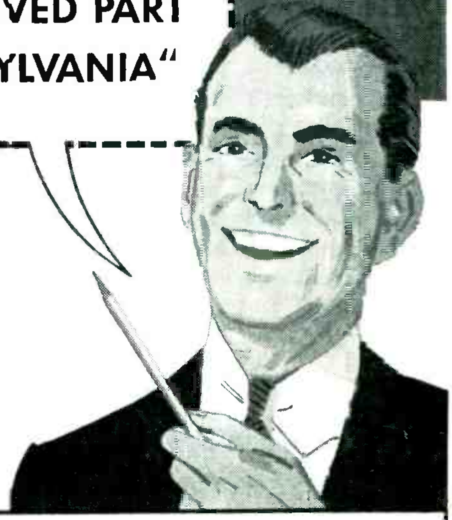
Assembling Germanium Diodes



Welding catwhisker to germanium diode

INDUCTION SOLDERING is employed for mounting a 0.045-inch square pellet of germanium on the flattened cathode electrode of a uhf





with this New Sylvania Integral Eyelet Socket

You'll speed up radio and television set assembly and pare down costs with this new Sylvania socket!

The eyelets are actually formed into the saddle. Just 2 simple operations and these sockets are firmly secured to the chassis. You save rivet costs, save time, and get a sturdy, durable, top-quality job.

Made with 3 types of bases

These new Sylvania sockets are now available with 7-pin, octal, or 9-pin bases. Insulators are either general-purpose or low-loss phenolic.

For prices and full information about this latest Sylvania quality part, write today to: Sylvania Electric Products Inc., Dept. 3A-1008 1740 Broadway, New York 19, N. Y.

SYLVANIA

RADIO • LIGHTING
ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

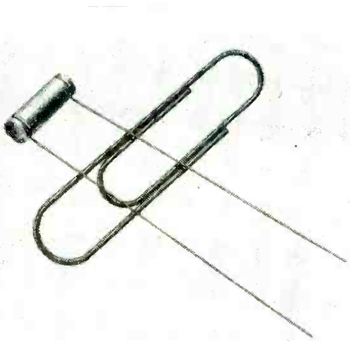
 Want more information? Use post card on last page.

www.americanradiohistory.com

tronic, nucleonic and related fields, since it provides wide-range voltage at comparatively heavy current. Meters and controls are conveniently arranged on a compact panel. The instrument is self-contained, easily rolled or transported from one location to another, and connects into any standard a-c outlet.

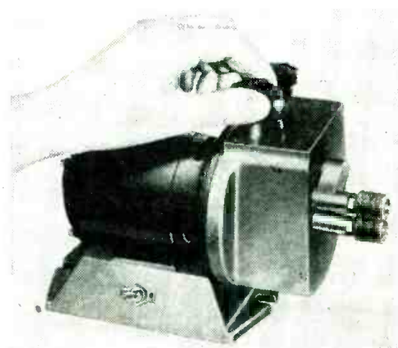
H-V POWER SUPPLY
is continuously variable

The Spellman Television Co., Inc., 3029 Webster Ave., Bronx, N. Y., has developed a new h-v power supply unit. Model LAB-40, which features a continuously variable regulated 25 to 40-kv d-c power supply, has a 4 to 6-kv focus tap for use with flying spot kinescope recording tubes and the like. The unit has regulations of 0.5 percent at 1 ma, and is available either with locking controls or a standard knob. The model is 19 in. wide, 12¼ in. high and 15 in. deep.



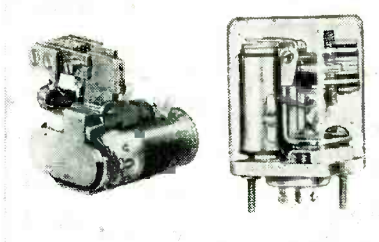
TINY RESISTOR
is rated at 0.10 w

The Daven Co., 191 Central Ave., Newark, N. J., has a new subminiature resistor, type 1106, ($\frac{3}{16}$ in. diameter x $\frac{5}{16}$ in. long), to meet the miniaturization program of the Armed Forces, aircraft and electronic industries. Maximum resistance, wound with Evenohm, Karma, or equivalent is 100,000 ohms. It is rated at 0.10 w. Other resistance wires with different temperature coefficients are available with a lesser maximum resistance per spool. This resistor is specially impregnated against conditions of extreme humidity. Tolerances are available to ± 0.05 percent. Regular wire or Tensolite leads can be furnished.



WIRE STRIPPER
is a tiny wheel-type

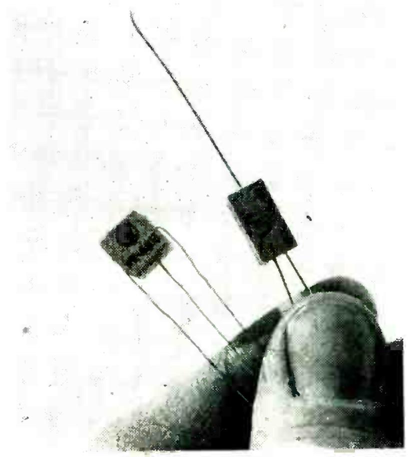
Rush Wire Stripper Division, The Eraser Co., Inc., 1068 S. Clinton St., Syracuse 4, N. Y. Model R-1 midget wheel-type wire stripper is specially designed for efficient high-production stripping of film insulation from very fine magnet wires. A built-in space-regulating screw limits minimum spacing between wheels—prevents breaking wires or reducing their diameter. A built-in pressure regulator allows the wheels to separate as the wires enter and brings them back to the fixed setting for complete stripping.



OPEN SS RELAY SS RELAY HERMETICALLY SEALED

AIRCRAFT RELAYS
are supersensitive units

Potter and Brumfield, Princeton, Ind. A new group of precision-built supersensitive relays, designated as the SS series, and operating on 10 mw or less with 10-G vibration resistance, has been developed for aircraft equipment. These relays are available in open ($1\frac{11}{16}$ in. x $1\frac{5}{16}$ in. x $1\frac{11}{16}$ in. high) and hermetically sealed ($1\frac{1}{2}$ in. x $1\frac{1}{2}$ in. x $2\frac{1}{16}$ in. high) types. Both types are equipped with 1 form C (spdt) pure silver contact combinations rated at 2 amperes, 28 v, d-c, or 115 v a-c. noninductive load. The balanced armature, set on needle-point bearings, is virtually friction-free in its movement. The beryllium copper torsion spring maintains stable performance over a wide operating temperature range. The relays are equipped with series-connected coils, available up to 60,000 ohms and maximum sensitivity of 1 to 2 mw.



TRANSISTORS
available in two types

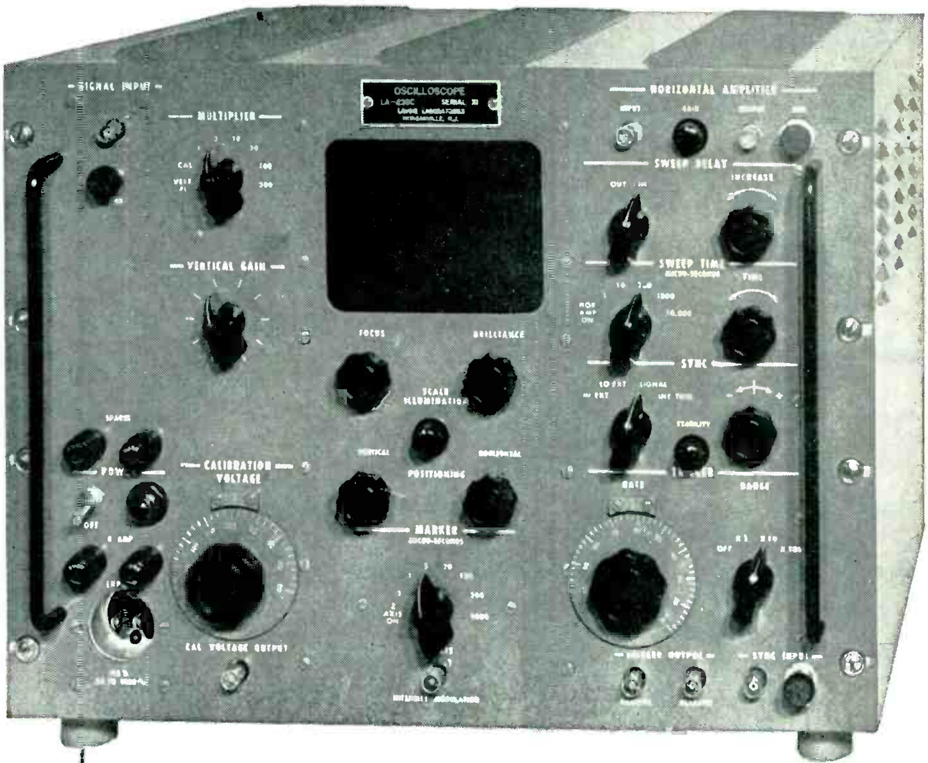
Westinghouse Electric Corp., Box 284, Elmira, N. Y. Two transistors, types WX-3347 and WX-4813, for developmental use in amplifier, oscillator and switching circuits, are available in sample lots. Both types are provided with leads for wired-in installation. The WX-3347 is a point-contact type transistor. Typical operating characteristics when used as a grounded-base amplifier under small signal conditions are: collector current, 2 to 3 ma; power gain, 18 db; and cut off frequency, 2 mc. The WX-4813 is a pnp junction-type transistor. When used as an amplifier with grounded emitter and base input, typical operating characteristics are: col-

www.americanradiohistory.com

SUPERIOR PERFORMANCE

On 3 Cycles to 20 Megacycles

The LA-239 C Oscilloscope



DATA

1. Wider Bandwidth: Complex waves from 5 Cycles to 15 Megacycles. Sine waves from 3 Cycles to 20 Megacycles.

2. Extended Sweep Frequencies: Linear from 10 Cycles to 20 Megacycles internally synchronized. Triggered sweep, from single random impulses to irregular pulse-intervals up to as high as 6 Megacycles.

3. Square Wave Response: Rise time 0.042 Microseconds; only 5% droop on flat-topped pulses as long as 30,000 Microseconds duration.

4. Greater Stability: Electronically regulated power supplies throughout to maintain accuracy and constant operation under varying line conditions or line surges. You can display surges on the line from which Model LA-239C is being powered without distortion of the trace!

5. Higher Signal Sensitivity: Maximum sensitivity without Probe: 10.4 millivolts. With Probe: 100 millivolts. (Maximum signals, 125 V. Peak and 450 V. Peak respectively.)

6. Timing Markers: Interval Markers of 0.2; 1; 5; 20; 100; 500; or 2,000 Microseconds may be superimposed on the trace for the accurate measurement of the time base.

7. Voltage Calibration: Signal amplitude is compared against a 1,000 cycle square wave (generated internally) the amplitude of which is controlled by a step-and-slide attenuator calibrated in peak volts. (A jack is provided to deliver 40V Peak for use in calibrating other instruments.)

8. Sweep Delay: Any portion of the sweep longer than a 10 Microsecond section may be expanded by 10:1 for detailed study of that portion of the signal.

9. Power Source: 110 to 130 V AC; from 50 to 1,000 cycles. 295 Watts. (Fused at 4 Amperes.)

10. Dimensions: In Bench Cabinet: 19½ in. Wide; 15¼ in. High; 16¾ in. Deep. In Rack Mounting (With cabinet removed to fit standard relay rack): 19½ in. Wide; 14 in. High.

THE LAVOIE MODEL LA-239C has been designed to surpass the high performance of the TS-239A/UP, which has been the standard test oscilloscope for the Armed Services since its introduction. Model LA-239C is the result of a long period of research and development which has included the study of new tubes, new circuits, and new techniques. Rugged design has been combined with functional simplicity to produce an instrument as attractive as it is efficient.

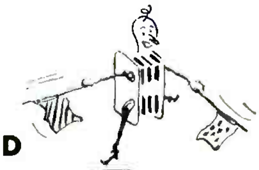
To create a circuit that will produce a certain complex wave form, or study transients and pulse phenomena, no better precision instrument is available today.

Lavoie Laboratories take pride in offering this precision oscilloscope as the combination of engineering perfection and manufacturing skill.

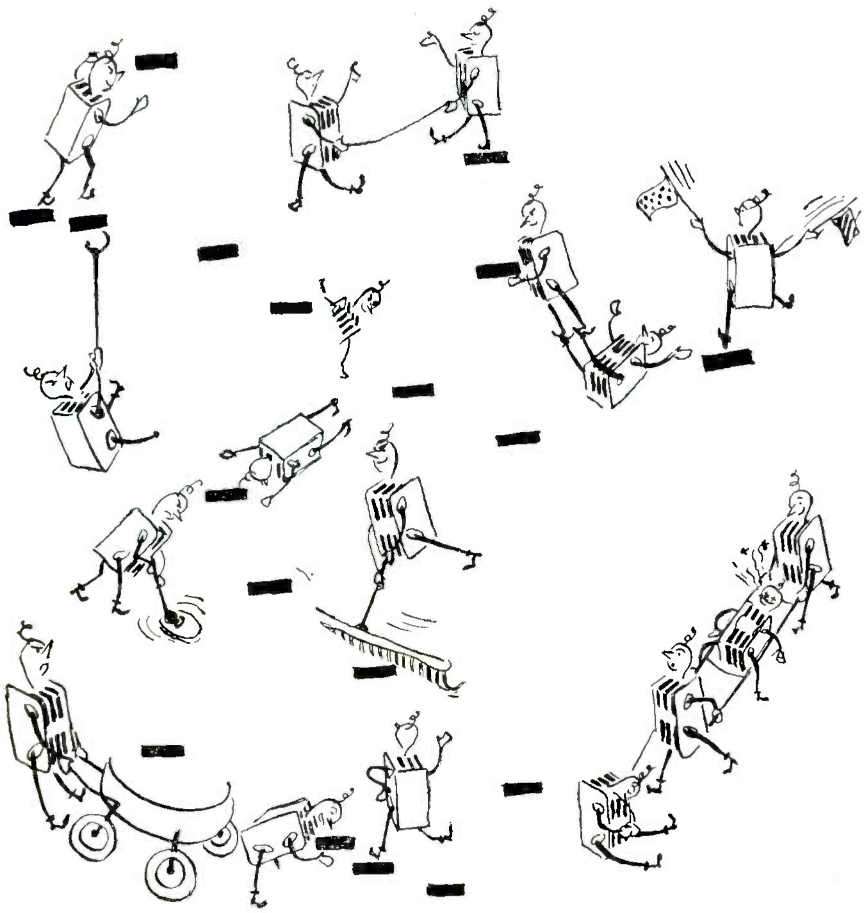
Lavoie Laboratories, Inc.
MORGANVILLE, NEW JERSEY
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

Want more information? Use post card on last page.

www.americanradiohistory.com



YOU MIGHT BE AMAZED AT WHAT YOU CAN DO WITH SIGMA SENSITIVE RELAYS



[redacted]'s new Automatic [redacted] is an electromechanical device which does everything that the old-fashioned human [redacted] did except demand a tip. Sigma is crowing about the five Sigma Type 6 magnetic latching memory relays which, together with a trifling few hundred pounds of machinery, make this all possible. The combination does everything for you except improve your [redacted], and the [redacted] rakes in the dough as never before, since the machine is not subject to strikes, hangover or bad temper. Even the displaced [redacted] are better off because they are now forced into decision — *either go on relief or get a job.*

[redacted] *CENSORED Unfortunately the proud manufacturer of the device we should be describing above is either a timid soul or lacks a sense of humor because he wouldn't hear of this type of reference to his pride and joy. By the time this was clear to us, it was too late to do anything except print it as above.*

P.S.-Tear this out and try it on your player piano

SIGMA

SIGMA INSTRUMENTS, INC.

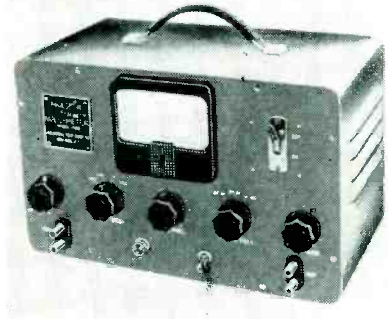
62 PEARL ST., SO. BRAINTREE, BOSTON 85, MASS.

6FZ2A2B

Here's a latching relay with only one moving part — the armature. No mechanical catches to wear and let go when subject to shock and vibration. Contacts up to 4PDT — rated 5 amperes.

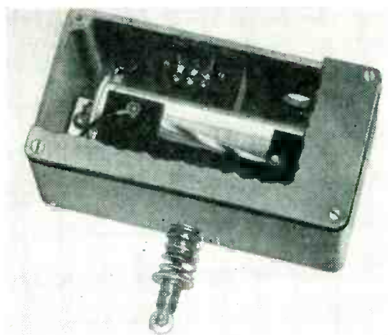
(This space paid for by Sales Manager)

lector current, 1 to 2 ma; and power gain, 30 db.



NULL METER
is phase sensitive

THE INDUSTRIAL TEST EQUIPMENT Co., 55 E. 11th St., New York, N. Y., has introduced the Phazor null meter, model 100A. The instrument permits phase sensitive null detection and effectively eliminates noise and harmonic components. It is extremely useful for bridge, potentiometer and other null-type circuits. It also finds wide application in synchro zeroing, incremental impedance detection and phasing of transformer devices. The unit features a sensitivity of 6 mv off-scale deflection; a frequency range of 30 to 10,000 cps; and an input impedance of 2.5 megohms shunted by 15 $\mu\mu$f. Power input is 105 or 125 v, 60 cps, 25 w.

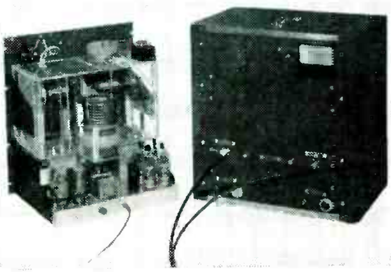


POTENTIOMETERS
for industrial control

WARD LEONARD ELECTRIC CO., Mt. Vernon, N. Y., has developed the Bulletin 68 plunger potentiometers designed for industrial electronic control applications such as constant cutting speed machine tool drives, winder drives and processing machinery as well as numerous "dancer roll" systems. The vitreous enameled resistance element and the precious metal sliding contact are protected by an oil-tight enclosure with external mounting holes. The operating plunger, with its roller-type cam follower, requires only $\frac{1}{2}$-in. linear movement for complete traverse of the 10,000-ohm potentiometer. The unit measures only $8\frac{1}{2}$ in. wide x $4\frac{1}{2}$ in. deep x $7\frac{7}{8}$ in. high over plunger roller.

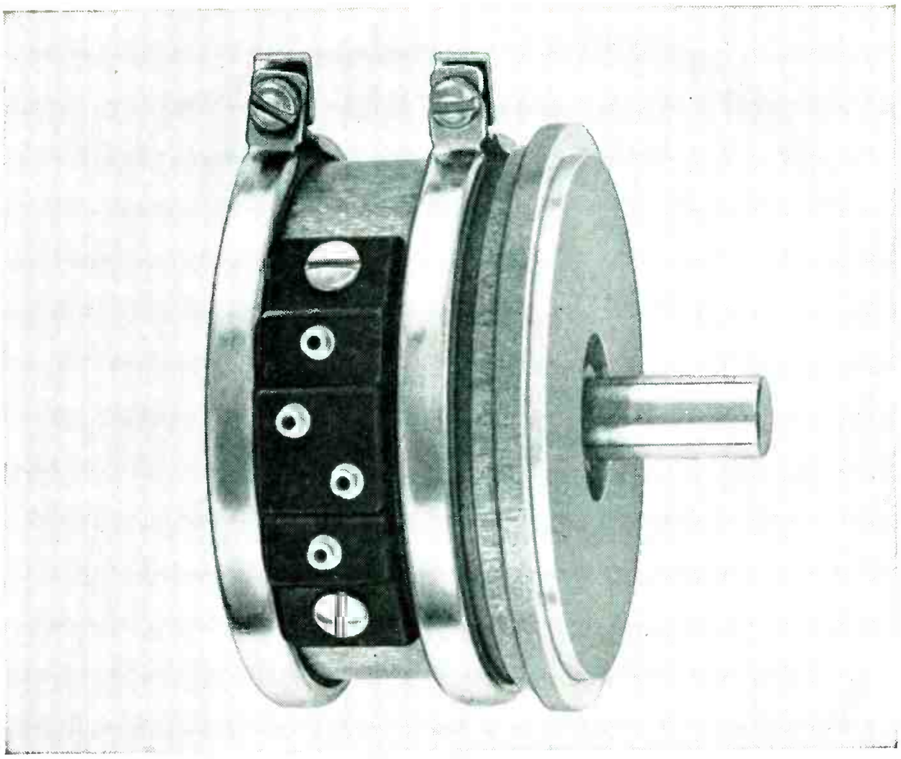
29 FRAME MOTOR
with centrifugal switch

INDUCTION MOTORS CORP., 55-17 37th Ave., Woodside 77, N. Y., announces that its 29 Frame Motor can now be supplied with a special centrifugal switch for use in control applications in electronic equipment. At present this switch is being used successfully at ambient 120C on a fan motor in electronic equipment in the event the fan becomes inoperative, thus avoiding damage to expensive components. The switch is designed in a special manner so that no wear occurs in actuating components, thus making for millions of trouble-free operations.



H-V POWER SUPPLY
has variety of uses

THE SPELLMAN TELEVISION CO., INC., 3029 Webster Ave., Bronx, N. Y. Model PN-60 high-voltage power supply is ideal for electrostatic paint spraying, capacitor charging and testing, as well as many other uses. Its reversible polarity r-f d-c power supply is continuously variable from 0 kv to 60 kv. Polarity changes are made on the front panel. Current output is



TYPE 756—
Fairchild's latest single-turn
PRECISION POTENTIOMETER
Gives you all these advantages...

1 Extremely low noise level and longer life with sustained high accuracy result from improved windings and wiper design. These improvements also permit higher rotational speeds with minimum of wear.

2 Higher resolution (0.05% at 2,000 turns) and close functional tolerances (linear ±0.25%; non-linear 0.35% with 3:1 slope ratio in high resistance ranges) give higher point-to-point tracking qualities.

3 Standard electrical functional angle is 320 deg. nominal with ORV tolerance of ±5% in resistance range from 800 to 40,000 ohms. Electrical functional angle of 350 deg. nominal with ORV tolerance of ±3% in resistance ranges of 50 to 45,000 ohms can be supplied on special order.

4 Greater flexibility—For non-linear functions as many as 13 taps can be provided by adding extra terminal boards.

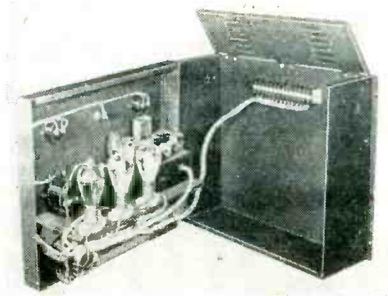
5 All the desirable qualities of the well-known Type 746 unit, including easy and more accurate phasing, ganging up to 20 units on a single shaft, all-metal precision-machined housing and shaft, low torque, etc., are included in the Type 756.

Full information about the entire line of Fairchild Precision Potentiometers, including specifications of the Type 756 unit and how we can help solve your potentiometer problems, is available for the asking. Write to *Potentiometer Division, Fairchild Camera and Instrument Corporation, Park Avenue, Hicksville, Long Island, New York, Department 140-39A1.*

FAIRCHILD
PRECISION POTENTIOMETERS

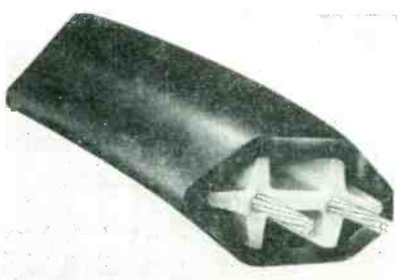
www.americanradiohistory.com

1 ma at 60 kv. The overall dimensions of the unit are 22½ in. x 21 in. x 15 in.



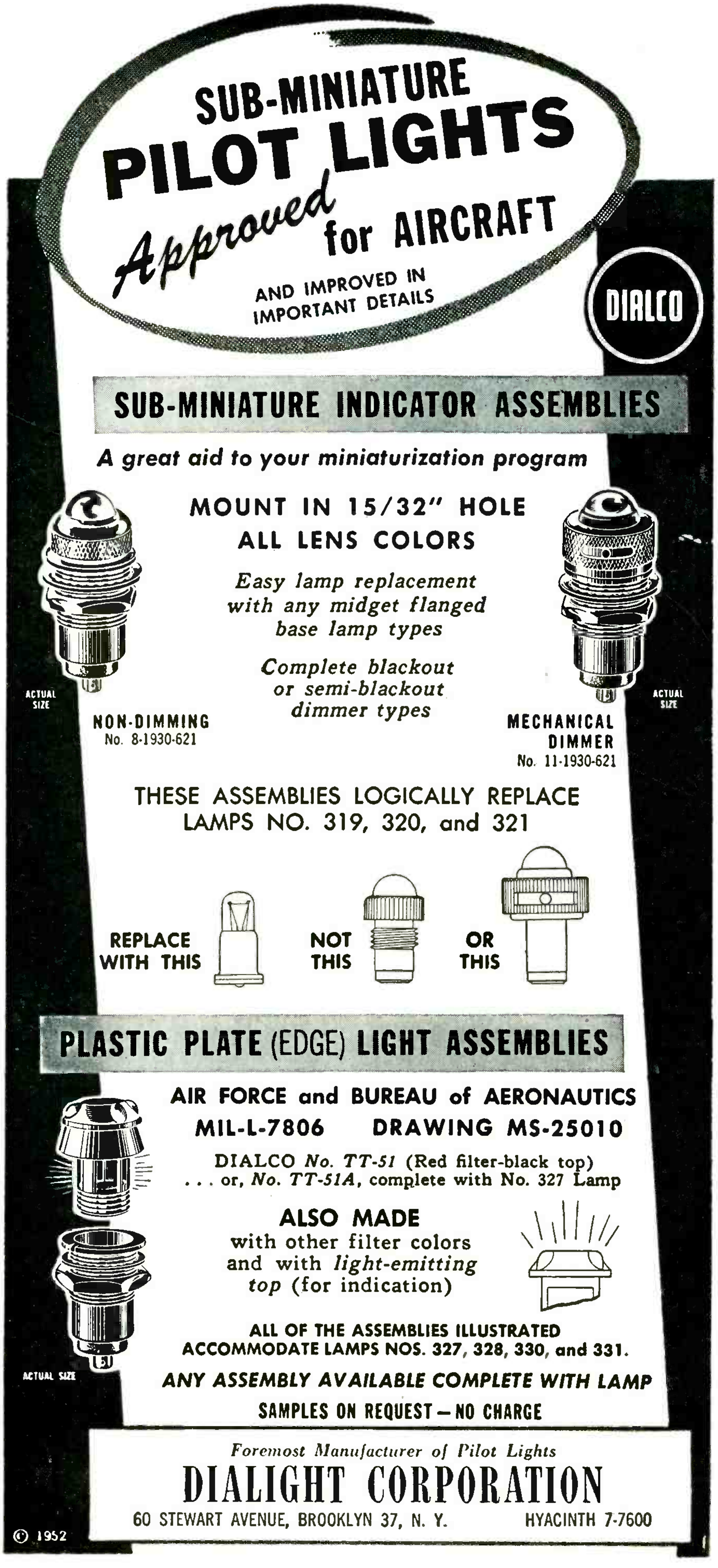
RECTIFIER
is three-phase type

THE ELECTRONIC RECTIFIER CO., Rochester, N. Y., has announced a new, 3-phase, 25-ampere rectifier, housed in a square cabinet about 22 in. wide and high, and approximately 8 in. deep. On its face are ammeter, voltmeter and switch. Ventilation is through louvres in the top. It is pierced for wall mounting in case shelf or floor mounting is not desired. It can be used to operate d-c motors, magnetic chucks, magnetic separators and the like. It can also be operated as a battery charger.



TRANSMISSION LINE
for uhf performance

PLASTOID CORP., 42–61 24th St., Long Island City 1, N. Y., has announced the Synkote Ultratube, a new tubular twin-lead for uhf, so designed that attenuation is negligible under all weather conditions. The new transmission line has the leads spaced several millimeters within the tube, equidistant from the outer insulation. Consequently, the magnetic field between them is unaffected by any moisture or salt that may condense on the outer covering, and signal strength is main-



tained at a maximum all the way down the line. Ultratube is recommended not only for uhf but for peak transmission vhf signals in stormy weather, in fringe areas, and in seacoast areas where moisture and salt spray are factors.

SIGNAL GENERATOR
uses no reactance tube

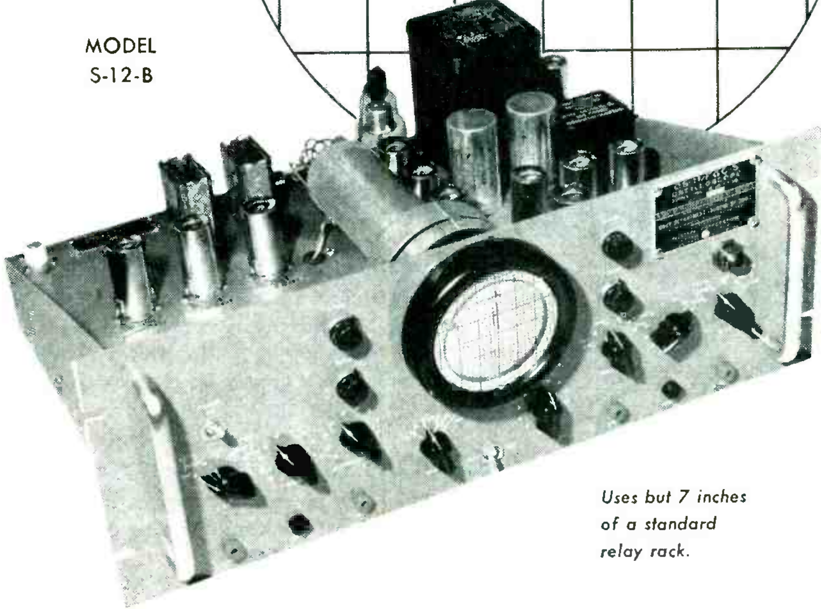
NEW LONDON INSTRUMENT CO., P. O. Box 189, New London, Conn., announces model 100C f-m signal generator with a single tuning range that covers 25 to 216 mc. The instrument is ideally fitted for testing the bandwidth, alignment and sensitivity of f-m receivers. Utilizing a novel, single-stage r-f circuit that contains no reactance tube, the 100C minimizes drift and reduces distortion, a-m and hum. Since it is designed on fundamentals, spurious outputs which might result from mixing and multiplication are eliminated. Accuracy is below 0.1 μv.

MAGNETIZER
charges permanent magnets

LEO KLEIN-ELECTRONICS, 2404 S. La Brea Ave., Los Angeles 16, Calif. Model LG16 electronic magnetizer provides an efficient, inexpensive means for charging permanent magnets. Used with simple coils

the Waterman JANized RAKSCOPE®

MODEL S-12-B



Uses but 7 inches of a standard relay rack.

ANOTHER EXAMPLE OF Waterman PIONEERING...

The S-12-B RAKSCOPE is a rack mounted, JANized version of the famous WATERMAN S-11-A POCKETSCOPE, with the addition of a triggered sweep and a special calibrating circuit for rapid frequency comparisons. The entire oscilloscope is built to occupy but seven inches when mounted in a standard relay rack. The vertical and horizontal amplifiers are identical, having sensitivities of 0.05 Volt rms/inch and frequency responses which are flat within —2 db from DC to 200 KC. These features permit observation of low frequency phenomena without undesirable trace bounce. The sweep rate is continuously variable from 5 cycles to 50 KC in either the triggered or repetitive mode with synchronization polarity optional. The return trace is blanked. Because provisions are made for applying input signals from the rear, as well as the front, the S-12-B is the ideal combination, systems monitor and trouble-shooting oscilloscope. Investigate the multiple applications of this instrument as an integral part of your "rack mounted" projects.

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.

CABLE ADDRESS: POKETSCOPE

MEMO... Write for details today!

WATERMAN PRODUCTS INCLUDE

S-4-A SAR PULSESCOPE®
S-5-A LAB PULSESCOPE
S-11-A INDUSTRIAL POCKETSCOPE®
S-14-A HIGH GAIN POCKETSCOPE
S-14-B WIDE BAND POCKETSCOPE
S-15-A TWIN TUBE POCKETSCOPE

Also RAYONIC® Cathode Ray Tubes and Other Associated Equipment

WATERMAN PRODUCTS

Want more information? Use post card on last page.

www.americanradiohistory.com

Here's how ELECTRO TEC miniature slip ring and commutator assemblies

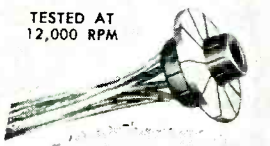
—solve TOUGH DESIGN PROBLEMS

- 6 INSULATED CONTACT RINGS
- RING WIDTH .030"
- BARRIER WIDTH .015"
- RING DIAMETER .045"
- WEIGHT 5.5 GRAINS (1/80 OUNCE)
- RINGS 60-70 BRINELL FINE SILVER
- TARNISH RESISTANT, FRICTION MINIMIZING SURFACE DEPOSITS
- 1000 VOLT HI-POT BETWEEN RINGS
- COLOR CODED LEADS

***PROBLEM:* ULTRA MINIATURIZATION** — Design and mass produce an extremely miniaturized slip ring assembly. Reduce diameter of rings to absolute minimum to lessen torque friction. Maintain micro-tolerances; eliminate accumulated errors common to "assembled" slip rings.

***SOLUTION:* ELECTRO TEC EXCLUSIVE* METHOD** of unitized, one piece construction provided a prompt, economical solution to this problem. Final design was even smaller than was originally specified and tolerances were held to closer limits.

TESTED AT 12,000 RPM



SILVER ON ONE PIECE NYLON FORM

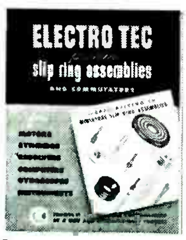
8 FLAT RINGS WITHIN 5/8" RADIUS

Same Exclusive* One-Piece Construction Used in All Electro Tec Assemblies

Diameter of Electro Tec assemblies range from .045" to 24" cylindrical or flat. Cross sections of the rings may range from .005" to .060" or more. Rings are polished to a jewel-like finish . . . can be held to four micro-inches or better. Regardless of size, the same exclusive Electro Tec manufacturing technique is used to guarantee precise concentricity, higher dielectric strength, longer life and closer tolerances.

WRITE FOR LITERATURE!

A completely illustrated, four page folder contains full information on Electro Tec Miniature Slip Rings and Commutators. Describes the Exclusive* method of construction that has made Electro Tec the leading supplier to America's major instrument manufacturers. Send for your free copy today on company letterhead.



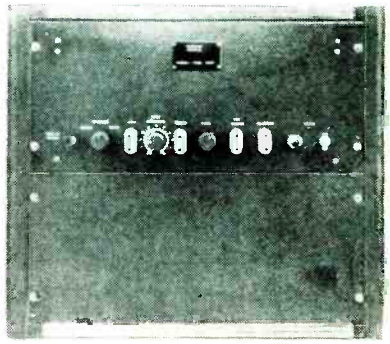
*PATENTS PENDING

ELECTRO TEC CORPORATION

SO. HACKENSACK NEW JERSEY

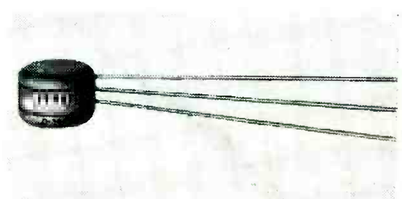
PRODUCTS OF PRECISION CRAFTSMANSHIP BY A NEW AND REVOLUTIONARY PROCESS

consisting of a few turns of wire wound to suit the shape of the piece to be magnetized, the LG16 is capable of charging magnets up to 4 cu in. in volume. Magnets contained in p-m motors and phono cartridges, ion traps and meters are easily charged often after assembly in the end product. It operates from standard 110–120 v, 50–60 cycle power outlet.



RECORDER has l-f characteristics

MAGNE-PULSE CORP., 140 Nassau St. New York 38, N. Y. "One shot" or irregular frequency phenomena containing components from d-c to 30-kc can now be recorded and displayed on an oscilloscope through the use of the type 103 magnetic transient recorder. The low frequency characteristics of this recorder, which makes possible the faithful reproduction of square waveforms with duration periods as long as 20,000 μsec, is achieved through the use of pulse-time modulation. This unit should find application in recording Geiger pulses, heart beats in hospitals, and in laboratories conducting research on radar, television, atomic phenomena, computers and allied fields.

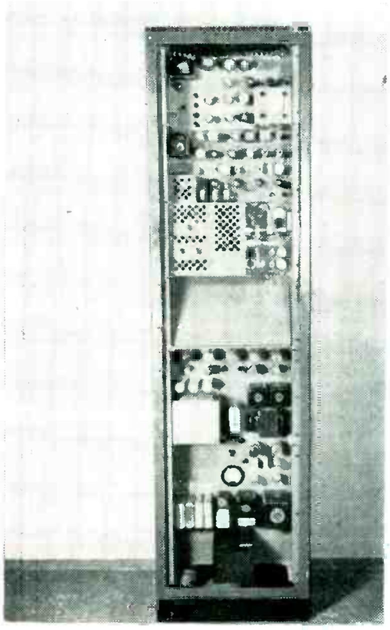


SUPPRESSOR for use with d-c relays

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif., has developed a rectifier-

www.americanradiohistory.com

suppressor for use with d-c relays. The type D-2906 is encapsulated within a thermosetting plastic material offering complete protection in adverse environmental conditions such as moisture, fungus, salt spray and corrosive vapors. The unit consists of two elements—one provides half-wave rectification of the a-c input and the other provides a path for the current resulting from the collapse of the magnetic field of the relay coil during the nonconducting half-cycle. This arrangement provides chatter-free operation of the relay. The unit measures ¾ in. in diameter and 1 in. long and is provided with three pigtail leads. It is rated 48 v maximum input and 5 ma output in 100 C. It is ideal for operation of 30 v d-c relays from an a-c supply.



MICROWAVE RELAY is easily installed

SARKES TARZIAN, INC., 539 S. Walnut St., Bloomington, Ind. Model MT-1A microwave relay is based on experience in relaying tv programs over long distances and studio remotes. Emphasis has been placed on simplicity and reliability of operation. Designed for unattended operation, the equipment has built-in facilities for monitoring programs and checking all circuits. Complexity of the circuits has been reduced so that equipment is easily installed and maintained. The equipment meets all the standards

Specialists in Magnetic Materials

Standard Designs—Special Shapes

Bulletin 151

Catalog SM-1252

Bulletin L-752

Bulletin WC-353

Permanent Magnets

Magnet Design—Bulletin 151. Written for the design engineer. Covers application, properties, design problems and testing of permanent magnets.

Standard Magnets—Catalog SM-1252. Complete data with dimensional drawings of standard magnets offered from stock for working models, small requirements, without special tooling.

Core Materials

Laminations—Bulletin L-752. Data on stamped silicon-iron laminations covering material applications, general specifications, typical value graphs. Also covers T & S OrthoSil oriented materials.

Wound Cores—Bulletin WC-353. New bulletin describing T & S Wound "C" and Toroidal Cores. Complete with specifications and value graphs.

Select the bulletin or catalog you need—write Thomas & Skinner today.

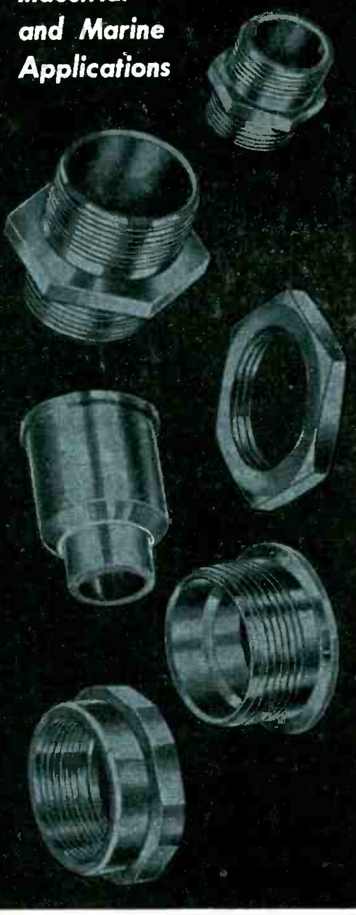
THOMAS & SKINNER Steel Products Company, Inc.

1122 EAST 23RD STREET, INDIANAPOLIS 7, INDIANA

www.americanradiohistory.com

SOLID BRASS ELECTRONIC HARDWARE AND FITTINGS

for Industrial and Marine Applications



Precision machined from solid brass . . . plated to your requirements.

Spherical seat (ball and cone type). RF fittings including ferrules, adapters, couplings, nuts, receptacles, etc. Made in accordance with BuShips drawing **RE-49A-501A** for use with flexible metal hose, conduit, tubing, etc.

Rapid delivery on standard or special sizes. Let's discuss your needs! Write or phone, today.

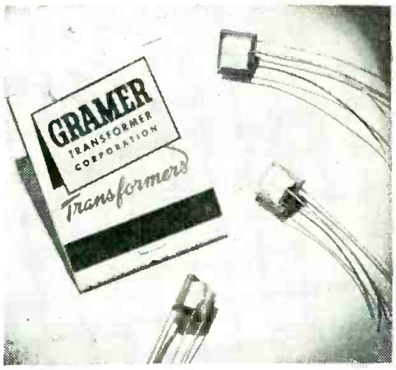
HARDWARE DIVISION

HOPKINS Engineering Co.

FACTORY: 2082 Lincoln Ave. Altadena, Calif. *Sycamore 8-1185*
Offices in WASHINGTON, D. C. and DETROIT

Want more information? Use post card on last page.

of commercial tv program relays. Technical information is available on request.



TRANSFORMERS
for transistor circuits

GRAMER TRANSFORMER CORP., 2734 N. Pulaski Rd., Chicago 39, Ill. The tiny transformers illustrated are being used mostly in conjunction with transistors by manufacturers of hearing aids, portable f-m transceivers, radios and a wide range of advanced miniature electronic equipment for defense as well as in miniature electronic apparatus for civilian use. Size is $\frac{11}{32}$ in. x $\frac{3}{8}$ in.; weight, 0.005 lb; match impedance, 20,000 to 1,000 ohms; primary inductance, 5.5 henrys with 0.5 ma d-c at 1 v, 1,000 cycles. Primary d-c resistance is 1,150 ohms.

ANALYZER
measures resistances

THE KULJIAN CORP., 1200 N. Broad St., Philadelphia 21, Pa., has produced an electronic resistance analyzer that is particularly adapted to the selection and measurement of resistances used in analog computers. The instrument can be used by resistor manufacturers for selecting resistors to within speci-

NEW Servotrol POT-kit

. . . instantly ready for setting up single or ganged, linear or non-linear potentiometer assemblies.

Experimental laboratories and design engineers! . . .

. . . Servotrol's Pot-kit provides *you* with a versatile assortment of "Unitized" Type RVC2 potentiometers, mounting plates and clamp rings. With this set of transducers mechanical shaft rotation can be converted to almost any linear or non-linear electrical relationship.

Versatility of the Pot-kit eliminates delays!

Any of the fourteen linear potentiometers may be converted to non-linear functions by connecting shunt resistors of proper value across the three equally spaced taps on the winding. The Pot-kit enables *you* to translate your ideas to conclusions without delay.

***NEW, UNIQUE SERVOCALCULATOR* included in the kit**

Calculating values of shunt resistors and effective potentiometer resistance accomplished in a matter of seconds with direct readings from the disc scales. Eliminates time-consuming computations.

360° Sine Function

A sine function potentiometer with a complete 360° function angle of rotation is provided to broaden the range of experimentation with the Pot-kit.

The extreme versatility of Servatrol's Pot-kit B simplifies breadboarding and speeds decision as to the needed potentiometer or assembly for your prototype systems.

ENGINEERING REPRESENTATIVES

Cleveland, Ohio — PRospect 1-6171
Chicago, Ill. — UPtown 8-1141
Rochester, N. Y. — Monroe 3143
Canaan, Conn. — Canaan 649
Dayton, Ohio — Michigan 8721
Baltimore, Md. — Plaza 7694
Arnprior, Ontario, Can. — Arnprior 400
New York, N. Y. — MUrray Hill 8-5858
Cambridge, Mass. — ELiot 4-1751
Hollywood, Cal. — HOllywood 9-6305
Dallas, Texas — DIxon 9918

Immediate deliveries:

For further details —
Write, wire or phone for Bulletin #E-8

Servo-trol SERVOTROL COMPANY

114 W. ILLINOIS ST., CHICAGO 10, ILLINOIS
• TEL. SUPERIOR 7-3087
EASTERN OFFICE: FRAMINGHAM CENTRE, MASS.
• TEL. FRAMINGHAM 4421

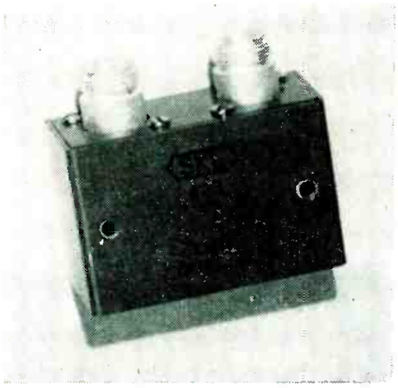
Want more information? Use post card on last page.

www.americanradiohistory.com

fied limits. A precision of balance of 0.02 percent is realized over almost the entire range. The instrument is designed for 115 v a-c operation. Range and accuracy are as follows: 1,000 to 10,000 ohms to 0.5 percent; 10,000 to 11 megohms to 0.15 percent; and 11 megohms to 111 megohms to 1 percent.

FILTERS
for s-s equipment

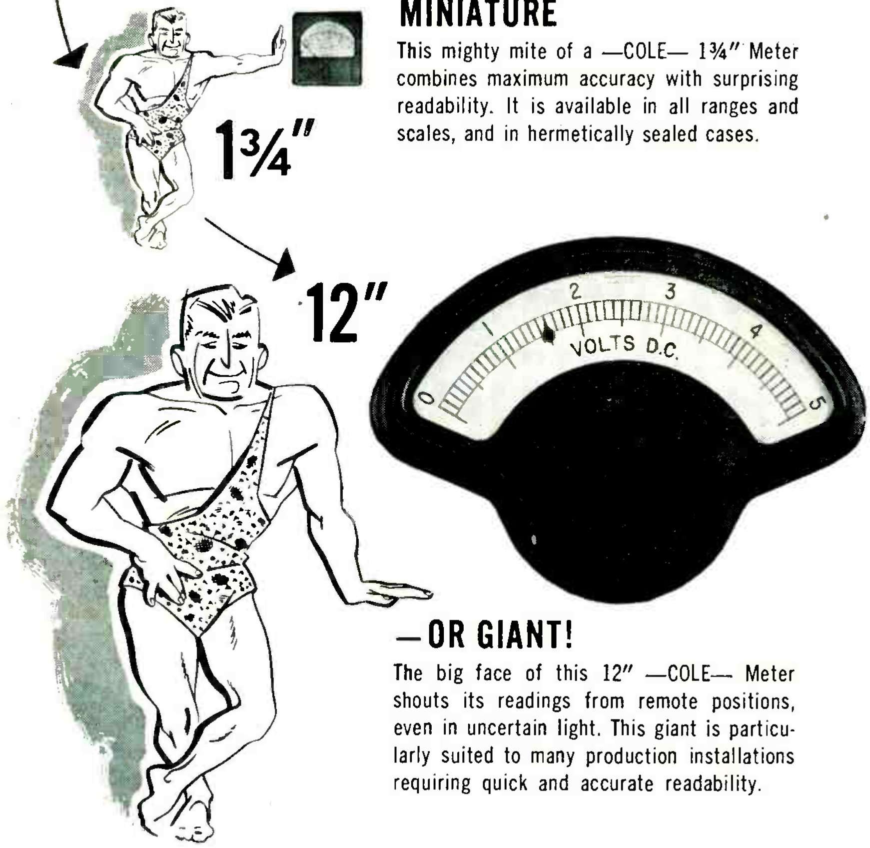
BURNELL & Co., 45 Warburton Ave., Yonkers, N. Y., announces development of a new series of filters for commercial single-sideband receiving equipment. For most applications these filters can replace the more expensive and hard to get crystal filters. The filters result from a new approach which employs a 25-kc i-f system.



LINE EQUALIZERS
for community tv

SPENCER-KENNEDY LABORATORIES, INC., 186 Massachusetts Ave., Cambridge 39, Mass. Like long telephone lines, wideband tv distribution systems in large hotels and apartment houses or cities and towns present an equalization problem because the coax cables have higher attenuation for the higher frequency tv channels than for the lower frequency tv channels. As a result, it is necessary to equalize or compensate for this loss when more than a few hundred feet of cable is used. The series 400 line equalizers are designed to provide this equalization. Models 423 and 431 are meant for use in community tv systems. They have standout type N connectors and accurately

Only -COLE- has this RANGE of METERS



MINIATURE

This mighty mite of a —COLE— 1¾" Meter combines maximum accuracy with surprising readability. It is available in all ranges and scales, and in hermetically sealed cases.

—OR GIANT!

The big face of this 12" —COLE— Meter shouts its readings from remote positions, even in uncertain light. This giant is particularly suited to many production installations requiring quick and accurate readability.

Between the miniature and the giant, many other —COLE— Meters meet the needs of defense, industry, and science. A quarter of a century of fine custom building has established their ruggedness and quality. —COLE— has combined the finest of materials and workmanship to produce standard meters with accuracies as high as ½ per cent.

Best of all, these highest-quality **—COLE— Meters can be delivered immediately.** Special orders take just a little longer.

You may wait longer, but you will not get a better meter than a —COLE—.

Be sure to see our exhibit, Booth 903, at the Western Electronics Show and Convention, Civic Auditorium, San Francisco, August 19-21.

Fill in and mail the coupon for quick information on -COLE- Meters.

-COLE-
Instrument Company
1320 SO. GRAND AVENUE
LOS ANGELES 15, CALIF.

Yes, I want more information on -COLE- Meters. D-18

NAME______ TITLE______

COMPANY______

STREET ADDRESS, OR BOX NUMBER______

CITY______ ZONE______ STATE______

the most economical way to FOCUS a TV tube

the original Focomag

CUTS RECEIVER COSTS BY ELIMINATING CENTERING AND FOCUSING RHEOSTATS. Also lowers cost of power transformer. Perfectly focuses 27", 21" and all smaller tubes having magnetic deflection. Highly efficient ring magnet uses only 4 oz. Alnico P. M.

NO HARMFUL EXTERNAL FIELD. Ring magnet is completely enclosed by the external shunt (an original Heppner design). This prevents the leakage field from having any magnetic effect on other components. Uniform field produced by ring magnet.

FLEXIBLE NYLON ADJUSTING SHAFT ELIMINATES BREAKAGE.
Picture-positioning lever. You specify mounting arrangement.

Write today for information on lowering your set costs with this FOCOMAG.

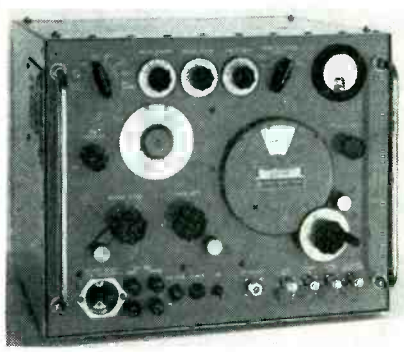
HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives:
John J. Kopple
60 E. 42nd St., New York 17, N. Y.
James C. Muggleworth
506 Richey Ave., W. Collingswood, N. J.
Ralph Haffey
R. R. 1, U. S. 27, Coldwater Rd., Ft. Wayne 3, Indiana
Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, Calif.

match 75 ohms at both input and output to prevent any reflections. Model 413 is equipped with miniature connectors for use in large apartment house and hotel systems.

P-M MATERIAL
is made of ceramic

Henry L. Crowley & Co., Inc., West Orange, N. J., is producing Cromag, a new ceramic permanent-magnet material featuring magnetic and physical potentials applicable in numerous fields. Light weight, magnetically-hard Cromag has exceptionally high coercive force and at the same time has a suitable residual induction to cover a wide variety of applications. In h-f applications it shows a very low loss and minimum proximity effect on associated circuitry. Cromag is a powdered material that is fabricated by powder metallurgy methods adaptable to pressing in a wide variety of intricate shapes with no machining necessary. In addition, this material can be supplied in long rods, tubes, square, rectangular or other symmetrical shapes.

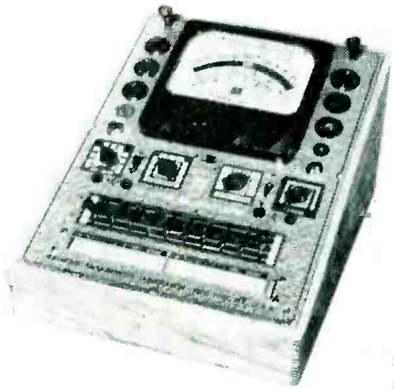


SIGNAL GENERATOR
for 3,800 to 7,600 mc

Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif. Model 618B signal generator, designed for use in the 3,800 to 7,600-mc range, is particularly applicable for the testing of radar and radio relay equipment. The repetition rate is continuously variable from 40 to 4,000 pps, and pulse width is variable from 0.5 to 10 μsec. Sync-out signals are simultaneous with the r-f pulse, or in advance of the r-f pulse by any time span from 3 to

www.americanradiohistory.com

300 μsec. The instrument may be synchronized with an external sine-wave or with positive or negative pulse signals.



MULTITESTER
has 7½-in. meter

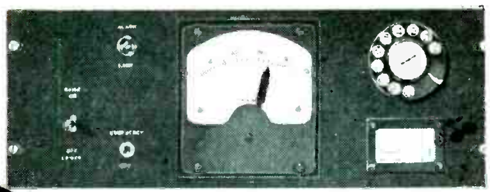
ELECTRONIC MEASUREMENTS CORP., 280 Lafayette St., New York 19, N. Y. Model 207 tests tubes, batteries, resistance and capacitance. It features a large, easy to read, 7½-in. meter for counter use. It is a durable, accurate instrument that gives direct readings for all tubes through the standard emission method of testing. Four-position lever type switches are used.

TINY CONNECTOR
is pressure-tight

WINCHESTER ELECTRONICS, INC., Glenbrook, Conn. The CR5-2-R miniature multicontact pressure-tight connector, with leakage of less than 1 cu. in. per hr at 30 psi pressure differential, finds extensive use in airborne electronic equipment. It provides individual neoprene seal rings around each contact and between the molded body and the die cast aluminum housing. Use of individual rings assures positive sealing and allows the contacts to float thereby precluding alignment difficulties. Dimensions are 1 in. maxi-

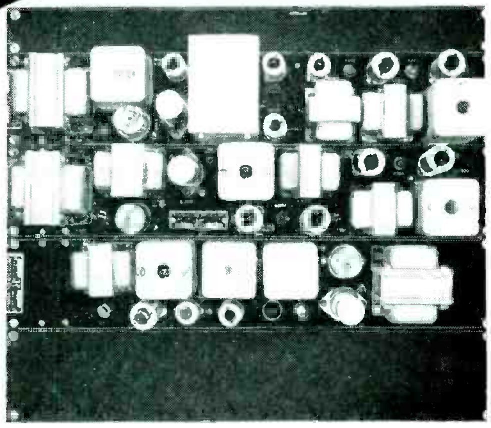
HAMMARLUND REMOTE CONTROL & METERING

For **Unattended Broadcast Transmitters!**



Control panel for installation at the studio end.

Control equipment for installation at the studio end.



Economical, dependable system . . . Needs only a single telephone circuit!

Substantial reductions in operating costs can be made by taking advantage of the recent authorization by the FCC to permit remote control of AM and FM broadcast transmitters. FCC regulations for this mode of operation stipulate that complete and continuous control of remotely situated transmitters must be maintained at all times. It is desirable, also, to obtain highly dependable equipment having a reasonable first cost and low operating expense. Hammarlund equipment offers distinctive advantages in all these respects.

Included in the Hammarlund remote control and metering system are the following basic features that are vital to efficient and economical remote transmitter operations:

1. Only a single telephone circuit is required. May be operated over VHF or microwave. No DC circuit is used.
2. Full control of up to nine separate circuits.
3. Telemetering of nine separate electrical quantities.
4. Up to four emergency alarm indications.
5. Fail-safe operations assured at all times.

In most cases, this equipment will pay for itself through savings effected in operating costs in less than a year.

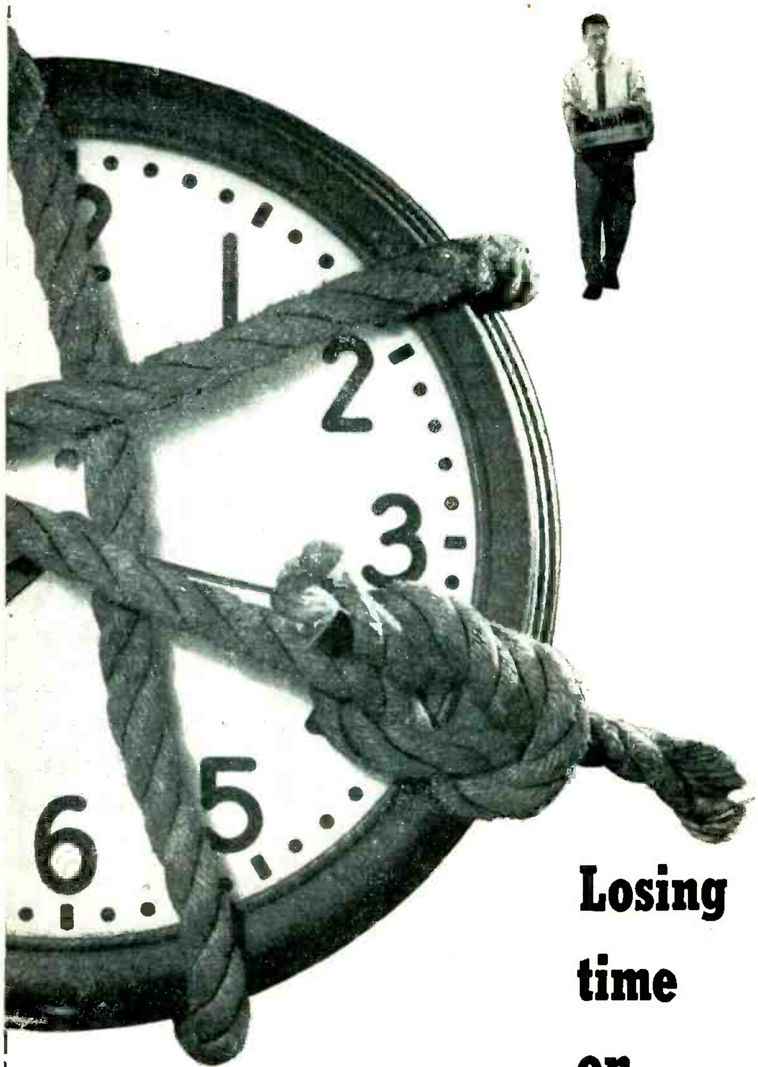
Write to The Hammarlund Manufacturing Company for full details about this equipment.

HAMMARLUND

The Hammarlund Manufacturing Co., Inc.
460 W. 34th Street, New York 1, N. Y.

Want more information? Use post card on last page.

www.americanradiohistory.com



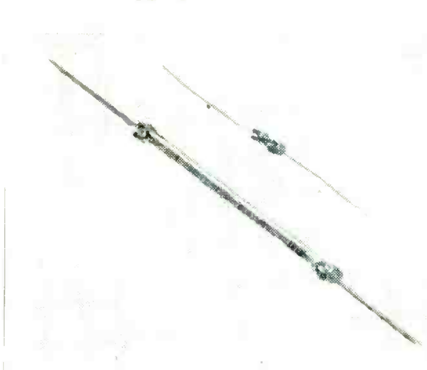
Losing time on repairs?

Maintenance and repairs will always be with us. But the time-wasting business of "getting at" a defective part can be practically eliminated. A component equipped with Grant Industrial Slides can be rolled out of its rack, pivoted and locked at a convenient working angle in about five seconds. Grant Industrial Slides are available in stock and ready for immediate delivery in a great variety of models, or custom designed to your special needs. Write for our Industrial Slide Catalog. Grant Pulley and Hardware Company, 31-73 Whitestone Parkway, Flushing, New York.

Grant Industrial Slides

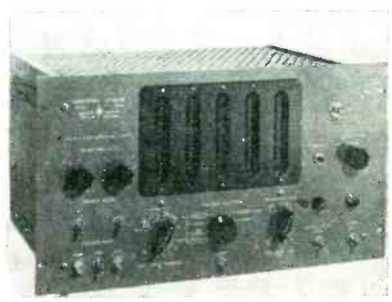
1. Continuous ball bearing action permits non-jar chassis removal. Locks when fully extended, unlocks to return.
2. Withdrawing release rods disengages them from quadrant mechanism, enables unit to be tilted by simply raising.
3. Unit locks at 45 or 90 degrees. Special pivoted positions can be obtained for individual requirements.
4. Maintenance, repairs easily made. Access is gained in a few seconds. Special slides give plus or minus 90° tilt.

mum diameter and 1 27/32 in. engaged length with a total weight of receptacle and plug of 2 oz.



VARISTORS
available in 5 cell sizes

INTERNATIONAL RESISTANCE CO., 401 N. Broad St., Philadelphia 8, Pa., has introduced a new line of Varistors (nonlinear resistors). The units have many applications in circuits where sharp variation of resistance with applied voltage is required, and are available in 5 convenient cell sizes (two of which are illustrated) in a wide variety of enclosures. Designed to conform with MIL and JAN specifications on humidity, shock, vibration, temperature cycling, solder pot and fungus resistance, they have unusually low shunt capacitance and can be used effectively in r-f circuits. The response is instantaneous. Ask for catalog data bulletin SR-3.

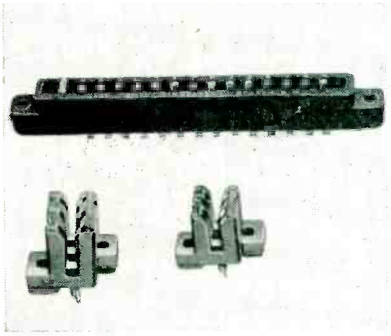


COUNTER
for lab and industry

HEWLETT-PACKARD CO., 395 Page Mill Road, Palo Alto, Calif. Model 522B electronic counter is a compact, low-cost, versatile instrument offering accurate frequency, period and time measurements, designed specifically for laboratory and industrial applications in the measurement of these quantities. Results are displayed instantly, automatically and in direct-reading form. It can be readily used by unskilled personnel. The unit will measure frequencies from 0.00001 cps to 100 kc with excellent accuracy. It is arranged to measure time intervals from 10 μsec to 100,000 seconds (27.8 hrs). Accuracy is ± 1 count ± stability (at least 5 parts per million per week.)

PULSE GENERATOR
is a wide range unit

TELETRONICS LABORATORY INC., 54 Kinkel St., Westbury, Long Island, N. Y. Model PG-200A pulse generator with two PGA-210 range extenders produces calibrated pulse widths from 0.1 to 1,000 μsec, calibrated rep rates from 0 to 17,500 pps, calibrated delays with respect to output trigger of ±0 to 1,000 μsec and pulse rise and fall times of 0.03 μsec. It can be driven with a simple sine wave down to 20 cps.



RECEPTACLES
for printed circuits

WINCHESTER ELECTRONICS, INC., Glenbrook, Conn., has available a line of printed-circuit receptacles, designated as series K, in sizes ranging from 2 to 22 contact positions. They permit easy removal and replacement of printed circuit cards for maintenance purposes, facilitate external wire soldering operations and provide proper identification of individual circuits. A polarizing pin allows engagement in the correct position only while the wiping action of the contacts insures positive contact at all times. Monobloc construction eliminates unnecessary creepage paths and re-

Preformed Contact Finger Stock is an ideal electrical weather stripping around doors of equipment cabinets as well as being excellent for use with VHF and UHF circuitry. Silver plated, it comes in three widths — $\frac{17}{32}$, $\frac{31}{32}$ and $1\frac{7}{16}$ inches.

Variable vacuum capacitors come in three models, are lightweight, compact, eliminate the effects of dust and atmospheric conditions and have low inductance. Also available are eight types of fixed vacuum capacitors.

Air-system sockets, designed for Eimac tube types 4-400A, 4-1000A, 4X150A, and 4X150D, simplify cooling and assure adequate air-flow to various seals. The 4-400A socket can also be used with the 4-125A and 4-250A radial-beam power tetrodes if desired.

HR heat dissipating connectors provide efficient heat transfer from the tube element and glass seal to the air while making electrical connections to plate and grid terminals. Precision machined from dural rod, HR connectors come in ten sizes to fit most of Eimac's internal anode tubes.

High Vacuum Rectifiers come in eight models, are instant heating, have radiation-cooled pyrovac* plates and can be operated in a variety of rectifying and voltage multiplying circuits. Also available are four types of mercury-vapor rectifiers.

*An Eimac trade name.

• For further information write our Application Engineering department

Eimac

EITEL-McCULLOUCH, INC.
SAN BRUNO · CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

www.americanradiohistory.com

MAXIMUM RELIABILITY

is achieved in Texas Instruments transistors by means of a hermetically sealed enclosure incorporating glass-to-metal seals. Moisture or other contamination due to ambient conditions *cannot* affect the operating characteristics.

NEW TI N-P-N grown-junction transistors meeting the latest basing standard are now available for amplifier and oscillator applications. Careful control of all manufacturing processes assures uniform electrical characteristics.

TI

junction transistors . . .

hermetically sealed

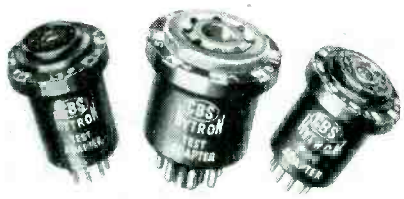
★ ACTUAL SIZE

TI hermetically sealed point-contact transistors are also available in limited quantities. For complete information on both point-contact and junction transistors, write *today*.

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVE. DALLAS 9, TEXAS

Want more information? Use post card on last page.

duces the number of moisture and dust pockets. Molded melamine bodies (in accordance with MIL-P-14b)—mineral filled—are fungus-proof and provide high dielectric and mechanical strength.

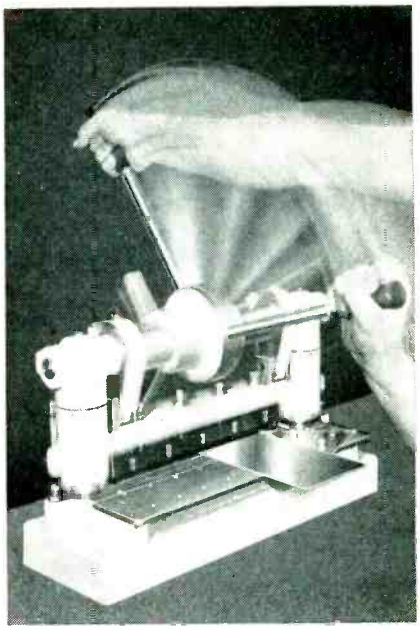


TEST ADAPTERS
available in three types

CBS-HYTRON, A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC., Danvers, Mass., is offering, in addition to its 7-pin test adapter, a 9-pin miniature test adapter and an 8-pin octal test adapter. Now servicemen can test all sockets top-side without wrestling with a heavy chassis. There is no need to disturb wiring or parts—just plug tubes into test adapters and adapters into sockets.

C-R TUBE
meets tough tolerances

ELECTRONIC TUBE CORP., 1200 E. Mermaid Lane, Philadelphia 18, Pa., has announced a c-r tube that displays up to five independent phenomena simultaneously. The type 7X, built to tighter RTMA specifications, is designed for multi-channel oscilloscopes where a number of transient, random or h-f signals must be observed simultane-



Want PRECISION SHEARING at HIGH SPEED?

Check these features and you'll want a DI-ACRO* SHEAR

- **PRECISION** — strips less than .025″ wide accurately sheared. Thousands of parts exactly duplicated.
- **CUTTING SPEED** — rivals that of power machines.
- **RATED CAPACITY** — 16 gauge.
- **EASY TO OPERATE** — a woman can operate it.
- **CHOICE OF MODELS** — available in four sizes. Widths from 6 to 24 inches. Four power models also available.
- **ENGINEERING SERVICE** — always at your disposal.
- **PORTABLE** — readily moved.
- **RUGGEDLY BUILT** — backed by one year warranty.
- **DELIVERY** — immediate on most models.
- **COST** — that's good too.

*pronounced Die-ock-ro

LIKE MORE INFORMATION?

Send for 32-page catalog

Gives full details on both hand and power operated Di-Acro Shears, Benders, Brakes, Notchers, Punch Presses, Rod Parters and Rollers. Mail your request today.

Creators of "DIE-LESS DUPLICATING"

di-acro PRECISION METALWORKING MACHINES

O'NEIL-IRWIN MFG. CO.
321 8th AVE.
LAKE CITY, MINN.

Want more information? Use post card on last page.

www.americanradiohistory.com

ously and with great accuracy. The tube uses electrostatic focusing and deflection for each of its five electron guns. Crosstalk is eliminated by adequate shielding of individual guns. The 7X employs a post accelerator intensifying electrode and has connections to the deflector plates brought out to a basing ring in the tube neck to minimize interelectrode capacitance.

VHF RECEIVER
requires little space

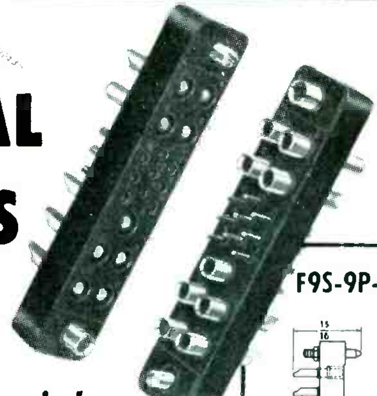
SCHUTTIG AND CO., INC., Ninth and Kearney Sts., N. E., Washington 17, D. C., has announced a new vhf communications receiver developed for airports, communication centers and other installations. Known as the S220A, it requires 40 percent less rack space than ordinary vhf receivers. Bandwidth at the 6 db point is ± 20 kc; at the 60 db point it is ± 100 kc. A 1-μv signal modulated 30 percent provides 1 watt audio output at 10 db or better signal-to-noise ratio. Its avc action keeps the output constant within 1 db at all input levels between 5 and 200,000 μv.

PULSE TRANSFORMER
for blocking oscillators

RAYTHEON MFG. CO., Waltham 54, Mass., has announced a new line of miniaturized pulse transformers for blocking oscillator applications. These new pulse transformers, suitable for use in commercial as well as in government equipments, are available in three different styles. One style has a plug-in octal base construction; the second, a hermetically sealed MIL-T-27 construction; and the third, an encapsulated version with a built-in solder seal for chassis mounting. Designed

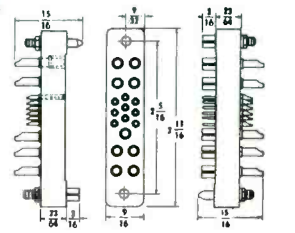
Winchester Electronics

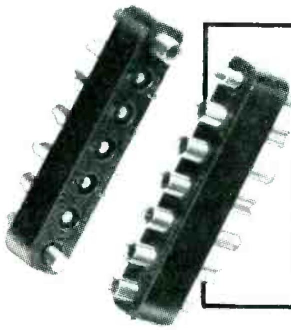
SPECIAL DESIGNS

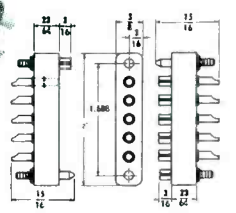


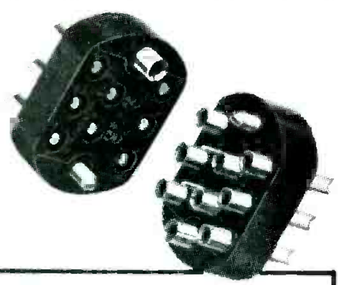
ILLUSTRATED
2/3 ACTUAL SIZE

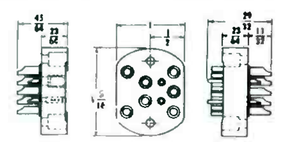
for your special
CONNECTOR
requirements











When your electronic equipment demands precision connectors of special design. Winchester Electronics' staff of experienced engineers is prepared to solve your problem. Unique designs with special contact sizes and arrangements are constantly being developed to fulfill requirements not satisfied by existing connectors. And at Winchester, trained personnel and extensive production facilities combine to assure you of the top quality your equipment deserves. The Sales Department invites your inquiries. For your convenience, a technical representative is ready to assist you by personal call.

PHYSICAL AND ELECTRICAL DATA

Plug Code No.	Receptacle Code No.	Small Contacts: Number of Contacts	Small Contacts: Solder Cup Dia. In.	Large Contacts: Number of Contacts	Large Contacts: Solder Cup Dia. In.	Weight—Oz.: Plug	Weight—Oz.: Rec.	D. C. Volts Breakdown Between Contacts: Sea Level Normal Humidity	D. C. Volts Breakdown Between Contacts: 60,000 Feet Altitude
F5P-G	F5S-G	—	—	5	.081	.5	.6	4500	1100
F2P-8S-G	F2S-8P-G	2	.043	8	.081	.8	.7	4500	1100
F9P-9S-G	F9S-9P-G	9	.043	9	.081	1.0	.9	4500	1100

IF GUIDE PINS ARE NOT DESIRED, OMIT "G" FROM CODE NOS.

MONOBLOC* CONSTRUCTION eliminates unnecessary creepage paths, moisture and dust pockets and provides stronger molded parts.

MOLDED MELAMINE BODIES (in accordance with MIL-P-14) mineral filled — are fungus-proof and provide mechanical strength as well as high arc and dielectric resistance.

PRECISION MACHINED CONTACTS: Pins from brass bar (QQ-B611) and sockets from spring temper phosphor bar (QQ-B746a). They are gold plated over silver for consistent low contact resistance, reduction of corrosion and ease of soldering.

POLARIZATION: Guide pins and guide sockets assure positive engagement.

RACK AND PANEL MOUNTING: Either plug or receptacle may be mounted on a panel or chassis.

Wire or write for catalog of other types or advise your special requirements

Winchester Products and Winchester Designs are Available Only From Winchester Electronics, Inc.

West Coast Branch: 1729 Wilshire Blvd., Santa Monica, California

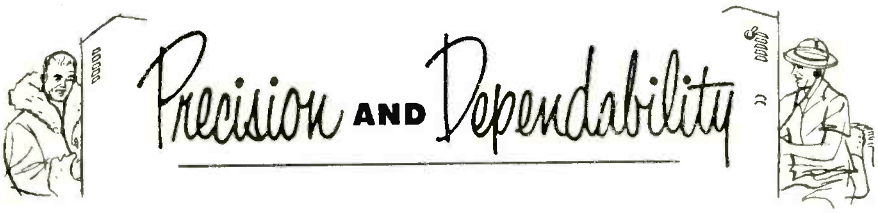
* Trademark

WINCHESTER ELECTRONICS INCORPORATED

GLENBROOK, CONN., U.S.A.

Want more information? Use post card on last page.

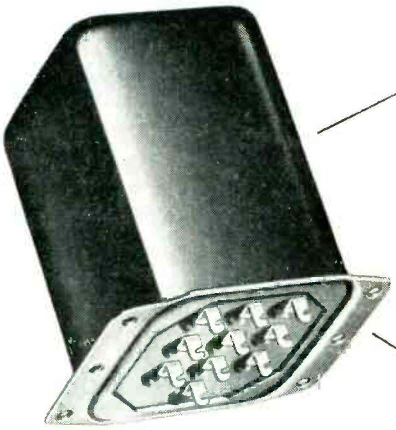
ALL-WEATHER COMMUNICATION DEMANDS

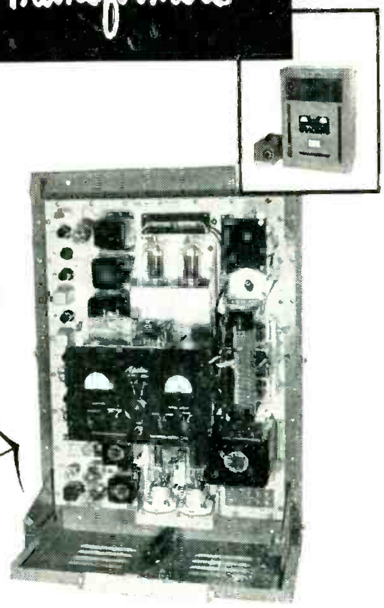


THAT'S WHY THE APELCO RADIOTELEPHONE USES

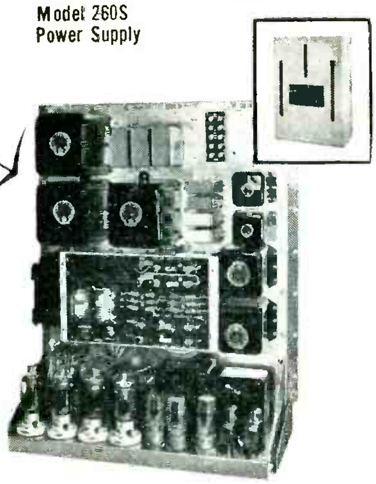
CHICAGO the World's Toughest Transformers

Applied Electronics Company, Inc., of San Francisco, builds the APELCO 260S Radiotelephone for point-to-point communication in oil exploration. This dependable equipment is the last word in rugged construction, designed to operate without failure in climatic extremes ranging from 35°F. below zero to the high temperatures and heavy humidity of tropical climates. For intermittent duty, the equipment must operate effectively from 80 volts to 140 volts input at 50-70 cycles.





Model 260S Power Supply



Because the rugged performance of APELCO Radiotelephone equipment is strongly dependent upon the quality of the components used, Applied Electronics specifies and uses CHICAGO Sealed-in-Steel Transformers throughout. Wherever optimum dependability and rugged performance are requirements, you'll find CHICAGO—the world's toughest transformers.

Model 260S Radiotelephone

Free "New Equipment" Catalog

You'll want the full details on CHICAGO'S *New Equipment Line*, covering the complete range of "Sealed-in-Steel" transformers for every modern circuit requirement. Write for your Free copy of Catalog CT-153 today, or get it from your electronic parts distributor.

CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

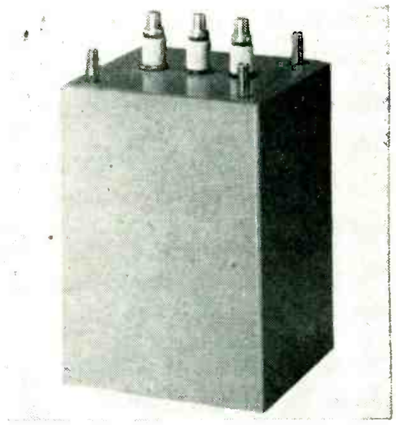
3501 ADDISON STREET, CHICAGO 18, ILL.

Export Sales Div.:
Scheel International, Inc
4237 N. Lincoln Ave.
Chicago, Ill., U.S.A.
CABLE ADDRESS: HARSHEEL

with a choice of several different wiring connections, these standard models will satisfy the large majority of applications of blocking oscillator circuits.

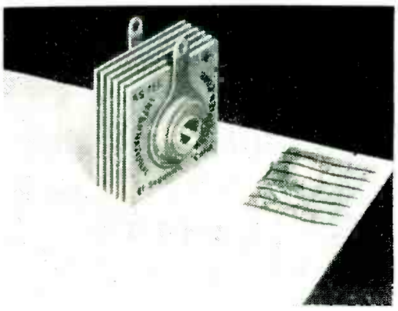
SIGNAL GENERATOR
for uhf and vhf

RADIO CITY PRODUCTS CO., INC., 152 W. 25th St., New York, N. Y., has developed the advanced design uhf-vhf Do-All tv signal generator. Covering all the uhf and vhf channels for every tv and f-m receiver, the model 750 contains test facilities for use as a pattern generator, marker generator and a signal generator. The instrument features an inductuner that insures accuracy within 0.5 percent over the entire range of 9 mc to 900 mc. It is designed for either portable or bench use.



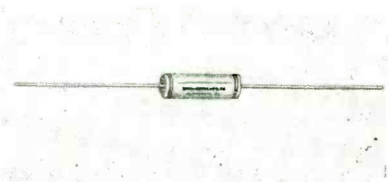
FILTERS
eliminate distortion

ORTHO FILTER CORP., 196 Albion Ave., Paterson, N. J., announces a new series of type DE filters for eliminating distortion from signal sources. They will eliminate harmonic frequencies from the second to the eighth by a minimum of 60 db, and are so designed that a drift of ±3 percent in frequency of the signal source will not affect the filtering action. These units are available in a variety of impedances and can be made for any frequency from 20 cps to 20 kc. The filters can be made for use in balanced or unbalanced circuits and find wide application in production test setups making low distortion measurements with any available signal generator.



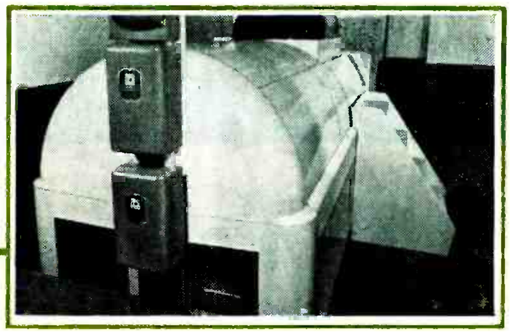
RECTIFIERS
for radio and tv use

INTERNATIONAL RECTIFIER CORP., 1521 E. Grand Ave., El Segundo, Calif., has developed a complete line of selenium rectifiers for use in radio, television, tv boosters and uhf converters. The units are rated for 130v rms maximum input for load currents of 20, 30, 40, 50, 65, 75, 100, 150, 200, 250, 300, 350, 450 and 1,000 ma. The rectifier illustrated is a type RS75E. It is rated as follows: maximum input, 130 v rms; maximum peak inverse, 380 v; maximum output current, 75 ma. A series resistor of at least 22 ohms is recommended as a current limiter when used with a capacitive filter. Overall dimensions are 1 in. wide x 1¼ in. high x ¾ in. deep. It is provided with a clearance hole for a number 8 machine screw for mounting.



RESISTOR
of the axial-lead type

SHALLCROSS MFG. CO., Collingdale, Pa., has developed a new axial-lead precision wirewound resistor for subminiature electric and electronic equipment. Type 18 resistor is rated at 0.25 w, yet it measures only ¾ in. long by 3/32 in. in diameter. Featuring a noninductive winding and a standard tolerance of 1 percent, the tiny resistor is available in resistance values up to 400,000 ohms. The resistor's tinned axial



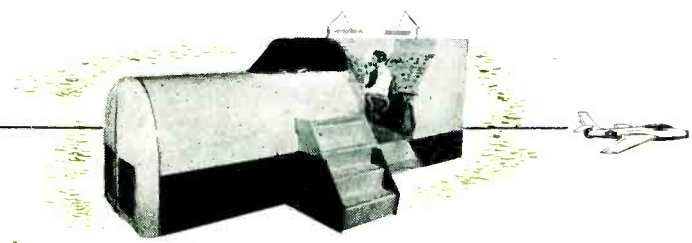
Front View of C-11B Jet Flight Trainer as it appears installed in its mobile training room. Steps lead to pilot's station under the canopy. Trailer training room is 14 x 20 with wall extended.

THE LINK TRAILERIZED ELECTRONIC JET TRAINER

Air National Guard units throughout the country now have the same time-saving jet-transition training as all of our flying services—made possible by the new Link C-11B Trailerized Electronic Jet Trainer.

In the same manner as stationary units installed at U. S. Air Force and U. S. Navy bases throughout the world, the new trailerized unit simulates every power and aerodynamic factor that influences take-off, flight and landing.

Link Electronic Jet Trainers operate with dependable certainty. They duplicate *exactly* the take-off, landing and "in air" conditions of today's most advanced aircraft—speed, direction, rate of climb, effect of fuel consumption on trim, flight position, deviation and a host of others.

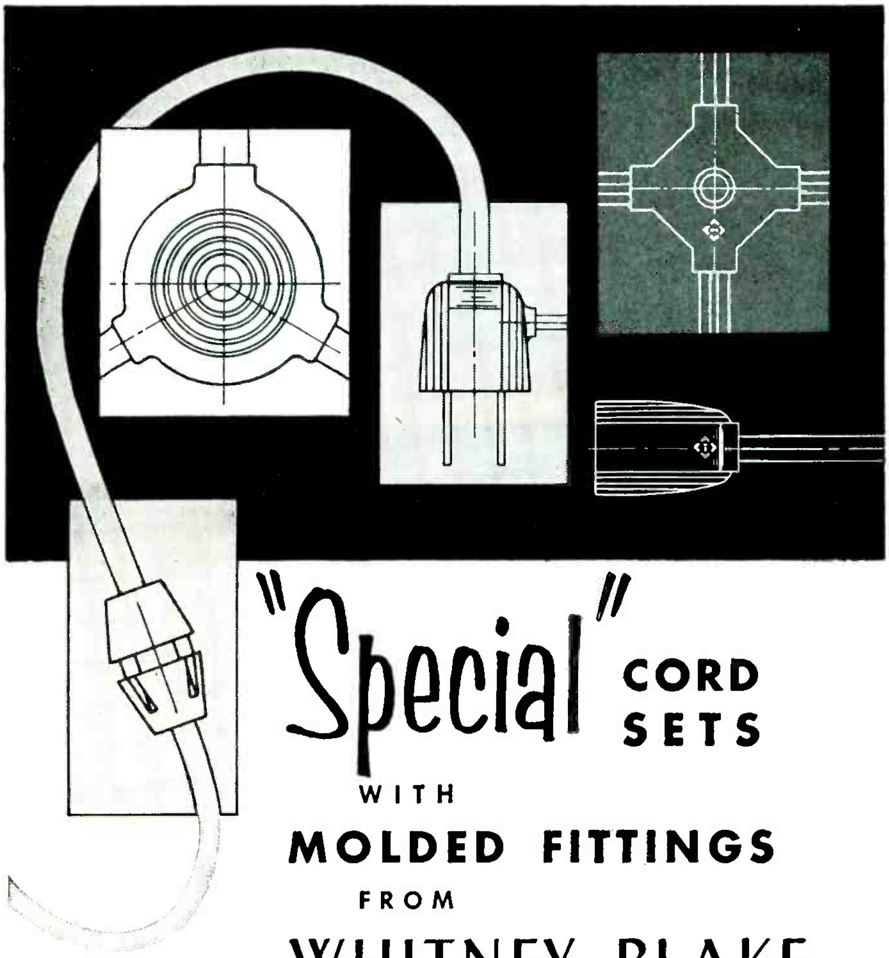


the connecting link between ground and sky

LINK AVIATION, INC. BINGHAMTON, N. Y.

LINK invites employment applications from engineers and draftsmen.

Want more information? Use post card on last page.



Whitney Blake Company is equipped to mold rubber and plastic fittings onto flexible cord, shielded communications wires and multiple conductor cables — in addition to making the cordage itself.

Whitney Blake has wide experience in designing and manufacturing shielded multiple conductor cables and assembling intricate connectors for electronic applications. Skilled workers, modern equipment, efficient production methods and careful quality control assure dependable, first quality cord sets.

Where standard molds are unsuitable, Whitney Blake will design and make special plugs, connectors, strain reliefs and junction box blocks that provide the water- and impact-resistance, small size, light weight and protection from tampering required for many new applications.

For help with your special cord set problems, contact us for the address of your nearest Whitney Blake representative. He will be glad to work with you. If your product is in the design stage, information on its intended use may enable him to suggest a cord set construction using conventional parts at savings to you.

WELL BUILT WIRES SINCE 1899

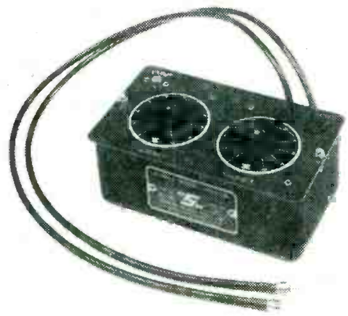
WB® WHITNEY BLAKE CO.

NEW HAVEN 14, CONNECTICUT

wire leads are firmly anchored to the steatite bobbin. When processed with the company's BX impregnation, the resistor will give reliable operation under prolonged exposure to high humidity. For less severe atmospheres, the resistor is available with lacquer coating.

C-R OSCILLOGRAPH
offers h-f analysis

Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J. Type 303AH c-r oscillograph operates at 10-kv accelerating potential, exhibits a maximum sweep speed of 6 in. per μsec, a deflection factor of 0.16 v per in. with 0.033-μsec rise time. In addition to excellent sync performance on rectangular waves, it syncs well on sine waves from 20 cps to more than 15 mc. These figures include the self-contained delay line.

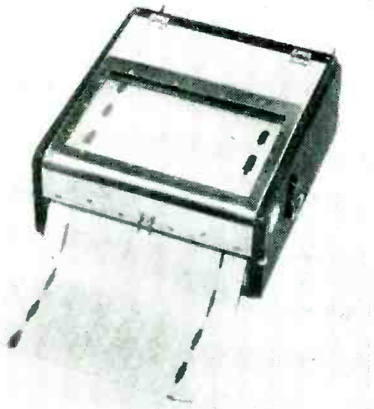


SPEAKER CROSSOVER
is resistive-capacitive

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass. With the 214-X8 variable speaker crossover, speaker woofers and tweeters can operate under the best condtions of speaker damping relative output balance, and without the undesirable effects of L-C crossover networks. Since the unit is entirely resistive-capacitive, all effects of resonant underdamping are eliminated, thereby avoiding effects of L-C filters which are critical with respect to terminated impedances. Two controls are provided. One provides continuous adjustment of crossover frequency from 175 to 3,000 cycles, and the other allows continuous adjustment of acoustical balance between woofer and tweeter to compensate for different speaker efficiencies.

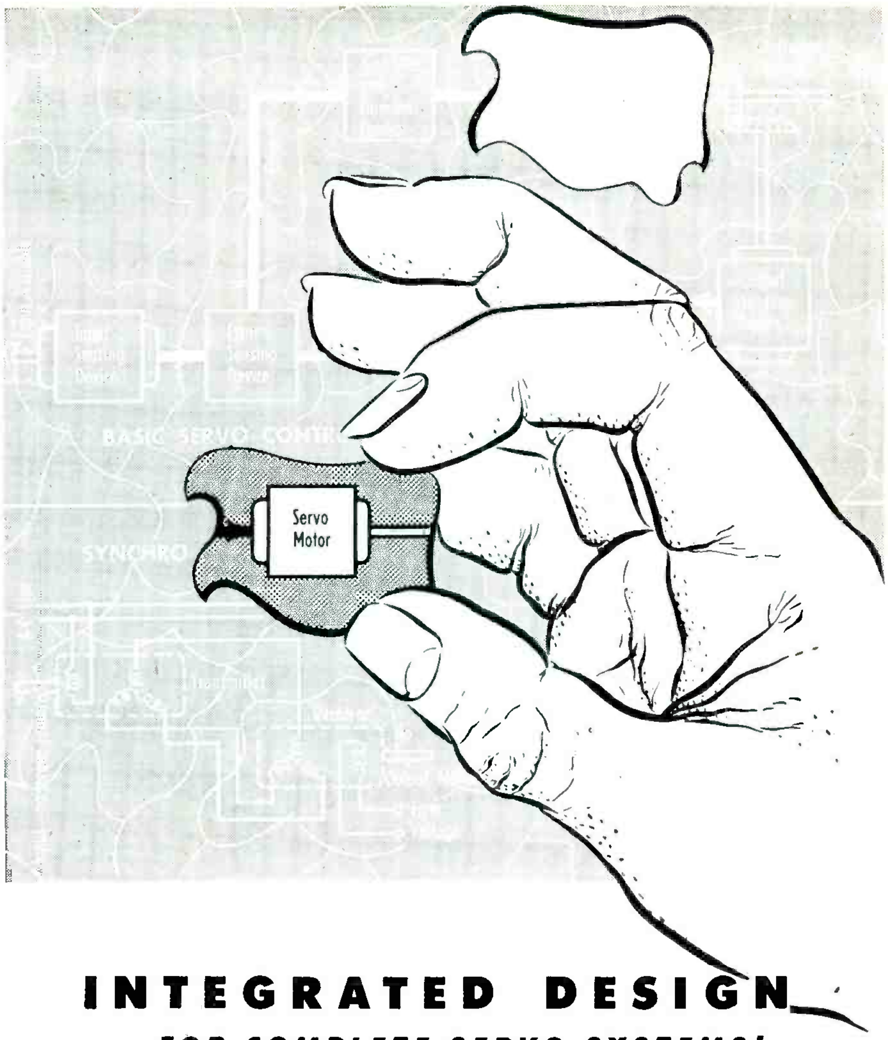
VARNISH
is heat-resistant type

IRVINGTON VARNISH AND INSULATOR Co., Irvington, N. J. A new insulating varnish, known as Irvington No. 180, has undergone extensive laboratory and preliminary field tests which indicate no adverse effects on numerous electrical applications when operated at elevated temperatures as high as 356F (180 C). It has a clear color, excellent oil and moisture resistance, with a dry dielectric strength of 2,100 v per mil. Complete information on its properties is found in a recently issued technical data sheet.



OSCILLOGRAPH
is compact and portable

BRUSH ELECTRONICS Co., 3405 Perkins Ave., Cleveland 14, Ohio, has announced a new portable 6-channel oscillograph, designed for use where the need for a lightweight, compact and portable instrument is important. Model BL-226 oscillograph is equipped with 6 model BL-902A Penmotors that permit the simultaneous recording of 6 channels of instantaneous electric phenomena, or mechanical phenomena that can be converted to electrical phenomena, in the frequency range of d-c to 100 cps. A large window in the top of the instrument permits viewing the chart as information is being recorded. Controls



INTEGRATED DESIGN

...FOR COMPLETE SERVO SYSTEMS!

Like pieces in a jig-saw puzzle, all components in a Transicoil servo system are designed to fit each other . . . coordinating to form the complete picture. Systems made by piecing together unmatched components usually spoil the picture by limiting the final efficiency of the entire system.

But if building your own system seems desirable, you'll find that individual Transicoil components offer the best performance in the job each is required to do. Built to your exact specifications, ready for immediate application, their ability to fit into the picture of your system is limited only by the restrictions you place upon them.

Details covering Transicoil Servo Systems, or components are available upon request to . . .

TRANSICOIL CORPORATION 107 GRAND STREET NEW YORK 13, N.Y.

Want more information? Use post card on last page.

www.americanradiohistory.com

For RF interference suppression

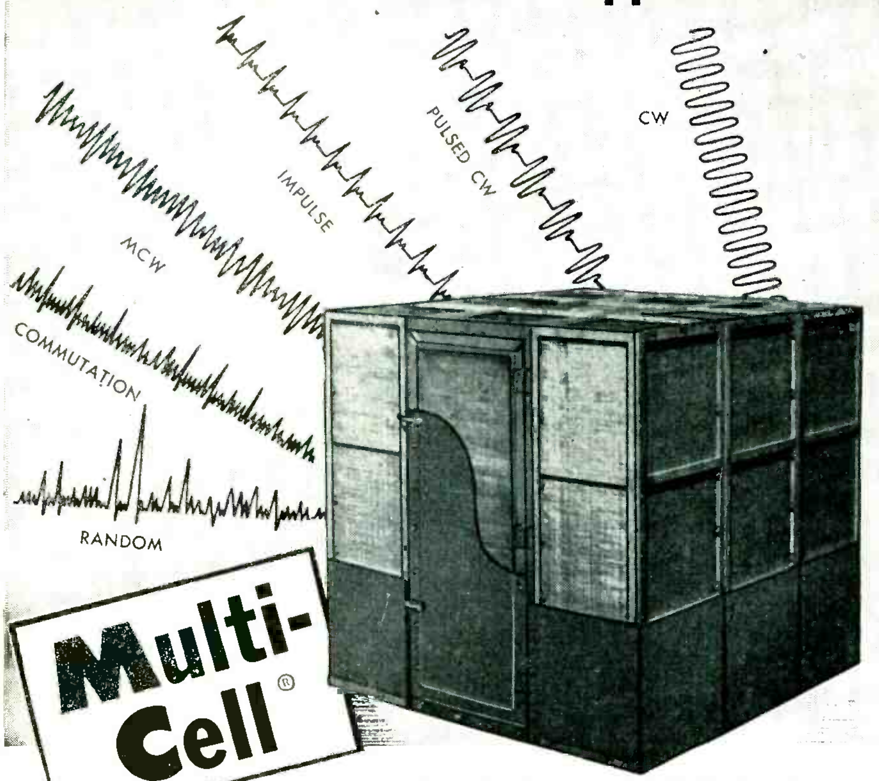


Illustration shows typical MULTI-CELL® double shield, multiple cell screen room with interchangeable sections and buffer panels.

REGISTERED

SHIELDING ROOMS

PROVEN . . . *the best shielding available over the major portion of the Spectrum in use today . . .*

Attenuation characteristics approaching the ultimate, jig-precision sectional construction, and superior set-up flexibility have won top rating for MULTI-CELL® Shielding rooms with military, industrial and scientific organizations. Their better performance, under the most difficult of field conditions, has been thoroughly proved and fully recorded for the information of engineers with shielding problems. Consultation available anywhere — without obligation.

JAN-1 225. 16E4 (Ships), MIL-1-16910,* MIL-S-4957

Specifications fully met, in addition to all others for electrical and electronic equipment performance in research, development and production. Attenuation Min. 100db from .15 to 10,000 MC. Room sizes and types as required.

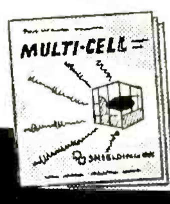
**Standard, approved Military specifications for shielding rooms.*

Greatly increased manufacturing facilities and personnel now enables us to give PROMPT SERVICE and FAST DELIVERY anywhere.

CHICAGO, ILL., OFFICE: 5306 W. Lawrence Ave.
Phone: Spring 7-8833

LOS ANGELES, CAL., OFFICE: 2924 Selby Ave.
Phone: Vermont 9-6388

CATALOG ON REQUEST



R-F SHIELDING ROOMS

SHIELDING, INC.

RIVERSIDE, N. J.

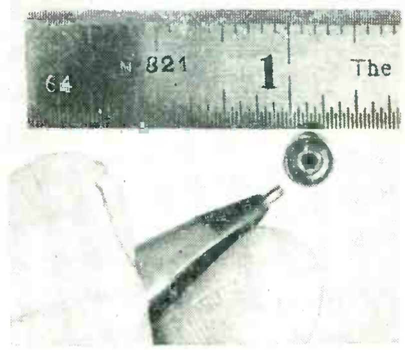
Phone: Riverside, N. J. 4-1202

"The Talent to Create— The Skill to Produce"

provide starting, stopping and selection of chart speeds of 5, 25 and 125 mm per sec.

BREAKDOWN TESTER
for high-voltage use

INDUSTRIAL INSTRUMENTS, INC., 89 Commerce Road, Cedar Grove, N. J., announces model P-7-20 high-voltage breakdown tester. It supplies a-c and d-c continuously variable between 0 and 20,000 v at low current drain. Maximum currents available are approximately 15 ma d-c or 20 ma a-c. Short circuit current is limited in value by the internal resistance of the test set and no damage will occur if the short circuit current is maintained for long periods of time. Cutoff control is provided so that power is turned off when load current exceeds any preset value from 5 to 20 ma. Load current, a-c or d-c, is read directly on the milliammeter. The d-c voltage and peak a-c voltage are read directly on the voltmeter.

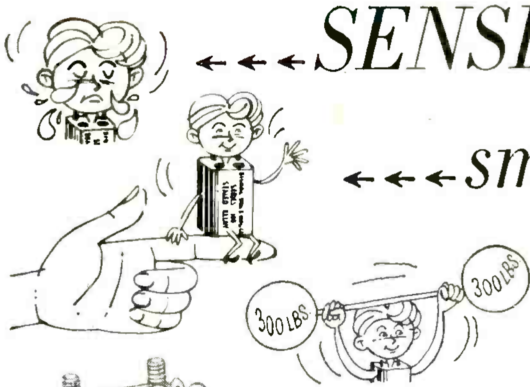


TINY BALL BEARING
is oil-sealed

LANDIS & GYR, 45 W. 45th St., New York 36, N. Y. Measuring 0.1969 in. O.D., with a bore of 0.0591 in., this miniature sealed ball bearing is a Conrad type with deep-groove inner and outer raceways and a ball retainer. Outstanding feature is a capillary film of lubricating oil that forms between the tapered outer surface of the inner race and the edge of a precision closure. This film of oil effectively seals the bearing against dirt and moisture and prevents loss of the lubricant, without any significant increase in fric-

Want more information? Use post card on last page.

www.americanradiohistory.com



←←←SENSITIVE...

←←←small...

←←←rugged

DIMENSIONS
1"x1"x1¾"

THE NEW SERIES 100 RELAY
(Hermetically Sealed)

One of the greatest challenges in the field of electronics is the designing of components small enough and rugged enough for today's and tomorrow's "miracle" machines and equipment.

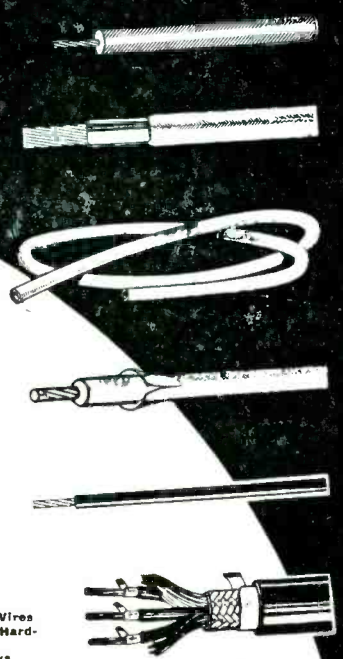
The engineers of the Signal Engineering & Mfg. Co., always alert to this challenge, now offer the new Series 100 Miniature Relay which is among the smallest and most sensitive of the double-pole type. It maintains high precision under varying conditions and is ideally suited to such equipment as military guided missile controls which must withstand extremes of shock, vibration, and temperature.

Write now for Bulletin SR—6

Engineering Representatives in Principal Cities.

Wheelock RELAYS
SIGNAL
ENGINEERING & MFG. CO.
154 WEST 14TH ST. NEW YORK 11, N.Y.

BIRNBACH
Electronic
WIRE & CABLE



For ALL Your Wiring Needs!

GOVT. SPEC. HOOKUP WIRE

- **JAN-C-76 SRIR-SRHV PLASTIC**
  Solid Colors or Spiral Markings
- **WL-EXTRUDED NYLON JACKET**
  Solid Colors or Spiral Markings
- **AIRCRAFT WIRE-NYLON JACKET**
  MIL-W-5086 (Supersedes AN-J-C-48a) also MIL-C-7078 (with shield).
- **105° C. U.L. APPROVED**
  Thermoplastic Hookup Wire
- **JAN-C-76 WL-GLASS BRAID**
  Solid or Tracer Colors
- **MULTICONDUCTOR, SHIELDED CABLES**
  1 to 8 cond., Rubber covered, shielded & unshielded.

COMPLETE WAREHOUSE STOCKS

- Vinyl Extruded and Radio Grade Tubing
- Multiconductor Rubber Covered Cables
- Tinned & Bare Wire
- Magnet Wire
- Formvar Wire
- Shielded Wires
- Insulated Hardware
- Plugs, Jacks, Sockets
- Test Leads, Switches
- Insulators, Steatite Ceramic
- Terminal Strips

Quality Products for the Electronics Industries since 1923

BIRNBACH

BIRNBACH RADIO CO. INC.
145 HUDSON STREET
NEW YORK 13, N. Y.

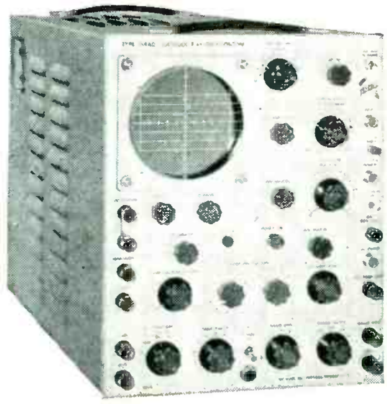
WRITE FOR CATALOG 53-E

To Readers Outside North America

The Field Maintenance Department of Tektronix, Inc. has replacement parts available for immediate shipment to users throughout the world. On replacement parts shipments, Tektronix assumes the cost of surface transportation anywhere, and the cost of emergency air shipments in North America. Although it is economically unsound to assume overseas AIR transportation costs, in the case of urgency Tektronix will assume half these costs. As a convenience we will prepay overseas air shipments and invoice the customer for his half of th cost. This service applies to "in-warranty" and "out-of-warranty" replacements, and is possible because the Tektronix Field Maintenance Department is operated as a non-profit customer service.

☆ ☆ ☆

Laboratory Oscilloscope



The Tektronix Type 514A-D Cathode-Ray Oscilloscope has the versatility necessary for general purpose laboratory use. Its direct-coupled 10 mc vertical amplifier provides excellent transient response. Six centimeters of undistorted vertical deflection can be displayed on the new precision flat-faced 5" cathode-ray tube. A new 5x sweep magnifier adds to the utility of the wide, continuously variable time base range. Direct-coupled unblanking assures a steady intensity level with sweep speed or duty cycle changes. The amplitude and duty cycle of the new square-wave voltage calibrator are both continuously variable.

Condensed Specifications

Vertical Amplifier
Risetime — 0.04 μsec
Bandwidth — dc to 10 mc
ac — 2 cycles to 10 mc

Sensitivity
dc — 0.3 v/cm to 100 v/cm
ac — 0.03 v/cm to 100 v/cm

Calibrator
0 to 50 v square wave, accurate within 3%, duty cycle variable 2% to 98%

Time Base Range
0.1 μsec/cm to 0.01 sec/cm, continuously variable, accurate within 5%

Single, triggered, or recurrent sweeps
5x sweep magnifier
3 kv accelerating potential
All dc voltages electronically regulated

Supply Voltage — 105 to 125 v or 210 to 250 v, 50 to 60 cycles.

Type 514A-D $950 f.o.b. Portland, Oregon

Tektronix, Inc.
P.O. Box 831A, Portland 7, Oregon
Cable: TEKTRONIX

 Want more information? Use post card on last page.

www.americanradiohistory.com

Tough... flexible... uniform

CAROL antenna cable

Carol antenna cable is ideal for connections to TV and FM receiving antennas and motorized antenna rotators. Insulation is Carol Polyethylene—a low-loss, high strength dielectric that stays flexible and strong over a wide temperature range, and resists moisture, oxidation and corona.

Consistently high quality in the cable you receive is guaranteed by precision extrusion . . . accurate temperature control . . . and strict production control methods including constant inspection and micrometer gauging.

Supplied in twin-conductor types, No. 18, 20 or 22 AWG; and 3, 4 or 5-conductor, No. 20 AWG; with clear, amber, or brown polyethylene.

Write or call Carol today for full details on our complete line of cables for electronic applications.

CAROL
CABLE DIVISION
of The
CRESCENT COMPANY INC.
Pawtucket, Rhode Island

Want more information? Use post card on last page.

tional torque. The bearings are recommended for indicating and recording meters, precision instruments, computers and any small mechanism where low torque and long life with a minimum of attention are desired.

Literature

Toroidal Inductors. Torocoil Co., 1374 Mobile Court, St. Louis 10, Mo., has released a two-page folder describing numerous features of its standard line of toroidally wound powdered molybdenum permalloy inductors. Frequency characteristics, temperature effect, quality factor, size and price of the individual units are covered.

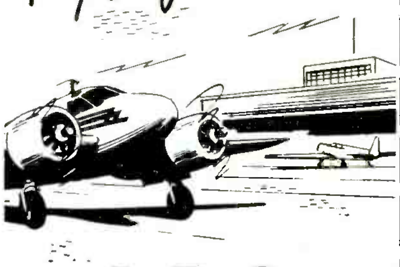
Single-Sideband Filters. Burnell & Co., 45 Warburton Ave., Yonkers, N. Y., announces a two-page flyer describing a new series of single-sideband filters and including frequency response curves. They also announce that there will soon be available an entirely new and complete catalog of toroidal coils, filters and audio networks.

Compound Diffraction Projector. Electro-Voice, Inc., Buchanan, Mich., has published bulletin No. 197 giving full details of the CDP compound diffraction projector, a new p-a loudspeaker system designed to provide improved voice penetration and full range musicasting. The bulletin explains the performance and operating features of this compact, rugged new type coaxial sound projector, illustrates and describes the audio diffraction principle, compares polar pattern and response curve with existing reentrant type horns, gives coverage and efficiency information and mounting instructions. It also lists and describes the accessories available for the CDP.

Quality Report. Hunter Spring Co., Lansdale, Pa. A new 12-page booklet discusses the quality report, its interpretation and value to users of springs and other manufactured products. Written in a clear, brief

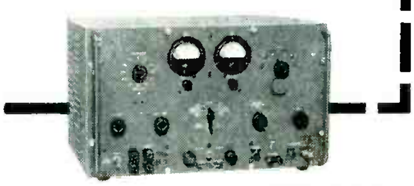
CHECK ACCURATELY...

Fly Confidently!



A.R.C. SIGNAL GENERATOR

Gives a Quick, Accurate Check of VHF Airborne Navigation Equipment



TYPE H-14
108-132 Megacycles

■ Favorite, dependable instrument for quick, accurate check of VHF airborne omnirange and localizer receivers in aircraft or on the bench. It checks up to 24 omni courses, omni course sensitivity, to-from and flag-alarm operation, left-center-right on 90/150 cycle localizers. Widely used for all quantitative bench tests. For ramp check, RF output 1 volt into 52 ohm line; for bench checks, 0-10,000 microvolts. AF output available for bench maintenance and trouble shooting.

Price $942.00 net, f.o.b. Boonton, N. J.

Ask for literature on new A.R.C. Type H-16 Standard Course Checker — a simple, precise instrument for checking the phase-accuracy of the modulation on VOR (omnirange) signal generators. For laboratory or field use.

Price $398.00 f.o.b. Boonton, N. J.

ARC — Dependable Airborne Electronic Equipment Since 1928

Aircraft Radio Corporation
BOONTON NEW JERSEY

Want more information? Use post card on last page.

www.americanradiohistory.com

ELIMINATE SHOCK PROBLEMS

SPECIFY *Standard Piezo* CRYSTALS

Standard Piezo Crystals are rugged . . . built to deliver dependable performance under extremely adverse conditions. Send for our completely illustrated catalog, or outline your own particular crystal problem. Our engineering department will be glad to assist you.

Standard Piezo
COMPANY
CARLISLE, PENNA.

SQUARE PULSE GENERATORS for the MILLIMICROSECOND TO MICROSECOND RANGE

Model 100

Model 200

For nuclear pulse work, radar, TV, wide band amplifiers and in the design, calibration, and servicing of fast electronic systems.

NOW—New Square Pulse Generators with a rise time of one millimicrosecond (10^{-9} seconds) and a pulse width which can be varied from one millimicrosecond to several microseconds is commercially available. Positive and negative pulses of 100 volts maximum amplitude are generated; the pulse amplitude can be varied from 100 volts to 0.006 volts in 1 db steps. The output impedance is matched to the common impedance coaxial cables in use.

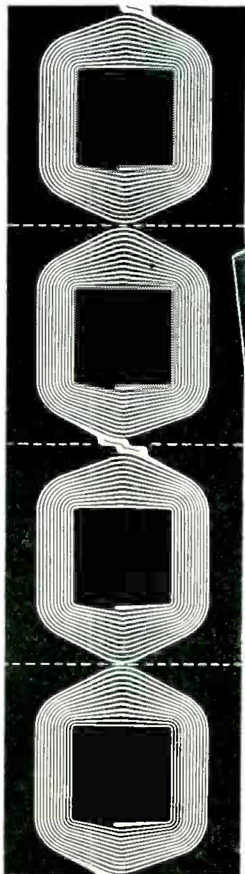
MODEL 100—Single pulse output
MODEL 200—Double pulse output—
(each pulse may be individually attenuated and delayed)
MODEL 300—Three or more pulse outputs

ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION

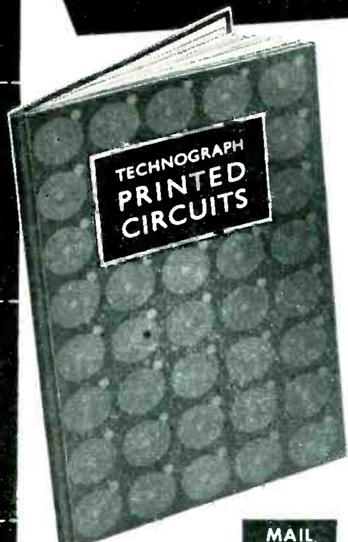
DESIGN, DEVELOPMENT AND MANUFACTURE
ELECTRONIC AND ELECTRICAL DEVICES

Sales and Business Office
25 West 43rd Street
New York 36, N. Y.
Telephone: Longacre 4-2265

Engineering Division
42-19 27th Street
Long Island City 1, N. Y.
Telephone: Stillwell 4-6389



Just released... $1.00



THE
TECHNOGRAPH
SYSTEM OF
PRINTED CIRCUITS
fully explained

in 48 pages of clear text and illustrations by the originators and holders of the basic patents . . . Technograph Printed Circuits, Ltd. (Henderson & Spalding) of England.

Valuable reading for Engineers and Businessmen alike . . . The key to future development of many electronic components.

48 pages 5⅝" x 8⅝" with attractive hard cover.

CONTENTS:
- Origin and Early Development
- The Technograph System Described
- Advantages of Printed Circuits
- Economic Aspects

MAIL COUPON TODAY

TECHNOGRAPH PRINTED ELECTRONICS, INC.
191 Main Street, Tarrytown, New York, Dept. E8
Gentlemen:
Please send me postpaid, ______ copies of your book, The Technograph System of Printed Circuits. I enclose $1.00 for each.
Name______
Street______
City______ State______

TECHNOGRAPH
PRINTED ELECTRONICS, INCORPORATED
191 Main Street • Tarrytown, New York

style for engineers and purchasing agents as well as for inspectors, the handy $5\frac{1}{2} \times 7\frac{1}{4}$ in. booklet is divided into 8 sections covering such subjects as "Types of Inspection" and "How to Use a Quality Report." A quality report is a frequency distribution of the critical characteristics of a product, prepared during final inspection by the manufacturer and delivered to the user with each shipment as graphic verification of conformance to specifications. The booklet describes the preparation of a frequency distribution in variables inspection by either the user or manufacturer. A section called "Interpreting the Quality Report" gives 15 typical frequency distributions and states for each what product condition it represents and what action is indicated.

Meters and Controls. Bailey Meter Co., 1050 Invanhoe Road, Cleveland 10, Ohio. Bulletin 18 is a comprehensive catalog offering information on the company's complete line of meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, illustrations and detailed literature references are included.

Regulated Power Supplies. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif. Bulletin L453 is an 8-page publication covering a line of magnetic amplifier regulated power supplies for laboratory testing applications. The bulletin describes high-voltage and low-voltage power supplies with regulations down to 0.15 percent.

Sound Equipment. Shields Laboratories, Inc., 810 N. Lincoln Ave., Pittsburgh 12, Pa., has available two catalog sheets on its audio equipment. One describes and illustrates the model PE-1 preamplifier-equalizer that fulfills necessary functions in the reproduction of recorded music from modern magnetic pickups. The other lists the outstanding features of the model

U. G. CONNECTORS

Our Coaxial Cable Connectors Meet All Government Specifications

★ ALL ORDERS DELIVERED PROMPTLY ★

Manufacturers of Highest Quality Connectors

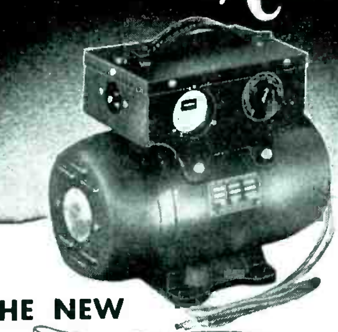
•

ALLIED INDUSTRIES, INC.

1023 S. 21st STREET
LOUISVILLE 10, KY.

Phone Arlington 4640

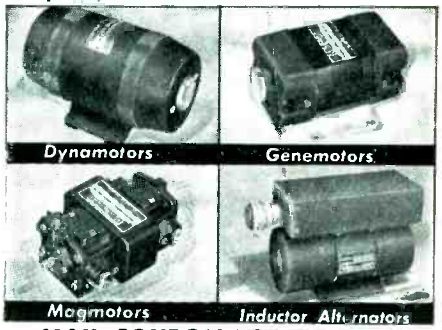
COMPACT
DEPENDABLE
EFFICIENT
Rotary Power by Carter



THE NEW *Custom*

DC-AC CONVERTER

These latest of all Carter DC to AC Converters are specially engineered for professional and commercial applications requiring a high capacity source of 60 cycle AC from a DC power supply. Operates from storage batteries, or from DC line voltage. Three "Custom" models, delivering 300, 400, or 500 watts 115 or 220 V. AC. Wide range of input voltage, 12, 24, 32, 64, 110 or 230 V. DC. Unequalled capacity for operating professional recording, sound movie equipment and large screen TV receivers. Available with or without manual frequency control feature.



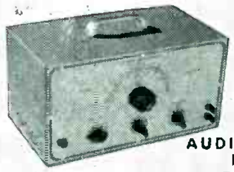
MAIL COUPON FOR CATALOG

Carter Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. MAIL COUPON NOW for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

Carter MOTOR CO.
2646 N. Maplewood Ave.
Chicago 47

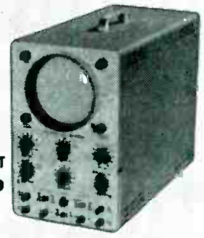
Carter Motor Co.
2646 N. Maplewood Ave., Chicago 47
Please send new catalogs containing complete information on Carter "Custom" Converters and other Rotary Power Supplies.

Name____________________
Address____________________
City______________State________



AUDIO GEN. KIT
$29.50

R. F. SIGNAL GEN. KIT
$19.50



5" SCOPE KIT
$43.50

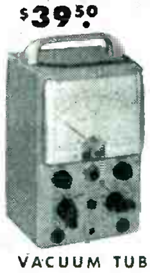
T.V. ALIGN. GEN. KIT
$39.50

BUILD YOUR OWN
Heathkit
TEST EQUIPMENT

SIGNAL TRACER KIT
$22.50

Heathkits are completely engineered instruments supplied unassembled. Every kit goes together smoothly and easily. All drilling, punching, and painting has already been done for you. All parts are furnished and are of highest quality.

Detailed construction manual shows clearly where each wire and part goes and tells exactly how to build the kit. Write for free catalog.



VACUUM TUBE VOLTMETER KIT
$24.50

BATTERY ELIMINATOR KIT
$24.50

HEATH COMPANY

BENTON HARBOR 14, MICHIGAN

EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 East 40th Street
NEW YORK CITY (16)

IMPEDANCE BRIDGE KIT
$69.50

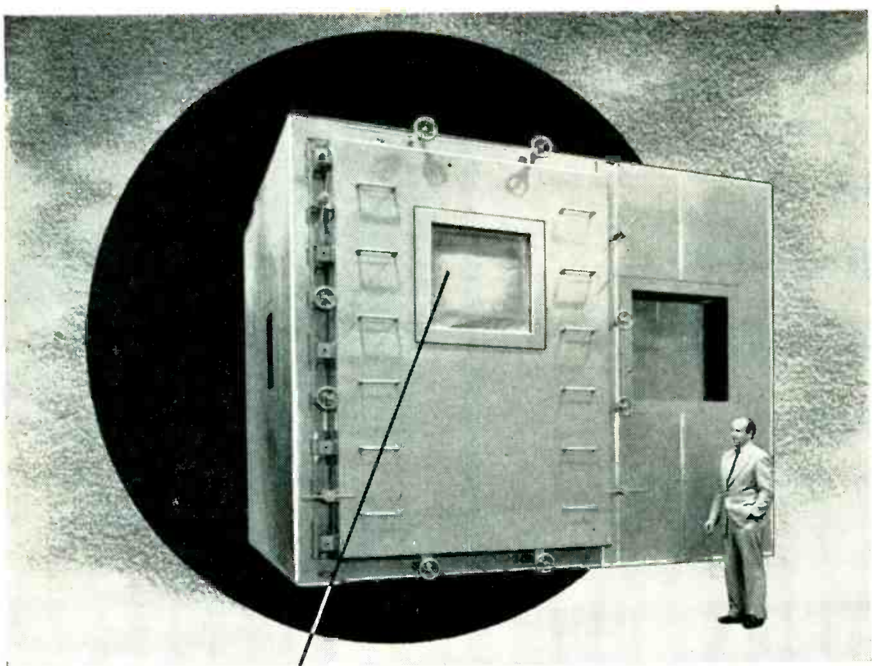
TUBE CHECKER KIT
$29.50

GRID DIP METER KIT $19.50

CONDENSER CHECKER KIT
$19.50

Want more information? Use post card on last page.

www.americanradiohistory.com

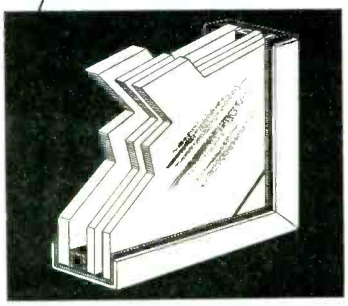


BOWSER ENGINEERED . . . YOU SEE

Frosting of windows is no problem in a Bowser Low Temperature Test Chamber. Special Nesa glass, with its electrically conductive surface, insures clear vision of items under test. This is just one of the many "extras" that Bowser has engineered into its test chambers . . . another reason why—for all your needs in environmental test equipment—your best bet is Bowser, the pioneer.
Performance characteristics of this Bowser chamber include:

- Temperature range from −100°F to 185°F.
- Altitude simulation up to 85,000 feet.
- Evacuation rate of 5000 F.P.M.

With outside dimensions of 13' 2" wide x 11' 2" high x 16' 6" long, this standard model chamber has an interior working area of 10' x 10' x 8' high. Door is 5' wide x 8' high, its window 30" x 30", and wall window 36" x 36".



NESA GLASS

Nesa Coated Glass used in Bowser Low Temperature Chambers has an electrically conductive surface that can be heated . . . preventing icing, frosting or fogging of observation windows.

BTR DEPENDABILITY

BOWSER TECHNICAL REFRIGERATION

DIVISION BOWSER, INC. TERRYVILLE CONNECTICUT

RVC-10 remote volume control that is designed to provide the user with a convenient means of varying the volume of any high-fidelity music system, radio or tv receiver from a remote point. The RVC-10 described provides over 30 db of continuous, smooth volume variation.

Components Catalog. P. R. Mallory & Co. Inc., 3029 E. Washington St., Indianapolis 6, Ind., has available the 1953 catalog (No. 553) of precision electronic components. The catalog lists and describes more than 2,200 items, mostly replacement components, that are handled through the company's distributor system. The catalog also includes list prices for items listed. Components shown represent 7 of the company's 10 manufacturing divisions: Battery, Capacitor, Rectifier, Resistor, Switch, Tuner and Vibrator.

Microwave Radio for Pipelines. Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Application of the new 2,000-mc microwave radio equipment to the pipeline industry is described in booklet B-5851. Features of the type FR microwave radio and type FJ multiplexing equipment and their importance to the pipeline industry are discussed. Points covered include frequency division multiplexing, crystal frequency control, standby equipment, maintenance features and many others.

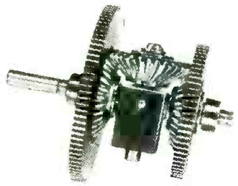
Electronic Computer. Ferranti Ltd., Moston, Manchester 10, Lancashire, England, has published a well-illustrated booklet dealing with the Manchester universal electronic computer. Included are historical information, a complete description of the application of computers, technical data on this particular type and a brief survey of the company's products. One page of the booklet is devoted to an invitation for inquiries.

Tubular Paper Capacitors. Pyramid Electric Co., 1445 Hudson Blvd., North Bergen, N. J. Catalog PG-3 contains complete engineering data, performance curves, construction styles, sizes, capacitance and voltage listings for a line of

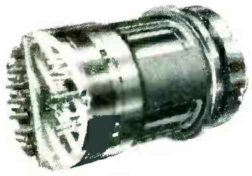
www.americanradiohistory.com

FORD INSTRUMENT COMPONENTS

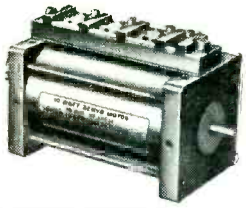
Ford Instrument Company makes the finest precision instruments and mechanisms for industry and the armed forces.



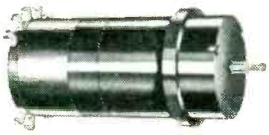
FORD MECHANICAL DIFFERENTIALS with single spider gear—available in 3/16," 1/4" and 5/16" shaft diameters —high accuracy, low friction.



FORD TELESYN UNITS are available in wide selection of sizes—proved precision accuracy, corrosion and fungus resistance mean better synchros when you specify Telesyn.



FORD SERVO MOTORS (60 and 400 cycles) for extremely low inertia and high frequency response. 1/5; ½; 1½; 2½; 5; 10-watt models in both low and high voltage, including magnetic amplifier controlled types.



FORD ELECTRICAL RESOLVERS available in sizes 23 and 31—interchangeability, temperature compensation −60°F to +160°F, highest accuracy, adaptability, 400 cycle frequency.

Ford Instrument also makes magnetic amplifier systems, computers, converters, mechanical integrators and other instruments and equipment. Write for more details.

11

FORD INSTRUMENT COMPANY

Division of The Sperry Corporation
31-10 Thomson Ave., Long Island City 1, N. Y.

SWITCHCRAFT* NEW "JACK COVERS"

No. 510—Olive Drab
No. 515—Black
No. 520—Navy Grey

A rugged Jack Cover that provides a moisture-proof seal over the opening of a Phone Jack. This Jack Cover is a special lock-nut with hinged cover—special molded rubber washer inside cover provides a close fit to the special nut.

Switchcraft produces a complete line of Jacks to meet JAN specifications, consisting of such types as JJ-026, JJ-033, JJ-034, JJ-082, JJ-089, etc. Full information will be found in our catalog. Send for catalog S-52.

SWITCHCRAFT INC.

1336 N. Halsted St., Chicago 22, Ill.

Canadian Representative:
Atlas Radio Corp. Ltd., 560 King St. W., Toronto 2B, Canada. Phone: Waverly 4761

* Registered Trademark

VISIT OUR BOOTH
No. 919
WESTERN ELECTRONIC SHOW and CONVENTION
SAN FRANCISCO
AUGUST 19–21

AVAILABLE AT ALL LEADING RADIO PARTS JOBBERS •

TAKE NO CHANCES WITH VITAL EQUIPMENT... *Specify*

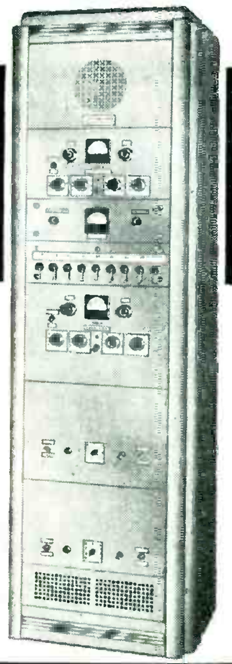
SERIES 6918 or 6924

RACKS by PAR-METAL

18½" or 24" DEEP, for 19" WIDE PANELS

- *Panel Spaces:* 61¼", 70", or 77" high.
- Finished in Prime Coat, Black Wrinkle, Grey Lacquer, Grey Wrinkle.
- Series 6918 or 6924 Racks may be used in "rows" or "gangs," as corner trims are removable from *front* of cabinet.
- Standard shelves and roller trucks are manufactured by us for use with these Racks.

THESE RACKS ARE MODERATELY PRICED and AVAILABLE FOR SHIPMENT FROM STOCK



Our P-6924 Rack as used by Gai-Tronics, Inc., Reading, Pa.

Planning an electronic product? Consult Par-Metal for

RACKS • CABINETS
CHASSIS • PANELS

Remember, Par-Metal equipment is made by *electronic specialists*, not just a sheet metal shop.

Made by Electronic Specialists!

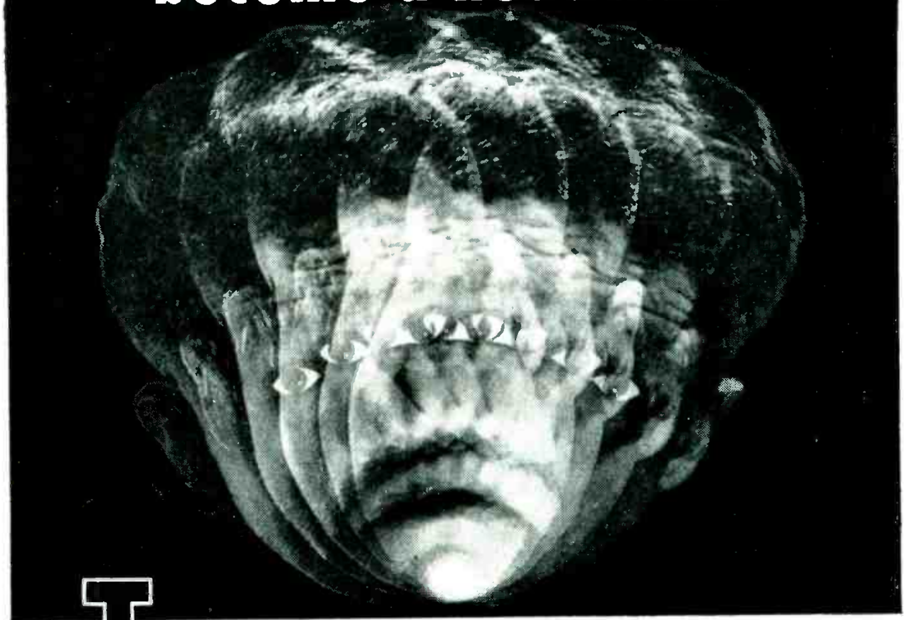
PAR-METAL ELECTRONIC HOUSINGS

PAR-METAL PRODUCTS CORPORATION
32-62 — 49th ST., LONG ISLAND CITY 3, N. Y.
Tel.: AStoria 8-8905
Export Dept.: Rocke International Corp.
13 East 40 Street, New York 16, N. Y.

WRITE FOR CATALOG!

www.americanradiohistory.com

When
VIBRATION
AND SHOCK
become a headache—



Turn to FINNFLEX for relief !

FINNFLEX offers MAXIMUM PROTECTION for VITAL EQUIPMENT by means of:—

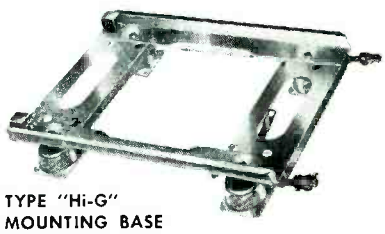
AIRBORNE MOUNTING BASES
VIBRATION ISOLATORS
SHOCK MOUNTS

Conform to JAN-C-172A, but are actually made to exceed MIL-E-5400 (Superseding AN-E-19) Drop Test requirements.

FINNFLEX Mounts isolate vibration and shock from Electronic, Communication, and Control Equipment. They offer unimpaired efficiency from —80° to +250°F., "*Selective Action*" friction dampening, *non-linear steel springs*, and other features. Many sizes, load ratings available.

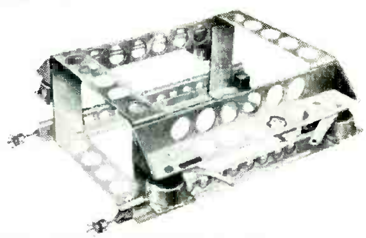
FINNFLEX 3-POINT SERVICE for SPECIAL PROBLEMS: (1) ***Testing:*** We have complete laboratory facilities for Vibration, Shock and Drop Testing . . . (2) ***Designing:*** We design and recommend a Shock or Vibration Mount best suited to your special needs . . . (3) ***Manufacturing:*** We have substantial facilities for manufacturing the desired unit in *any quantity, economically, and on schedule.*

Send us your problem today, or write for Catalog MB-110.



TYPE "Hi-G" MOUNTING BASE

These units have exceptional ruggedness, plus *a special reinforced structure* to withstand shock far in excess of 30 "G". This characteristic makes these bases ideal for use in carrier-based aircraft.



TYPE "CG" MOUNTING BASE

Especially designed for equipment having eccentric CG permitting a wide variation in the loads applied to the individual mounting. The use of FINNFLEX Vibration and Shock Material assures you of superlative Industrial or Governmental Bases and Mounts.

FINNFLEX

T. R. FINN & COMPANY, Inc.
Specialists in Vibration Control
333 JACKSON AVENUE, NEW YORK 54, N. Y.
Phone: CYpress 2-4192-3-4

Glasseal hermetically sealed miniature tubular paper capacitors. Also available is a wall chart giving a graphic representation of minimum insulation resistance requirements of the type H (Halowax impregnated), type M (mineral oil impregnated) and type X (synthetic oil impregnated).

Tape Wound Cores. Thomas & Skinner Steel Products Co., Inc., 1122 E. 23rd St., Indianapolis, Ind. Bulletin WC-353 describes a line of tape wound cores for saturable reactors, power transformers, and other electronic and electrical applications. It covers cores in both rectangular C and round toroidal types. Specifications and value graphs are provided, covering wound cores in 12 mil Ortho Sil, or oriented silicon-iron, for 60-cycle applications; and in 4 mil OrthoSil for 400 cycle and higher applications. The value graphs give evidence of Ortho Sil's high flux densities, with correspondingly low losses. Also shown by graph is OrthoSil's orthographic characteristic, providing an extremely rectangular hysteresis loop.

Power Wire Wound Resistors. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. Catalog bulletin C-1 covers tubular and flat power wire wound resistors. It includes comprehensive data on adjustable features, brackets, characteristics, coating, dimensions, derating, insulation, specifications, tolerances and windings. Contained in the 12 pages are photos, detailed charts and graphs.

Capacitors and Pulse Forming Networks. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa., has published a 28-page brochure that provides design and test data on Capitron capacitors and pulse forming networks and gives information on all important features of these components. Particular attention is given to Amplifilm, the new synthetic dielectric that makes it possible to effect tremendous reductions in size and weight of the units. Profusely illustrated with reproductions of

www.americanradiohistory.com

let WILLIAMS help you apply ferric oxides to the manufacture of your

FERRITES

You'll be well repaid by getting the facts on a special group of Pure Ferric Oxides, developed by Williams especially for use in the manufacture of ferrites.

Williams Ferric Oxides analyze better than 99% Fe_2O_3. They contain a minimum of impurities. They are available in a broad range of particle sizes and shapes. Among them, we're certain you'll find one that's "just right" for your requirements. The proper application of Ferric Oxides to the manufacture of Ferrites is our specialty.

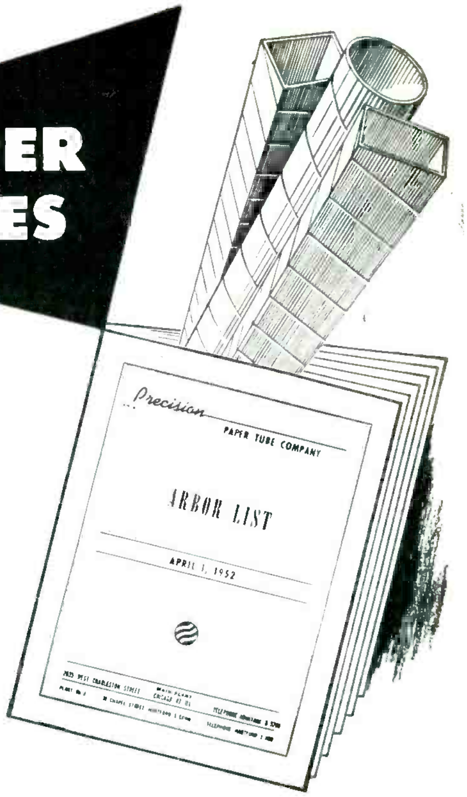
Tell us your requirements . . . we'll gladly send samples for test. Chances are good that our Ferric Oxide "Know How" can save you considerable time and money. Address Dept. 25, C. K. Williams & Co., Easton, Pa.

WILLIAMS
COLORS & PIGMENTS

C. K. WILLIAMS & CO.
Easton, Pa. • East St. Louis, Ill.
Emeryville, Cal.

P. S. We also produce IRN Magnetic Iron powders for the Electronic Core Industry, the Magnetic Tape Recording Industry and others. Write for complete technical information.

PRECISION PAPER TUBES



any shape . . . length . . . ID or OD . . . to meet your specific requirements

SEND FOR ARBOR LIST

Free to you upon request . . . lists over 2000 sizes . . . all promptly available. A free sample is also yours for the asking . . . just send your specifications.

Precision Paper Tubes are spiral-wound of finest dielectric kraft, fish paper, cellulose acetate, or combinations.

Write us today!

PRECISION PAPER TUBE CO.
PRECISION
2041 W. Charleston St. Chicago 47, Ill.
Plant No. 2: 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Bobbins

A timely tip on timing

Won't you take a timely tip on timing and take your timing problems to a company with a proven performance record. The A. W. HAYDON CO. has repeatedly been called upon by industry to solve the most difficult timing problems.

Regardless of how difficult your timing problems may appear to be, remember there has to be a solution . . . The A. W. HAYDON CO. are past masters at solving the most difficult and exacting of these problems.

Past performances prove future accomplishments . . . take a timely tip on timing and call The A. W. HAYDON CO. . . . their engineer consultants will gladly talk over any problem you may have.

The A. W. HAYDON COMPANY
235 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices

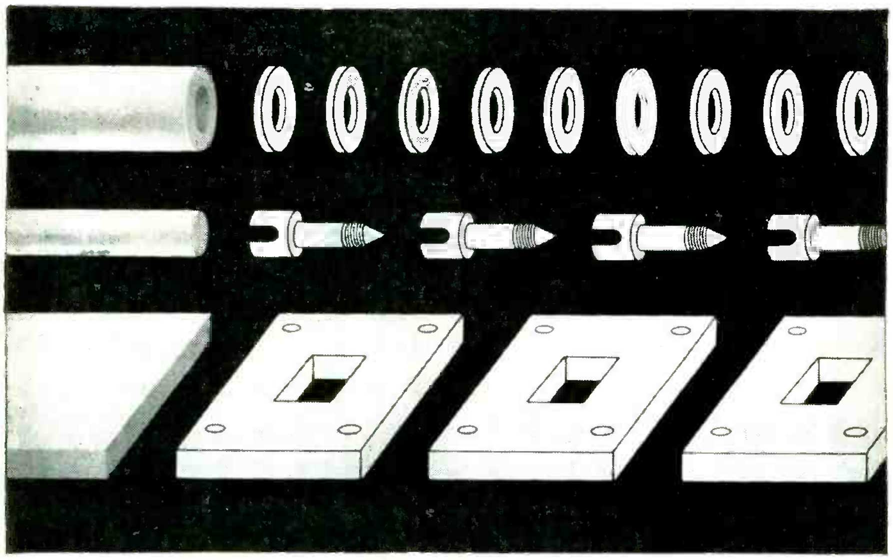
PREFERRED WHERE PERFORMANCE IS PARAMOUNT

Want more information? Use post card on last page.

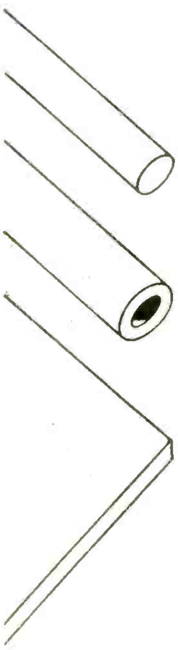
www.americanradiohistory.com

this TEFLON* gives you uniform parts...

electrically...dimensionally



Non porous **FLUOROFLEX®-T** *assures electrical stability.*
It's stress relieved for uniform machinability.



It's in the processing—not in the appearance—that the real difference in Teflon shows up. Natural discolorations don't mean a thing to performance. But variable *properties* do.

That's why Fluoroflex-T products are extruded or molded under rigid control. Specially designed equipment compacts Teflon powder to the critical density—which not only prevents porosity, but also assures highest tensile strength. Resistoflex processing relieves internal stresses to provide better dimensional stability without any porosity. In short, Fluoroflex-T rods, tubes and sheets offer *uniformly* optimum properties.

All this means non absorbent insulators, for optimum UHF performance . . . and also uniform machining with fewer rejects. Why not specify Fluoroflex-T for *your* Teflon parts? For more information write for Bulletin FT-1.

**DuPont trade mark for its tetrafluoroethylene resin.*
® Resistoflex trade mark for products from fluorocarbon resins.

RESISTOFLEX
corporation

Belleville 9, N. J.

SPECIALLY ENGINEERED FLEXIBLE RESISTANT PRODUCTS FOR INDUSTRY

actual test charts, the booklet points out that Capitrons are not made in a standard line of types or models, but are designed for the specific requirements of the equipment in which they are to be used.

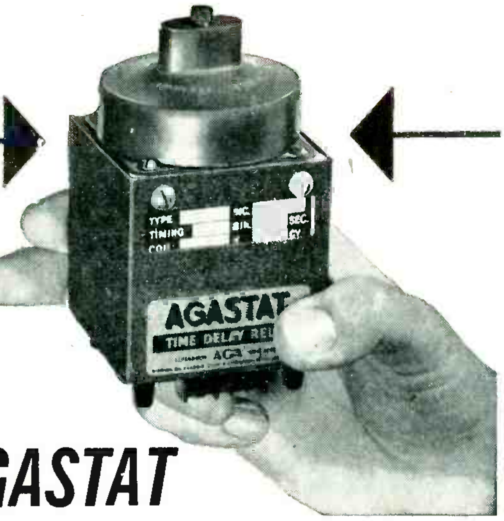
TV Fuse Guide. Littelfuse, Inc., 1865 Miner St., Desplains, Ill., has prepared a new and up-to-date tv fuse guide containing the very latest information on fuse usage in modern tv sets. The style of the revised guide has been changed because of the increase in the numbers of tv sets and models since the previous issue was published. The booklet is perforated so that set manufacturers, jobbers and service men can hang it on the wall conveniently and easily.

Silicon Diodes. Microwave Associates, Inc., 22 Cummington St., Boston, Mass., announces a new 2-color, 4-page brochure describing 11 silicon diodes for microwave mixer and video use. Designated as catalog 53S, the brochure is complete with distribution charts and tables for diodes for use from 10 to less than 1 cm. Special mention is made of new low noise, uniform impedance characteristic detectors for radar and the new microwave relay frequencies. Several types of diodes matched for use in balanced mixer use are described.

Airborne Transformer-Rectifiers. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif., has available literature dealing with a new series of airborne transformer-rectifier units for 28-v aircraft d-c power systems. The units described have current ratings up to 200 amperes; and are designed in accordance with the environmental and electrical requirements of MIL specifications, and result in considerable savings in weight, space and efficiency.

Mass Spectrometer. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif. Bulletin CEC-1824 deals with the model 21-610 mass spectrometer that is designed for accurate, high-speed process monitoring and control. The instrument described is tailored to the needs of the oil

www.americanradiohistory.com



AGASTAT

Compact . . . Dust-Proof

TIME DELAY RELAYS

solenoid actuated—pneumatically timed

Introduces time delays into a-c or d-c circuits. Easily adjusted to provide delays ranging from 0.1 second to five or more minutes.

The AGASTAT is small, light, and operates in any position. Dust-proof timing chamber assures long operating life with a minimum of maintenance.

Write for Bulletin.
Dept. A1-84,

AGA

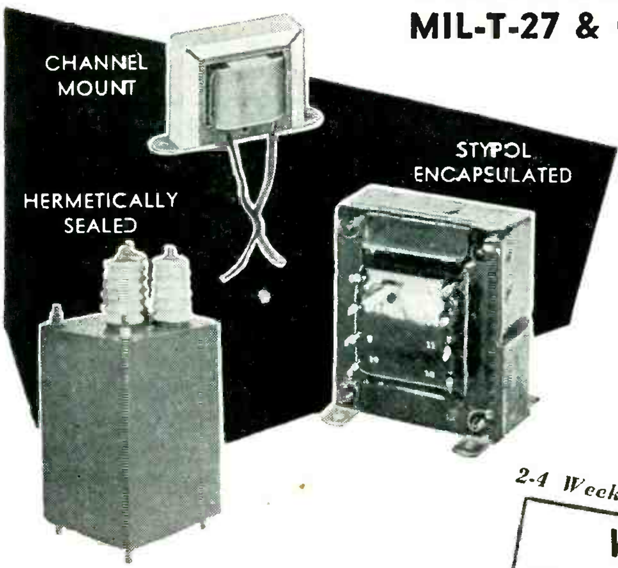
Division of Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth 3, New Jersey

STERLING

A DEPENDABLE SOURCE FOR

TRANSFORMERS

MIL-T-27 & COMMERCIAL



- ***Pulse***
- ***Audio***
- ***Power***
- ***Filter Choke***
- ***Filament***
- ***RF Coils***

Custom Built to your Specifications

2-4 Week Delivery on Prototypes

WE SOLICIT SAMPLES AND SHORT RUN PRODUCTION

STERLING
STC TRANSFORMER CORP.
BROOKLYN, N. Y.

297 North 7th St., Brooklyn 11, N. Y.

60-DAY FREE TRIAL

of America's most popular bench assembly stool

A tired worker costs *MUCH* more than a good chair

- 4-way adjustable backrest
- Scroll shaped posture seat
- Tamper-proof tubular all-welded construction
- Adjustable height ranges from 17" to 25" or 24" to 32"

Now test Royal's famous No. 515 stool in your own plant without cost or obligation. See why the country's top firms choose it for superior versatility and durability. Write for free trial stool today!

metal furniture since '97 Royal

Royal Metal Manufacturing Co.
175 North Michigan Avenue, Dept. 2108, Chicago 1

Factories: Los Angeles • Michigan City, Indiana
Warren, Pa. • Walden, N. Y. • Galt, Ontario
Showrooms: Chicago • Los Angeles • San Francisco
New York City • Authorized Dealers Everywhere

MAIL TODAY

Royal Metal Mfg. Co., 175 N. Michigan Ave., Dept. 2108, Chicago 1, Ill.

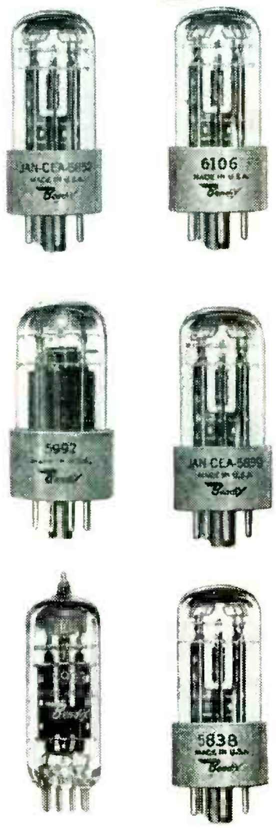
☐ We want to test your No. 515 stool for 60 days without obligation. Send short_____tall_____model.
☐ Please send your new catalog of industrial seating.

Name____________________
Firm Name____________________
Address____________________
City__________Zone____State______

www.americanradiohistory.com

DEPEND ON

Bendix Red Bank



RELIABLE ELECTRON TUBES

With electronic controls taking over more and more operational functions in aircraft, it's becoming increasingly important that the electron tubes used be dependable under conditions of high altitude, continuous vibration, varying voltages and frequent shock. Because of their advanced design and construction . . . born of never-ceasing research and special production skills . . . Bendix Red Bank Reliable Electron Tubes have the dependability necessary to meet these severe operating conditions. You can depend on our long, specialized experience to give you the right answer . . . for all types of regular as well as special-purpose tube applications. Call on us for full details.

Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors and Fractional D. C. Motors

TYPE AND MODEL INDEX				TYPICAL OPERATING CONDITIONS		
Bendix No.	RTMA No.	JAN No.	General Type	Heater Voltage	Plate Voltage Per Plate	M.A. Load
TE-2		5839	OCTAL FULL WAVE RECTIFIER	26.5	350	70
TE-3	5838		OCTAL FULL WAVE RECTIFIER	12.6	350	70
TE-5		5852	OCTAL FULL WAVE RECTIFIER	6.3	350	70
TE-10	5993		MINIATURE FULL WAVE RECTIFIER	6.3	350	70
TE-22	6106		OCTAL FULL WAVE RECTIFIER	5.0	350	100

BEAM POWER AMPLIFIER TUBE	
SPECIFICATIONS	
BENDIX NO.	TE-8
RTMA NO.	5992
HEATER VOLTAGE	6.3 V
PLATE VOLTAGE	250 V
SCREEN VOLTAGE	250 V
GRID VOLTAGE	12.5 V
G. M.	4000
PLATE CURRENT	45 MA
POWER OUTPUT	3.5W

Bendix Red Bank DIVISION OF Bendix AVIATION CORPORATION — THE NAME MILLIONS TRUST

EATONTOWN, N. J.

Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

refinery, chemical plant and laboratory. The 4-page brochure is well-illustrated and fully describes the instrument's operation.

Germanium Diodes. National Union Radio Corp., Hatboro, Pa. Bulletin 1001 gives the electrical characteristics for 19 point-contact germanium diodes in the company's line. Included are an illustrated description, mechanical and electrical specifications.

Temperature-Limited Diodes. Thermosen, Inc., 1700 Summer St., Stamford, Conn. A 4-page folder gives complete specifications for six temperature-limited diodes having stable emission characteristic and which are available from the manufacturer as standard catalog items. Three of the tubes described incorporate a safety feature by which filament failure closes an external high impedance circuit. All of the tubes are illustrated in the folder; data include electrical and mechanical specifications, basing diagrams and basing designations.

D-C Power Amplifier. Southwestern Industrial Electronics Co., Inc., 2831 Post Oak Road, Houston 19, Texas. A 4-page loose-leaf perforated catalog illustrates and describes the model B d-c power amplifier for the sonic and subsonic frequency ranges. Applications, electrical and mechanical specifications, and a schematic diagram are included.

Continuous Tape Reproducer. Ampex Electric Corp., 934 Charter St., Redwood City, Calif. A 4-page folder covers the type 450 continuous tape reproducer, a new concept in background music and continuous sound reproduction. Included are a complete description, illustration, design data, general performance characteristics and specifications.

Antenna Handbook. Channel Master Corp., Ellenville, N. Y., has published a tv antenna handbook for vhf and uhf. It is a 12-page manual illustrating and describing more than 60 different vhf and uhf antennas currently being produced, and is designed to assist the

www.americanradiohistory.com

4 mmf/ft

AIR-SPACED ARTICULATED
CO-AX
CABLES

offer a unique combination of

- ✔ FRACTIONAL CAPACITANCE
- ✔ HIGH IMPEDANCE
- ✔ MINIMUM ATTENUATION

ALONG WITH

- ✔ EXCEPTIONAL FLEXIBILITY
- ✔ LIGHT WEIGHT

38 STOCK TYPES

FOR ANY OF YOUR STANDARD OR SPECIAL APPLICATIONS

A few of the very low capacitance types are:

Type No.	*Capacitance* $\mu\mu$ *F/ft.*	*Impedance ohms*	*O.D.*
C.44	4.1	252	1.03″
C.4	4.6	229	1.03″
C.33	4.8	220	0.64″
C.3	5.4	197	0.64″
C.22	5.5	184	0.44″
C.2	6.3	171	0.44″
C.11	6.3	173	0.36″
C.1	7.3	150	0.36″

WE ARE SPECIALLY ORGANIZED TO HANDLE DIRECT ORDERS OR ENQUIRIES FROM OVERSEAS

SPOT DELIVERIES FOR U.S.

BILLED IN DOLLARS—SETTLEMENT BY YOUR CHECK

CABLE OR AIRMAIL TODAY

TRANSRADIO LTD.

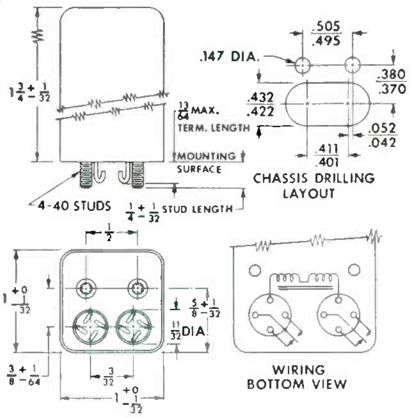
CONTRACTORS TO H.M. GOVERNMENT

138A CROMWELL RD., LONDON, S.W.7 ENGLAND

CABLES: TRANSRAD LONDON

Phaostron SENSITIVE MINIATURE RELAYS

PERFECTLY COUNTER-BALANCED



Contact arrangements up to and including DP DT 3 Amp at 28 volts D.C., or 100 Milliamperes at 150 volts D.C. resistive load.

Hermetically Sealed.

Required coil power as low as 20 milliwatts.

Coil resistance up to 15,000 ohms.

Weight, maximum 3.5 oz.

DUE TO ITS PERFECTLY COUNTER-BALANCED FEATURES THIS RELAY WILL WITHSTAND HIGH ACCELERATION, VIBRATION, SHOCK AND TUMBLING

Mass Production Requirements Invited

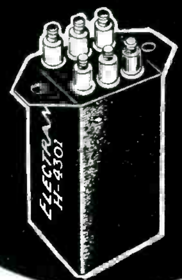
Detailed information on request.

ENVIRONMENT FREE ELECTRICAL EQUIPMENT by Phaostron

PHAOSTRON COMPANY • 151 PASADENA AVE. • SOUTH PASADENA, CALIF.

ELECTRAN

- ★ *Transformers*
- ★ *Saturable Reactors*
- ★ *Electronic Devices*



Transformers

Dependable Components

Dependable delivery schedules

Designers and Custom Builders—small and medium quantities—from milli-watts to 50 KVA, single or polyphase.

May We Bid On Your Requirements?

ELECTRAN MFG. CO.

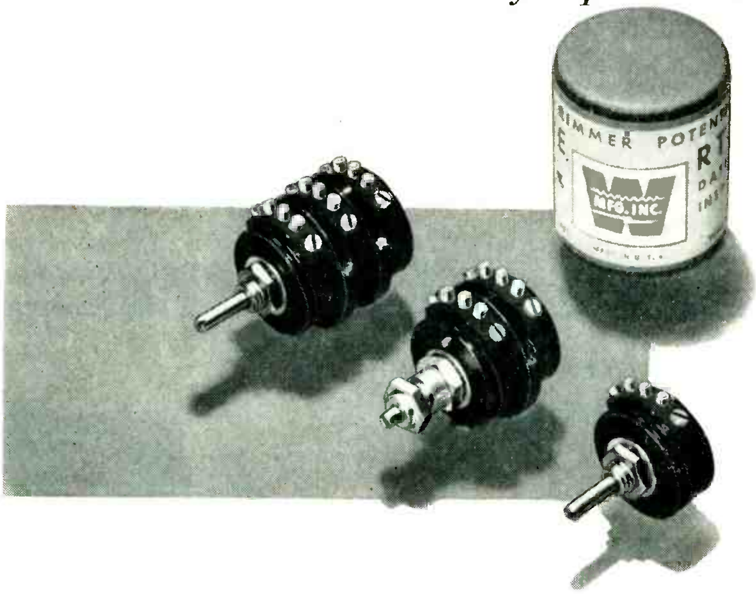
1901 CLYBOURN AVENUE • CHICAGO 14, ILLINOIS

Want more information? Use post card on last page.

www.americanradiohistory.com

MINIATURE
HIGH-RELIABILITY WIRE-WOUND
POTENTIOMETERS

Precision-built, to military requirements



THE WATERS TYPE RT SERIES of miniature, wire-wound potentiometers will satisfy your most stringent requirements. Anodized-aluminum bodies with sealed, line-reamed shaft bushings and sealed terminal plates enable these units to meet severe environmental tests — immersion, salt spray, fungus, shock, vibration, and wide temperature range.

CHECK THESE SPECIFICATIONS:

- *Size* . . . 7/8" diameter, 3/8" depth.
- *Power dissipation* . . . 3 watts at 80 degrees C.
- *Operating temperature* . . . —55 degrees C to +80 degrees C.
- *Weight* . . . 5/16 ounce.
- *Temperature coefficient* . . . 0.002% per degree C, above 100 ohms.
- *Rotational life* . . . more than 1,000,000 revolutions.
- All mechanical contacts of precious metal.
- All non-wiping contacts soldered as well as mechanically secured.
- *Resistances* . . . 10 ohms to 50,000 ohms, linear taper.

WRITE TODAY FOR FULL TECHNICAL INFORMATION AND PRICES

WATERS MANUFACTURING, inc.
Waltham 54, Massachusetts
APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

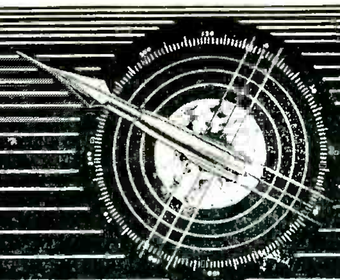
installation man in selecting the proper antennas for all types of reception areas and conditions. Full technical data, including gain curves and directivity patterns are included on most of the models. Completely up-to-date, the 2-color brochure also includes a section on interaction filters, which permit the use of a single transmission lead with two or more antennas, vhf and uhf. Complete information is also included on towers, telescoping masts, mounting accessories and the Katy-B tv booster.

Electronic Components. Erie Resistor Corp., 644 W. 12th St., Erie, Pa., has issued a complete, new 16-page catalog of electronic components for distributors and service departments. This catalog, D-53, supersedes previous catalogs and includes all new items introduced since publication of their last catalog, together with the longtime standard numbers. It is complete with up-to-date listings, illustrations and descriptions.

Tape Recorder. Ampex Electric Corp., 934 Charter St., Redwood City, Calif. A 4-page folder illustrates and describes the model 350 professional-type magnetic tape recorder that is designed for broadcast stations, recording studios, educational institutions, high-fidelity enthusiasts and other highly critical users. The unit described features convenience, ease of cueing and editing, simplicity of control, accessibility for servicing and reliability. General performance characteristics and specifications are given.

Tube Characteristics. Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., has released new versions of its characteristics booklets. The familiar green "Sylvania Television Picture Tube and General Purpose Cathode Ray Tube" characteristic chart has been revised to include the latest modifications, type changes and the like. Over 30 tube types have been added, which brings the total types listed in the booklet to over 250. There are 56 different basing diagrams accompanying these tube types. The revised "Sylvania Radio and Television Re-

www.americanradiohistory.com



ENGINEERING OPPORTUNITIES

WITH THE PACEMAKER IN AVIATION PROGRESS

BELL Aircraft CORPORATION

NEEDS

MISSILE

Engineers and Technicians

For Field Test Positions

IN

NEW MEXICO

"The Land of Enchantment"

ON

GUIDANCE

FLIGHT TESTING

SERVOMECHANISMS

TELEMETERING

TEST EQUIPMENT

AIRBORNE ELECTRONICS EQUIPMENT

IDEAL WORKING CONDITIONS

WRITE:

Field Test Director
Bell Aircraft Corporation
Post Office Box 391
Holloman Air Development Center
Alamagordo, New Mexico

S.S.White MOLDED RESISTORS

The "All-Weather" Resistors

TYPE 65X
(Actual Size

The resistors that give you . .

- *Inherent low noise level*
- *Good stability in all climates*

STANDARD RANGE

1,000 OHMS TO 9 MEGOHMS

These resistors are used extensively in commercial equipment, including radio, telephone, telegraph, sound pictures, television, etc. They are also used in a variety of U. S. Navy equipment.

HIGH VALUE RANGE

10 TO 10,000,000 MEGOHMS

This unusual range of high value resistors has been developed to meet the needs of scientific and industrial control, measuring and laboratory devices—and of high voltage applications.

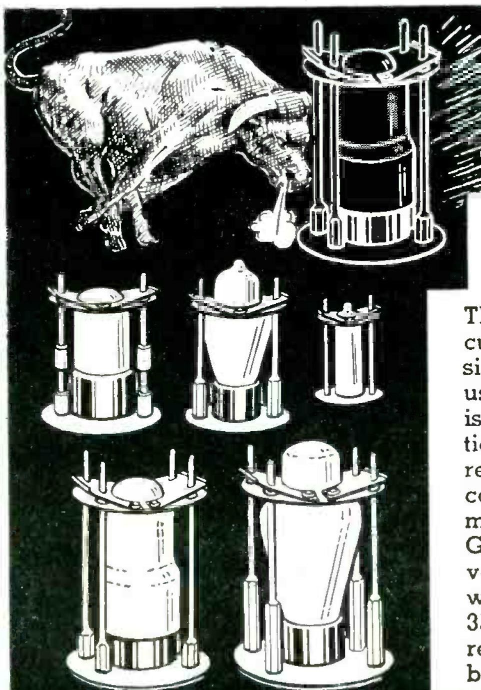
SEND FOR BULLETIN 4906

It gives details of Standard and High Value Resistors, including construction, characteristics, dimensions, etc. Also described are S.S.White 80X Resistors, designed for extremely high voltage equipment. Copy with Price List sent on request.

THE S.S.White DENTAL MFG. CO. INDUSTRIAL DIVISION
Dept. R, 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.

SHOCK PROOF



VACUUM TUBE RETAINERS

These retainers are used to secure Vacuum Tubes and to resist side motion of Vacuum Tubes used in radio equipment which is subject to shock and vibrations. These retainers meet the requirement of all JAN specifications. The insulated portion is made of a melamine base Fibre Glass Phenol which provides 300 volts insulation to ground and withstands a temperature of 350 F. The insulated plate can readily be fastened or released by hand.

Available for envelope types T7, T8, MT8, T9, T12, ST12, T12ZDI, ST14, S14, ST16, T5½, T6½, MT-IC, ST19, T14, ST128CT-9.

Manufacturers of Electronic Components

JAMES IPPOLITO & CO., INC.
401 CONCORD AVENUE, BRONX 54, N. Y.

Want more information? Use post card on last page.

www.americanradiohistory.com

ceiving Tubes" booklet includes, in addition to previously listed types, the very latest of the company's tv receiver and subminiature tubes. Over 750 different receiving tube types are listed in the chart—along with their basing diagrams. For easy reference, the basing diagram appears on the same page as the tube to which each belongs.

Casting Resins. R. S. Aries & Associates, 400 Madison Ave., New York, N. Y. An 8-page brochure deals with Aritemp potting and casting resins for high and low temperature electrical and other applications. Illustrations and information on encapsulating techniques are included. Also given are general characteristics, applications and mechanical and electrical properties of Aritemp 201 and Aritemp 302.

Subminiature Paper Capacitors. Astron Corp., 255 Grant Ave., East Newark, N. J., has available bulletin AB-18 containing complete performance characteristics and test specifications on new Meteor high-temperature subminiature paper capacitors. In the line described, dependable operation at temperatures up to 125C without derating is provided through the use of a newly developed impregnant, X-250. Chief features of the capacitors are outlined.

Volt-Ohm-Milliammeter. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill., has prepared a special publication entitled "1001 Uses For the Model 260," a new booklet dealing with the model 260 volt-ohm-milliammeter that will read electrical quantities of voltage, current and resistance. In its 50 pages, profusely illustrated, the publication offers detailed data on technical features of the unit, explaining how it works under various types of applications.

TVOR. The Collins Radio Co., Cedar Rapids, Iowa. A single-sheet bulletin illustrates and describes the company's tvor equipment that provides in packaged form all the units necessary for a complete terminal visual omni-

SHARP PERMANENT MARKING

WITH HI-DUTY MARKING TOOLS

For legible permanent marking of metal components use GTS engraved lettering tools. Precision engraved dies and inserts for indenting or embossing identification on your parts will

1. Improve appearance.
2. Advertise throughout life of part.
3. Facilitate reordering.

Write for free catalog on Production Marking Equipment.

GEO. T. SCHMIDT, INC.

MARKING MACHINES • MARKING TOOLS

1804 Belle Plaine Ave., Chicago 13, Ill.

COMPLETE MACHINE FACILITIES TO PRODUCE

- Hand Stamps
- Engraved Inserts for Dies
- Shank Style Stamping Dies
- Embossing Dies
- Code Stamps
- Steel Type
- Numbering Heads
- Marking Machines
- Nameplate Marking Equipment

- ELECTRONICALLY
- REGULATED

Laboratory

POWER SUPPLIES

BENCH MODEL 50

0-500 VDC · 0-500 MA
CONTINUOUSLY VARIABLE

A general-purpose, heavy-duty precision-regulated power supply for bench use. Incorporates stable 5651 reference tube, overload circuit-breakers, time-delay tube protection.

Also available for standard rack mounting (Model 50 R. Panel size 10½" x 19". Depth 14¼".)

*Specifications**

INPUT: . . . 105-125 VAC, 50-60c

OUTPUT VOLTAGES

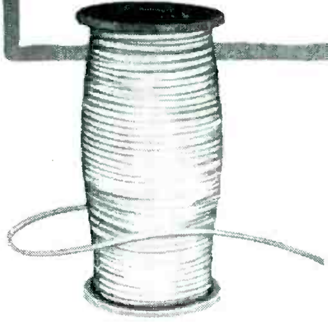
- **0-500 VDC, 0-500 MA**
  - Regulation (line): . . . . < 0.15%
  - Regulation (load): . . . . < 0.5%
  - Internal Impedance: . . < 2 ohms
  - Ripple and Noise: . . < 8 mv rms
  - Polarity: + or − may be grounded
- **0-50 VDC, 0-200 VDC** . . . bias
  - Regulation (line): . . . . . < 0.1%
  - Internal Imped: 32,500 ohms max
  - Ripple and Noise: . . . < 5 mv rms
- 6.3 VAC, 5A . . . . . unregulated
- 6.3 VAC, 5A . . . . . unregulated

STABLE · DEPENDABLE
MODERATELY PRICED

LAMBDA
ELECTRONICS CORP.
CORONA 68, NEW YORK

**For complete specifications on these and other models write for catalog E-50.*

New! All-Nylon! Fungus-Proof!
GUDE-NYLACE
Flat Braided Lacing Tape



Write for samples, complete information

- *EASY ON HANDS*
- *SAVES TIME*
- *FLAME RESISTANT*

Flat braided lacing tape for all electrical harnesses with either continuous or interrupted ties.

Guaranteed free of all wax and foreign materials—only 100% pure Dupont Nylon is used in the construction of Gude-Nylace—excellent for strength, durability.

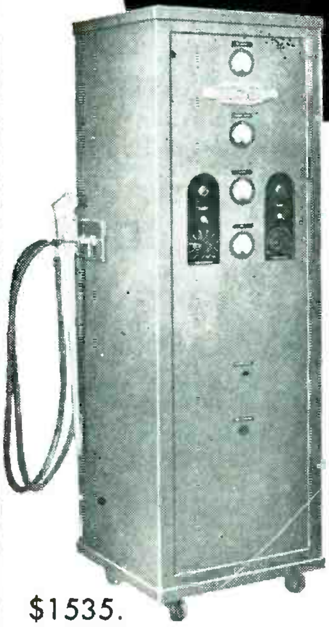
Slip-proof knots, easy to tie, easy on operator's hands even without gloves.

Complies with fungus resistant requirements of Gov. Spec. Jan-T-713.

GUDEBROD BROS. SILK CO., INC.
Electronic Division: 225 West 34th Street, New York 1, N. Y.
Executive Offices: 12 South 12th Street, Philadelphia 7, Pa.

---

for maximum economy...
5KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT



$1535.

Simple...Easy to Operate...Economical Standardization of Unit Makes This New Low Price Possible.

Maximum economies can be obtained only by use of correct frequency and power combinations when applying the techniques of induction heating to manufacturing processes.

It is significant that only Scientific Electric in the present market, can offer you a selection of frequencies depending on power required, in wide power range. 2-3½-5-6-7½-10-12½-15-18-25-40-60 KW (all units above 60 KW are considered custom built). This means that electronic heating equipment produced by Scientific Electric is tailored to your needs . . . fitted perfectly to the task entrusted to it, enabling you to keep your initial investment in equipment to a minimum while affording you all the proven advantages of electronic heating.

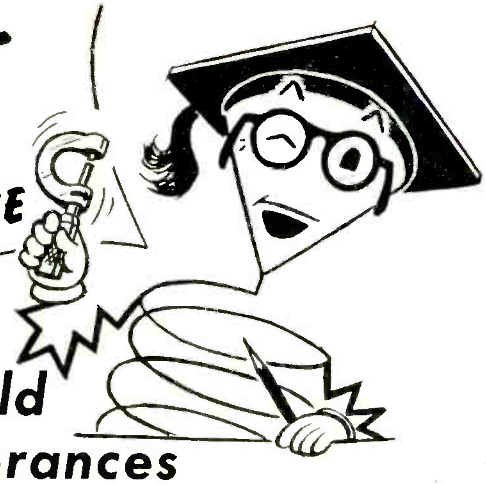
Write now for complete information or send samples of work to be processed. Specify time cycle for your particular job. We will quote on proper size unit for your requirements.

DESIGNERS AND MANUFACTURERS OF HIGH FREQUENCY AND HIGH VOLTAGE EQUIPMENT SINCE 1921

Scientific Electric
105-119 MONROE ST SCIENTIFIC ELECTRIC GARFIELD, N. J.

www.americanradiohistory.com

CERTAINLY— "Lavite" PRESSED STEATITE



—can be held —to close tolerances

You know from experience, I'm sure, how troublesome varying shrinkage can be. Well, here again Steward's Engineers have an answer that will give you accurate, uniform "Lavite" Steatite parts right through your entire order and all repeat orders.

That's right — allowance is made for possible shrinkage and then they can be machined to final closer tolerances if required. And, please remember, Steward's interest in your parts start with the material. That's why "Lavite" Steatite — a product of private research and development—can claim and prove individually superior qualities. Why not learn first-hand, on your own parts, how this dimensional control can save your production time and help you produce a better product at a saving.

D. M. STEWARD MANUFACTURING CO.

3604 Jerome Ave., Chattanooga 1, Tennessee

Sales Offices in Principal Cities

Steward's Engineers—are your Engineers—Consult them freely and often. No obligation!

Send your specifications for recommendations.

range ground station. The entire package station discussed is supplied complete with external housing, main antenna, monitor antenna, 50-w vhf transmitter, modulation eliminator, monitor and local and remote control units. A tvor block diagram is included.

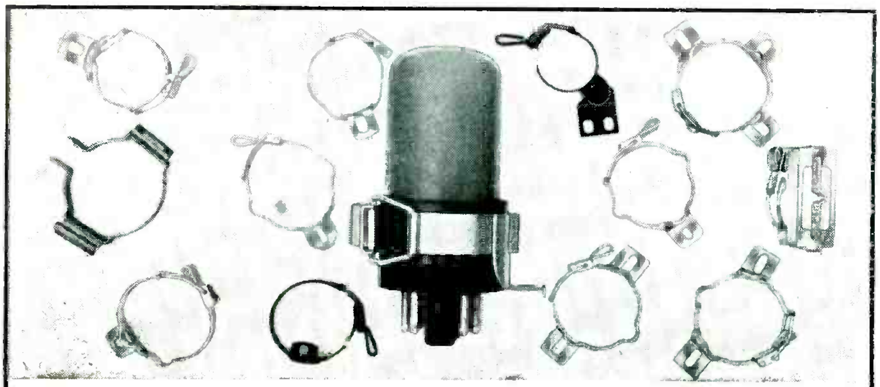
Wires and Cables. United States Wire & Cable Corp., Progress & Monroe Sts., Union N. J. A new, compact catalog No. PM-3 has been issued. It lists and illustrates wires and cables used in such industries as communications, electronics, aviation, transporation and television. This 24-page catalog is lithographed in two colors for added legibility, and contains many valuable reference tables, diagrams and charts. Each class of wire or cable is described in detail as to construction, chemical and physical properties, and typical uses.

Miniature Variable Speed Changers. Metron Instrument Co., 432 Lincoln St., Denver 3, Colorado, has available the technical data sheet No. 3 describing general specifications and ratings plus the principle of operation for the series-3 miniature variable speed changers. Helpful engineering data such as horsepower ratings, torque ratings, speed ratings and speed adjustability are given in logical sequence and easy-to-understand graph form. Principle of operation is easily comprehended with an exploded and cutaway view and reference descriptive copy of the unit.

Industrial Motors. General Dynamics Corp., Ave. A and North St., Bayonne, N. J., has published a new 12-page consolidated catalog giving detailed information on performance, dimensional data, construction advantages, installation photographs and company history on a line of motors for ordinary applications of polyphase squirrel-cage induction use. It also tells about electrical and mechanical modifications that are available for particular installation needs.

Audio Equipment. Atlas Sound Corp., 1449 39th St., Brooklyn, N. Y. The latest 12-page catalog describes

www.americanradiohistory.com



A CLAMP FOR EVERY SPECIFICATION

In electronics or any part of the electrical field where clamps are needed for rigidity and stability in holding tubes, compact plugs or socket type units, Augat clamps provide the answer. Approved and used in electronic equipment for the armed forces, an innumerable variety of stock numbers are ready for immediate delivery while clamps made to your specifications can be had easily and quickly.

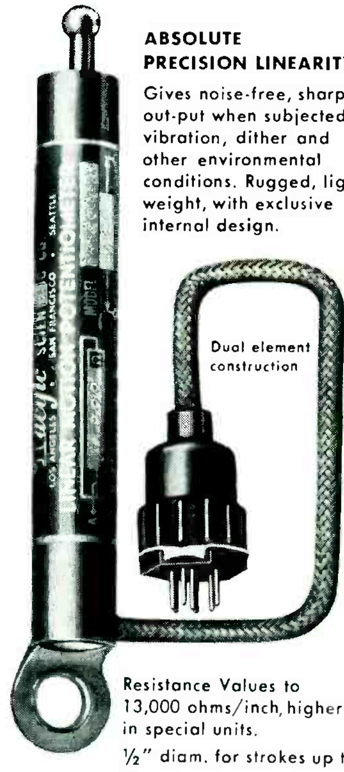
Augat clamps are precision produced and made of 18% *nickel silver* for greater fatigue value, increased tensile strength and for utmost durability. They have withstood a two hundred-hour salt spray test with no adverse effect.

Catalog and samples promptly sent on request.

AUGAT BROS. INC.

31 PERRY AVENUE · ATTLEBORO, MASS.

HUMPHREY LINEAR POTENTIOMETER



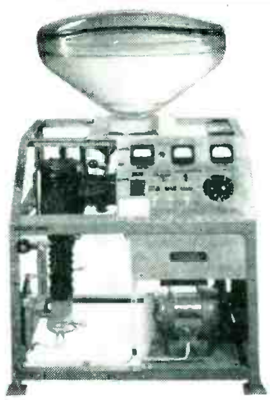
ABSOLUTE PRECISION LINEARITY

Gives noise-free, sharp out-put when subjected to vibration, dither and other environmental conditions. Rugged, lightweight, with exclusive internal design.

Resistance Values to 13,000 ohms/inch, higher in special units.

½" diam. for strokes up to 3"
¾" diam. for strokes over 3"

SPECIAL CONSTRUCTION AVAILABLE FOR HIGH TEMPERATURE APPLICATIONS



TELEVISION TUBE ALUMINIZERS

From laboratory or semi-production models to complete production systems.

We also make oil diffusion pumps, high vacuum evaporators, pumping systems, vacuum metallizers, high vacuum furnaces. We can supply special high vacuum equipment to customers' specifications.

OPTICAL FILM ENGINEERING COMPANY
2731-37 North Sixth Street
Philadelphia 33, Pennsylvania

NEW HUMPHREY ACCELEROMETER

Readily adapted to wide selection of g ranges.

Accuracy: From plus or minus 1% at zero, to plus or minus 2% at maximum acceleration.

A RUGGED, COMPACT ACCELEROMETER with integral Potentiometer take-off, giving amazing accuracy under adverse conditions, due to the rugged construction. No "cross-talk".

FULLY TESTED AND QUALIFIED FOR MILITARY APPLICATIONS

Pacific SCIENTIFIC CO.

1430 Grande Vista Ave., Los Angeles 23, Calif.
25 Stillman Street, San Francisco 7, California
1915 1st Avenue South, Seattle 4, Washington
806 East Abram Street, Arlington, Texas

EASTERN REPRESENTATIVE: AERO ENGINEERING INC.
Mineola L.I., N.Y. · Indianapolis · Baltimore · Montreal

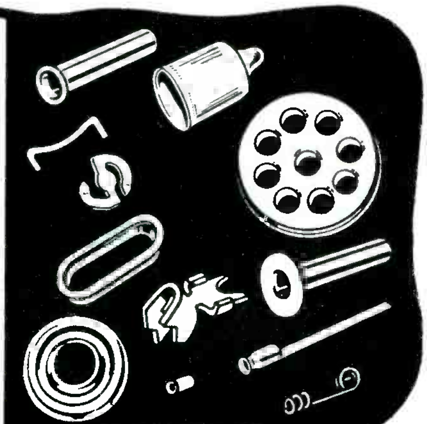
PIX WIRE FORMING SPECIALISTS

Precision Parts to meet your Production and Engineering needs. From .002" dia. to .125" dia. Radio tube parts—Stampings—Drawings Modern facilities, high-production equipment.

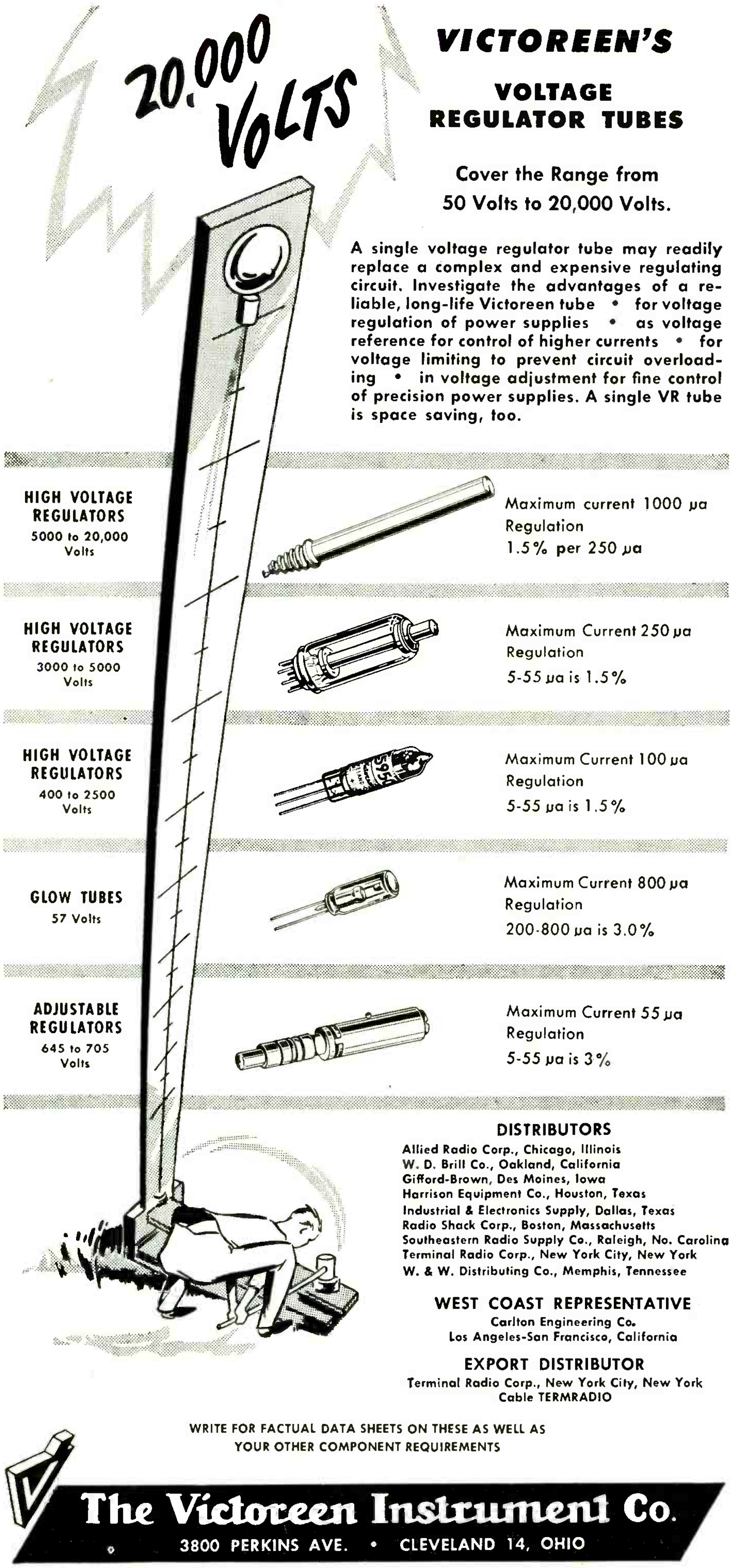
Metal Crystal Holder Parts

Send sketch or print for quotation.

PIX MANUFACTURING CO., Inc.
24A Bedford St. Newark 3, N. J.



www.americanradiohistory.com



the complete line of p-a loudspeakers and accessories, microphone stands and accessories as well as recommended applications for each product. In the category of loudspeakers, the catalog illustrates and lists specifications for such products as projectors, radials, pagings, talk-backs, tweeters, baffles, driver units and transformers. Microphone floor stands, desk stands, boom stands, boom brackets, sky hooks and cable hangers are among the many products in the mike stand category discussed.

Tiny Bushings. Thor Ceramics, Inc., 225 Belleville Ave., Bloomfield, N. J. A complete line of standard Steatite miniature Feed-Thru bushings for efficient low- and high-frequency equipment are illustrated and fully described in the new catalog Bulletin No. 153. Complete with full engineering data, specifications and dimensional drawings, the bulletin covers the company's standard miniature Feed-Thru bushings, made to conform to government and commercial specifications.

Furnace & Oven Control Instruments. The Bristol Co., Waterbury 20, Conn., has published a new catalog of control instruments for furnaces, ovens, dryers and kilns. The catalog, No. P1255, features electronic Dynamaster potentiometer and millivoltmeter type pyrometer controllers, recorders and indicators. A wide variety of electric, air-operated, and electronic control instruments for use with fuel-fired and electric heating equipment of all types is listed. Complete engineering specifications and prices are given. In addition to numerous photographs, the catalog is liberally illustrated with diagrams of the various control arrangements and dimension sketches.

Research and Development Services. Designers for Industry, Inc., 2915 Detroit Ave., Cleveland 13, Ohio, has issued a 4-page folder calling attention to the need for careful direction and scheduling of research in the mechanical, hydraulic, electromechanical and electronic engineering fields. A de-

VULCAN
ELECTRIC HEATING UNITS

CARTRIDGE

Concentrated electric heat for small areas.

Brass sheath for temperatures up to about 750°. Other metals for higher temperatures.

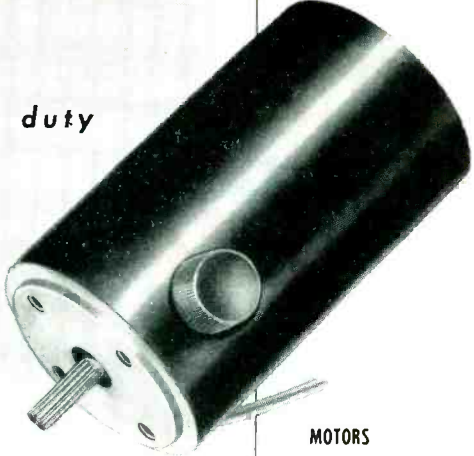
Standard sizes and types listed in the Vulcan catalog, or size, sheath, terminals and lead wires adapted to your specific problems.

VULCAN
ELECTRIC COMPANY
DANVERS 10, MASS

☆ model 1200

☆ *continuous duty*

REVERSIBLE DC MOTORS



18 to 30 volts with or without brake . . .

- Ambient temperature: — 55° C to + 105° C.
- Size: 1.25 in. diameter, 2.18 in. long.
- Weighs 5.3 ounces . . . without brake.

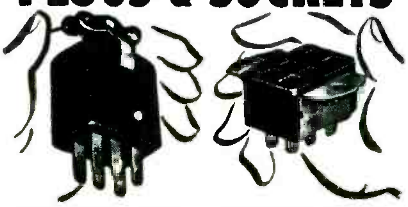
We can manufacture these motors to meet your specifications. This particular motor is used on an actuator for aircraft use.

Let's discuss your need!
Write or wire us, TODAY

MOTORS
GENERATORS
RELAYS
TRANSFORMERS
SPEED CONTROL GOVERNORS
MAGNETIC SERVO AMPLIFIERS
MAGNETIC CONTROLS & CIRCUITS

MOTORDYNE INC.
Dept. J, 2661 S. Myrtle Ave.
MONROVIA, CALIFORNIA

INSURE *Proven Quality* with JONES PLUGS & SOCKETS



P-306-CCT — Plug, Cable Clamp in cap.

S-306-AB — Socket with Angle Brackets.

Series 300 Small Plugs & Sockets for 1001 Uses

Made in 2 to 33 contacts for 45 volts, 5 amps, for cap or panel mounting. Higher ratings where circuits permit. All plugs and sockets polarized. Knife switch socket contacts phosphor bronze, cadmium plated. Engage both sides of flat plug—double contact area. Bar type plug contacts hard brass cadmium plated. Body molded bakelite.

Get full details in Catalog 18. Complete Jones line of Electrical Connecting Devices, Plugs, Sockets, Terminal Strips. Write today.

HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

Fine Aluminum Wire

● To meet the growing demand from producers of light-weight, high-frequency Galvanometer movements, we have expanded our facilities designed to process *Wire of 2S Aluminum* . . . This wire can be supplied in diameters ranging from approximately .001 inch through .005 inch . . . *Anodized* with exceptionally thin and flexible dieletric coating.

● Also available: wires of aluminum alloys *enameled* as small as .001 inch diameter, to meet rigid specifications of resistance, size and straightness.

Write for Latest List of Products

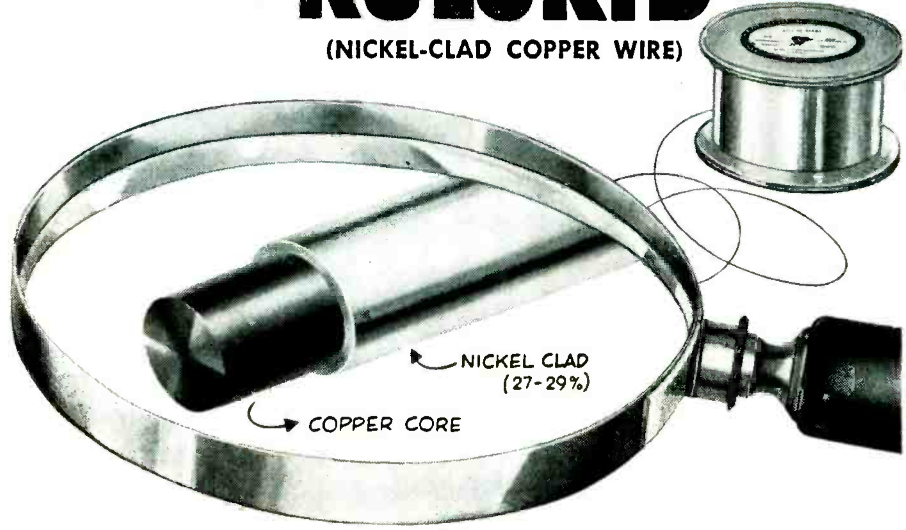
SINCE 1901

SIGMUND COHN CORP. 121 So. Columbus Avenue • Mount Vernon, N.Y.

www.americanradiohistory.com

Introducing **KULGRID**

(NICKEL-CLAD COPPER WIRE)



...today's best answer to high temperature electrical-conductive problems

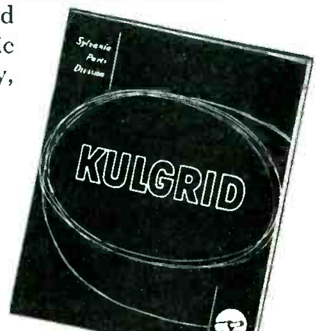
Electrical engineers in many industries now give Sylvania's Kulgrid the highest rating. This improved nickel-clad copper wire maintains excellent electrical conductivity at advanced temperatures. Its heavy nickel coating resists corrosion and guards the copper conductor against oxidation, flaking, brittleness or deterioration.

IDEAL FOR MANY APPLICATIONS

Kulgrid shows exceptional stability and performance in the high temperature operation of vacuum tubes. Other applications include: wiring of electric furnaces, industrial baking ovens, electric stoves, and numerous aircraft electrical installations, including jet engines.

AVAILABLE IN STRANDED FORMS

You can now obtain Kulgrid in stranded forms in various combinations of diameters and numbers of strands. Kulgrid welds readily to itself, nickel, copper, and can be welded to tungsten and molybdenum. New illustrated booklet gives detailed data. For your copy, address: Sylvania Electric Products Inc., Dept. 3A-1008, 1740 Broadway, New York 19, N. Y.



SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine St., Montreal, P. Q.

scription of the services offered in development engineering projects is included with the steps undertaken in a typical research and development program.

Metallized Paper Capacitors. Astron Corp., 255 Grant Ave., East Newark, N. J., has available a new 4-page bulletin, AB-19, containing complete performance characteristics and test specifications on the new Hy-Mets high temperature metallized paper capacitors. The capacitors described are designed for exceptionally dependable operation over a wide temperature range of −55C to +125C.

Video Recorder. Allen B. DuMont Laboratories, Inc., 1000 Main Ave., Clifton, N. J. A recent catalog sheet illustrates and describes the video recorder, a unit designed and manufactured to provide the tv broadcaster with superior quality recorded television programs. The unit discussed uses a special 7-in. picture tube to provide a clear tv picture on which a standard television recording camera is focused. Chief features and operating information are included.

Transistor Curve Tracer. Sylvania Electric Products Inc., 254 Rano St., Buffalo 7, N. Y. A 4-page bulletin illustrates and lists specifications for the model 664 transistor curve tracer. Principles of operation, circuit description and application notes are included.

Resistance-Sensitive Relay. General Electric Co., Schenectady 5, N. Y. Bulletin GEA-5893 covers a new electronic resistance-sensitive relay. Chief features are illustrated and described. Dimensional diagrams and technical specifications are included.

Line Regulators & Frequency Changers. Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. Catalog No. 353 gives full information on an extensive line of electronic a-c line regulators, as well as descriptions and specifications for electronic frequency changers. The regulators described include models with capacities ranging from 150 va to 15 kva, at nominal

Research • Development • Engineering • Manufacturing

CUSTOM BUILT ELECTRONICS!

CDC are designers and engineers of Electronic Devices to fit *your* requirements.

- Digital and Analogue Computers
- Test and Measuring Equipment
- Servo Systems
- Instrumentation
- Engineering Consulting Service
- Product Engineering and Design
- Parts Machining and Assembly
- Instrument and Electronic Equipment Overhaul
- Field Maintenance of Electronic Computers
- Developments for Armed Forces

YOUR ENQUIRIES WILL RECEIVE PROMPT AND EFFICIENT ATTENTION

COMPUTING DEVICES of CANADA LIMITED

General Offices—338 Queen Street Laboratories—475 Cambridge Street, Ottawa, Ontario, Canada

---

New 800-2600 mcs FREQUENCY METERS

Lightweight — Portable Units

...For Field and Laboratory Use!

SPECIFICATIONS

1. **ACCURACY**
   Better than .05% from 20°F to 120°F
2. **SENSITIVITY**
   Usable indication with 1 milliwatt input
   Adjustable for higher levels
3. **INDICATOR**
   50 Microammeter
4. **INPUT**
   50 Ohm Type N Connector
5. **EXTERNAL DC OUTPUT**
   Pin Jacks
6. **EXCURSION OF MICROMETER**
   One-half inch
7. **MICROMETER SCALE**
   at 1000 Mc —
   1 Division equals 290 KC
   at 1400 Mc —
   1 Division equals 350 KC
   at 2000 Mc —
   1 Division equals 450 KC
   at 2600 Mc —
   1 Division equals 555 KC
8. **EXTERNAL SIZE**
   6½ x 9¾ x 7"
9. **WEIGHT**
   Four pounds

(Cavity units are also available for custom housing)

Models

FS-C-171-A	800-1200 MCS.
FS-C-172-A	1200-1600 MCS.
FS-C-173-A	1600-2250 MCS.
FS-C-174-A	1700-2600 MCS.

Units consist of cavity body, micrometer control, crystal, suitable connectors and calibration chart. Write for specifications and prices.

frequency standards

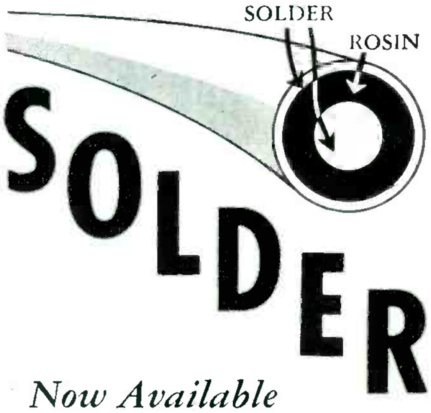
P. O. Box 504.
Asbury Park, New Jersey

ALPHA's

CEN-TRI-CORE

"ENERGIZED"

ROSIN-FILLED



Now Available For

PRINTED CIRCUIT SOLDERING

This solder provides improved electrical conductivity, with melting point below the tin-lead eutectic.

Special alloys for all types of PRINTED CIRCUITS.

Solder also available in bar form for dipping, with Alpha's PRINTED CIRCUIT FLUXES.

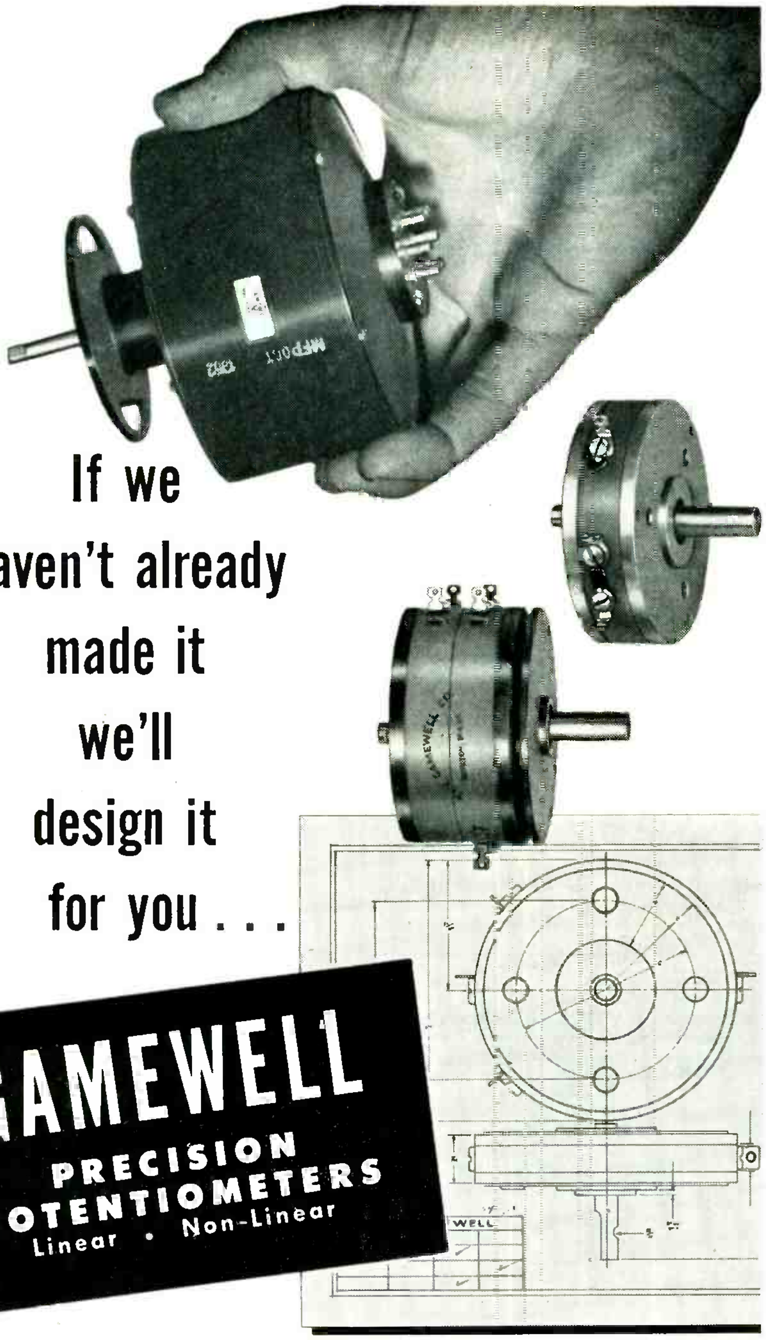
Approved by leading manufacturers of PRINTED CIRCUITS.

for further information write...

FASTER MELTING · POSITIVE FLUXING

ALPHA METALS, INC.
59 WATER ST., JERSEY CITY 4, N. J.

Specialists **IN SOLDER** For Over Fifty Years



If we haven't already made it we'll design it for you . . .

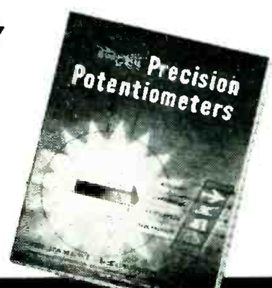
GAMEWELL
PRECISION POTENTIOMETERS
Linear • Non-Linear

To solve your specific potentiometer problem, send an outline of your specs to Gamewell. You'll get prompt service on your order for a prototype to meet your requirements.

Linear and non-linear Gamewell Precision Potentiometers are described in the booklet shown below. We'll be glad to send you a copy.

THE GAMEWELL COMPANY
NEWTON UPPER FALLS 64, MASSACHUSETTS
In Canada: Northern Electric Co., Ltd., Belleville, Ont.

GAMEWELL®



PRECISION POTENTIOMETERS

Manufacturers of precision electrical equipment since 1855

115 or 230 v. The frequency changers discussed convert 60-cycle line to regulated 400-cycle (adjustable $\pm$10 percent) or regulated 50/60-cycle similarly adjustable. The catalog includes abundant information on electronic regulator circuitry, uses of regulators, and requirements for special regulators. General specifications and electrical specifications are treated at length.

High Temperature Alloys. The H. M. Harper Co., 8251 Lehigh Ave., Morton Grove, Ill. Pertinent nontechnical information about high temperature alloys and how they are being made into the highest precision fastenings is contained in Volume 18, No. 2 of "Bolt News." An illustrated 2-page article takes one behind the scenes at the company's new Aero Division. Supplementing the lead story is a descriptive article on the process known as "cold heading" and four informative stories on unusual applications of the company's corrosion-resistant fastenings.

Radiation Instruments. Radiation Instrument Development Laboratory, 2337 W. 67th St., Chicago 36, Ill., has published a 32 page booklet illustrating and describing a line of radiation instruments. Included in the line dealt with are 4 basic laboratories, 8 special purpose instruments, 6 decimal scalers, 8 binary scalers, 6 counters, special counters and accessories.

Electronic Tachometer. The Standard Electric Time Co., Springfield, Mass. Bulletin No. 200 covers the company's electronic tachometer for precisely measuring speed or frequency. It includes illustrations, general information, some outstanding features of design and technical specifications. A listing of the tube complement is given.

Crystal Diode Interchangeability Chart. National Union Radio Corp., Hatboro, Pa., has prepared an interchangeability chart for germanimum type diode crystals to aid service engineers and technicians in determining what diode types may be used as replacements or as substitutions in various tv

Electron Tube Technicians

We now have openings for work in the fabrication and processing of experimental electron tubes.

Applicants should be high school graduates with a natural aptitude for making small parts. Experience in electronics, precision machine work and experimental tube work is desirable.

Address resume of experience and training to

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES
Technical Personnel Department
Culver City, Los Angeles County, California

ZOPHAR

WAXES
COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc.

Cold flows from 100°F. to 285°F.

Special waxes non-cracking at −76°F.

Compounds meeting Government specifications plain or fungus resistant.

Let us help you with your engineering problems.

ZOPHAR MILLS — QUALITY INC SERVICE — 107 YEARS EXPERIENCE

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

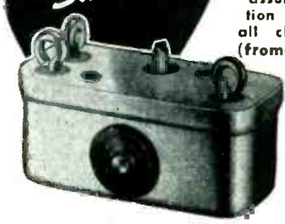
POSITIVE ACTION UNDER ALL CLIMATIC CONDITIONS

For Adverse Environmental Conditions... Specify **HAYDON'S** *New Hermetically Sealed Precision Snap Switches*

This hermetically sealed precision snap switch is the answer where sand, dust, ice, humidity, oil, grease, water or fungus cause ordinary switches to fail.

Here is the story on the Haydon hermetically sealed snap action switch:

1. Smallest hermetically sealed switch on the market
2. Longer life
3. High contact pressure — resistant to vibration
4. Actuator pin bonded in specially developed silicone (like a shock mount)
5. Available in single pole, double throw — two-circuit type or double pole, double throw. (DPDT is slightly larger.)
6. Interchangeable mounting-wise with certain other widely used unsealed switches.
7. Sealed construction assures positive operation under practically all climatic conditions (from —70°F to +200°F)



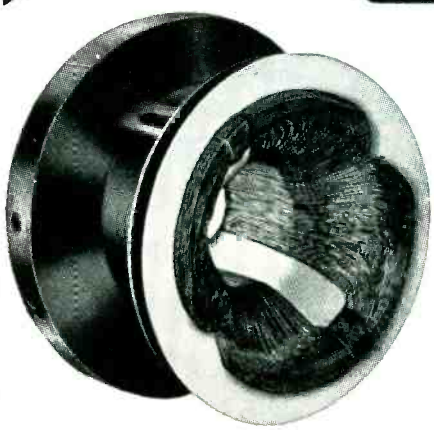
Currently Being Used In Aircraft Applications

Send for descriptive bulletin

HAYDON SWITCH CO.
232 NORTH ELM ST., WATERBURY, CONN.

NOW DX 90° DEFLECTION YOKE

... an Accepted Standard of Major Manufacturers!



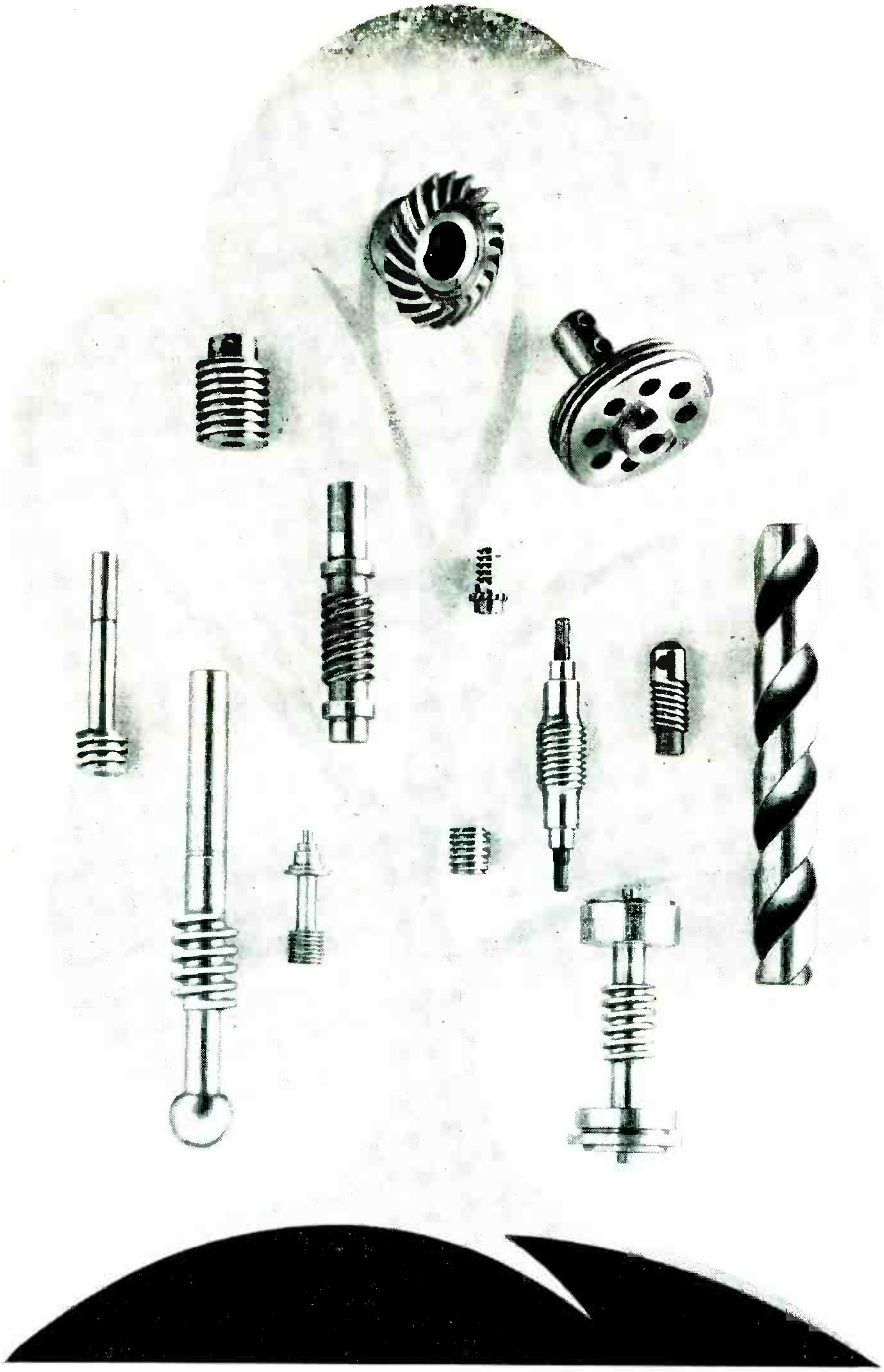
Yes, as leading manufacturers know . . . the DX 90° Deflection Yoke for 27" receivers gives the ultimate in performance and compactness. Enclosed in an Underwriters' Approved Tenite case, this yoke assures a sharp, full-screen focus without use of pincushion magnets. Ingeniously designed for mass production on special equipment, it provides the attractive price and top quality major manufacturers demand. We invite your inquiry.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

DX COMPONENTS "the heart of a good television receiver" TRADE MARK

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

www.americanradiohistory.com


THE FRUITS OF "KNOW HOW"

GROUND THREAD WORMS

SPIRAL BEVEL GEARS

QUAKER CITY GEAR WORKS

INCORPORATED

BETHAYRES, PA., CHAPEL HILL 0800

and electronic equipment. It shows outlines of the various styles of diodes to scale, so that full cognizance of the variations in physical characteristics may be taken into account. Ask for bulletin 1003.

Picture Tube Data. Allen B. DuMont Laboratories, Inc., 1500 Main Ave., Clifton, N. J., has announced the eighth edition of its picture tube data chart that lists complete specifications for more than 150 picture tubes of all manufacturers. It incorporates all newly manufactured 21-, 24- and 27-in. tubes registered with the RTMA at the time of printing. Typical data listed for both magnetic focus and electrostatic focus types are: basings; bulb dimensions; deflection angle; radius of face curvature; envelope and contact; ion trap magnet; maximum design center values; application notes and comparative focus current. The chart is suitable for wall hanging and is also folded to handy notebook size.

Molded Plastic Capacitors. Astron Corp., 255 Grant Ave., East Newark, N. J., has available a new 4-page bulletin, AB-20A, containing complete performance characteristics and test specifications on Blue-Point molded plastic capacitors. The capacitors described are housed in a yellow, tough, noninflammable molded plastic case and are permanently sealed against heat and moisture by means of a special solid glass-like thermosetting bond that becomes an integral part of the case. The bond discussed also locks in the leads so that they cannot be pulled out. (Neither lead, bond nor case is affected by flame or soldering iron heat, regardless of how close they are applied.)

Decade Inductor Units. Torocoil Co., 1374 Mobile Court, St. Louis 10, Mo., has released a new bulletin describing the characteristics of a new line of precision decade inductor units. The units discussed are designed so as to be used either singly or in combination to give an extremely wide range in inductance selection. Included with the specifications are typical uses, quality factor, rating, accuracy and the price of the individual units.

PREMAX

FOR TELEVISION

and other electric installations

Ground Rods

Low cost drawn steel Ground Rods, heavily copper plated to insure perfect electrical contact—and pointed for easy driving. In 4′, 6′ and 8′ lengths, 3/8 to 5/8″ diameter. Send for Bulletin and prices, and use Premax in your TV installations.

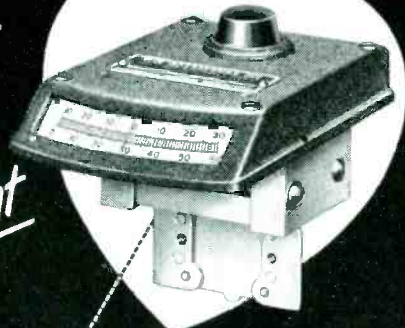
PREMAX PRODUCTS
DIVISION CHISHOLM-RYDER CO., INC.

5301 Highland Ave. Niagara Falls, N. Y.

Make a G-M PORTABLE D'ARSONVAL

GALVANOMETER

the Heart of Your Instrument



FOR MEASURING LIGHT reflectance and color, the Photovolt Corporation of New York uses a Model 600 G-M Galvanometer for its popular Reflection Meter (left). Whatever your own particular instrument field, you can achieve this same self-contained portability, ruggedness and high sensitivity with G-M Galvanometers. Complete catalog on request.

G-M LABORATORIES·INC.

In Canada: Cossor (Canada) Ltd., 301 Windsor St., Halifax, N. S.

4336 NORTH KNOX AVE., CHICAGO 41

BREW DELAY LINES

Flexible type
delay from .1 to 2 usec.

Here at Brew, complete design and manufacturing facilities . . . *plus real cooperation* . . . gives you the flexible delay lines you want . . . delivered on schedule.

SPECIFICATIONS: To military specifications. Delay .1 to 2 usec. Tol. ± .05 usec. Z 1200 ohms ±15%. Hermetically sealed, non-nutrient construction. Available in cans.

Send today for data . . . or send us your requirements.

BREW
RICHARD D. BREW and Company, Inc.
106 Concord Ave., Belmont 78, Mass.

IN-RES-CO TYPES CX & BX WIRE WOUND RESISTORS

FEATHERWEIGHT!

—another IN-RES-CO solution for CIRCUIT DESIGNERS

SEALED IN MOLDED BAKELITE PLUS LIGHTWEIGHT

The dependable resistive elements that combine positive sealing with the important advantage of lightweight. Molded Bakelite core reduces weight by one-half compared to ceramics. Positive seal effectively protects the winding against harmful climatic conditions. Additional IN-RES-CO features include long life stability, hard soldered connections to terminals and extra-sturdy, vibration proof terminal leads. Both CX and BX Resistors include space-saving terminal supported axial terminals of tinned wire.

IN-RES-CO TYPE CX NON-INDUCTIVE RESISTOR

IN-RES-CO TYPE BX NON-INDUCTIVE RESISTOR

ASK FOR THE NEW RESISTOR HANDBOOK - Contains complete data on resistors for every purpose and their recommended applications. Please make request on company letterhead.

INSTRUMENT RESISTORS CO.

COMMERCE AVENUE · IN-RES-CO · UNION NEW JERSEY

APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

Want more information? Use post card on last page.

www.americanradiohistory.com

PLANTS AND PEOPLE

Edited by WILLIAM G. ARNOLD

OTHER DEPARTMENTS featured in this issue:

RTMA Elects McDaniel Temporary President

GLENN MCDANIEL, who served as the first paid president of the Radio-Television Manufacturers Association in 1951-52, was elected as temporary president of RTMA pending the selection of another full-time paid president. He also will continue as general counsel of the Association.

The RTMA board of directors also elected Robert C. Sprague, chairman of the board of Sprague Electric Co., as chairman of the RTMA board for the next fiscal year. Mr. Sprague, who succeeds A. D. Plamondon, Jr., is a past president of the association and served as its chairman for two years in 1950-52.

Leslie F. Muter, president of the Muter Company, was re-elected treasurer, and W. R. G. Baker, vice-president of GE, was re-elected director of the engineering department of RTMA.

Other RTMA officers re-elected by the board are James D. Secrest, executive vice-president and secretary, and John W. Van Allen as general counsel emeritus.

The elections occurred at the final business sessions concluding the four-day 29th annual convention of RTMA at the Palmer House in Chicago.

Earlier, members of the five divisions elected their respective chairmen and directors. The division chairmen and newly elected directors are as follows:

Set Division: Robert S. Alexander, president of Wells-Gardner & Co., chairman; Leonard F. Cramer, vice-president and assistant general manager of Crosley Division of Avco Mfg. Corp., director.

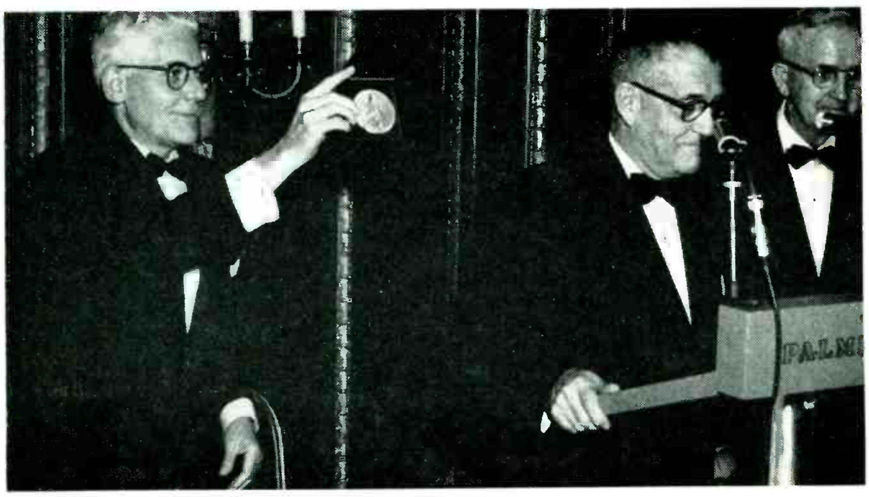
Tube Division: John Q. Adams, vice-president and sales manager of Hytron Radio & Electronics Co., chairman.

Parts Division: Matt Little, president of Quam-Nicols Co., chairman.

Technical Products Division: Carlyle W. Miller, application engineering manager of Westinghouse Electric Corp., chairman; Harold L. George, vice-president & general manager of Hughes Aircraft Co., director.

Amplifier & Sound Equipment Division: F. W. Bell, president of Bell Sound Systems, chairman and director.

BAKER AWARDED MEDAL OF HONOR



Former RTMA president and chairman of the board of directors, A. D. Plamondon, Jr., displays the RTMA Medal of Honor as W. R. G. Baker, vice-president of GE and director of the RTMA Engineering Department, (center) expresses his thanks. Max F. Balcom, of Sylvania Electric Products Co. and a former RTMA president (right) looks on as Dr. Baker receives the 1953 RTMA Medal of Honor for his outstanding contributions to the radio-television-electronics industry

WESCON Program Established

AUGUST 19TH OPENS the ninth annual Western Electronic (Trade) Show at Civic Auditorium, San Francisco for a three-day run. Electronic manufacturers will occupy 327 booths to display products used in broadcasting, communication, telemetry, air and marine navigational aids, industrial production and controls, instrumentation, computers, professional electronic research and education, nucleonic and geophysical detection and research, servicing and installation accessories. No home-use receivers are to be displayed, and the general public is not admitted. Trade and engineering attendance is expected to reach 14,000.

Four technical sessions daily, at an advanced level, sponsored by the 7th Region of the Institute of Radio Engineers, are to take place. The complete technical sessions

www.americanradiohistory.com


WORLD'S MOST WANTED AUTOCHANGER
BSR
Music lovers everywhere are demanding the Monarch—the new ideal for automatic record changers. Never before have they had such fidelity of tone, completely automatic selection of all records—12", 10" and 7"; such ease of operation and unfailing reliability.
Many leading set makers fit the Monarch as standard—your request for information will bring full details by return.
Birmingham Sound Reproducers Ltd., Old Hill, Staffs. Grams: 'Electronic Old Hill, Cradley Heath.'

schedule follows on page 381.

Community Antennamen Rename Malarkey

AT THEIR SECOND annual national convention held Monday, June 8 in New York's Park Sheraton Hotel, members of the National Community Television Association reelected Martin F. Malarkey, president of Transvideo Corp., Pottsville, Pa., president of the association for a one-year term.

Other officers include: Gerard B. Henderson of Carmel, Calif., vice president; Claude E. Reinhard of Palmerton, Pa., secretary; and William J. Calsam of Schuylkillhaven, Pa., treasurer. Members of the association's 10-man board of directors include: Clyde Davis II of Wilkes-Barre, Pa., A. J. Malin of Laconia, N. H., J. Holland Rannells of Cumberland, Md., Eli Kramer of Harrisburg, Pa., C. C. Daker of New Philadelphia, O., Kenneth H. Chapman of Honesville, Pa., John Colling of Grass Valley, Calif., Sumner Sewell of Bath, Me., George H. Bright, Jr. of Lansford, Pa., and Ned Cogswell of Oil City, Pa.

Westinghouse Builds New Research Center

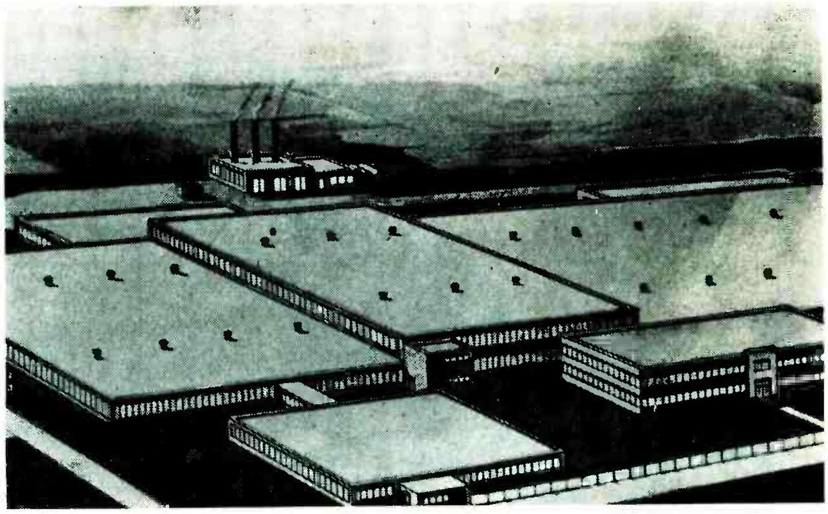
WESTINGHOUSE ELECTRIC CORP. has broken ground for a new research center on a 70-acre plot about 10 miles east of downtown Pittsburgh's Golden Triangle.

Construction of the center will give current company research activities a new home and provide the necessary space and flexibility to meet new research requirements.

The new labs will be approximately one-third larger than the present laboratories and will provide room for future expansion. In addition to laboratories and offices the structure will house an auditorium capable of seating about 250 persons, a cafeteria of similar size and a large technical library, one of the most complete in the area.

The new research center will ultimately replace the present Westinghouse Research Laboratories, located since 1916 only a few miles away from the new site.

Sylvania Plans New Television Set Plant



Proposed Sylvania tv receiver plant

SYLVANIA ELECTRIC laid plans for a new 416,000 sq ft tv set-manufacturing plant to be built in Batavia, N. Y.

H. Ward Zimmer, Sylvania president, said the new plant will be built in anticipation of greatly increased production and sales of Sylvania tv sets.

John K. McDonough, general manager of the division, said division headquarters will remain in Buffalo, N. Y. The activities of the Buffalo plants will also continue as in the past.

The plant is expected to be completed about February 1, 1954, and manufacturing operations will begin on a partial basis immediately thereafter. It is expected that the Batavia plant will be in full operation within six months of the completion date.

Mr. Zimmer said the new plant will employ approximately 1,200 persons when in full operation. Some key personnel of the tv set-manufacturing operation at Buffalo will be transferred to Batavia, while approximately 1,100 persons from the Batavia area will be employed.

The new facility, which will be the largest Sylvania plant under one roof, brings the company's total square footage in manufacturing plants to approximately 4,650,000. Batavia will be the 33rd community in ten states in which the company has at least one manufacturing plant.

McNaughten Joins RCA; NARTB Appoints Walker

NEAL MCNAUGHTEN, formerly director of engineering for the NARTB, joined the RCA Victor Division of RCA as administrator of the broadcast market planning section of the Engineering Products Department.

In a statement commenting on the announcement, Harold E. Feows, president of NARTB, declared:

"Neal McNaughten has performed many fine services for the nation's broadcasters during the time he headed NARTB's engineering operations. The most recent evidence of this performance was the successful broadcast engineering conferenec in Los Angeles, which Neal directed. We regret his loss to NARTB but wish him every success in his new position with RCA."

A. Prose Walker, presently eastern supervisor of Conelrad for the FCC, will assume the post of manager of engineering for the association, succeeding Mr. McNaughten. Mr. Walker has had thirteen years of service with the FCC. He has been eastern supervisor of Conelrad for the FCC, reporting to FCC Commissioner George Sterling, since July, 1951. He has been responsible

www.americanradiohistory.com

DON'T JUST LONG FOR IT!

Success begins when longing stops and action starts! The important thing for engineers in these times is to look to the future. Do you feel that perhaps there might be a place for you in an industry that offers exceptional advantages today, and even greater opportunity for tomorrow? Longing won't get it for you.

Perhaps you are not employed at your highest skill. At Westinghouse, top management philosophy dictates that every engineer be provided with challenging assignments . . . that management potential be quickly recognized and developed . . . and that inventive abilities be stimulated and encouraged.

For many years, Westinghouse has been setting the pace for the electrical industry. Westinghouse engineers have profited from this . . . in the form of excellent pay . . . liberal patent awards and stock-purchasing plans . . . and all of the usual personal security benefits.

Opportunities exist for men with experience as

Circuit Engineers
Computer Engineers
Servo Engineers
Technical Writers

DON'T just long for these things . . . write us today and tell us about yourself. We'll reply by return mail.

Dept. AE

Westinghouse

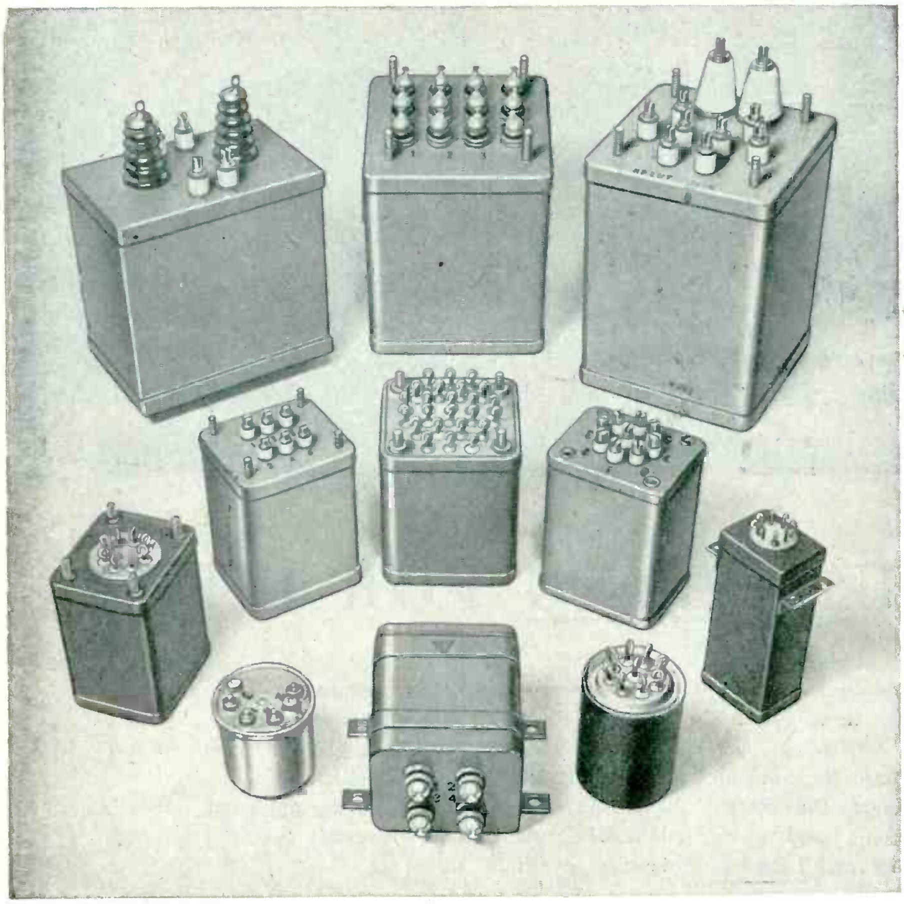
ELECTRIC CORPORATION

109 W. LOMBARD ST. BALTIMORE 1, MD.

Want more information? Use post card on last page.

www.americanradiohistory.com

TRANSFORMERS



HERMETICALLY SEALED TO MIL-T-27 SPECIFICATIONS

NYT offers a wide variety of transformer types to meet military and civilian specifications, designed and manufactured by specialists in transformer development.

Latest NYT service for customers is a complete test laboratory equipped and approved for on-the-spot MIL-T-27 testing and faster approvals.

NEW YORK TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

for providing technical assistance to the Air Defense Command affecting plans for the Control of Electromagnetic Radiation (Conelrad) concerning all non-government radio services licensed and regulated by the FCC.

Clevite-Brush Appoints Three Executives

APPOINTMENT OF THREE new executives of Clevite-Brush Development Co., the product development unit of the Clevite Corp. group of companies, has been announced by A. L. W. Williams, president of the unit.

Waldo H. Kliever, formerly director of research of Minneapolis-Honeywell, joined the company as vice-president and director of instrument development.

Dr. Kliever, who became research director of Minneapolis-Honeywell in 1945, will have charge of the measuring instruments and magnetic recording sections, and is to head a control development section.

Thomas E. Lynch becomes vice-president and continues as director of ordnance products development. He joined the Brush Development Co. in 1939 as an engineer and has worked in the fields of underwater sound detection and magnetic recording.

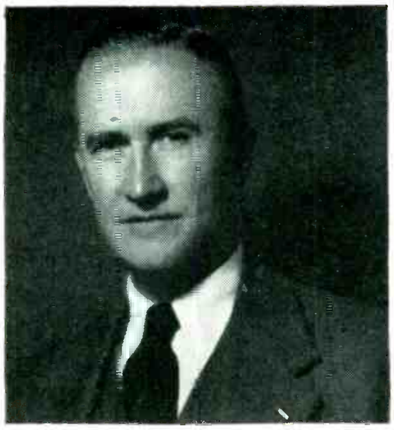
William P. Short becomes vice-president in his position as director of piezoelectric and sonic products development. He joined Clevite-Brush in March of this year, coming from Pleasantville Instrument Corp., where he had been vice-president in charge of operations.

General Leavey Elected President Of Federal Labs

MAJOR GENERAL EDMOND H. LEAVEY, U.S.A. (RETIRED), has been elected president of Federal Telecommunication Laboratories, Nutley, N. J. research associate of IT&T, it was announced by Col. Sosthenes Behn, chairman and William H. Harrison, president of IT&T. General Leavey fills the vacancy created by the recent death of Vice-Admiral Carl F. Holden.

General Leavey has been vice-president of IT&T since November, 1952, when he joined the corpora-

www.americanradiohistory.com



General Edmond H. Leavey

tion, and also is a member of the board of directors of a number of the corporation's subsidiary companies.

General Leavey is experienced in both the operational and administrative fields of engineering. He was chief of the Logistics Division of Supreme Headquarters of the Allied Powers in Europe (SHAPE) before his retirement in 1952. During World War II, he occupied key posts in both the European and Pacific theaters.

General Leavey, a registered professional engineer in civil and industrial engineering, also holds honorary degrees of Doctor of Laws and Doctor of Engineering from Texas A.&M. and Rensselaer Polytechnic Institute, respectively.

Sylvania Appoints Carter And Richardson

SYLVANIA ELECTRIC PRODUCTS, Inc. announced the appointments of E. Finley Carter as vice-president and

E. Finley Carter

Another New Heiland Product

Heiland

Amplifier System

Model 119—*Designed as a companion to the versatile "700 Series" Heiland Recording Oscillograph and Model 82-6 Bridge Balance unit.*

for Multi-Channel Oscillograph Recordings

Now, for the first time, a complete measuring system, including Oscillograph, Amplifier and DC balancing units, can be conveniently installed in a standard 19-inch relay rack with the accessory mounts available, or placed side by side on tables with equal ease and simplicity. Removable shock mount bases can also be supplied for installation in moving vehicles, aircraft, etc., where shocks and accelerations are encountered. Housed in a rugged, yet lightweight cast aluminum case finished in attractive silver-gray gloss enamel.

FEATURES:

- Rack, table or shock mounting
- Plug-in units, readily removable
- Compact
- Rugged
- One - surface operation
- Local or remote calibration
- High sensitivity
- Carrier Amplifier flat to 1000 cps.
- High power output
- Two or more systems may be synchronized
- Low gage - voltage required for maximum output
- Highly stable carrier generator
- High stability amplifiers

Specifications

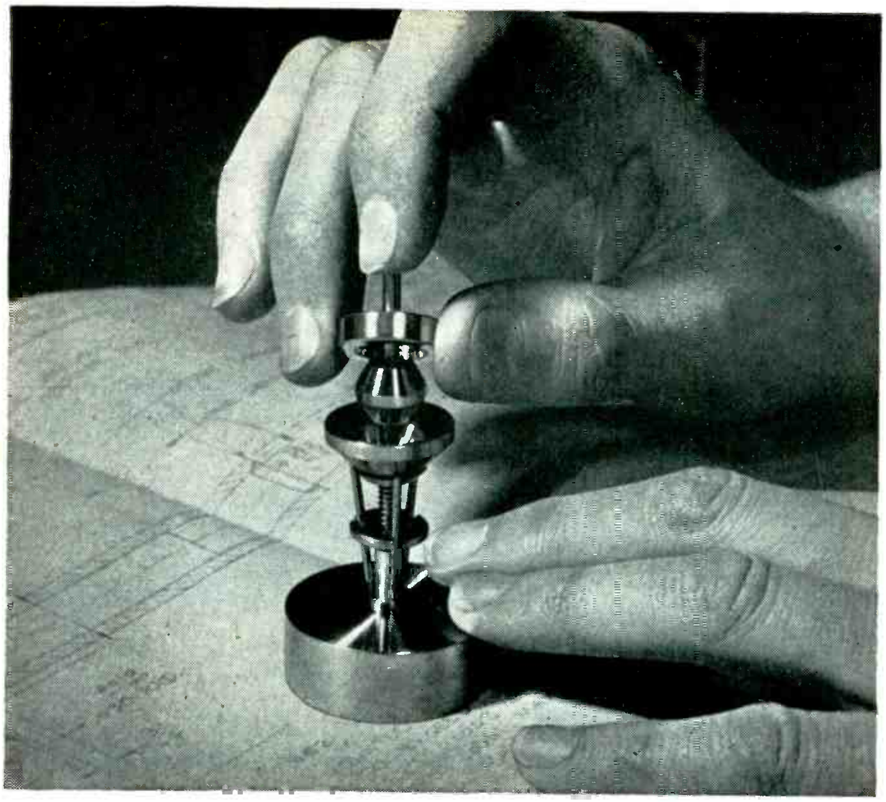
Size: 11" x 16" x 18" (6 channels and power supply)
Weight: Approximately 70 pounds (6 channels and power supply)
Number of Channels: 6
Power Output: ± 50 Ma. into 18 ohm load
Sensitivity: .0005 volts input for full scale output
Carrier Frequency: 5000 cps.
Frequency Range: Carrier 1000 cps., linear integrating 3000 cps.

See the first showing of the Heiland Model 119 Amplifier System at the I.S.A. Show—Chicago, September 21 through 25.

Write for our free catalog of Recording Oscillographs, Bridge Balance units & Galvanometers.

Heiland Research Corporation
130 East Fifth Avenue, Denver, Colorado

Want more information? Use post card on last page.



SKILLED HANDS

Yours for the Asking . . . These are special hands . . . skilled hands . . . hands trained to translate creative engineering and design into production reality. These hands produce compact, high precision gyros, synchros, and servo motors providing the sensory information, the computing brain and the muscle for the automatic controls of modern industry and aviation.

These helping hands are ready, willing and able to assist by the development and manufacture of the advanced precision components you require for today's problems and tomorrow's progress.

Let us Help. Inquiries for information on standard or special units, for a particular application are cordially invited. Technical Bulletins are available and will be sent upon request.

KEARFOTT COMPONENTS INCLUDE:
Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Kearfott
SINCE 1917
CREATIVE ENGINEERING
PRODUCTION ACHIEVEMENT

KEARFOTT COMPANY, INC., 1150 McBride Ave., Little Falls, N. J.
West Coast Office: 253 N. Vinedo Ave., Pasadena, Calif.
A General Precision Equipment Corporation Subsidiary

Howard L. Richardson

technical director of the company and Howard L. Richardson as vice-president in charge of engineering operations. Mr. Carter has been a vice-president since 1945 and Mr. Richardson since 1951.

President H. Ward Zimmer, in making the announcement, said Mr. Carter's new appointment came as the result of the heavily increasing role that broad technical problems are playing in overall management decisions. In his new capacity, the president said, Mr. Carter will furnish technical counsel to Sylvania's management and engineering groups, and will handle broad technical relations with industry, universities, the armed services and other organizations.

Mr. Richardson assumes the operating responsibilities that previously were held by Mr. Carter as vice-president in charge of engineering. He was formerly vice-president in charge of industrial relations.

GE Tube Department Opens Midwest Quarters

FORMAL OPENING of the new GE Tube Department central regional headquarters and distribution center in Chicago was attended by more than 300 electronics, business and civic leaders. I. J. Kaar, manager of engineering for GE's Electronics Division, speaking at the opening ceremonies, said that GE predicts an increase in the industry-wide tube business of 57 percent from 1953 to 1961.

The $875,000 structure has almost 100,000 sq ft of floor space. The building, besides serving as a warehouse, also is sales head-

www.americanradiohistory.com

quarters and commercial service headquarters for the GE Tube Department central regional sales organization.

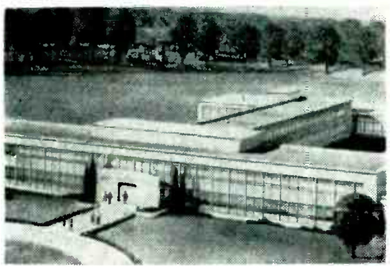
The regional sales organization services 16 midwest and central states, including the electronics and manufacturing area in the immediate vicinity of Chicago. Included in the new one-story brick building are complete laboratory facilities employing specially built GE testing equipment to enable company engineers to work more closely with electronics equipment manufacturers.

The present staff at the new building is expected to increase to 160 when peak operation is attained later in the year.

Warehouse manager is John A. Cavaliere, while J. J. Shafter is supervisor of commercial service. Walter J. Fitzpatrick heads the replacement sales organization and Roger F. Long heads the original equipment sales organization.

Midwest Research Plans Million-Dollar Lab

A FUNCTIONAL 2-STORY laboratory and headquarters structure, planned to provide maximum area for tasks of scientific inquiry as well as space for future expansion, is planned for construction soon by the Midwest



Proposed Midwest laboratory

Research Institute in Kansas City, Missouri.

The new building will contain 71,000 sq ft of floor area and will be located on a 9-acre plot in the cultural center of Kansas City.

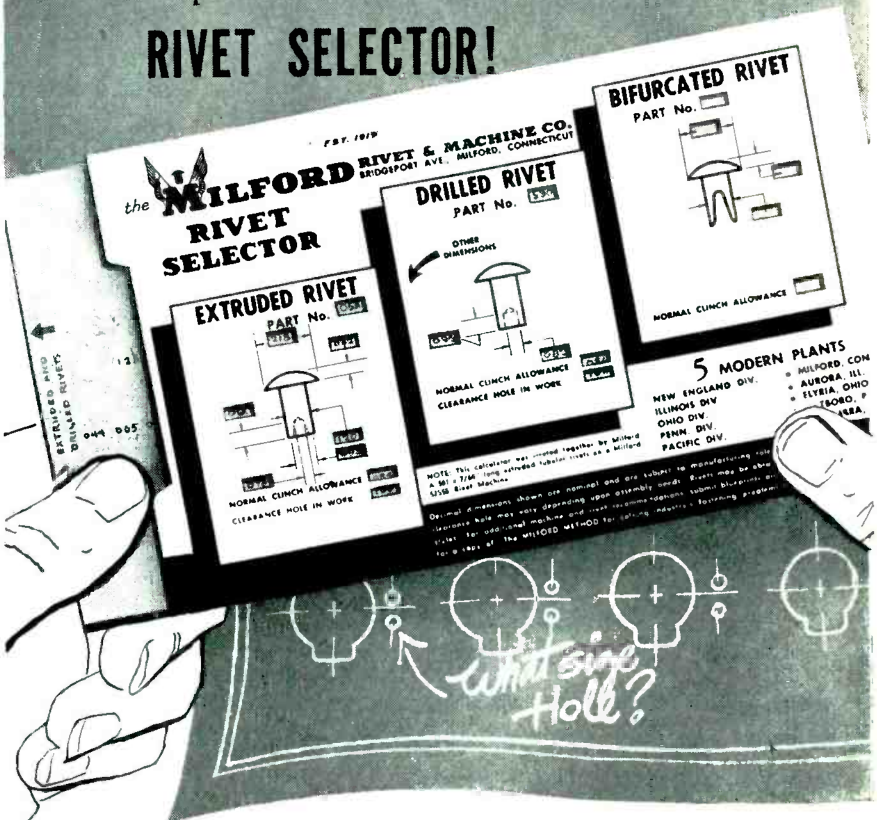
Construction will probably start in October on the building, planned to cost one and a quarter million dollars. All operations of Midwest will be consolidated in the structure. The Institute now occupies six scattered buildings.

Organized nine years ago to serve

newest aid to users of fasteners

Everyone who designs, specifies or purchases needs this useful

RIVET SELECTOR!



Handiest selector you ever saw!

Simplifies your job; saves time, speeds choice of right fastener. Easy to read, easy to use, handsomely lithographed in red, white and blue. Shows various tubular and split rivets, part catalog number, normal clinch allowance, size of clearance hole in work and other details to aid your product manufacturing. Sturdily riveted together for lasting use. Write for yours today!

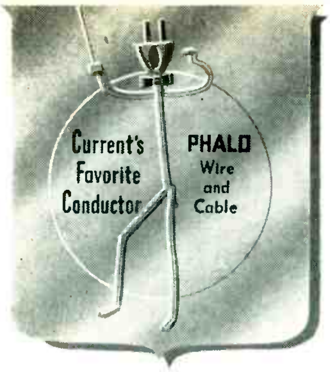
EST. 1919
MILFORD
The name to *RIVET* in your memory for fasteners.

THE MILFORD RIVET & MACHINE COMPANY

855 BRIDGEPORT AVENUE, MILFORD, CONNECTICUT
806 ILLINOIS AVENUE, AURORA, ILLINOIS
1106 WEST RIVER STREET, ELYRIA, OHIO
26 PLATT STREET, HATBORO, PENNSYLVANIA
715 SO. PALM AVENUE, ALHAMBRA, CALIFORNIA

Want more information? Use post card on last page.

www.americanradiohistory.com



A Standard of Quality

Just a short time back the custom-made cord set shown here did not exist! It was custom created and produced for a very special application by *PHALO!*

PHALO has an industry-wide reputation for designing and producing the unusual in cords and cord sets . . . and in so doing, solving the "unsolvable" problems!

See the *PHALOCORD* section of the new PHALO CATALOG for details. ASK FOR CATALOG.

ASK ALSO FOR THE NAME OF YOUR NEAREST PHALO SALES REPRESENTATIVE IN THE FOLLOWING CITIES:

New York, N. Y.
Rochester, N. Y.
Philadelphia, Pa.
Greensboro, N. C.
Wichita, Kansas
Natick, Mass.
Cleveland, Ohio
Houston, Texas
Phoenix, Ariz.
Chicago, Ill
Detroit, Mich.
Los Angeles, Cal.
San Francisco, Cal.

PHALO PLASTICS CORPORATION

CORNER OF COMMERCIAL ST. • WORCESTER • MASS.

Insulated Wire and Cables — Cord Set Assemblies

as a technological and research center for middlewestern states, Midwest Research Institute now carries on projects for sponsors and clients throughout the nation. Its annual research volume is in excess of one million dollars. It has served some 460 sponsors and has undertaken more than 1,000 separate projects.

Among special services now being developed is an electronic computer center, which will house both digital and analog devices to be employed by business and industrial organizations for solution of special computational problems.

Sprague Expands In North Carolina

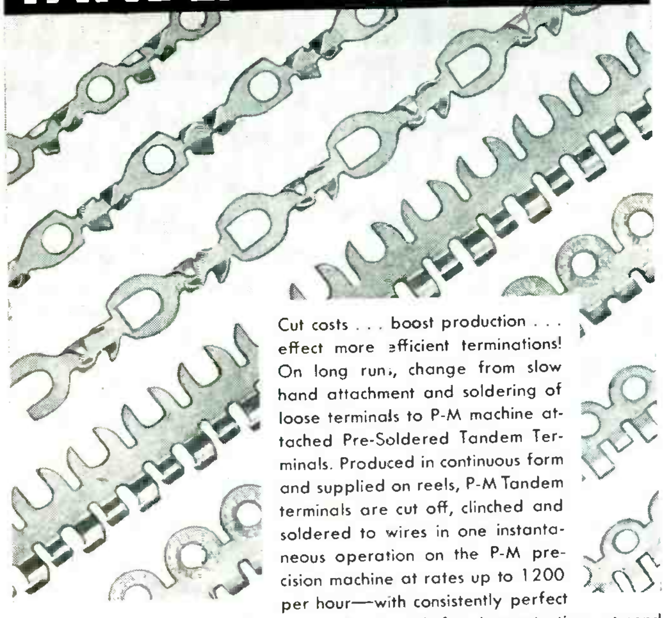
SPRAGUE ELECTRIC CO. is undertaking construction of a new plant in the Blue Ridge Mountain area in extreme northwestern North Carolina, which will employ about 250 workers when it reaches full scheduled production. In announcing plans for the company's seventh branch operation, Julian K. Sprague, president, said that the new plant will manufacture capacitors, the most important of the many types of electronic components made by the company.

Location of the plant will be about seven miles from West Jefferson, Ashe county, which is only a few miles from both the Tennessee and Virginia state lines. Ernest L. Ward, executive vice-president, said construction of the manufacturing plant and of auxiliary water purification facilities will begin immediately. It is expected that the plant will start operation about November 1 of this year. At that time training of a small complement of employees will begin, and the plant will be expanded as fast as the training program permits until the initial target of 250 employees is reached.

The new Sprague factory will be of modern design in steel and red brick construction and will contain 50,000 sq ft of floor space. It will be situated on a 30-acre tract on a bend of the New River. Process water for the manufacturing operations will be taken from the stream, purified, and returned to the river

www.americanradiohistory.com

TANDEM TERMINALS



Cut costs . . . boost production . . . effect more efficient terminations! On long runs, change from slow hand attachment and soldering of loose terminals to P-M machine attached Pre-Soldered Tandem Terminals. Produced in continuous form and supplied on reels, P-M Tandem terminals are cut off, clinched and soldered to wires in one instantaneous operation on the P-M precision machine at rates up to 1200 per hour—with consistently perfect terminations. Many standard types available. Ask for demonstration, or send for details and enclose sample of terminal and wire now used. Catalog on request.

For ordinary runs we have dies to produce over 400 different kinds of separate terminals for electric wires. Also, we are large producers of Small Metal Stampings made exact to customers' prints.

PATTON-MacGUYER COMPANY

201 Chapman Street, Providence, R. I.

GERMANIUM DIODE TEST SET

Accurate
LAB MEASUREMENTS

Rapid
INSPECTION TESTING

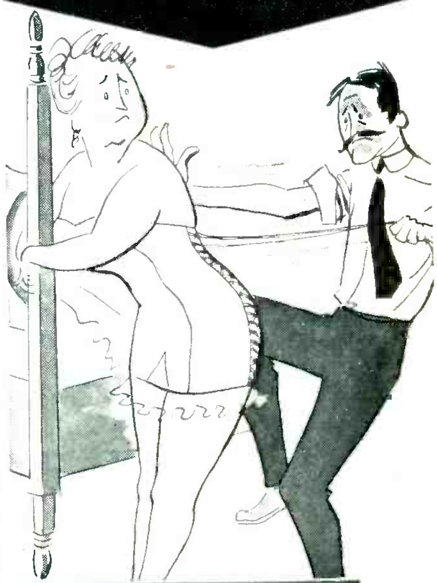
- Pre-set regulated reverse voltages
- −10, −50, −100, 0–150 volts at 5 ma
- Forward current to 500 ma at 1.0 volt
- Controls interlocked for routine tests
- Reversed or shorted diode indication
- Test fixture allows quick connections
- Provision for accessory diode heater

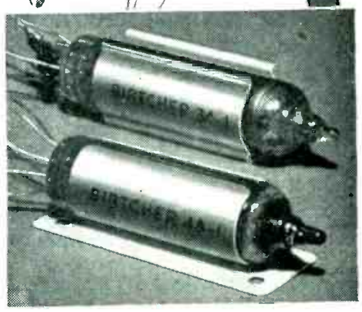
MODEL DT-100

TELETRONICS LABORATORY INC.
WESTBURY, L. I., N. Y.

MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND PRODUCTION TEST EQUIPMENT

there's a BIRTCHER CLAMP for *almost* every purpose!





NEW SUB-MINIATURE TUBE CLAMPS

The Birtcher KOOL KLAMPS were developed for use under conditions of extreme heat and severe vibration and shock. Made from a heat treatable silver alloy of high thermal conductivity, reducing bulb temperatures by as much as 40° C, KOOL KLAMPS are improving the reliability of miniaturized electronic equipment.

The Birtcher Corporation, world's largest producer of electro-surgical devices, maintains a separate division for the manufacture and sale of tube and component clamps.

The BIRTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, California

Please send catalog and samples by *return mail.*

Company ______________________ E-8-3
Attention of: ______________________
Address ______________________
City ______________ State ______________

www.americanradiohistory.com

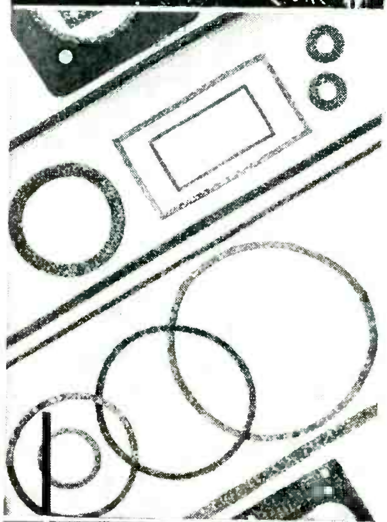
. . . WHEN YOU DESIGN METEX ELECTRONIC WEATHERSTRIPPING INTO YOUR EQUIPMENT YOU GET ITS POSITIVE SHIELDING EFFECTIVENESS —AT MAXIMUM OVERALL ECONOMY

Plan *now* to take full advantage of *Metex Electronic Weatherstripping*'s unusual effectiveness in shielding all types of electronic equipment. Because it is made of *knitted* wire mesh, *Metex Electronic Weatherstripping* is both conductive *and* resilient. It assures positive metal-to-metal contact between all mating surfaces. And being resilient it accommodates itself positively to surface inequalities.

In reality, *Metex Electronic Weatherstripping* can do more for you than just shield RF leakage. It can cut the cost of machining mating surfaces to close tolerances. It can eliminate the need for extra fasteners and many other costly means of making joints RF tight.

To get the best results and lowest production costs, design with *Metex Electronic Weatherstripping,* available in 3 basic forms:

1. Continuous lengths in various cross sectional shapes with or without fin for attachment.
2. Die-formed shielding gaskets, and
3. Sealing gaskets where the knitted wire gasket is combined with a sealing medium.



METEX ELECTRONIC WEATHERSTRIPPING
For shielding on all types of electronic and electrical equipment

For detailed information on METEX ELECTRONIC PRODUCTS, write for FREE copy of "Metex Electronic Weatherstrips" or outline your SPECIFIC shielding problem — it will receive our immediate attention.

Each of these is made in various sizes and shapes which are readily adaptable to practically any equipment. The resiliency can be varied where necessary to meet specific requirements.

Applications in which *Metex Electronic Weatherstripping* has already proved its effectiveness include pulse modulator shields, wave-guide choke-flange gaskets, local oscillators on TV sets, dielectric heaters, etc.

METAL TEXTILE CORPORATION
KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY
METEX
Roselle, New Jersey

after being passed through a filter plant to be built by the company.

In addition to the new southern plant, Sprague now operates three plants in North Adams, Mass. and branch plants in Bennington and Barre, Vermont; Nashua, New Hampshire, Saugerties and Kingston, New York; and Grafton, Wisconsin. About 6,000 employees are on the payroll of the Sprague operations at the present time.

RCA Promotes Two Executives

ELECTION OF W. Walter Watts as vice-president in charge of technical products, and of Theodore A. Smith as vice-president in charge of the Engineering Products Department of the RCA Victor Division of RCA, was announced by Walter A. Buck, vice-president and general manager of RCA Victor, following a meeting of the RCA board of directors.

Mr. Watts, previously vice-president in charge of the Engineering Products Department, now assumes the position formerly held by L. W. Teegarden, who became executive vice-president of RCA last February. In his new assignment, Mr. Watts will supervise the activities of both the Engineering Products Department and the Tube Department of the RCA Victor Division.

Mr. Watts joined RCA Victor after wartime service as a Colonel and Commanding Officer of the Signal Corps Distribution Agency and as a Signal Corps Procurement Director for which he was awarded the Legion of Merit. He was earlier associated with Montgomery Ward as mail order sales manager, and

W. Walter Watts

Theodore A. Smith

was vice-president in charge of the Wincharger Corp. His work in the sales and distribution phases of the electronics industry began in 1923.

Mr. Smith, previously assistant manager of the Engineering Products Department, has been associated with RCA since 1925 when he joined RCA's Technical and Test Laboratories at Van Cortlandt Park, New York. Three years later, in 1928, he supervised the construction of RCA's pioneer television station in New York.

Mr. Smith entered commercial engineering work in 1930 as RCA eastern district sales manager for broadcast equipment. In 1938, he was assigned to Camden headquarters, where he since has held key sales and administrative posts in the RCA Victor Division.

GE's Utica Electronic Plant Starts Operations

RESEARCH, DEVELOPMENT and manufacturing operations for the production of specialized electronics equipment for military purposes are now in full progress at GE's newly-completed military electronics plant on French Road in Utica, N. Y.

The plant consists of a steel-frame, single-story structure, 842 ft long and 352 ft wide, with a two-story office and laboratory section 632 ft long and 75 ft wide. Four penthouses on the roof of the structure are used for special engineering development work on antennas. While a major portion of the plant is for bench assembly of a wide

It Takes BIG-Time Know-How To Mass Produce SMALL Crystals With Watch-Like Precision

Ever since 1875 the Bulova name has been the symbol for integrity . . . quality . . precision craftsmanship . . . and dependability These are the very factors demanded by users of crystal units!

Now Bulova applies the art of precision production to the fabrication of crystal units for standard and special application. In production now and available in quantity lots are 100 KC-GT standards. The 100 KC-GT unit has been accepted by the National Bureau of Standards as the basis for Time Measurement reference.

The supreme accuracy and quality that are inherent in *all* Bulova products are also found in the mass-produced CR types . . . which meet the most exacting military and commercial demands.

On Crystals for Your Special Application . . . Write:

QUARTZ CRYSTAL DIVISION

BULOVA WATCH COMPANY, INC.,

BULOVA PARK, FLUSHING 70, NEW YORK

Want more information? Use post card on last page.

Write Dept. E-8. DeJUR AMSCO CORPORATION, 45-01 Northern Blvd., Long Island City 1, N. Y.
West Coast: 405 North Maple Drive, Beverly Hills, California

variety of electronic military equipment, a substantial portion is devoted to development and testing of new types of equipment.

For convenience, compactness and efficiency, power supply for research and production test facilities are centralized in a 51 ft by 176 ft area termed the Test Powerhouse. An unusual feature of this area is a 72 ft long main plug board with a thousand-cable distribution network. To get power at desired voltages and frequencies, the technician at the test station calls the plug board operator who wears a headphone, and the operator thereupon makes the proper plug-in on the board.

Test areas in the plant include production test cubicles, shock, vibration, environmental and special shielded test rooms, and the test penthouses on the roof. The production test cubicles are six-foot square steel enclosures mounted on platforms elevated eight feet above the floor and fastened to the building columns. This arrangement permits maximum free floor space for assembly benches.

Paint, welding and machine shops, and a completely equipped plating installation located in a special area walled off from the rest of the plant because of corrosive plating liquids, are included in the plant.

An elaborate conveyor system running around the interior of the plant transports thousands of small parts used and produced in the plant, into and out of storage.

Honeywell Names Research Head

THE APPOINTMENT of Finn J. Larsen as director of research for Minneapolis-Honeywell Regulator Co. was announced recently by William J. McGoldrick, vice-president.

Dr. Larsen, a member of the company's research and engineering organization since 1948, succeeds Waldo Kliever who has resigned to accept a position with Clevite-Brush Development Co.

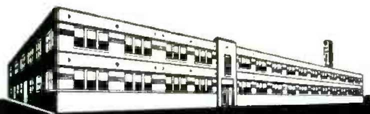
Since 1952, Dr. Larsen has been director of ordnance engineering for Honeywell, supervising the

Runzel CORD, WIRE & CABLE

PRECISION MADE WIRE FOR *Quality Products*

The consistent quality standard of Runzel wire, cord and cable offers manufacturers complete assurance of performance. Runzel products undergo such thorough inspections in the process of their manufacture that flaws are reduced to an absolute minimum.

Your wire needs in hook-up, lead-in, shielded wire speaker cords and all types of insulated wire are available from this centrally located source. We maintain a complete engineering service. Your wiring problems are solicited. For their scientific solution, the Runzel Laboratory provides research assistance.



RUNZEL CORD AND WIRE CO.
4727 WEST MONTROSE AVE. CHICAGO, ILLINOIS

Still Another NEW *from* NEW LONDON • FM SIGNAL GENERATOR 25 to 216 MC

The new FM Signal Generator Model 100C gives the same excellent performance as the 100A and 100B—but increases the tuning range to cover all the way from 25 to 216 megacycles in a single band.

Leakage, spurious outputs, drift and hum are all very low. There is no mixing, no multiplication. A piston attenuator gives accurate attenuation from .02 to 100,000 microvolts. Frequency deviation is in two ranges: 0 to 30 kc and 0 to 250 kc.

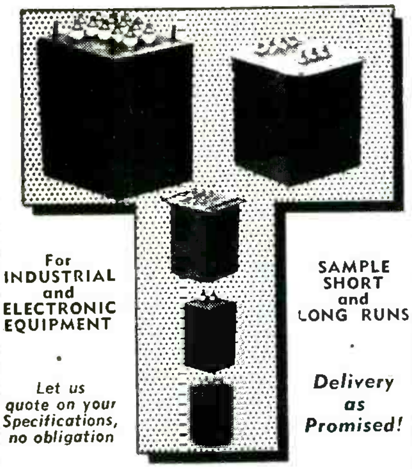
Designed and constructed to withstand hard use, the 100C is an ideal production test as well as a highly accurate laboratory instrument.

PRICE $875.-
DELIVERY ONE WEEK

New London Instrument Company
NEW LONDON, CONNECTICUT

EPCO TRANSFORMERS

"Fill Your Need to a "



For INDUSTRIAL and ELECTRONIC EQUIPMENT

Let us quote on your Specifications, no obligation

SAMPLE SHORT and LONG RUNS

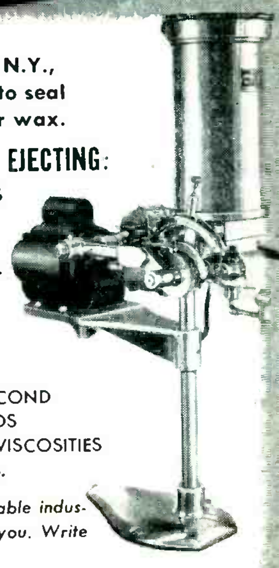
Delivery as Promised!

DESIGNED TO COMMERCIAL AND MILITARY SPECIFICATIONS (MIL-T-27 and AN-E-19)

EPCO Products Inc.
2500 Atlantic Ave.
Brooklyn 7, New York

"INCREASED PRODUCTION" "LESS REJECTS" "IMPROVED PRODUCT APPEARANCE"

—reports Electronic Devices, Inc., Brooklyn, N.Y., where a Robinson Metering Pump is used to seal Plastisel Selenium Rectifiers with condenser wax.



VERSATILE ROBINSON METERING PUMPS FOR EJECTING:

- ASPHALT • RESIN • PITCH • ROSIN • ADHESIVES
- STEARIC ACID AND PLASTER OF PARIS
- PORTLAND CEMENT AND VARNISH MIXTURE
- SEALING COMPOUND • POLYAMIDE • PLASTISOL
- PASTES • GLYPTAL MIXTURES
- RUBBER • BAKELITE

FASTER! MORE ACCURATE! ECONOMICAL!

- EJECTS ACCURATE QUANTITY IN ⅔ OF A SECOND
- EJECTION QUANTITY CHANGED IN 2 SECONDS
- THERMOSTATIC HEAT FROM 70° TO 500°F. • VISCOSITIES FROM #10 S.A.E. OIL TO 200,000 CENTIPOISES.

The Robinson Metering Pump, adaptable to innumerable industrial metering applications, may solve a problem for you. Write for informative free folder.

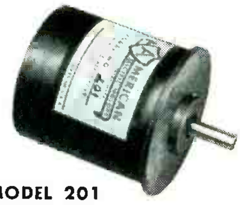
EDWARD E. ROBINSON
INCORPORATED
P.O. Box 47
95 PARK AVE. • NUTLEY 10, NEW JERSEY
Telephone NUtley 2-4510

AMERICAN ELECTRIC
Miniature Motors

Weigh only OUNCES yet deliver

POWER-HOUSE PERFORMANCE

Aloft or Aground!



MODEL 201
Hysteresis Type
Synchronous Drive Motor

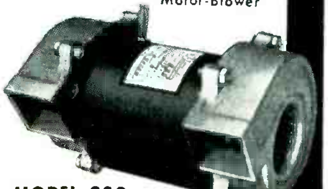
MODEL 228
Induction Drive Motor

MODEL 300
Reluctance Type
Synchronous Drive Motor

MODEL 168
Propeller Fan

MODEL 182A
Axial Flow Fan

MODEL 219
Single Ended
Motor-Blower



MODEL 220
Double Ended
Motor-Blower

Need low weight for mechanization of airborne gear . . . want unusual compactness for ground equipment? AMERICAN ELECTRIC can provide the drive motor to fit your specialized requirements.

These miniatures are built as small as 1.45 inches in diameter . . . Even the "big boys" measure only $3\frac{5}{16}$ inches across! Yet with all their diminutive size and weight AMERICAN ELECTRIC Miniatures are regular "power-houses" in their field *. . . designed to utilize all magnetic materials to the ultimate, thus reducing useless, "no-pay" weight to an absolute minimum!*

No design compromises—AMERICAN ELECTRIC offers the greatest range of production and prototype models available today! Let AMERICAN ELECTRIC quote on your miniature motor requirements. Write, wire or phone today!

TWO MINIATURE DRIVE MOTOR TYPES

Induction Motors—Output torque range: 1/2 in. oz. to 120 in. oz.

Synchronous Motors—Output torque range: .01 in. oz. to 10 in. oz. in both Hysteresis and Reluctance types.

TWO MINIATURE COOLING TYPES

Centrifugal Blowers
Propeller Fans

Manufacturers also of HIGH FREQUENCY POWER SUPPLIES Inductor-Alternator type, 500 Watts to 75 KVA output. Portable, Semi-Portable and Stationary Types.

AMERICAN ELECTRIC MOTORS
TRADE MARK

4811 Telegraph Road,
Los Angeles 22,
California

Engineering Representatives: TRAVCO ENGINEERING CO.
Silver Spring (Md.), Chicago, New York, Los Angeles

work the company's expanded ordnance division has been carrying out in the development of fire control systems for tanks, as well as other control devises in the fields of radio activity, explosives and missiles.

He will continue to have responsibility for this work, in addition to his new duties as research director.

Dr. Larsen joined Honeywell after receiving his Ph. D. in 1948 from Iowa State College, where he also was an instructor in physics. He started as a physicist in the company's research department. Before becoming director of ordnance engineering, he was assistant to the director of research.

Marconi Marine Names Technical Manager

THE MARCONI INTERNATIONAL Marine Communication Co. announced that George J. McDonald, deputy technical manager of the company, has been appointed technical manager.

Mr. McDonald joined Marconi Wireless in 1935 and engaged in research and development work under G. M. Wright, now engineer-in-chief of that company, concentrating especially on direction-finding technique. He transferred to the Marconi Marine Co as deputy technical manager in 1949, on the staff of the late F. P. Best who was technical manager.

National Company Names Cosgrove

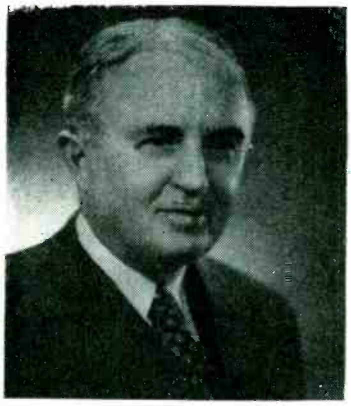
CHARLES C. HORNBOSTEL, president of the National Company, has announced the retirement, effective

Raymond C. Cosgrove

June 1, of William A. Ready as chairman of the board of directors and member of the executive committee.

Mr. Ready has been an official of the company for 38 years and until March of this year served as president and chairman of the board.

Mr. Ready has been succeeded as board chairman by Raymond C. Cosgrove, formerly executive vice-president of the Avco Manufacturing Corp. and president of RTMA.



William A. Ready

Minnesota Mining Acquires American Lava

ACQUISITION OF AMERICAN Lava Corp. of Chattanooga, Tenn. by Minnesota Mining & Manufacturing Co. through a $5 million stock transfer was announced recently.

Herbert P. Buetow, 3M president, and John Kruesi, president of American Lava, said officers of the two firms have approved a deal by which the Chattanooga firm would become a wholly-owned 3M subsidiary.

Terms call for American Lava stockholders to trade their common and preferred shares for 3M common.

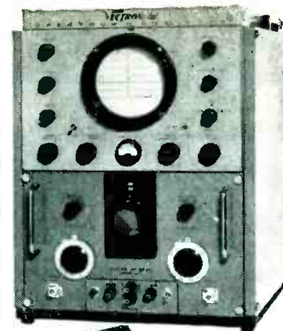
Mr. Buetow said his firm's primary interest in acquiring Lava was to broaden 3M's participation in the electronics field.

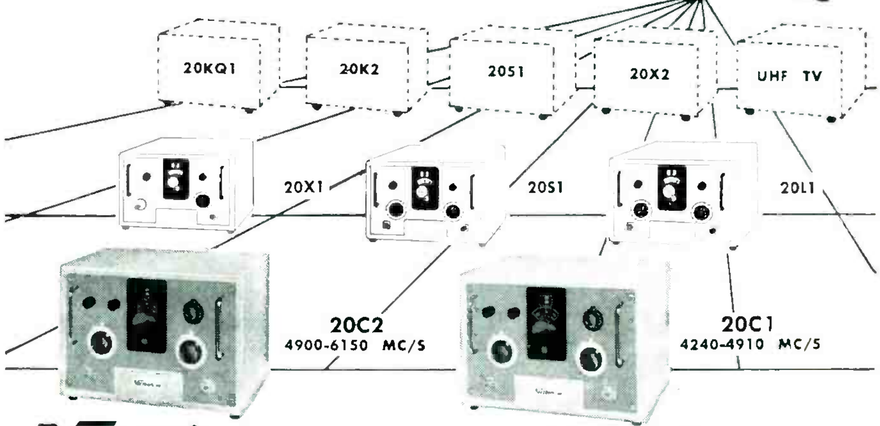
"We are the world's largest producer of flexible electrical insulating materials," Mr. Buetow said. "The electronics industry is already a giant on the American business scene and many phases of its development are just beginning. By joining forces, 3M and American Lava will play a far larger role in

TWO NEW C-BAND HEADS

for VECTRON'S

MICROWAVE SPECTRUM ANALYZER





VECTRON'S two new R. F. Heads, 20C1 and 20C2, provide continuous coverage of microwave frequencies in C-band from 4,240 mc/s to 6,150 mc/s. They are engineered for immediate operation in Vectron's Spectrum Analyzer Chassis SA10 or SA20 . . . no conversion, no adaptation.

Specific Band Coverage . . . Vectron's R. F. Heads (L-band, S-band, C-band and X-band) are interchangeable in any Vectron SA20 Spectrum Analyzer. Display Unit and Heads can be purchased separately, as needed, to provide a wide choice of operating frequencies without the bulk and unnecessary expense of equipment which covers large areas in unused bands.

Early Delivery . . . Individual R. F. Heads and SA20 Analyzers are available for early delivery. Other new Heads are well along in development and will be announced soon. Send for Bulletin SA20 (see below) and specify the frequencies you need.

For Microwave Radar and Communications Equipment The Vectron SA20 Spectrum Analyzer presents visually the frequency distribution spectrum of the power output of pulsed or CW microwave oscillators and can be used as a sensitive R. F. detector for checks and measurements in the design, production and maintenance of microwave radar and communications equipment and components.

Vectron's development program includes additional R. F. Heads to cover microwave frequencies newly opened for military and civilian use. For information on these additional R. F. Heads and for complete engineering data, send for Bulletin SA20. Write today and be sure to specify the operating frequencies you need.

FEATURES

- Large, clear 5" oscilloscope pattern
- Standard bezel to accept camera, hood or filter
- Minimum number of controls . . . maximum operating convenience
- Double conversion assures I. F. alignment stability
- Built in regulated supply for Klystron oscillator
- Easy access for maintenance or adjustment
- New Provision for D.C. Filament supply for Klystron oscillator

SPECIFICATIONS

- Overall Gain — 130 decibels
- Sensitivity — At least 60 dbm for 1 usec. pulse — 80 dbm for CW
- IF Bandwidth — Choice of 50 kc, recommended for CW and 0.2 to 2 usec. pulse widths, or 20 kc bandwith to 5 usec.
- Sweep Frequency — 10 to 30 cps standard — available to 2 cps and with long persistence tube
- Power supply 105-125V, 50-400 cycles
- New Low-noise 20kc IF strip for higher useable gain.

VECTRON, inc. *Electronic and Electro-Mechanical Equipment*

404 MAIN STREET, WALTHAM 54, MASS.

Vectron invites your inquiries regarding the development and manufacture of:

Gyro-mechanisms	Precision Mechanical Devices	Synchros and Servomechanisms	Microwave Equipment
Gyro-stabilized Platforms	Computers and Calculators	Electronic Systems	Microwave Test Equipment
Gyros and Gyro Systems	Gear Assemblies	Precision Electronic Components	Radar Units and Systems
Aircraft Instruments	Test Instruments	Communication Networks and Filters	Echo Boxes

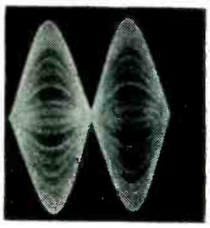
Want more information? Use post card on last page.

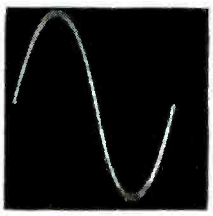
www.americanradiohistory.com

Visit Us at Booth 1319—Western Electronic Show & Convention

FOR RAPID SERVO ANALYSIS

ONLY THE SERVOSCOPE





Output wave forms of Servoscope displayed against internal linear sweep generator frequency ½ cycle.

* is applicable to both AC carrier and DC servo systems.
* has a built-in low frequency sine wave generator for obtaining frequency response of DC servo systems.
* has a built-in electronic sweep with no sweep potentiometer to wear out and require replacement.
* has a dynamic frequency control range of 200 to 1.

MORE and MORE aircraft companies, universities, process control manufacturers, government laboratories and others are adding the Servoscope to their list of required laboratory equipment. If you are designing, developing or producing servomechanisms or process controls, the Servoscope will save many hours of design and engineering time.

The Servoscope is available in two standard models—1100A (.1 to 20 cps.), 1100B (.15 to 30 cps.) Custom modifications quoted on request.

For bulletin giving complete specifications: write Dept. E-8

SERVO CORPORATION OF AMERICA

2020 Jericho Turnpike, New Hyde Park, N. Y.

Fieldstone 7-2810

the industry than they could hope to play separately."

"American Lava's excellent record in the field of ceramic insulators dovetails with the business 3M has developed through its electrical insulating and sound recording tape division," he added.

Mr. Buetow said 3M plans no changes either in American Lava's management group or in its operating policies. Mr. Kruesi will continue as president and all officers and executives will continue in their present capacities.

Robert L. Westbee, general manager of 3M's electrical insulating and sound recording tape division, will be responsible for liaison between the parent company and the new subsidiary.

Pearce And Williams Join AMF Electronics

John M. Pearce

JOHN M. PEARCE, former president of Phebco, and Douglas R. G. Williams, former works manager of Arma Corp., have joined American Machine & Foundry Co., Electronics Division, Boston, as director of engineering and factory manager, respectively, it was announced by Morehead Patterson, AMF board chairman and president.

Mr. Pearce holds the Presidential Citation of Merit, highest civilian award given by the government, bestowed in recognition of his pioneering contribution to the proximity fuze program at the Applied Physics Laboratory at Johns Hopkins University during World War II. He was also actively engaged in the guided missile program from

IBM
TRADE MARK

Leading manufacturer of electronic digital computers, electronic and electrical business machines, time systems and electric typewriters.

offers career opportunities for

Electrical and Electronic Engineers

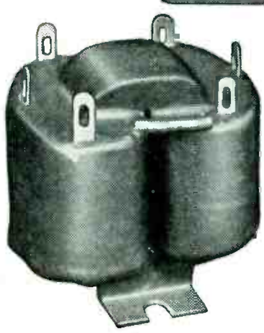
at

Endicott, N. Y. Poughkeepsie, N. Y.

If your background has been in: Electronic Design, Computer Design, Electrical Design, Product Engineering or Product Development—you owe it to yourself and your future to investigate the opportunities waiting to be filled at IBM. Interview will be arranged in your city. Write, giving full details of education and experience to:

Mr. C. F. McElwain
Dept. 686 (4)
International Business Machines
590 Madison Avenue
New York 22, N. Y.

MAKING TRANSFORMERS IS OUR BUSINESS



• For more than 35 years Acme Electric transformers have become components of all types of electrical and electronic equipment. The vast technical experience accumulated during this time is now available to west coast manufacturers through our Los Angeles branch.

ACME ELECTRIC CORPORATION
MAIN PLANT: 318 Water Street • Cuba, N. Y.
West Coast Engineering Laboratories: 1375 W. Jefferson Blvd. • Los Angeles, Calif.
In Canada: ACME ELECTRIC CORP. LTD. • 50 North Line Rd. • Toronto, Ont.

Acme ACME Electric
TRANSFORMERS

for sub-miniature, miniature

SLIP RINGS

Brush holders, commutators, electronic specialties
Standard sizes or to your specification
4-6 Micro finish
Minimum coefficient of friction, wear, brush noise
Diameters from .035 — to your specification
Operating capacities — 1 amp intermittent, .6 amp continuous load
Rhodium or gold plating over silver rings
No porosity factor
Concentricity guaranteed to .002 T.I.R. — to your specification

specify

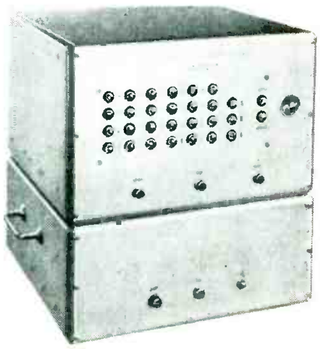
ICI

Our staff available for consultation on your problem. Write for ICI catalog containing complete engineering data on standard sizes.

Instrument Components Inc.
1834 Franklin St., Santa Monica, Calif.
Division: Marshall Engineering Company

when time is short...

Potter Instrument Company, Inc.



depend on this new, reliable 8mc COUNTER-CHRONOGRAPH

MEASURE TIME IN 1/8 μsec. STEPS FOR:

- VELOCITY
- ACCELERATION
- DETONATION TIME
- DOPPLER FREQUENCIES
- PULSE CHARACTERISTICS

For every timing application where a fraction of a microsecond is important, specify this new Potter high-resolution Counter-Chronograph. You can split a second into 8,000,000 parts — read the results quickly and directly with an accuracy of 1/8 usec.

Here are the features that make this precision instrument, the Model 471, outstanding *when time is short:*

ACCURATE 8mc time base provides the highest resolution of time measurement available in direct reading instruments.

DIRECT READING Digital registration indicates time from 1 usec to 1 second on patented Potter decades. Fractional parts of a microsecond are counted and indicated by a three stage binary in steps of 1/8 usec.

DEPENDABLE Straightforward three stage binary used at 8mc frequency assures highest stability.

PROVED PERFORMANCE 11 years of service in proving grounds and research centers are your best assurance that the Potter Counter-Chronograph provides maximum reliability for critical timing applications.

VERSATILE There is a Potter instrument for every timing application, and digital recorders are available for permanent records at rates up to 150 per second. For information on the best equipment to fit your requirements, write to **Dept. E-7.**

POTTER INSTRUMENT COMPANY
INCORPORATED
116 CUTTER MILL ROAD, GREAT NECK, NEW YORK

108

Douglas R. G. Williams

1947 to 1952 at the Glenn L. Martin Co. of Baltimore as chief electronic engineer. Prior to that he was chief engineer in charge of development of guided missiles at Bendix Aviation Corp., Pacific Division. For 17 years he was assistant chief engineer at radio station WGN in Chicago.

Mr. Williams, the new factory manager, will be in complete charge of all manufacturing operations at the AMF Electronics Division. He was with Western Electric Company for four years and with the Foxboro Co. for eight years as sales engineer. Following this, Mr. Williams was factory manager and assistant to the vice-president for manufacturing and engineering of Behr Manning Corp. More recently he was works manager at Arma Corp. in Brooklyn, N. Y.

Smith Elected Head Of Indiana Steel

ROBERT F. SMITH, vice-president of the Indiana Steel Products Co., Valparaiso, Ind., and acting chief executive of the company for the past several months, has been elected president of the company and a member of its board of directors, according to an announcement by the company.

The company also announced the election of John H. Bouwmeester, vice-president in charge of manufacturing, as a member of the board of directors, and Anthony Astrologes, formerly manufacturing controller and assistant treasurer, as treasurer.

At the same time, Ivan A. Dickey, assistant sales manager, was promoted to sales manager, and P. M.

www.americanradiohistory.com

Wheeler was named mid-western regional sales manager with offices in Chicago. Mr. Bouwmeester and Charles A. Maynard, vice-president in charge of engineering and research, were re-elected to vice-presidencies.

Mr. Smith, a veteran of 16 years service with the company, had served as vice-president since 1948 and as general manager since May, 1949.

The 45-year-old firm produces over 50 million magnets a year for thousands of industrial and consumer applications.

Robert F. Smith

RCA Victor To Build Plant In Ohio

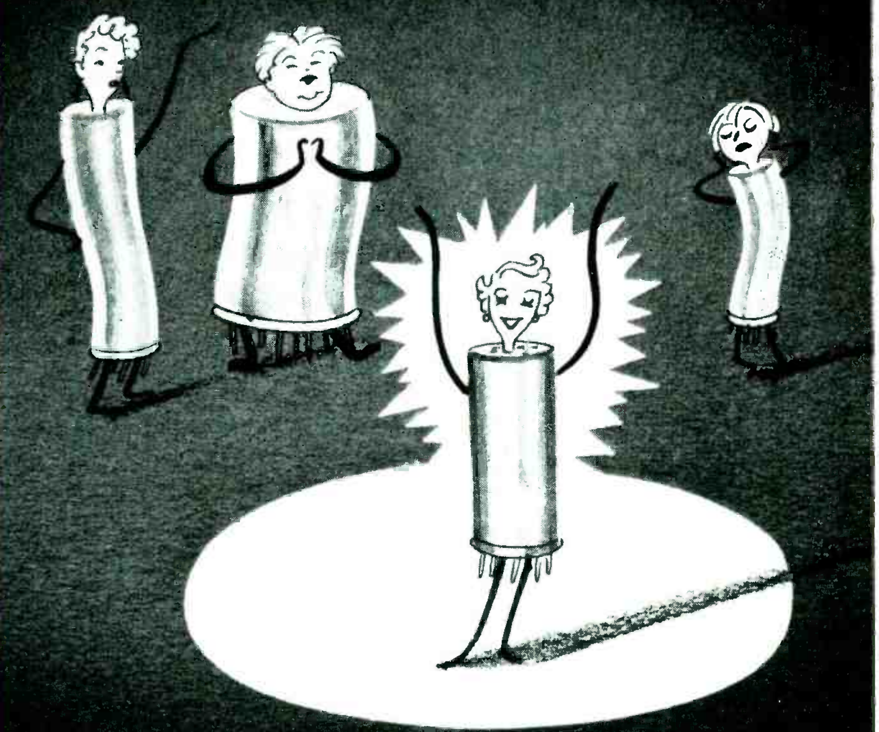
THE RCA VICTOR Division of RCA announced the purchase of ground to construct a new plant at Findlay, Ohio, for the manufacture of electronic component parts for radio and tv home receivers.

Present plans call for the building of a modern, single-story structure providing approximately 150,000 sq ft of floor space, according to R. T. Orth, vice-president in charge of the RCA Tube Department which will operate the plant.

Mr. Orth said ground-breaking is scheduled for late this summer. The first unit of the new facilities is expected to be in operation in the spring of 1954. A major item to be produced will be deflection components for tv receivers.

The new Findlay plant, 50 miles southwest of Toledo, will become RCA's fourth manufacturing center in Ohio. The company now produces electron tubes at Cincinnati,

One stands out!



Who's the best performer of the miniature choppers?

the "MIDGET"

Airpax chopper, by long odds!

THE RIGHT WEIGHT . . . weighs only 1.2 ounces!
THE RIGHT LENGTH . . . measures only 1.625" long!
THE RIGHT DIAMETER . . . .755" and will fit a 7-pin miniature shield base!

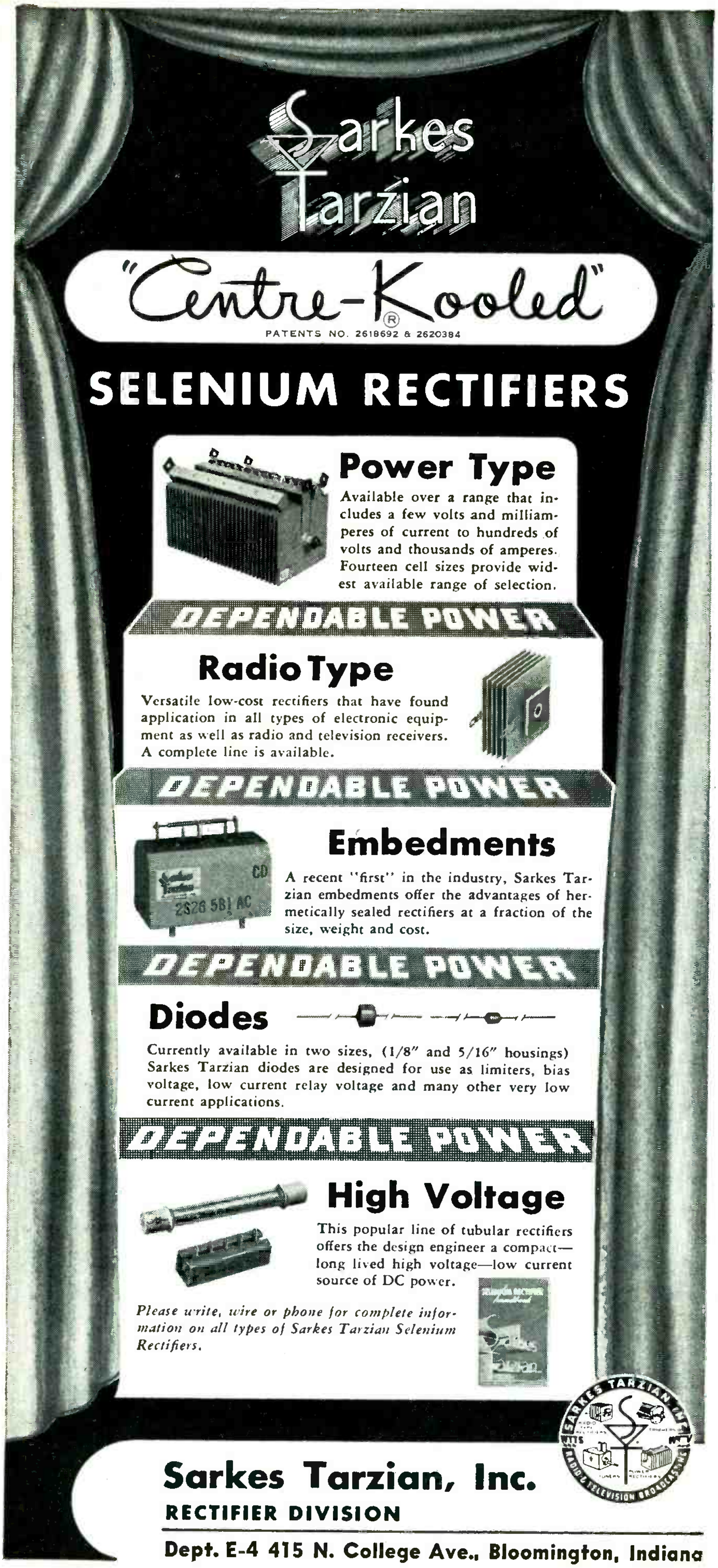
THE RIGHT DESIGN FOR MAXIMUM PERFORMANCE!

Small size and big performance have won wide acclaim for the C747 MIDGET chopper. Available with SPDT contacts, a 6.3 volt drive for 400 cycle operation, usually a 380 to 420 cycle frequency range. Phase angle nominal 65°, dwell time of 135°.

AIRPAX PRODUCTS COMPANY
DESIGNERS ENGINEERS
MIDDLE RIVER, BALTIMORE 20, MD.

Want more information? Use post card on last page.

www.americanradiohistory.com



RCA Estate gas and electric kitchen ranges at Hamilton, and Victrola phonographs at Cambridge.

Keys Named President Of Guthman Co.

Eugene M. Keys

EUGENE M. KEYS was named president of the Edwin I. Guthman Co. of Chicago, following action by the board of directors.

Mr. Keys formerly was the executive vice-president of the electronic components manufacturing company, whose founder, Edwin I. Guthman, died in April.

The new president, who is 37 years old, joined the company in 1942 as a member of the purchasing department. In 1945 he was named assistant sales manager and in 1947 he was promoted to the position of sales manager, a post he retained for four years.

In 1951 he was named vice-president in charge of sales and a year later was made executive vice-president of the company, the position he held at the time of his appointment to the presidency.

SAMA Elects New Officers, Directors

EDWARD J. ALBERT, president of Thwing-Albert Instrument Company, Philadelphia, was elected president of the Scientific Apparatus Makers Association. Election of the officers and board members took place at the annual meeting held recently at The Greenbrier, White Sulphur Springs, W. Va.

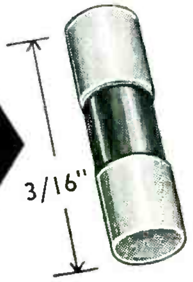
L. B. Swift, chairman of the

www.americanradiohistory.com

MICROWAVE RESISTORS TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE

(Ideal for Miniaturization)



TYPICAL APPLICATIONS
- Power measurement at any frequency
- Matched terminations for wave-guides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

FILM THICKNESS offers negligible skin effect, at microwave frequencies.

POWER CAPACITY of 1/4 watt provides high power handling ability.

PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS

Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

"PERFECT"...

That's What Production Engineers Say about DANO COILS

And, it's no accident, of course. The Dano rigid policy of attentive testing and inspecting every coil in all vital stages of production guarantees perfect performance.
Send us samples or specifications with quantity requirements for our recommendation. No obligation!

- **Form Wound**
- **Paper Section**
- **Acetate Bobbin**
- **Molded Coils**
- **Bakelite Bobbin**
- **Cotton Interweave**
- **Coils for High Temperature Application.**

Also, Transformers Made To Order

DANO

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

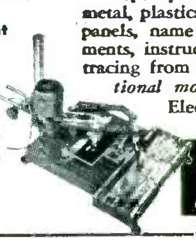
The Green Engraver

ENGRAVES ✓ ROUTS ✓ PROFILES ✓ and MODELS

Used and endorsed by tool and die, electronic, machine, plastics, radio, electrical and instrument manufacturers.
A real money saver.

Specify the Green Engraver for precision engraving on metal, plastics, wood, glass, hard rubber etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs . . . by simple tracing from master. *Routing, profiling and three dimensional modeling indicate its versatility.*
Electric etching attachment available.

Special attachments and engineering service available for production work.

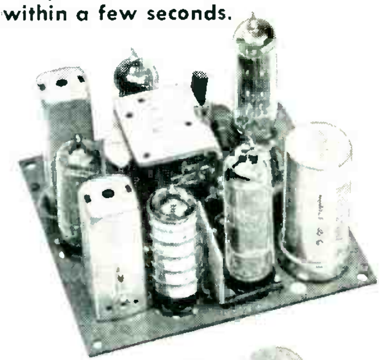


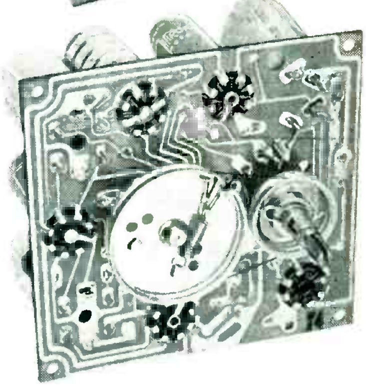
FREE: Brochure— yours upon request.

Green Instrument Co.
INCORPORATED
363 PUTNAM AVENUE • CAMBRIDGE • MASS.

a Printed Circuit is a WIRING DEVICE

Yes, a *Printed Circuit*, more accurately termed a *Printed Wiring Board*, is nothing more nor less than a *Wiring Device*. It is a most significant wiring device in that volume applications in conjunction with multiple soldering techniques permit the simultaneous production of up to 100 electrical connections within a few seconds.





A five tube superheterodyne in volume production utilizing multiple soldering and semi-automatic assembly techniques . . . an excellent application of printed wiring methods by Raytheon Manufacturing Company.

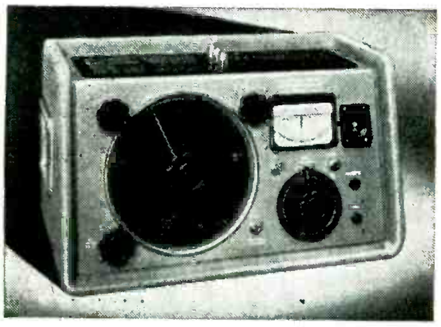
Printed Wiring Boards can be made to your engineering specifications by Methode, an electronic wiring device manufacturer equipped and experienced in the specialized manufacturing techniques necessary to support continuous high production. Typically, the printed wiring panel will be a smaller cost item than most other major component portions of an electronic device.

METHODE
Manufacturing Company
2021 W. Churchill St.
Chicago 47, Ill.
Geared to produce Plastic and Metal Electronic Components

www.americanradiohistory.com

FM/AM SIGNAL GENERATOR TF 995

A crystal standardized generator either frequency or amplitude modulated. Frequency range: 13.5 to 216 megacycles. Output range 0.1 microvolts to 100 millivolts. Internal or external modulation gives f.m. deviations to 600 kilocycles and a.m. depths to 50 per cent.

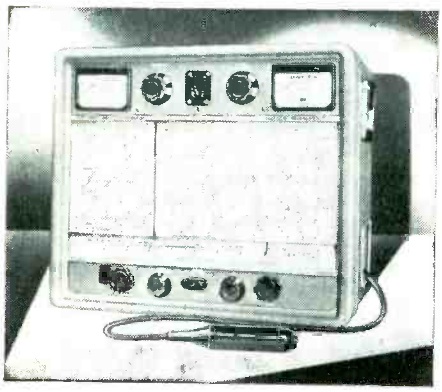


UNIVERSAL BRIDGE TF 868

Measures inductance and capacitance at 1,000 cycles, resistance at d.c.; direct reading 1 microhenry to 100 henries, 1 micro-microfarad to 100 microfarads, and 0.1 ohms to 10 megohms. Q range 0.1 to 1.000, tanδ 0.001 to 10.

FM DEVIATION METER TF 934

With crystal-standardized deviation ranges of 5, 25 and 75 kilocycles, alternative high- and low-level buffered inlets, visual checking for optimum tuning and level, together with a separately buffered audio outlet, this ruggedized deviation meter is ideal for carriers in the range 2.5 to 200 megacycles.



STANDARD SIGNAL GENERATOR TF 867

For precision receiver measurements: Covers on an expanded full-vision scale 15 kilocycles (or less) to 30 megacycles, crystal standardized, with an output continuously variable from 4 volts to 0.4 microvolts. Up to 100 per cent. a.m., with unmeasurable f.m., monitored by dual rectification.

MARCONI INSTRUMENTS

VACUUM TUBE VOLTMETERS · FREQUENCY STANDARDS · OUTPUT METERS
WAVE METERS · WAVE ANALYSERS · Q METERS · BEAT FREQUENCY OSCILLATORS

23-25 BEAVER STREET · NEW YORK 4

CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED, ST. ALBANS, HERTFORDSHIRE
Managing Agents in Export:
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

board of Taylor Instrument Companies, Rochester, N. Y., was elected president pro-tempore of SAMA and T. M. Mints, president of E. H. Sargent & Companies, Chicago, was re-elected treasurer of the group.

New section chairman include E. J. Rhein, sales manager of the scientific division of Kimble Glass Company, Toledo, laboratory apparatus section; L. B. McKinley, vice-president of Bausch & Lomb Optical Co., optical section and P. R. Bassett of Sperry Gyroscope Co., Great Neck, L. I., nautical, aeronautical and military instrument section.

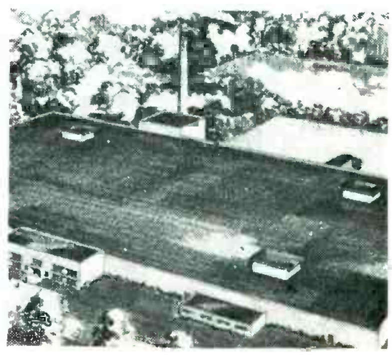
The following were re-elected chairmen of their sections: G. A. Downsbrough, president of Boonton Radio Corp., industrial instruments; O. L. Lethander, president of L. Peterson & Co., Chicago, laboratory equipment; and Henry F. Dever, president of Minneapolis-Honeywell Regulator Co., Brown Instrument Division of Philadelphia, recorder-controller section.

Cornell-Dubilier Plant Near Completion

CORNELL-DUBILIER Electric Corporation's new capacitor manufacturing plant, being built at Sanford, North Carolina, is nearing completion, it was announced by Octave Blake, president of the corporation.

Production has already begun on paper tubular and electrolytic type capacitors at the new plant, Mr. Blake stated.

Situated on a 27-acre tract, the new plant, part of the expanding program of the corporation, will provide 270,000 sq ft of operating



Cornell-Dubilier plant

space, including a two-story administration building.

Facilities are provided for a potential of some 2,900 employees, Mr. Blake pointed out, and additional expansion has been planned for anticipated future requirements.

Ohio Crankshaft Names Benninghoff V-P

W. E. Benninghoff

OHIO CRANKSHAFT'S president, W. C. Dunn, announced the election by the board of directors of W. E. Benninghoff to the post of vice-president of the company. Mr. Benninghoff continues as general manager of the company's Tocco division. Another major executive change was the election of Foster H. Pettay, a vice-president, to the additional post of secretary-treasurer of the company.

Mr. Benninghoff was graduated from Case Institute of Technology in 1920 with an electrical engineering degree. Until 1935 he was associated with the Cleveland Electric Illuminating Co. as a power sales engineer. In that year president W. C. Dunn brought him to Ohio Crankshaft for the development of high-frequency induction hardening of crankshafts. From this beginning he guided the Tocco Division of the company to its present position in the induction heating field.

Westinghouse Plans Missile Subdivision

AS A RESULT of the rapid growth of development work in guided missiles, the Westinghouse Electric Corp. is expanding the engineering

● Hidden in the lid of every Deepfreeze Home Freezer is a Honeywell Mercury Switch. This tiny, glass enclosed unit acts to flash on the lamp which lights up the freezer.

Engineers of Deepfreeze Appliance Division, Motor Products Corporation, selected this Honeywell Mercury Switch because:

1 It operates by the mere action of tilting the lid.
2 It assures long life and absolute dependability.
3 It is unaffected by extreme cold or temperature variations or by moisture.

Experiences have shown that devices controlled by Honeywell Mercury Switches do not fail. Mercury switches go a long ways toward reducing manufacturing costs and eliminating field service expense. If your application provides tilt motion and requires low operating force, a Honeywell Mercury Switch may be the component you are looking for. MICRO field engineers, fully experienced in all types of switch problems, are available to help you choose the switch best suited to your needs. Write or call the nearest MICRO branch office.

MICRO
MAKERS OF PRECISION SWITCHES
FREEPORT, ILLINOIS
A DIVISION OF
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
H HONEYWELL

www.americanradiohistory.com

RAYTHEON **miniature**

PULSE TRANSFORMERS

For universal blocking oscillator use

UX-7307A—UX-7350A

These hermetically sealed, MIL-T-27 type pulse transformers are designed for universal blocking oscillator use at repetition rates from 50 to 5000 pps.

UX-7307A and UX-7350A are identical in electrical characteristics, having two windings for 1000 ohms impedance and two windings to match 250 ohms. To cover a wider variety of applications, the windings are arranged differently in the two transformers.

These units are also available in octal type tube bases as UX-7307 and UX-7350. Bulletin DL-K-320 gives complete information including typical circuits. Write for it.

AVAILABLE FROM STOCK

Pulse Width in Micro Seconds*	Rise Time in Micro Seconds	Droop	Front-edge Overshoot	Trailing Edge Back Swing
0.25	.07	1%	4%	5%
0.50	.07	1%	4%	6%
1.00	.07	2%	4%	6%
2.00	.07	4%	4%	7%
5.00	.07	10%	4%	11%

*measured at base of pulse

Electrical characteristics measured by a H-P #212A pulse generator and a Dumont #303 oscilloscope. Measurements made with secondary loaded with 1000 ohms. The transformers are tested at 1000 V D.C., and the maximum voltage across the 1000 ohm windings is 300 volts peak.

RAYTHEON
MANUFACTURING COMPANY
EQUIPMENT SALES DIVISION
DEPT. 6270-A WALTHAM 54, MASSACHUSETTS
DISTRICT OFFICES: BOSTON, NEW YORK, CLEVELAND, CHICAGO, NEW ORLEANS, LOS ANGELES (WILMINGTON), SAN FRANCISCO, SEATTLE
INTERNATIONAL DIVISION: 19 RECTOR ST., NEW YORK CITY

RAYTHEON PRODUCTS INCLUDE: WELDPOWER* welders; Voltage stabilizers (regulators); Transformers; Sonic oscillators for laboratory research; Standard control knobs; Electronic calculators and computers; Radio, television, subminiature and special purpose tubes and other electronic equipment. *Reg. U. S. Pat. Off.

BUILD
RAYTHEON
Excellence in Electronics
DEPENDABILITY INTO YOUR PRODUCTS

facilities of the Electronics Division in Baltimore, Md., according to Walter E. Benoit, division manager.

The new engineering subdivision will be known as Guided Missile Ground Control Engineering. The section will concern itself exclusively with the development, design and manufacture of models and equipment for guidance of high-speed, high-altitude missiles.

The new subdivision will eventually be housed in its own building, which will be located adjacent to the company's microwave manufacturing plant.

Named to head up the new department was Maynard R. Briggs, a veteran of 23 years with Westinghouse, and formerly engineering manager of the communication equipment subdivision in Baltimore.

Horizons Appoints Cameron G. Harman

HORIZONS INCORPORATED of Princeton, New Jersey, and Cleveland, Ohio, announced that Cameron G. Harman has joined its scientific staff in Cleveland as head of the ceramics department.

For the past eight years, Dr. Harman has been the head of the ceramic division of the Battelle Memorial Institute of Columbus, Ohio. He is currently a trustee of the American Ceramic Society and chairman of the ceramic committee in the American Society for Testing Materials.

For a period of ten years he was

Cameron G. Harman

www.americanradiohistory.com

Measurements Corporation

MODEL 59 MEGACYCLE METER

The only grid-dip meter covering the wide range of
2.2 Mc. to 400 Mc.

FREQUENCY CALIBRATION: ±2%

For determining the resonant frequency of tuned circuits, antennas, transmission lines, bypass condensers, chokes, etc. For measuring inductance and capacitance. May also be used as an auxiliary signal generator; for signal tracing and many other applications.

Complete data on request.

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

IF ITS WILMAD

ITS PRECISIONIZED★ *Glass Components for*

BEARINGS
RESISTORS
DASHPOTS
CAPACITORS
U.H.F. TUNERS
VOLTAGE REGULATORS

★WILMAD PRECISION BORE TUBING

. . . is available in uniformity and accuracy never before known possible for America's electronics industry

CHEMICAL LABORATORY GLASSWARE

WILMAD GLASS Co. INC.
LANDISVILLE, NEW JERSEY
Specialists to Research and Industry

Our engineers will gladly collaborate on any of your glass requirements.

for the ELECTRONIC INDUSTRIES

Quality Ribbons STRIPS

MOLYBDENUM
TUNGSTEN
TANTALUM
FORMED PIECES

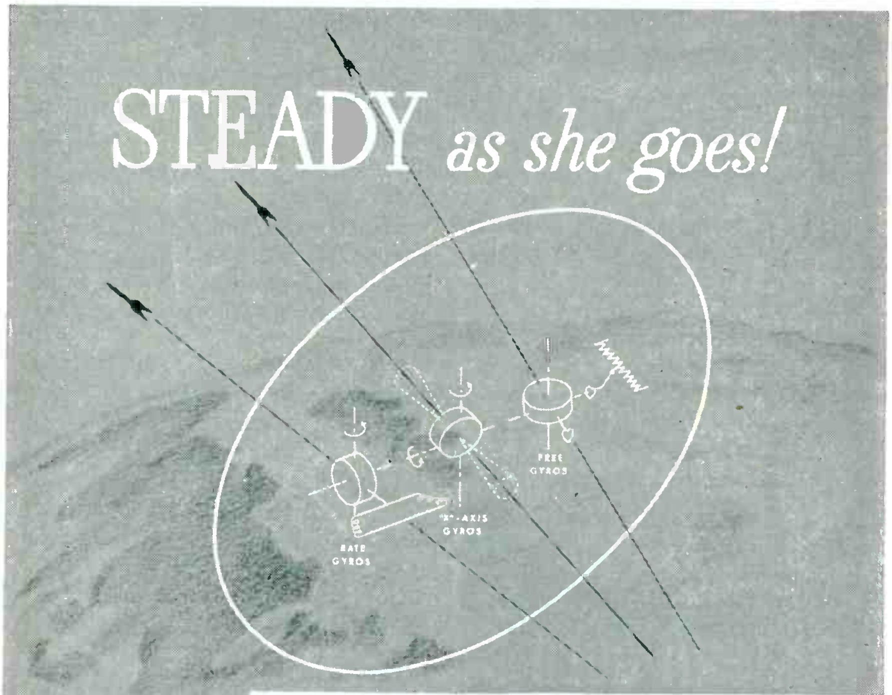
•

Your Special Metals Rolled to Thin Sizes & Close Tolerances

•

YOUR INQUIRIES WILL RECEIVE PROMPT ATTENTION

H. CROSS CO.
15 BEEKMAN ST., N. Y. 38, N. Y.
WOrth 2-2044 and COrtlandt 7-0470



GYROMECHANISMS, INC.
HALESITE • LONG ISLAND • NEW YORK

GYROSCOPES • POTENTIOMETERS • ELECTRONIC AND HYDRAULIC DEVICES FOR INSTRUMENTATION AND CONTROL
WRITE FOR LITERATURE

Improve Tube Performance with WESGO "AL-300" ALUMINA INSULATORS

- 97% Al_2O_3 content
- Vacuum tight — extraordinary strength
- Low loss factor—High Te value
- Non "gassing" — no poisoning of emitters
- High strength at all temperatures up to 1500° C.
- Can be supplied in most any shape to extremely close tolerances

Our Engineering Department will gladly answer all inquiries relative to your particular problems

WESTERN GOLD & PLATINUM WORKS
Ceramic Division
589 BRYANT STREET
SAN FRANCISCO, CALIF.

Want more information? Use post card on last page.

the assistant professor of ceramic engineering at the University of Illinois, following which he was the chief ceramic engineer for the Locke Insulator Corp. of Baltimore in the general field of electrical porcelain.

Motorola Opens New Parts Depot

Motorola's parts depot

E. S. GOEBEL, national sales and service manager of Motorola Communications and Electronics, recently announced the establishment of a new regional parts depot in Dallas, Texas. The parts section occupies approximately 6,000 sq ft of floor space in the new $100,000 building located in the Trinity industrial district of Dallas.

Richard J. Clark has been appointed the new parts depot manager.

An additional 3,000 sq ft of office space in the new building will be occupied by the southwest regional office. E. L. Falls, southwest regional manager, heads the parts depot activities and a group of approximately 25 radio communications engineers who serve six zones covering five southwestern states.

Magnavox Plans New Production Facilities

THE MAGNAVOX CO. has purchased a 22-acre industrial tract at Urbana, Ill., and is moving ahead with plans for the development of new production facilites in that city.

The land was purchased from Modern Research Industries of Urbana and is located east of the business section in a newly developed industrial area.

"We have selected this site after a nationwide survey of possible new plant locations," it was explained by Frank Freimann, president. "Our studies show that Urbana, Ill., offers Magnavox the best possible

new

PRECISION RF STEP ATTENUATOR*

Model AT-120 0 to 1000 MC

Small, rugged ladder attenuator achieves attenuation accuracy and low vswr from dc to uhf. Suitable for all signal and sweep generators in this frequency range.

Care in design assures maximum flexibility in mounting, drive, and types of input and output connections.

Easily adaptable for inclusion in different types of test equipment and in laboratory and production test applications.

SPECIFICATIONS

MAXIMUM STEPS
Ten (eleven contact positions)

ATTENUATION RANGE
Up to 120 db total
Attenuation per step optional

OUTPUT IMPEDANCE
50 or 75 ohms nominal

INPUT IMPEDANCE
100 or 150 ohms nominal
50 or 75 ohms optional

INPUT AND OUTPUT VSWR
1.1 to 1000 mc at 50 ohms

ACCURACY
± .3 db per 20 db step from its dc value up to 1000 mc.

*PAT. PENDING

TRAD TELEVISION CORPORATION
Dept. E-8
1001 FIRST AVENUE
ASBURY PARK, N. J.

Want more information? Use post card on last page.

combination of geographical location, labor availability, access to raw materials, transportation, housing facilities and other factors important to the successful operation of our type of business. In addition, the outstanding engineering and research facilities of the University of Illinois offer an unusual advantage to an electronics manufacturer."

The company is now completing plans for use of the land and for the erection of modern facilities for the production of its products.

Hoffman Radio Appoints Willard Geer

Willard Geer

WILLARD GEER has been appointed a consultant on color in tv and military applications at the Hoffman Radio Corp. and Hoffman Laboratories, according to announcement by H. Leslie Hoffman, president.

Dr. Geer is currently associate professor of physics at the University of Southern California and has been a faculty member there since 1943. Previous to that he was a physics instructor for five years at the Long Beach, Calif. City College.

While his services will include activity with the tv manufacturing division, it is expected that most of his Hoffman assignments will be on military gear.

Acme Expands In California

CONSTRUCTION HAS BEEN started on a new office and factory building to be occupied by Acme Electronics of Pasadena, a subsidiary of Aerovox Corp. The new plant will include more than 51,000 sq ft of office and

Oster
AVIATION PRODUCTS
for air-borne quality and dependability

SAFER FLIGHT
EXTRA FIGHT

Here is an engineering and production skill you can use to help you achieve safer flight, extra fight. For 25 years, OSTER has specialized in electro-mechanical products. A staff of trained field engineers is at your service. Call on us to help you select the product best suited to your job.

INSTRUMENT CONTROL MOTORS
1. Synchro Generator
2. Synchro Control Transformer
3. Synchro Transmitters
4. Synchro Differentials
5. Synchro Receivers
6. Synchro Resolvers
7. Two Speed Synchros
8. Reference Generators
9. Low Inertia Servo Motors
10. Servo Torque Units
11. Tachometer Generators

DRIVE MOTORS & BLOWER MOTORS
1. Permanent Magnet
2. DC
3. 60 Cycle AC
4. 400 Cycle, 1 Phase
5. 400 Cycle, 2 Phase
6. 400 Cycle, 3 Phase
7. 50 — 1600 Cycle, Variable Frequency

AIRCRAFT ACTUATORS
1. Rotary
2. Linear

JOHN OSTER MANUFACTURING COMPANY
AVIATION DIVISION
RACINE, WISCONSIN

© 1953

SECON

DEVELOPMENT and PRODUCTION METALLURGISTS

Fine wire and ribbon in base, rare, and precious metals, and alloys for new and highly engineered applications. In small units and sizes, and to close tolerances.

Further details on request.

SECON

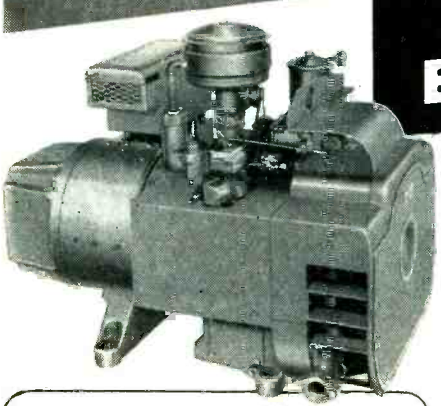
SECON METALS CORPORATION
228 East 45th Street, N. Y. 17, N. Y., MU 7-1594

Want more information? Use post card on last page.

www.americanradiohistory.com

The STANDOUT ELECTRIC PLANT

for STANDBY ELECTRIC POWER



the New ONAN "CW"

5000, AND 10,000 WATTS

Here's a powerhouse of emergency electricity with features and performance that make it a standout!

The CW is compact and lightweight. It's easier to install and requires a minimum of servicing. Air-cooling avoids trouble from leaking or freezing.

New vacuum cooling and the smooth-running, 4-cycle, twin-cylinder engine give the CW amazing quietness. All moving or heated parts are safely enclosed.

The Onan CW, with all its exclusive advantages, *costs less than any other complete electric plant of its capacity.*

DeLuxe equipment. Nothing extra to buy.

WRITE FOR SPECIFICATIONS

★ **COMPACT**—Requires less than one cubic yard of space. 10KW model needs only half the space of other 10KW units.

★ **BUILT FOR HEAVY DUTY**—Twin-cylinder, horizontally-opposed, 4-cycle, air-cooled engines operate at moderate speed.

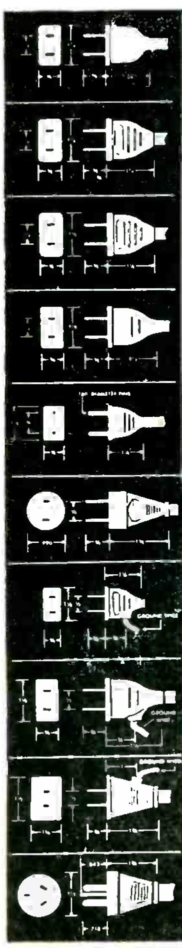
★ **UNI-DUCT COOLING**—Air cools both engine and generator and is expelled through one small vent which also discharges engine exhaust.

Onan ELECTRIC PLANTS

D. W. ONAN & SONS INC.

7035 University Avenue S.E. • Minneapolis 14, Minnesota

GLUTTONS for PUNISHMENT

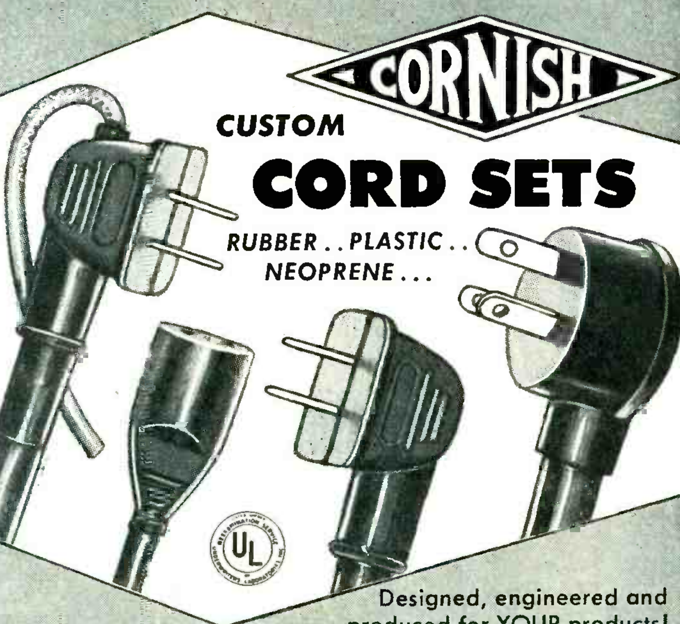


CORNISH

CUSTOM

CORD SETS

RUBBER .. PLASTIC .. NEOPRENE ...



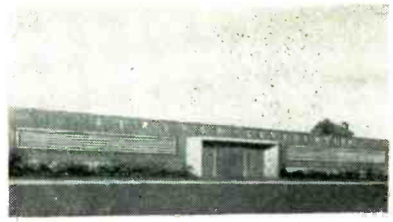
Designed, engineered and produced for YOUR products! For a delicate "walkie-talkie" or a huge arc welding unit . . . put your wire problems up to CORNISH experts!

Also "NOFLAME-COR" *The Television Hookup Wire*

"MADE BY ENGINEERS FOR ENGINEERS"

CORNISH WIRE CO., INC.

50 Church St. New York 7, N. Y.



New Acme Plant

plant space on a $9\frac{1}{2}$-acre site located at Monrovia, Calif.

W. Myron Owen, president of Aerovox, announced that the erection of the structure marks another step in the Aerovox long-range program to provide fast delivery service on quality electronic components to all markets.

Hugh P. Moore, president of Acme, announced that the company expects to add approximately 200 employees to the organization when the new building is completed and anticipates considerably higher production on both the existing Acme line and the Aerovox capacitor line.

Donat Joins TRESCO

OSWALD DONAT, formerly of Keystone Products Co., has been appointed production and quality control director of Transformer and Electronic Specialties Co. in Philadelphia, according to Edward Fisher, president of Tresco.

Johnson & Hoffman Move Into New Plant

JOHNSON & HOFFMAN MANUFACTURING Co., designers and producers of electronic parts, moved into their new plant in Mineola, L. I., N. Y. The factory includes a completely equipped tool and die shop, automatic production facilities and a new parts assembly section.

Production is already under way in the new facilities on the company's line of standard parts and on made-to-order components.

Guthman Names Dendy

KING DENDY HAS been appointed to the research staff of the engineering division of the Edwin I. Guthman Co., according to E. M. Keys, president. Mr. Dendy, who formerly was head of research and development for PCA Electronics of

PIPELINE TO PRECISION

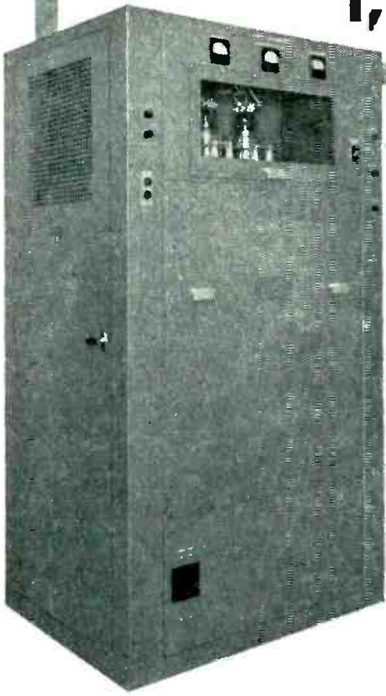
Model WWVR

Designed specifically to conveniently receive and make maximum use of all the Standard Frequency Transmissions of WWV without any special setup.

Send for complete specifications

SPECIFIC | PRODUCTS
5864 HOLLYWOOD BOULEVARD
LOS ANGELES 28, CALIFORNIA

AMPLIFIES INPUT SIGNALS 1,000,000 TIMES!



Look at the extremely high power output of this new Westinghouse Type FG variable-frequency amplifier. It can take an audio signal of about 10 milliwatts from any conventional 30 to 20,000 cps source . . . and build it up to 5 or 10 KW with uniform response and low distortion.

This suggests uses such as: powering vibration shakers . . . powering supersonic transducers . . . exploring high-frequency vibration phenomena . . . producing supply power at any audio frequency . . . testing equipment under laboratory-controlled conditions.

The Type FG amplifier is completely self-contained, and self-protected against overload or blower failure. Easily installed, the unit requires only 23 square feet of floor space. Conversion from 5 KW to 10 KW is simple. For information write Westinghouse Electric Corporation, Electronics Division, I.E. Devices Section, 2519 Wilkens Avenue, Baltimore 3, Maryland.

YOU CAN BE SURE...IF IT'S Westinghouse

J 02275

A Company Is Known by the Company It Keeps

We have been officially authorized by these companies to accurately and promptly service your immediate electronic requirements from stock:

AMPHENOL	"AN" UG UHF CONNECTORS
FTR Federal Telephone & Radio	COAXIAL CABLES
ipc	RF CONNECTORS
Cannon Electric	"AN" CONNECTORS AND HARDWARE
OHMITE	RESISTORS, RHEOSTATS, POTENTIOMETERS
Kenyon	KENYON TRANSFORMERS
ADVANCE RELAYS	RELAYS "AN" COAXIAL
Eimac	VACUUM TUBES

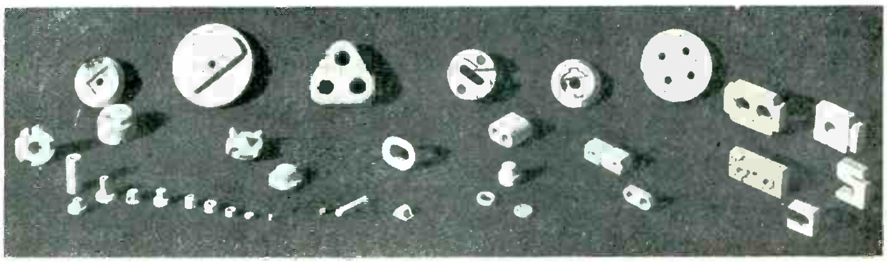
Write, wire or phone GArden City 7-652C for our latest bulletin and price schedules.

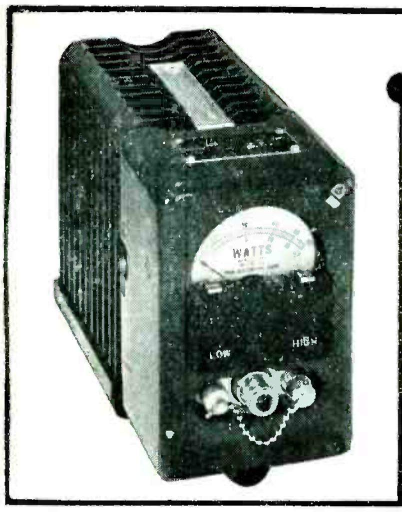
Schweber ELECTRONICS
122 Herricks Road, Mineola, New York
A NAME BUILT ON RESULTS — NOT PROMISES

if you're looking for SOMETHING SPECIAL in STEATITE call on......

"Special" is right down STAR's alley for we have built our business on *Custom Porcelain Specialties* for more than 50 years. Every piece of STAR porcelain produced is designed and fabricated to meet customers' specific needs for high dielectric strength, low loss factor, heat and moisture resistance, thermal shock resistance and other properties essential to high performance.

Star PORCELAIN COMPANY
49 Muirhead Avenue • Trenton 9, N. J.





Models 611 and 612 are popular instruments in research and design laboratories, vacuum tube plants, transmitter manufacturing plants, and in fixed and mobile communication services.

They are ruggedly built for portable use, and are as simple to use as a D.C. voltmeter. The power absorbing load resistor is non-radiating, thus preventing transmission of unwanted signals which interfere with message traffic in communication services.

Frequency range: 30 to 500 MC (30 to 1,000 MC by special calibration)

Impedance: 51.5 OHMS—VSWR less than 1.1

Accuracy: Within 5% of full scale

Input connector: Female "N" which mates with UG-21 or UG-21B. Adapter UG-146/U is supplied to mate with VHF plug, PL259.

Special Scale Model "61s" are available as low as ½ watt full scale, and other models as high as 5 KW full scale.

Catalog Furnished on Request

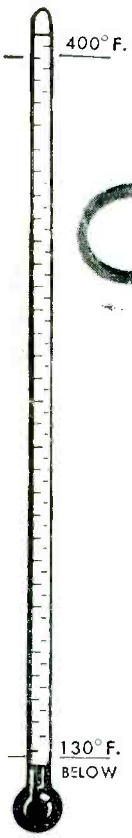
TERMALINE
DIRECT READING
R. F. WATTMETERS
(DUAL RANGE)
MODEL 611—0-15 and 0-60 Watts
MODEL 612—0-20 and 0-80 Watts
IMPEDANCE—51½ Ohms

BIRD ELECTRONIC CORP.
1800 EAST 38TH ST., CLEVELAND 14, OHIO
TERMALINE Coaxial Line Instruments

NEELY ENTERPRISES
Hollywood • San Francisco
Albuquerque

EARL LIPSCOMB ASSOCIATES
Dallas • Houston

for HIGH or LOW temp.



Specify *Injection Molded*
SILICONE RUBBER

Designers of original equipment now specify silicone rubber parts if they must undergo *extreme temperature changes* or if they require *constant dielectric properties*. Insulators, bushings, grommets and other small units are in continuous mass-production in our plants. *Prompt quotations on receipt of your sample or blueprint.*

MINNESOTA SILICONE RUBBER CO.
5724 West 36th Street • MINNEAPOLIS 16, MINNESOTA

Affiliated with Minnesota Rubber & Gasket Co.
OFFICES IN PRINCIPAL CITIES

Santa Monica, Calif., will specialize in delay lines and pulse transformers for the Guthman Company.

WCEMA Awards Over $6,000 In Scholarships

THE WEST COAST Electronic Manufacturer's Association has awarded over $6,000 in electronic scholarships, according to Noel E. Porter, chairman of the WCEMA scholarship fund trustees.

The scholarships, for deserving students to start or continue studies in electronic engineering or allied branches of technical education, have been divided between eight coast institutions, in collaboration with the deans of engineering in each college or university.

They include: California Institute Of Technology; Stanford University; University of Washington; University of California; University of California at Los Angeles; University of Southern California; Oregon State College and the University of Santa Clara.

Canter Elected Head Of Mica Fabricators

J. W. CANTER, president of the Mica Fabricating Co. of Rochelle Park, N. J., was elected president of the Mica Fabricators Association at its annual meeting at the Greenbrier in White Sulphur Springs, West Virginia.

The association represents about 90 percent of the nation's custom fabricators of strategic mica.

F. C. Farnam of the Farnam Manufacturing Co. of Asheville, North Carolina and Peter Yannello of the Reliance Mica Co. of Brooklyn, N. Y. were elected as vice-presidents. The Association acted on matters affecting the industry and approved an appropriation for a quarterly Mica Review to present facts on mica and its use, to assist engineers and purchasing agents in mica-using industries.

Power Leaves Hoffman

RALPH L. POWER, rounding out his tenth year as editor of the Hoffman Transmitter (Hoffman Radio Corp., Los Angeles) and heading its trade publicity division, resigned in July and embarked on a leisurely cruise around South America.

Upon return, Dr. Power will again operate his own public relations office for manufacturing clients including Cinema Engineering Co., Gertsch Products, Inc., James B. Lansing Sound, Inc., Helipot Corp., California Chassis Co. and others.

A onetime professor at USC, he has been in technical radio since 1922 and is currently executive secretary-treasurer of the Los Angeles chapter of The Representatives.

Ralph L. Power

Wescon Program Established

WEDNESDAY, 10:00 AM-12:30 PM, AUGUST 19th

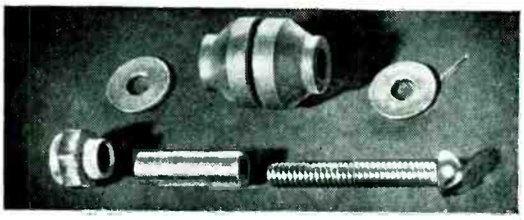
Session I: Electron Devices I

Session Chairman: Dr. Chodorow, Stanford University.
1. A 1.8—4 KMC High Gain Wideband TWT Amplifier
S. F. Kaisel, L. A. Roberts, and R. P. Lagerstrom, Electronics Research Laboratory, Stanford University.
2. A Wideband Power Mixer Tube
H. R. Johnson, Hughes Research and Development Laboratories.
3. A Wide Tuning Range Microwave Oscillator-Amplifier
John L. Putz and William R. Luebke, Electronics Research Laboratory, Stanford University.
4. Helix-Type Backward-Wave Oscillators
D. A. Watkins, Stanford University.
5. Cross-Modulation In Traveling-Wave Amplifiers
Arthur W. C. Nation and Joseph W. Christie, Dept. of Electrical Engineering, University of Washington.

Session II: Computers I.

Session Chairman: (To be announced in official program).
1. A Series-To-Parallel Data Converter
G. A. Neff, R. L. Sink, and H. E. Burke, Consolidated Engineering Corporation, Pasadena, California.
2. A New Analog-To-Digital Voltage Con-

Try Remler for Service-Tested "Hard-to-Get" Components



SILASTIC RUBBER SHOCK MOUNTS

① Ideal for sub-panel mounting. Isolates tubes from shock and vibration. Mount retains compliance from *minus* 70° to *plus* 480°F. Invaluable for military and airborne equipment.

MINIATURE TUBE CLAMP

② Corrosion resistant. Holds miniatures in sockets under severe conditions of shock and vibration without restricting air circulation. Easy to insert and withdraw tubes. Three sizes.

Custom Components

Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

Remler Company Ltd.
2101 Bryant St. San Francisco 10, Calif.

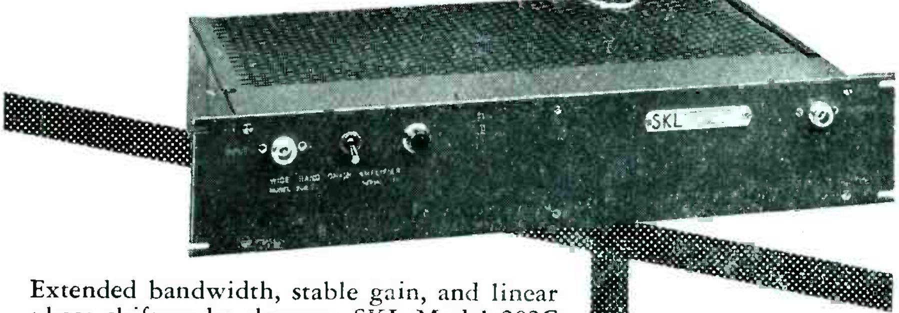
Remler

Since 1918 PIONEERS IN ELECTRONICS AND PLASTICS

NEW MODEL 202C

WIDE-BAND CHAIN AMPLIFIER

EXTENDED LOW FREQUENCY RESPONSE
1 kc - 210 mc



Extended bandwidth, stable gain, and linear phase shift make the new SKL Model 202C Wide-Band Chain Amplifier ideal for the accurate amplification of pulses and transients. The flat frequency response curve of the Model 202C Wide-Band Chain Amplifier permits cascading of a number of stages. Thus, low-level broad band voltages such as pulses, transients, and television signals can be amplified to useful levels. The Model 202C Wide-Band Chain Amplifier finds application in oscillography, radar, nuclear and television research.

SPECIFICATIONS

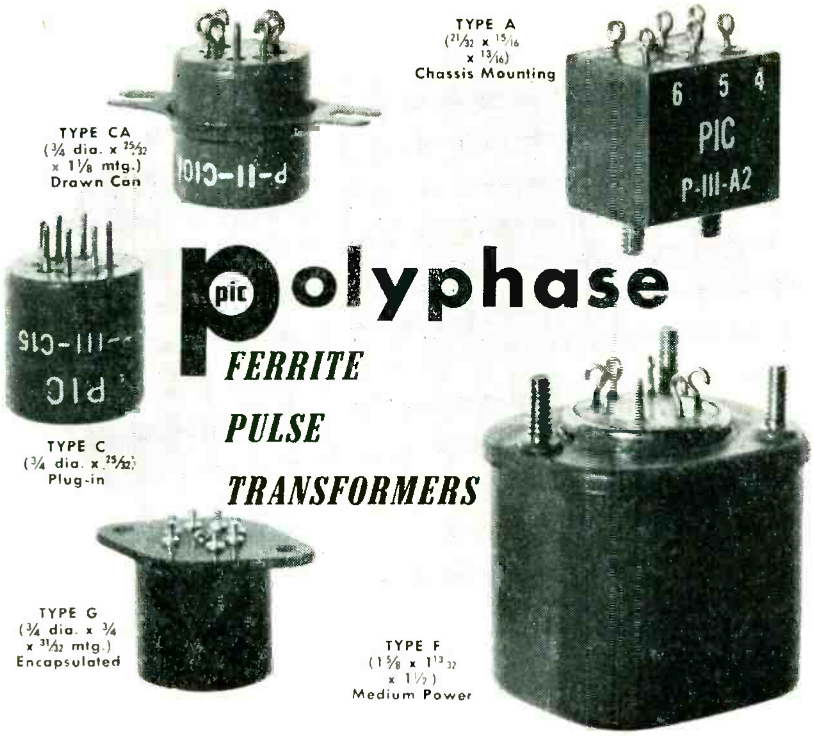
- **RISE TIME** .0026 μsec
- **VOLTAGE GAIN** 20 db
- **BANDWIDTH** 1 kc — 210 mc
- **IMPEDANCE** 200 ohms
- **STABILIZED POWER SUPPLY**

For further information write for Bulletin 202P-4

SKL SPENCER·KENNEDY LABORATORIES, INC.
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

Want more information? Use post card on last page.

www.americanradiohistory.com

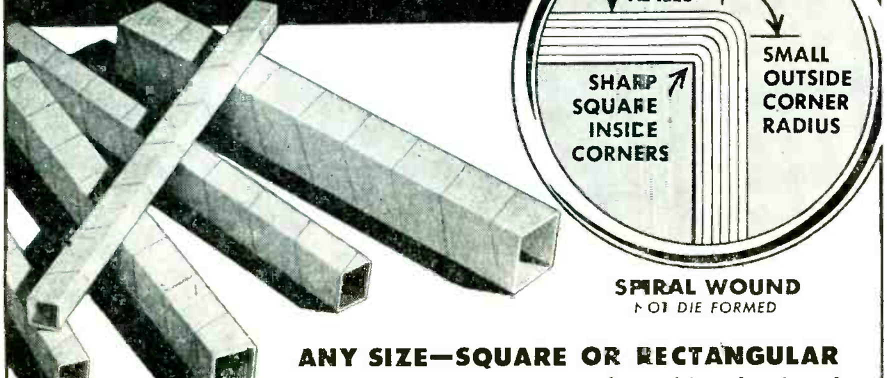


- WITH—short rise time and flat top pulses
- FOR — blocking oscillator, impedance matching, or isolation applications
- AT—low or medium average power
- IN—plug-in or chassis mounting, hermetically sealed or encapsulated units

POLYPHASE INSTRUMENT CO., BRYN MAWR, PA.

NEW "PARAFORMED" PAPER TUBES

MAKE YOUR COIL WINDING EASIER! FASTER! BETTER!



ANY SIZE—SQUARE OR RECTANGULAR

Entirely new technique in tube making developed and perfected by PARAMOUNT now for the first time solves many coil winding problems, *yet costs you no more!* Hi-Dielectric. Hi-Strength. Kraft, Fish Paper, Acetate, Red Rope or any combination wound on automatic machines. Produced from stock arbors or special sizes engineered for you.

Write on Company letterhead for Stock Arbor List of over 2000 sizes

- No sharp outside edges to cut wire
- Has full rigidity and physical strength
- Permits winding coils to closer tolerances
- No need for wedges to tighten wire
- Allows faster stacking of wound coils

PARAMOUNT PAPER TUBE CORP.

616 LAFAYETTE STREET, FORT WAYNE 2, INDIANA

Manufacturers of Paper Tubing for the Electrical Industry Since 1931

verter
J. Zweizig, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.
3. An Analog-To-Digital Conversion System With Printed Decimal Read Out
John L. Lindesmith, Clary Multiplier Corporation, San Gabriel, California.
4. An Analog-To-Digital Converter
A. D. Scarbrough, Hughes Aircraft Company, Culver City, California.
5. The Analyzing Reader
David H. Shepard, Intelligent Machines Research Corporation, Arlington, Virginia.

Session III: Noise And Signal Spectra

Session Chairman: W. W. Harman, Stanford University.
1. Instantaneous Or Measurable Frequency Spectra
A. D. Watt and V. J. Zurick, National Bureau of Standards.
2. The Response Of Linear Systems To Non-Gaussian Noise
B. Gold and G. O. Young, Hughes Research and Development Laboratories.
3. Linear Detection Of Non-Stationary Noise-Like Signals
Ralph Deutsch, Hughes Research & Development Laboratories.
4. A System Of Noise Analysis
S. D. Wanlass and D. M. Jacob, Hughes Research and Development Laboratories.

WEDNESDAY 2:30 PM-5:30 PM, AUGUST 19th

Session IV: Computers II

Session Chairman: Dr. Torben Meisling, University of California, Berkeley.
1. On Improved Reading System For Magnetically Recorded Digital Data
Samuel Lubkin, Electronic Computer Division, Underwood Corporation.
2. Magnetic Materials For Digital Computers
David R. Brown, Digital Computer Laboratory, Massachusetts Institute of Technology.
3. Panel Discussion On The Relative Merits Of Different Memory Types
Moderator: Professor P. L. Morton, University of California, Berkeley.

Session V: Airborne Electronics

Session Chairman: Allen R. Ellis, Stanford Research Institute.
1. The Air Navigation Development Board's Program For The Development Of The Common System Of Air Navigation And Traffic Control
D. K. Martin, Air Navigation Development Board.
2. The Measurement Of Performance Of Airborne, Voice-Modulated Communication Systems
E. J. Moore and John Taylor, Stanford Research Institute.
3. Corona Interference Reduction By Polarity Discrimination
M. M. Newman, Lightning and Transients Research Institute.
4. Magnetic Amplifiers And Their Applications
Victor Boros and David Seddman, Polytechnic Research and Development Company.
5. Airborne Weather Radar For Transport Aircraft
Richard White, TransWorld Airlines, Inc.

Session VI: Instrumentation I

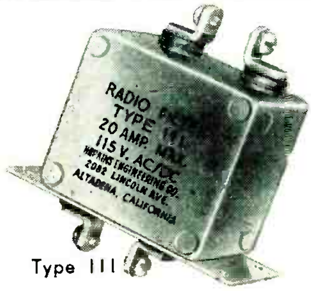
Session Chairman: Dr. D. B. Sinclair, General Radio Company.
1. The Application Of Counter Techniques To Precision Frequency Measurements
A. F. Boff, Berkeley Scientific Division of Beckman Instruments, Richmond, California.
2. Two Timing Circuit Inovations
H. B. Brooks, Hughes Aircraft Co., Tuscon, Arizona.
3. Strain Gage Oscillator
E. A. Varallo, Raymond Rosen Engineering Products, Philadelphia, Pennsylvania.
4. Measurements Of Time Jitter In Trains Of Video Pulses
John L. Fitch and Robert R. Buss, Electronics Research Laboratory, Stanford University.
5. A Peak Reading Vacuum Tube Voltmeter Which Has A Long Decay Time And Is Capable Of Measuring The Amplitude Of Short Pulses
Leonard S. Cutler, Gertsch Products, Inc., Los Angeles.

Session VII: Electron Devices

Session Chairman: Dr. T. Moreno, Varian

DEPENDABLE *Miniature*

RADIO FILTERS



Type 111

—Saves space !
—115 V ac/dc, 20 amp.
—Excellent attenuation
—Feed through installation
—Flange mounting bracket
—Corrosion & fungus resistant

If you have radio interference problems, write or wire us, TODAY !

HOPKINS *Engineering Co.*

FACTORY: 2082 Lincoln Ave., Altadena, Calif. *SYcamore 8-1185*
Offices in WASHINGTON, D. C. and DETROIT

The Miniature of Miniatures-

THE SERIES 23 WAS DESIGNED FOR SMALL SPACE AND LONG SERVICE. CONTACT RESISTANCES TESTED AT .007 OHMS MAXIMUM BEFORE USE AND .015 OHMS MAXIMUM AFTER 200,000 OPERATIONS. LIFE EXPECTANCY 800,000 OPERATIONS. NO. 23-1 NORMALLY OPEN — SINGLE POLE, SINGLE THROW, MOMENTARY CONTACT. RATED ¼ AMP., 115 V., AC, NON-INDUCTIVE.

GRAYHILL
Series 23
Push Button Switch

Overall only 1.047"x½"

Write or Phone for complete information.

Grayhill
523 Hillgrove Ave., LaGrange, Ill.
Phone: LaGrange 8000

PHAZOR PHASE METER
Pat. Pend.
MODEL 200A

$349.50 F.O.B. New York, N. Y.

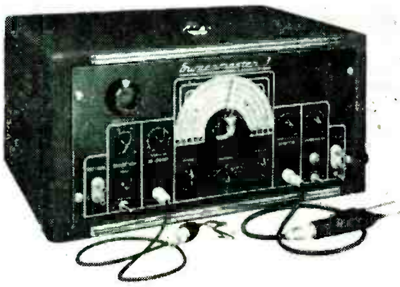
Measures phase shift in transformers, amplifiers, filters, and phase displacement networks.

- Measures from 0 to 360 degrees.
- Readings not affected by noise and harmonics.
- Phase shifts of the order of .01 degree can be measured employing special circuit techniques.
- Measures in-phase and quadrature components separately.

SPECIFICATIONS

Accuracy—Basic accuracy plus or minus 2 degrees. Plus or minus 1 degree due to meter error.
Noise and Harmonic Rejection .... 40 db. down
Sensitivity .... 6 millivolts full scale
Maximum Input Voltage .... 125 volts RMS
Peak Input Signal .... 400 volts
Frequency Range .... 20 to 20,000 cps.
Input Impedance
High Gain ... 2.0 megohm shunted by 25 mmfd.
Low Gain ... 2.5 megohm shunted by 10 mmfd.
Reference Input Impedance .... 4000 ohms
Power Supply ... 105 to 125 volts, 60 cps., 25 watts
Dimensions—Length 15 in., Hgt. 9 in., Depth 8 in.
Weight .... 25 pounds

INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th ST., N. Y. 3 - Tel: GR. 3-4684



SWEEPMASTER
Sweep Frequency Generators give you these outstanding advantages . . .

- Frequency Marker with an accuracy independent of Sweep Width. Inserted after external detection, it eliminates erroneous interpretation—eliminates possibility of undesirable transient distortion or limiting actions. The Marker is adjustable in amplitude and, after adjustment, remains independent of other controls.
- An attenuator whose performance is free of Frequency, assuring you that the Output Envelope is the same as that indicated by the Internal Monitor.
- A simple switching operation to permit examination of either Envelope of the Swept Frequency Signal.
- Durable, compact, lightweight Output and Detector Probes, either of which can be detached easily and replaced by cables having standard connectors.

SPECIFICATIONS

MODEL	CENTER FREQUENCY	RF OUTPUT 50 ohm * TERMINATION	SWEEPWIDTH CONTINUOUS ADJUSTMENT	FREQUENCY MARKER
SM I	100 KC to 14 MC	1 volt RMS	150 KC to 14 MC	100 KC to 14 MC
SM II	500 KC to 50 MC	0.2 volt RMS	150 KC to 20 MC	500 KC to 50 MC
SM III	500 KC to 75 MC	0.1 volt RMS	150 KC to 20 MC	500 KC to 75 MC

FLATNESS: Less than 1 DB variation over maximum sweepwidth range.
FREQUENCY MARKER: Engraved calibration accurate to ±2%.

HORIZONTAL DEFLECTION: A 60 cps sine wave for application to horizontal input of oscilloscope is supplied.
BLANKING: The RF signal may be operated continuously or blanked out for ½ of each 60 cycle period.
EXTERNAL DETECTOR: Blocking capacitor of 400 volt breakdown capacity.

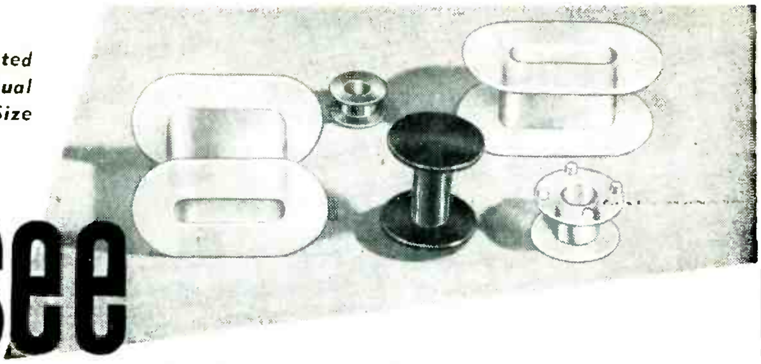
**75 ohm available when specified*

MANUFACTURERS ENGINEERING & EQUIPMENT CORP.
15 Mill Road • Hatboro, Pa.

Want more information? Use post card on last page.

www.americanradiohistory.com

Illustrated Actual Size



see

the advantages in performance and economy that are yours with

SMALL NYLON COIL BOBBINS

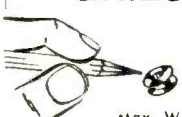
These plastic moldings are more uniform, more accurate, less expensive . . .

- THE SUPERIOR RESULT OF

an exclusive single cavity molding method which assures low mold and maintenance costs. Only from Gries can you get the many advantages of

GRIES' PAT'D MOLDING METHOD

Write for sample of Gries coil bobbins and similar small parts in nylon and other thermoplastics



Max. Wgt. .025 oz
Max. length 1"
SMALLNESS UNLIMITED

Send Specifications for Prompt Quotation

GRIES REPRODUCER CORP.

151 Beechwood Ave. New Rochelle, N. Y.. Phone: New Rochelle 3-8600

GRC

R. F. WATTMETER ME-82/U

Model MM-625 Series 50 to more than 1000 MCS.

This series of instruments was designed to measure RF power up to 400 watts, and serve as an excellent dummy antenna load over the frequency range 50 to more than 1000 MCS in 52 ohm coaxial line circuits.

Some of the outstanding features are:

1. Directional coupler pick-up probe which eliminates high frequency resonant responses and errors due to slight deviations in the load impedance.

2. Rugged construction for field and laboratory use.

3. Hermetically sealed and ruggedized indicating instrument in accordance with specifications MIL-M-10304.

4. Two spare crystal rectifier supplied with each instrument.

5. Model MM-625 has recently been assigned the Armed Forces nomenclature ME-82/U.

SPECIFICATIONS

Impedance	52 Ohms
Frequency Range	50 to over 1000 MCS.
Maximum VSWR	1.2
RF Power Scale	
Model MM-625	120 watts
Model MM-626	40 watts
Model MM-627	400 watts
Accuracy	±5% of full scale
RF Connector	Type C (Adapters available for other types)
Size	6 x 7⅛ x 13-9/16
Weight	9½ lbs.

MC Jones

M. C. JONES
ELECTRONICS COMPANY
BRISTOL, CONNECTICUT

Distributed outside of Continental U.S.A. by RCA International Div., N.Y., N.Y., U.S.A.

Associates.
1. Convection Current Noise—Theory And Experiment
S. V. Yadavalli, Microwave Tube Group, University of California.
2. Microwave Oscillator Stability
George Hetland and Robert R. Buss, Electronics Research Laboratory, Stanford University, Stanford, California.
3. Air-Coolers For High Power Vacuum Tubes
A. L. London, Department of Mechanical Engineering, Stanford University, Stanford, California.
4. A High-Gain K-Band Amplifier
W. G. Abraham and F. L. Salisbury, Varian Associates.
5. Operating Behavior Of High-Power Pulsed Klystrons
John Jasberg, Microwave Laboratory, Stanford University.

THURSDAY 10:00 AM-12:30 PM, AUGUST 20th

Session VIII: Transistors

Session Chairman: (To be announced in official program)
1. Recovery Time Measurements On Point Contact Germanium Diodes
Morgan McMahon, T. E. Firle, J. F. Roach, Research and Development Laboratories, Hughes Aircraft Company.
2. A Point Emitter-Junction Collector Transistor
R. H. Kingston, Lincoln Laboratory, Massachusetts Institute of Technology.
3. Measurement Of The Small Signal Parameters Of Transistors
Geoffrey Knight, Jr., R. A. Johnson, R. B. Holt, Transistor Products, Inc.
4. Rapid Determination Of Some Electrical Properties Of Semi-Conductors
Luther Davis, Jr., Lawrence Rubin, W. D. Straub, Raytheon Manufacturing Company.

Session IX: Antennas I

Session Chairman: A. S. Dunbar, Dalmo Victor Co., San Carlos, California.
1. Design And Performance Of Rotationally Symetric Feeds For Paraboloidal Reflectors
H. W. Haas, R. W. Dressel, R. D. Ewing, New Mexico College of Agriculture and Mechanic Arts. State College, New Mexico.
2. A New Antenna Feed Having Equal E And H Plane Patterns
Alvin Chlavin, Hughes Aircraft Company, Culver City, California.
3. Waveguide Slot Arrays Of Large Squint Angle
R. J. Adams, A. M. Lide, Naval Research Laboratory, Washington, D. C.
4. The Impedance Properties Of Narrow Radiating Slots In The Broad Face Of Rectangular Waveguides
Arthur A. Oliner, Microwave Research Institute, Polytechnic Institute of Brooklyn.
5. Principles Of Spiral Scanners For Equal Pulse Distribution
J. Richard Huynen, Dalmo Victor Co., San Carlos, California.
6. Boresight Theory For Homogeneous Dielectric Radomes
M. C. Horton, W. E. L. Boyce, E. O. Hartig, Goodyear Aircraft Corp., Akron, Ohio.

Session X: Nuclear Radiation Measurements

Session Chairman: H. S. Bright, U. S. Naval Radiological Defense Laboratory, San Francisco.
Tentative Topics:
1. Gamma And Electron Spectrometry With Crystals At High Energy
2. A Discussion Of Some Unsolved Instrumentation Problems In Nuclear Physics
3. The Current Status Of Radiation Detector Development
4. Neutron Source Standardization
(Titles and speakers to be announced in official program).

Session XI: Servomechanisms

Session Chairman: Otto J. Smith, Electrical Engineering Division, University of California, Berkeley.
1. Nonlinear Control Systems With Random Inputs
R. C. Booton, Jr., Dynamic Analysis and Control Laboratory, Massachusetts Institute of Technology.
2. Comparison Of Linear And Nonlinear Servomechanism Response
T. M. Stout, Electrical Engineering Divi-

www.americanradiohistory.com

sion, University of Washington.
3. Time Quantization In A Feedback System
J. F. Waddel and H. D. Morris, Radiation Laboratory, University of California.
4. Stability Of Feedback Systems Using A Dual Locus Diagram
Paul Jones, Jet Propulsion Laboratory, California Institute of Technology, Pasadena.
5. Geometrical Interpretation Of The Response Of Linear Systems To Special Inputs
J. R. Moore, North American Aviation, Downey, California.

THURSDAY 2:30 PM-5:00 PM, AUGUST 20th

Session XII: Transistor Circuits

Session Chairman: H. M. Zeidler, Stanford Research Institute.
1. Recent Developments In Transistors
Irving Wolff, Radio Corporation of America.
2. Transistor Shift Registers
R. H. Baker, I. L. Lebow, R. E. McMahon, Lincoln Laboratory, Massachusetts Institute of Technology.
3. A Point Contact Transistor VHF FM Transmitter
D. E. Thomas, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
4. A Four-Digit Transistor Accumulator
D. J. Eckl, Lincoln Laboratory, Massachusetts Institute of Technology.
5. A Transistor Feedback Amplifier For Carrier Frequency Applications
J. C. Lozier, D. D. Cherry, Bell Telephone Laboratories, Inc., Murray Hill, N. J.

Session XIII: Microwave Theory & Techniques I

Session Chairman: E. T. Jaynes, Stanford University.
1. Mode Representations In Open And Closed Uniform Waveguides.
Nathan Marcuvitz, Polytechnic Institute of Brooklyn.
2. Applications Of Coupled Helices
Peter D. Lacy, Hewlett-Packard Company.
3. New Applications Of Faraday Rotation In Waveguides
A. G. Fox, M. T. Weiss, S. E. Miller, Bell Telephone Laboratories, Inc., Holmdel, N. J.
4. Non-Reciprocal Circuits Comprising Ferrite-Loaded Rectangular Waveguides
A. G. Fox, M. T. Weiss, S. 7. Miller, Bell Telephone Laboratories, Inc., Holmdel, N. J.
5. The Generation Of Electromagnetic Oscillations In The Microwave Region Using An Adiabatic Kind Of Amplification
Gedalia Held, Electronics Research Laboratory, University of California, Berkeley.

Session XIV: Antennas II

Session Chairman: J. T. Bolljahn, Stanford Research Institute.
1. Arrays Of Closely Spaced Non-Resonant Slots
Robert J. Stegen and Richard H. Reed, Hughes Aircraft Co., Culver City, California.
2. Diffraction Theory And The Patterns Of Suppressed Antennas
George Sinclair, Antenna Laboratory, University of Toronto.
3. Beam Shaping And Optimum Bandwidth Methods Applied To UHF TV Transmitting Antennas
John Ruze and John E. Martin, The Gabriel Laboratories, Needham Heights, Massachusetts.
4. Voltage Protection Of Isolated Cap Aircraft Antennas
Robert L. Tanner, Stanford Research Institute.
5. A Slotted Cylinder Omni Range Projector
J. P. Shanklin, Collins Radio Co.

Session XV: Servomechanism Equipment

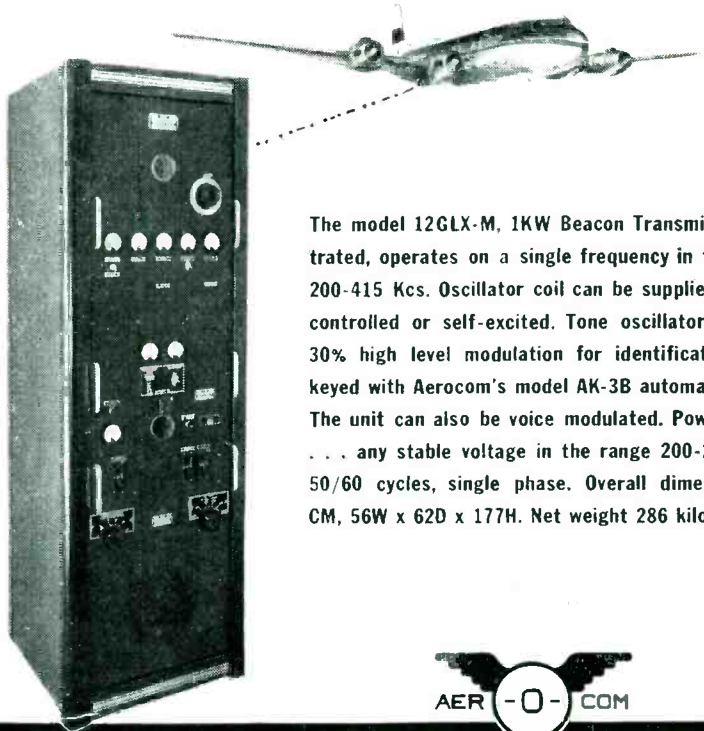
Session Chairman: (To be announced in official program)
(Titles and authors to be listed in official program).

THURSDAY EVENING 8:00 P.M.-10:00 P.M., AUGUST 20th.

Session XVI: The NTSC And Color Television

Session Chairman: W. H. Doherty, Bell Telephone Laboratories, Inc. Murray Hill, N. J.
Speakers: W. R. G. Baker, Vice President

AEROCOM MEANS TROUBLE-FREE SERVICE!
From Ground To Air or Point to Point



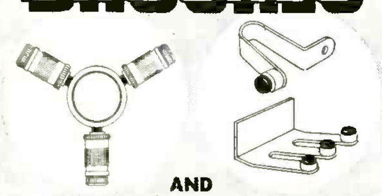
The model 12GLX-M, 1KW Beacon Transmitter illustrated, operates on a single frequency in the range 200-415 Kcs. Oscillator coil can be supplied crystal-controlled or self-excited. Tone oscillator provides 30% high level modulation for identification when keyed with Aerocom's model AK-3B automatic keyer. The unit can also be voice modulated. Power supply . . . any stable voltage in the range 200-240 volts, 50/60 cycles, single phase. Overall dimensions in CM, 56W x 62D x 177H. Net weight 286 kilos.

AER-O-COM
3090 DOUGLAS ROAD MIAMI 33, FLA.

NWL
Nothelfer
SPECIALISTS IN TRANSFORMERS
NOTHELFER
WINDING LABORATORIES
9 ALBERMARLE AVE. TRENTON 3, N. J.

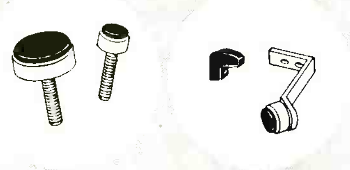
SILVER GRAPHALLOY

BRUSHES



AND

CONTACTS



...for applications requiring low electrical noise, low and constant contact drop, high current density and minimum wear.

GRAPHALLOY
TRADE MARK REG. U. S. PAT. OFF.

EXTENSIVELY USED IN

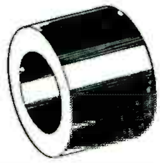
SELSYNS
ROTATING THERMOCOUPLE and STRAIN-GAGE CIRCUITS
ROTATING JOINTS
GUN-FIRE CONTROLS
DYNAMOTORS etc.

Wide range of grades available for standard and special applications.

Brush holders and coin silver slip rings available for use with Silver Graphalloy Brushes.

OTHER GRAPHALLOY PRODUCTS:

Oil-free self-lubricating Bushings and Bearings, Oil-free Piston Rings, Seal Rings, Thrust and Friction Washers, Pump Vanes.



Write us for Data Sheets and further information.

GRAPHITE METALLIZING CORPORATION
1055 NEPPERHAN AVENUE • YONKERS, NEW YORK

☐ Please send data on Graphalloy BRUSHES and CONTACTS.
☐ Send data on BUSHINGS.

NAME & TITLE
COMPANY
STREET
CITY ZONE STATE

Want more information? Use post card on last page.

in charge of Electronics, General Electric Co., Syracuse, N. Y.; and Chairman of the National Television Systems Committee. Donald G. Fink, Director of Research, (R, T & A), Philco Corporation, Philadelphia, Pa.; Chairman, Panel 12 of the NTSC.

FRIDAY 10:00 AM-12:30 PM, AUGUST 21st

Session XVII: Audio Symposium

Session Chairman: Vincent Salmon, Stanford Research Institute.
Panel: Microphones: William B. Snow, Western Electro-Acoustic Laboratory, Beverly Hills, Calif.
Recording: Frank G. Lennert, Ampex Corporation, Redwood City, California
Amplifiers: Arthur N. Curtiss, RCA Victor Division, Los Angeles.
Loudspeakers: Bob Hugh Smith, University of California, Berkeley.

Session XVIII: Circuit Theory 1

Session Chairman: B. J. Bennett, Stanford Research Institute, Stanford, California.
1. The Practical Implication And Applications Of Formal Network Theory
D. F. Tuttle, Stanford University.
2. Design Of A Simple Band-Pass Amplifier With Approximate Ideal Frequency Characteristics
W. E. Bradley, Philco Corporation.
3. Quasi-Distortionless Filter Functions
J. L. Stewart, University of Michigan.
4. Fluctuation Noise Theory As Applied To Circuit Design
T. S. George, Air Force Missile Test Center, Patrick Air Force Base, Florida.

Session XIX: Microwave Theory & Techniques II

Session Chairman: J. R. Whinnery, University of California, Berkeley.
1. A Microwave Oscillograph
Richard C. Honey, Stanford Research Institute.
2. Instrumentation Of Microwave Electron Resonance In Magnetic Fields: R. C. Mackey and W. D. Hershberger, University of California, Los Angeles.
3. An Improved Cross Guide Directional Coupler
Henry J. Riblet, Microwave Development Laboratories, Inc., Waltham, Massachusetts.
4. Two Novel Types Of Waveguide Switches
Amasa Pratt, Century Electronics, Division of Century Metalcraft Corp., Van Nuys, California.
5. Broad Banding Circular Polarizing Transducers
D. L. Margerum, Microwave Engineering Company, Los Angeles.

Session XX: Propagation—General

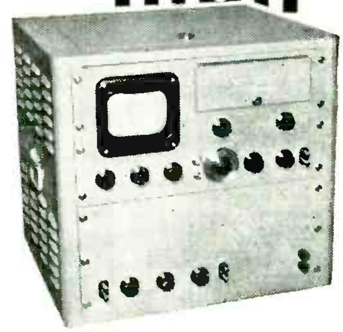
Session Chairman: Dr. Allen M. Peterson, Radio Propagation Laboratory, Stanford University.
1. Waveguiding On Surfaces With And Without Loss
Francis J. Zucker, Air Force Cambridge Research Center.
2. A New Solution To The Ionospheric Wave Equation
A. J. Mallinckrodt, The Ralph M. Parsons Company, Pasadena.
3. Ionosphere Sounding By Cross-Correlation Techniques
P. B. Gallagher and A. M. Peterson, Radio Propagation Laboratory, Department of Electrical Engineering, Stanford University.
4. The Long-Distance Horizontal Directivity Of A 13.7 Mc. Antenna
Richard Silberstein, National Bureau of Standards, Washington, D. C.
5. Whistlers
J. H. Crary and R. A. Helliwell, Radio Propogation Laboratory, Stanford University.

FRIDAY 2:30 PM-5:00 P.M., AUGUST 21st

Session XXI: Propagation VHF UHF

Session Chairman: Dr. J. B. Smyth, U. S. Naval Electronics Laboratory, San Diego, California.
1. Results Of Tropospheric Propagation Measurements On Frequencies From 92 to 1046 Mc. At The Cheyenne Mountain Field Station
Alfred F. Barghausen and K. O. Hornberg, National Bureau of Standards, Boulder, Colorado.
2. Characteristic Of A Radio Transmission

A NEW HIGH



IN AUDIO WAVE FORM ANALYSIS

PANORAMIC SONIC ANALYZER LP-1

Specifically designed for applications demanding maximum resolution, the LP-1 offers many new possibilities and high speed analysis of sounds, vibrations and electrical wave forms.

4 Selectable Scanning Ranges

Log Scan 40 cps to 20,000 cps

3 Linear Scanning Ranges	Resolution
100 cps	26 cps
500 cps	53 cps
1500 cps	105 cps

• Graphic presentation of frequency vs voltage • Selection and magnification of any spectrum segment for sharp, detailed analysis • Automatic maximum resolution on all scanning ranges • Continuously variable tuning control from 40cps to 20 KC • One cycle per second scanning rate • Wide input voltage range of 500M.V to 500V • Sweep oscillator output connection for operation with Panoramic Sonic Response Indicator G-2

SPECIAL APPLICATIONS

• Investigations of closely spaced sound and vibration frequencies • Harmonic analysis of waveforms having low frequency fundamentals • Spectrum analysis requiring constant band width

Write Today For Complete Specifications

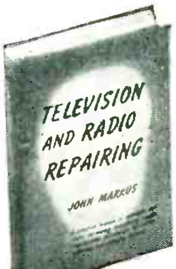
PANORAMIC RADIO PRODUCTS, INC.

10 South Second Ave., Mount Vernon, N. Y.
Phone: MOunt Vernon 4-3970

Want more information? Use post card on last page.

FIX 3 OUT OF 4 Television and Radio Receivers

Just by reading this one book!



Repair your own set or those of your friends with the really simple, practical methods shown in this book. Planned as the plainest sort of guide for men who want to become professional servicemen. So down-to-earth that anyone with the interest can quickly learn to handle three out of four of the breakdowns that usually occur in television and radio receivers.

Just Published!

TELEVISION AND RADIO REPAIRING

by John Markus

Associate Editor, ELECTRONICS

556 pages, 225 illus., $7.95

Gives all these helps:

- **How to** test and replace tubes
- **How to** test tubes without equipment
- **How to** eliminate receiver noises
- **How to** improve dim TV pictures
- **How to** repair, replace, and adjust:
  - —Power supplies
  - —Carbon and wire-wound resistors
  - —Controls and switches
  - —Condensers, coils, and transformers
  - —Tuning devices
- **How to** fix phono pickups
- **How to** repair wood and plastic cabinets
- **How to** install, adjust, and repair different types of antennas
- . . and many others

The practical, quick approach

Even before you're halfway through this book you can start actual repairs. Completely practical, it deals only with the things that go wrong in sets—the individual parts—and how to handle them, including trouble-shooting, and mechanical methods such as soldering, tube replacement, wire splicing, etc.

Simple, easy steps

For every television and radio part, no matter what make the set is, Markus shows you how to recognize symptoms of trouble . . . how to test to make sure . . . how to order the new part . . . and how to install it. Numerous diagrams and repair pictures illustrate each step of the way.

TELEVISION AND RADIO REPAIRING shows you how to test television and radio parts with a multimeter, how to test and replace all tubes including picture tubes, how to repair, adjust, or replace all parts, install antennas, and even repair phonograph pickups and cabinets.

Your first repair pays for the book!

10 DAYS' FREE EXAMINATION

McGraw-Hill Book Co.,
330 W. 42nd St., NYC 36

Send me John Markus' **TELEVISION AND RADIO REPAIRING** for 10 days' examination on approval. In 10 days I will remit $7.95, plus few cents for delivery, or return book postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

(Print)
Name ....

Address ....

City .... Zone .... State ....

Company ....

Position L-8

(This offer applies in U. S. only)

For SPECIFIED PERFORMANCE Specify JELLIFF RESISTANCE WIRE

COMPLETE CONTROL OF MANUFACTURE . . .
A WIDE RANGE OF EXPERIENCE . . .
A WIDE RANGE OF ALLOYS . . .

make JELLIFF the ideal source of Resistance Wire to assure your Product's

Performance According to Specs.

Precision resistors—rheostats—relays—thermocouples—ohmmeters—bridges—high-temperature furnaces can all benefit from the **PLUS-PERFORMANCE of JELLIFF RESISTANCE WIRE**

THE C. O. JELLIFF MANUFACTURING CORPORATION SOUTHPORT, CONN.

DIPPING BASKETS • LEKTROMESH • RESISTANCE WIRE • FILTERS • STRAINERS • WIRE CLOTH • WIRE MESH PARTS

WIRE PRODUCTS SINCE 1880

Detailed Enquiries Welcomed. Address Dept. 25

---

made right to work right

BENDIX-FRIEZ

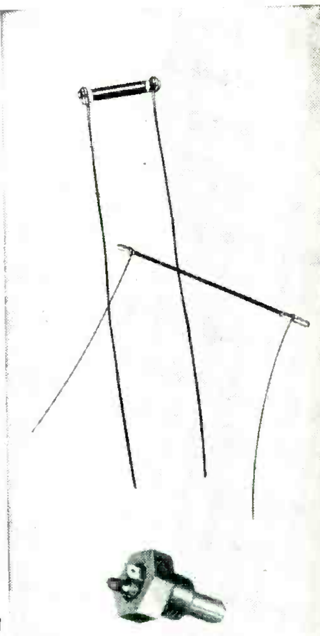
high-precision thermistors

Whether you use these temperature responsive resistors in standard or special models, you can be sure of this. *They'll match your needs* for resistance values, size, temperature coefficient, mountings and quality. Made in our own plant under carefully controlled conditions, Bendix-Friez Thermistors know no equal.

STANDARD TYPES FOR IMMEDIATE DELIVERY

Size (inches)	@ +30°C.	@ 0°C.	@ −30°C.
.140 x .75	45.0 ohms	86 ohms	194 ohms
.040 x 1.5	12,250 ohms	26,200 ohms	65,340 ohms
.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

Write for details.



Used in this typical application for sensing the temperature of hydraulic oil.

FRIEZ INSTRUMENT DIVISION of . . Bendix AVIATION CORPORATION

1454 Taylor Avenue, BALTIMORE 4, MARYLAND

Export Sales: Bendix International Division
72 Fifth Avenue, New York 11, N. Y.

Want more information? Use post card on last page.

www.americanradiohistory.com

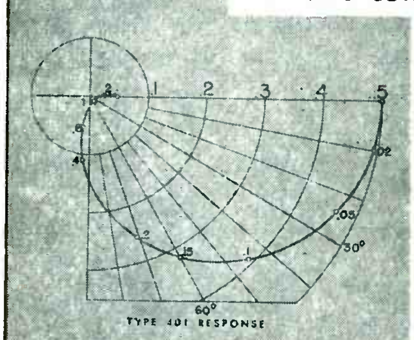
effective winding

In your design, plan to use the correct type of winding for your specific requirement. Our engineers co-operate in prototype designing . . . can advise on proper coil application from low-cost bobbin to highest quality interwoven type. Coto-Coil Company, 65 Pavilion Avenue, Providence 5, R. I. New York Office: 10 E. 42nd Street, New York 17.

Coto PRECISION WOUND Coils

A New **LOW PASS FILTER SERIES**

Investigate the 400 Series low pass filters based on a new resistance-capacity network, and specially designed for amplifier and control circuits.



- Linear phase shift
- Low insertion loss
- An attenuation peak to reject carrier or power frequencies
- Stability over wide ambient temperature variation
- Small size and weight
- Encapsulated for protection

Write for Bulletin 400

White INSTRUMENT LABORATORIES
203 RIVERSIDE DRIVE
AUSTIN 4, TEXAS

459

Path At 8.6 mm
C. W. Tolbert and A. W. Straiton, The University of Texas.
3. An investigation Of The Variation Of VHF Field Strength Beyond Line-Of-Sight
G. H. Keitel and H. M. Swarm, University of Washington.
4. Air To Air Propagation—Experimental And Theoretical Results
Ming S. Wong, Aircraft Radiation Laboratory, Wright Air Development Center, Wright Field.
5. The Role Of Angular Distance In Tropospheric Radio Wave Propagation
Kenneth A. Norton, National Bureau of Standards, Boulder, Colorado.
6. Normal Propogation Of Short Radio Waves Well Beyond The Horizon
Thomas J. Carroll and Rose M. Ring, Massachusetts Institute of Technology.

Session XXII: Circuit Theory II

Session Chairman: George L. Matthaei, University of California, Berkeley.
1. Solving Physical Systems With Very Large Number Of Variables In Easy Stages
Gabriel Kron, Consulting Engineer, General Electric Company, Schenectady, N. Y.
2. Matric Analysis Of Linear Time-Varying Circuits
Louis A. Pipes, University of California, Los Angeles, and U. S. Naval Ordnance Test Station, Inyokern.
3. Unbalanced RLC Networks Containing Only One Resistance And One Real Transformer
Louis Weinberg, Hughes Research and Development Laboratories, Culver City, California.
4. An Iterative Method For Network Synthesis
R. E. Scott, Research Laboratory of Electronics, Massachusetts Institute of Technology, and R. L. Blanchard, Transonics, Inc., Bedford Airport, Massachusetts.

Session XXIII: Instrumentation II

Session Chairman: W. B. Wholey, Hewlett-Packard Co.
1. Measurement Problems In VHF-UHF Television Antenna Systems
R. A. Soderman, General Radio Co.
2. An Auto Impedance Meter For VHF-UHF
John Ebert, Polytechnic Research Development Co., Brooklyn, N. Y.
3. A Ratiometer
Nicholas L. Pappas, Hewlett-Packard Co.
4. An Improved Method Of Measuring The Current Amplification Of Junction Type Transistors
F. R. Stansel, Bell Telephone Laboratories, Murray Hill, N. J.

Session XXIV: Audio

Session Chairman: Roy Long, Stanford Research Institute.
1. Stereophonic Tape System
Ross H. Snyder, Ampex Electric Corp., Redwood City, Calif.
2. Application And Suggestions For Research Concerning Acoustical Problems In Medical Areas
John K. Hilliard, Altec Lansing Corp., Beverly Hills, Calif.
3. An Investigation Of The Air Chamber Of Horn Type Loudspeakers
Bob H. Smith, University of California, Berkeley.
4. A Simple Calibration Technique For Low Sensitivity Transducers
William J. Galloway, Signal Corps Engineering Laboratories and Department of Physics, University of California, Los Angeles.

FRIDAY EVENING 8:00 PM-10:00 PM, AUGUST 21st

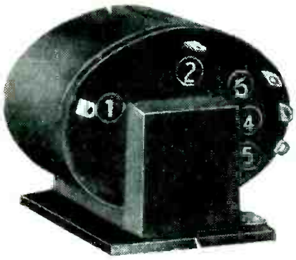
Session XXV: Medical Electronics

Session Chairman: Albert J. Morris, Scientific Research Coordinator, USN Office of Naval Research
1. Area Display By Electronic Mapping, Especially Of The Electrical Activity Of The Heart
Stanford Goldman, Professor of Electrical Engineering, Syracuse University.
2. Electronic Mapping Of The Brain
Archie R. Tunturi, Professor of Anatomy, University of Oregon Medical School, Portland, Oregon.
3. Radioactive Tracer Mapping
H. O. Anger and C. A. Tobias, Donner Laboratory of Medical Physics and the University of California Radiation Laboratory, Berkeley.

ACME STAR COMPOUND

FOR

MIL-T-27, GRADE 1 CLASS A



A Raytheon transformer molded with Acme Star Compound

NOTE THESE OUTSTANDING ADVANTAGES:

- Non-toxic
- Non-corrosive
- Eliminates Voids
- Thorough impregnation
- Simple one-phase molding process
- Tenacious adhesion to metal
- Assures complete moisture-proof seal

Acme Star Compound also passes Specification MIL-C-16923 (Ships), Compound, Embedding (Electronic Equipment), Type C.

Exterior cases are not required, as the compound alone provides protection.

ACME WIRE CO.

NEW HAVEN, CONN.

COILS • VARNISHED INSULATIONS • MAGNET WIRE

Want more information? Use post card on last page.

NEW BOOKS

Television Receiver Design I. F. Stages

By A. G. W. Uitjens, N. V. *Philips' Gloeilampenfabrieken, Philips' Technical Library, Cleaver Hume Press, London; Elsevier Press, New York,* 1953, 177 *pages*, $4.50.

This is the first of a series of six to eight monographs on television receiver design currently under preparation by Dutch engineers of the Philips organization. It deals with the use of pentodes in the i-f section of superheterodyne receivers and the r-f section of trf receivers. It treats, first, the two-terminal coupling network as used in stagger-tuned i-f stages. Three chapters give detailed accounts of the gain-bandwidth relations of such stages, the overall response curve of several stages, and distortions in the transmission of the step function. The fourth chapter covers the same ground, in somewhat more compact fashion, for the four-terminal (inductively or capacitively coupled) stage.

The theory and practice of noise reduction in r-f and i-f stages follow; the meaning and computation of noise figure and signal-noise ratio, and sources of noise within tubes (including the important subject of cathode-lead conductance) are extensively discussed. The nature and control of feedback in i-f and r-f stages occupy a chapter of 30 pages. The concluding chapter is devoted to practical considerations, such as overall sensitivity and gain requirements, choice of tubes and adjustment of stagger-tuning. Five appendices (on responses of tuned circuits, filters, step functions, noise figures, and the derivation of certain equations) and four tables (vacuum tube characteristics, stagger-tuning bandwidths, step function data and comparative bandwidths of synchronous and staggered stages) are included.

This volume is a definitive treatment, well balanced between theory and practice, and copiously illustrated. As such, it will serve as a valuable guide and reference work for students and engineers con-

2 MUSTS

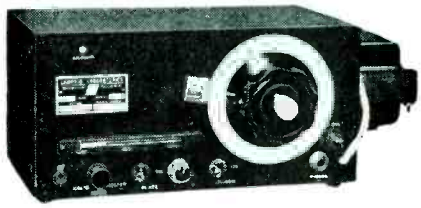
For Low-Cost Servicing of Mobile Radio Systems

Lampkin equipment gives you the lowest cost per channel, whether you supervise a large multiple-frequency system, or whether you service numerous smaller installations! Lampkin equipment measures center frequencies and modulation deviation, to FCC specifications!

The Type 205 FM Modulation Meter For Multiple Mobile Frequencies.

The Type 205 FM Modulation Meter measures peak frequency swing due to voice modulation of FM transmitters, as required by the FCC. Indicates 0-25 KC. deviation. Instantly tunable to any frequency from 25 MC. to 200 MC. Simple to use. Direct reading. No charts. Price Net $240.00.

For Any Number of Frequencies, AM or FM. The Type 105-B Micrometer Frequency Meter



The Type 105-B Micrometer Frequency Meter measures center-frequency deviation on any number of transmitters, from 100 KC. to 175 MC.; also precisely simulates weak transmitter signals, for mobile receiver alignment, 20 MC. to 175 MC. Overall accuracy within 0.0025%, with spot check on WWV. Price $220.00.

Return coupon TODAY for complete literature.

LAMPKIN LABORATORIES, INC.
Instruments Div., Bradenton, Florida

Please send me complete technical literature and delivery information on the following Lampkin-designed instruments:

☐ Type 205 FM Modulation Meter
☐ Type 105-B Micrometer Frequency Meter

Name ....
Address ....
City .... Zone ..... State ......

Want more information? Use post card on last page.

AN INSTRUMENT FOR ALL YOUR MAGNETIC MEASURING PROBLEMS

Dyna-Labs

D-79 GAUSSMETER

This precision built instrument measures flux density, determines direction of flow. It locates and measures stray fields and plots variations in strength and checks production lots against a standard. Simple to operate. No ballistic readings . . . no jerking or pulling. Supplied with protective carrying case.

- Other Features -
- Reads 10 to 30,000 Gauss Flux Fields
- Probe is only .025" thick
- Active area .01 square inches
- Overall size 13" x 6-3/4" x 10-1/2"
- Net weight only 10-1/2 lbs
- Power supply 105-125 volts, 50-60 cycles

We invite inquiries. For literature write department E 8.

Dyna-Labs INC.

1075 STEWART AVENUE, GARDEN CITY, L. I., N. Y. GARDEN CITY 3-2700

PRECISION TRANSFORMERS

. . . *for Exacting*

MILITARY AND INDUSTRIAL REQUIREMENTS

Atlas offers a thoroughly reliable source of custom built transformers. We design — to your performance requirements — transformers incorporating the latest manufacturing techniques. Atlas precision controlled processes and inspection assure reliable performance.

Atlas facilities are arranged for fast delivery of small or large scale production. Testing facilities include a wide range of instruments, insuring exhaustive testing of even the most exacting circuits. We manufacture to MIL-T-27 or ANE-19 government specifications. Available are all standard transformers: power, pulse, audio, interstage, output, modulation, phase changing etc., as well as all types of chokes, reactors, bobbins and layer wound coils.

We specialize in:

MAGNETIC AMPLIFIERS and associated circuit development for industrial sensing and control applications.

INSTRUMENT TYPE REFERENCE TRANSFORMERS and bridge transformers featuring: phase errors as low as 1/20°, ratio errors to 1/100 of 1%.

Construction Types:

- **Hermetically sealed cans**
- **Fosterite**
- **Scotch cast**
- **Open type**

ATLAS *ATLAS ENGINEERING CO., Inc.*

3 EDGEWOOD ST., ROXBURY, MASS.

cerned with this aspect of television receiver design. It contains far more detail, as might be expected of a specialized monograph, than is available in other books; as such it fills a unique place in the technical literature.

This is not to say that the book answers all questions currently before designers. European engineers have not yet had to face the selectivity problem as fully as their American colleagues. In consequence, the treatment of traps is rudimentary; the general equations (notably as given in Appendix I) apply to trap design, of course, but there is no organized discussion of trap attenuation requirements and related problems.

A more important omission is the question of automatic gain control; the application of agc voltage to i-f and r-f stages is not treated except by inference in the selection of the applicable values of transconductance. This leaves uncovered one of the most intriguing recent developments in i-f amplifier design: the shifting poles and zeros in the tuned circuit design as a function of agc voltage.

It is, perhaps, too much to expect that techniques developed during the past four years would find full treatment in a textbook. In such matters, there is no substitute for actual contact with design engineers working on current problems. The inexperienced engineer, on joining such a group, will do well to study this book since it provides a thorough background for the majority of the problems in i-f amplifier design.—DONALD G. FINK, *Philco Corporation, Philadelphia, Pa.*

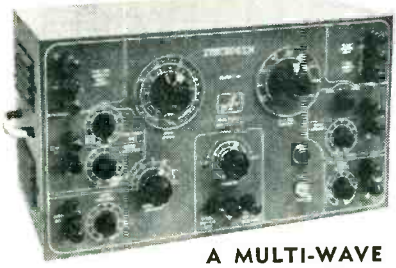
THUMBNAIL REVIEWS

Position of Electricity Industry in OEEC Countries. Columbia University Press, New York, N. Y., 45 pages, 8½ x 11 inch, $0.75, 1953. Results of a questionnaire into the installed capacity, production and consumption of electricity, 1951 and 1952.

Abstracts of Theses, June, 1951. Massachusetts Institute of Technology, 156 pages, $2.00. Abstracts of 79 theses offered in partial fulfillment of the requirements for Doctor's de-

MODEL E-10

SYNCROGEN



A MULTI-WAVE FORM GENERATOR AND PULSE SYNCRONIZATION UNIT . .

The E-10 provides, at repetition rates of 1 cycle per second to 100 kilocycles per second: 1. Sawtooth waves; 2. Square waves or Square Pulses, one microsecond to one second duration with rise time of 0.15 microseconds; 3. Integrated or Differentiated versions of the square waves and pulses. All outputs are simultaneously available and independently variable in amplitude. All outputs may be synchronized, triggered or gated by sine waves, pulses or other complex wave forms.

Additional applications of the SYNCROGEN include: oscilloscope sweep phaser, delayed pulse generator, oscilloscope trace expander, frequency divider, and pulse time or pulse width modulator. The SYNCROGEN is an excellent educational demonstrator and useful electronics laboratory accessory.

AMPLITRONIX INC.
280 9th Ave. NYC 1, N. Y.

ENGRAVING • PROFILING

for heavy production

with the Engravograph TM®

TRACER GUIDED FOR UNSKILLED LABOR

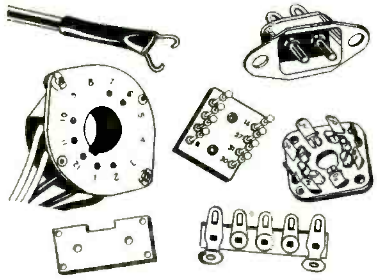
NEW HERMES, Inc.
13•19 University Place, New York 3, N.Y.

"INDUSTRIAL"

for

ELECTRONIC COMPONENTS

Precision engineered electronic components and connecting devices for all your needs.



- ANODE CONNECTORS
- INTERLOCK PLUGS
- LAMINATED TUBE SOCKETS
- TERMINAL STRIPS
- WIRED ASSEMBLIES
- METAL or BAKELITE STAMPINGS
- TERMINAL BOARD ASSEMBLIES
- SCREW MACHINE PARTS

——NEW ITEMS——

- TUNER STRIPS, SOCKETS and BRACKETS for UHF

Our extensive design and production facilities are available for developing your special requirements and applications. Representatives in principal cities throughout U.S.A. Call or write for samples and information. ORegon 7-1881.

INDUSTRIAL HARDWARE Mfg. Co., Inc.
109 PRINCE STREET • NEW YORK 12, N. Y.

Engravograph

TM®

Write for literature describing:

1. Heavy Duty model (as illustrated) — Catalog H 29
2. Portable models — Catalog IM 29

NEW HERMES, Inc. 13-19 University Place, N.Y. 3, N.Y.
In Canada: 359 St. James St., Montreal
World's Largest Manufacturer of Portable Engraving Machines

WHAT MAKES A MAILING CLICK?

for Results

Mc GRAW-HILL
DIRECT MAIL LIST SERVICE

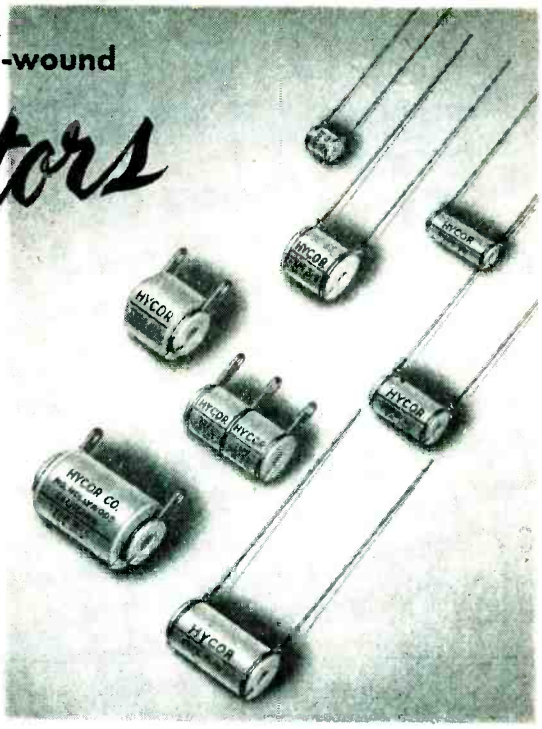
Advertising men agree . . . the list is more than half the story. McGraw-Hill Mailing Lists, used by leading manufacturers and industrial service organizations, direct your advertising and sales promotional efforts to key purchasing power.

In view of present day difficulties in maintaining your own mailing lists, this efficient personalized service is particularly important in securing the comprehensive market coverage you need and want. Investigate today.

McGraw-Hill Publishing Co., Inc.
DIRECT MAIL DIVISION
330 West 42nd Street New York 36, New York

www.americanradiohistory.com

HYCOR
Precision Wire-wound
Resistors



LET'S FACE FACTS!

Most manufacturers of precision wire-wound resistors offer products having similar physical appearances and electrical characteristics. Our claim to individuality is based upon **RELIABILITY OF PRODUCT**. The formula to obtain **RELIABILITY** is: *Skilled, painstaking attention to EVERY detail in EVERY step of fabrication!*

Our steady customers tell us that the formula works!

Our newly expanded production facilities now enable us to offer rapid delivery.

11423 VANOWEN ST., NORTH HOLLYWOOD, CALIFORNIA **HYCOR** Company, Inc. SUnset 3-3860

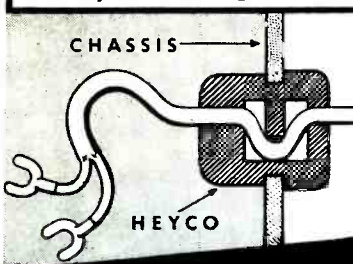
Manufacturers of Precision Resistors, Toroid Inductors and Electric Wave Filters

REPRESENTATIVES:
Jack Beebe, 5707 W. Lake Street, Chicago, Illinois
George E. Harris & Co., Box 3005, Municipal Airport, Wichita, Kansas
Marvin E. Nulsen, 5376 E. Washington St., Indianapolis 19, Indiana
Burlingame Associates, 103 Lafayette Street, New York City
Canada: John R. Tilton, 1166-A Lake Shore Road, Long Branch, Ontario

For further information contact your nearest Hycor representative or write for Bulletin R

Facts you should know about HEYCO STRAIN RELIEFS!

the Nylon Bushings that Anchor cord to housing



1. Absorb cord pull, push and torque
2. Insulate wire from housing

CUT PRODUCTION COSTS IMPROVE PRODUCT QUALITY

APPROVED

SAMPLES? Send wire size and chassis information—Try HEYCOS at no cost to you—today!
MADE IN ALL SIZES FOR CLOCK WIRE TO S-10/3 CABLE

HEYMAN MANUFACTURING COMPANY
KENILWORTH 2, NEW JERSEY

THE HEYMAN ORGANIZATION WITH 25 YEARS STAMPING EXPERIENCE HAS MODERN PRESS CAPACITY FOR OVER 2,000,000 FINISHED STAMPINGS PER DAY.

ASK FOR BULLETIN 33

HEYCO

gree, and listing by title of theses accepted for the Master's and the Engineer's degrees; 372 theses in all.

American Electricians' Handbook, 7th Edition. By Terrel Croft, revised by Clifford C. Carr. McGraw-Hill Book Co., New York, 1953, 1,773 pages, $10.00. A fully revised edition of a well-known practical electrician's handbook, taking into account the 1951 National Electrical Code. For the every-day electrical worker, with a minimum of theory and a maximum of down-to-earth data and guidance for selection, installation, operation and service of all types of electrical apparatus and materials.

Physical Formulae. By T. S. E. Thomas. John Wiley & Sons, Inc., New York, N. Y., 118 pages, 1953, $2.00. Another of the small Methuen Monographs on Physical Subjects, containing basic formulas and equations of mathematics and statistics, mechanics, hydraulics, elasticity, general physics, acoustics and Fourier series, heat, light, electricity and magnetism and electronic physics.

Construction and Applications of Conformal Maps. National Bureau of Standards, Applied Mathematics Series 18, 280 pages, $2.25 from Government Printing Office. Theory, applications and methods presented at NBS Institute for Numerical Analysis symposium, Los Angeles, 1949. Applications to electric and magnetic fields, elasticity, fluid dynamics, supersonic flows; methods include graphical, network, relaxation, and electrolytic tanks.

Clarostat TV Control Replacement Manual, 2nd edition. Clarostat Mfg. Co., Inc., Dover, N. H., 262 pages, $1. Lists replacement controls by set model and chassis designation, set manufacturer's part number, Clarostat catalog number, function and description. Guides distributor and service man in stocking the most likely replacements for any given locality or trade.

Numerical Solution of Differential Equations. By William E. Milne. John Wiley & Sons, Inc., New York, N. Y., 1953, 275 pages, $6.50. Many examples plus text on solving problems of mechanics, astronomy, electricity and nuclear physics. Ordinary and partial differential equations; explicit and implicit methods.

Mass Spectroscopy in Physics Research. Bureau of Standards Circular 522, 273 pages, 1953, U. S. Government Printing Office, $1.75. Proceedings of symposium September 6-8, 1951. A total of 36 papers by physicists from this country and 10 other countries on all aspects of mass spectroscopy.

Stochistic Processes. By J. L. Doob. John Wiley & Sons Inc., New York, N. Y., 1953, 654 pages, $10.00. Contents include: processes with mutually independent random variables; proces-

www.americanradiohistory.com

How to keep informed on the "with what" part of your business

AT YOUR FINGER TIPS, issue after issue, is one of your richest veins of job information—advertising. You might call it the "with what" type—which dovetails the "how" of the editorial pages. Easy to read, talking your language, geared specifically to the betterment of your business, this is the kind of practical data which may well help you do a job quicker, better—save your company money.

Each advertiser is obviously doing his level best to give you helpful information. By showing, through the advertising pages, how his product or service can benefit *you* and *your* company, he is taking *his* most efficient way toward a sale.

Add up all the advertisers and you've got a gold mine of current, on-the-job information. Yours for the reading are a wealth of data and facts on the very latest in products, services, tools . . . product developments, materials, processes, methods.

You, too, have a big stake in the advertising pages. Read them regularly, carefully to keep job-informed on the "with what" part of your business.

McGRAW-HILL PUBLICATIONS

McGRAW-HILL FOR BUSINESS

ses with mutually uncorrelated or orthogonal random variables; Markov processes—discrete and continuous parameter; and martingales. Processes with independent and orthogonal increments, stationary processes—discrete and continuous parameter, and linear least squares prediction—stationary (wide sense) processes.

Price Guide To Collectors' Records. Edited by J. M. Moses. American Record Collectors' Exchange, 825 Seventh Ave., New York 19, N. Y., 1952, 32 pages, paper-covered, $2.50. Lists every celebrity disc made up to 1925 with its current market price, with values ranging from $1 to $150. The approximately 7,300 listings include over 5,000 Victor Red Seal records. Most Caruso records are listed at $2 to $4 each.

How To Control Production Costs. Phil Carroll. McGraw-Hill Book Co., New York, 1953, 272 pages, $5.00. Practical guide to keeping costs down and product quality up, written specifically for management. Shows step by step how to get more accurate production costs, how to apply overhead expense properly to cost estimates, how to set budgets, how to set up real production control, how to improve engineering to cut production costs right at the start, how to use production incentives effectively, and how to take action when cost leaks are discovered and reported.

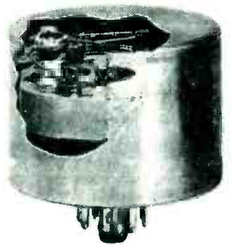
Remote Control By Radio. By A. H. Bruinsma. Philips Gloeilampenfabrieken, Eindhoven, Holland, 95 pages, $1.50. Distributed in this country by Elsevier Press, New York. Author describes series of radio-controlled model boats that he designed and built for exhibition. Complete circuit details are given, and many of the mechanical details are shown in photographs. One ship uses a relatively simple two-channel system; another uses an eight-channel system to control various functions remotely, including the catapulting of a miniature airplane from the deck of a three-foot model. A remote-controlled crane is also provided for fishing the plane from the water after launching.

High Frequency Heating And Temperature Distribution In Surface Hardening of Steel. By L. A. Dreyfus. Acta Polytechnica, Vol. 4. Nr. 5, 115 pages, 1952, Sw Kr. 18:00, Stockholm. An extensive engineering treatment of the subject, published as part of the electrical engineering series of the Royal Swedish Academy of Engineering Sciences.

Accounting Guide For Defense Contracts. By Paul M. Trueger. CCH Products Co., 214 N. Michigan Ave., Chicago. 384 pages, $7.50, 1953. How to handle the complicated accounting problems in connection with defense contracts, with samples of the required forms, how to renegotiate or terminate a contract, the facts of allowable and unallowable costs, etc.

(Advertisement)

Plug In Meter-Relay



Hermetically Sealed and Shock Mounted. Model 265 non-indicating meter-relay has balanced movement, locking contacts, 0.2 microamperes sensitivity and sealed case.

Sensitivity Ranges

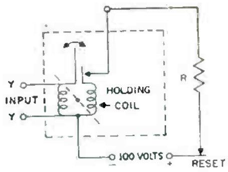
0.2 microamperes to 50 amperes, or .05 millivolts to 500 volts. The range can be changed with shunts or series resistors.

Accuracy

Factory adjustment within 3% of the specified current or voltage for most units. By adjusting circuit resistance the accuracy can be improved to better than 1%.

Contacts

S.P.S.T. or S.P.D.T. rated 5 to 25 milliamperes D.C. at 75 to 125 volts. Contacts lock in by a holding coil in the relay. They are released by breaking the circuit to the holding coil. The diagram shows internal wiring arrangement and basic circuit requirements. Load resistance R limits contact current to rated value.



Speed

Design variations allow for a range of response time from 1 millisecond to 10 seconds for most ranges. Time delay can be calibrated in seconds.

Case Style

Round metal can, sealed. Octal plug connector or other type of sealed header is optional. Rubber shock mount protects the jeweled movement from jars and vibration. Size: 2¼" dia. x 2¼".

A.C., D.C., R.F., F°, C°

The Model 265 used with copper oxide or crystal diode rectifiers works well on A.C. Rectifiers may be built in, likewise R.F. thermocouples. Calibrated in millivolts and with bimetal compensation this relay gives accurate control or safety alarm when used with temperature thermocouples. For further specifications write or call Bradley Thompson, Assembly Products Inc., Chagrin Falls 43, Ohio. Phone CH 7-7374

Want more information? Use post card on last page.

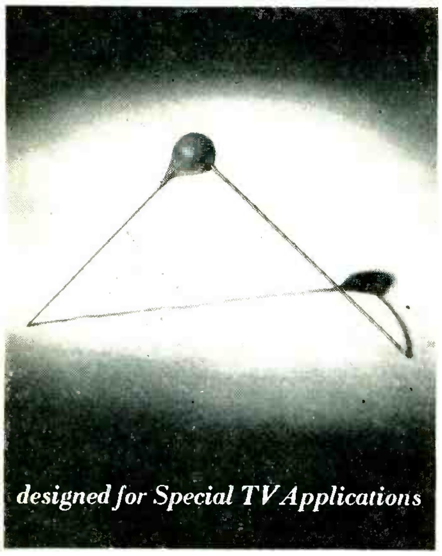
www.americanradiohistory.com

NEW!

GOLD BONDED

Germanium Diodes

Transistor Products germanium diodes, the smallest, *most efficient* diodes made, exhibit more uniform characteristics than any other diodes on the market. TP Germanium Diodes, with the Gold Bond feature, offer incomparable performance and dependability. The microminiaturized case, 3/16″ in diameter, gives new freedom of design and simplifies installation.



X-16 for use as a frequency multiplier in TV UHF tuners.

X-18 for use as a second detector in TV receivers.

X-13 particularly useful as a clamper and balanced modulator in color TV circuits.

The above types are available NOW.

Ready soon — a new cartridge-type UHF Mixer Diode.

Write Dept. E8 for descriptive literature

TP

TRANSISTOR PRODUCTS, INC.

SNOW AND UNION STREETS, BOSTON 35, MASSACHUSETTS

AN OPERATING UNIT OF CLEVITE CORPORATION

Want more information? Use post card on last page.

BACKTALK

Civilization??

DEAR SIRS:

DR. WIENER'S essay in the June issue of ELECTRONICS ("A Machine Wiser Than its Maker," New Books, p 368) carries the implication, at least to one so inclined, that ultimately nothing is impossible.

Lest anyone working in the physical sciences start getting too big for his breeches, it might be well to call attention to the pitiful smallness of what science and engineering have so far accomplished for the good of mankind.

As Rebecca West has pointed out, modern technology has not been able to provide a cheap house, nor cheap food.

Improvements in transportation have become, from the utilitarian point of view, smaller and smaller each year, with signs of retrogression appearing in automobile traffic. Floors must still be swept, clothes washed, dishes washed, taxes paid, clogged drains opened and lawns mowed in the usual way.

Science has made distinct inroads into some areas of the ancient problem of making life physically easier, for example, more efficient production of certain goods, public health, easy communication; and it has nibbled at the others. But in the broadest sense, the advances have been exceedingly small.

Humility is still a virtue.

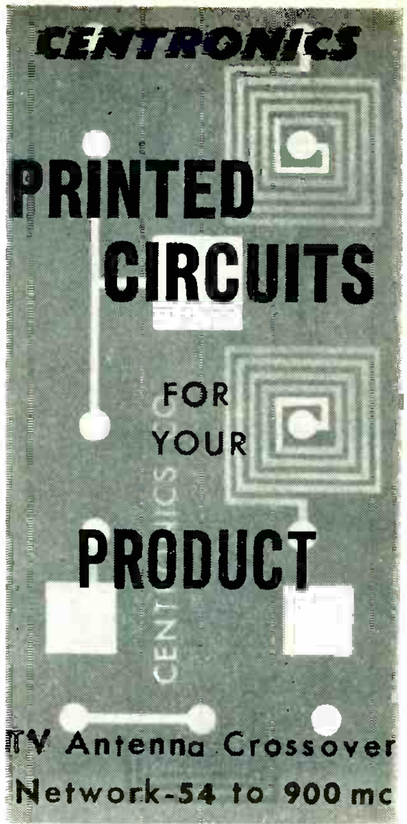
LAWRENCE FLEMING
Falls Church, Virginia

Dots Missing

DEAR SIRS:

WITH REGARD to the article by Gerald W. Lee entitled, "Broadcast Transmitter Remote Control System", appearing on page 138 of the June 1953 issue of ELECTRONICS, I fear that the diagram presented with the text is in need of some checking.

In the third paragraph on page 139, the author says that K_1 energizes K_2, which in turn pulls up K_3. Since the diagram shows K_2 cannot pull up until K_3 has pulled up, nor



USES OF PRINTED CIRCUITS

Printed Circuits have already replaced, in industry, many component parts. The following is a partial list of how printed circuits are now being used.

- Coils
- Condensers
- Resistors
- Switches
- Wiring

TYPICAL APPLICATIONS OF PRINTED CIRCUITS

- Amplifier wiring
- Radio chassis wiring
- TV antenna crossover networks
- Filter networks
- Flush switches
- Bounceless switches
- TV IF transformers
- Radio loop antennas
- Meter wiring

ADVANTAGES OF PRINTED CIRCUITS

- Costs are drastically reduced
- Eliminates all human errors
- Eliminates all soldering operations
- Circuits can be made extremely small

OUR ENGINEERING BROCHURE WILL GIVE YOU THE COMPLETE STORY, SEND FOR IT TODAY

A sketch or print of your product, sent to us, will receive an immediate reply with complete information as to its printed circuit appearance and price quotations.

If desired our sales engineer, in your area, will visit your plant and give you whatver assistance you need in adapting your product to printed circuits.

CENTRONICS COMPANY

21-04 122 Street
College Point, L. I., N. Y.
FLushing 3-7390

Want more information? Use post card on last page.

www.americanradiohistory.com

can K_3 pull up until K_2 has pulled up, it is a little hard to see how K_1 can do anything but drop out both relays *after* they have been pulled in by some other means.

I am sure you will take this comment in the spirit of pure correction, the article being very good in every respect—even with the error.

HILTON REMLEY
Des Plaines, Illinois

(Editor's Note: The error lies in the accidental omission of a dot at the junction between the 115-volt a-c supply wire [near the lettering K_2] and the wire between K_2 and the moving contact of K_3.)

DEAR SIRS:

WITH reference to the article "Constant-Current Power Amplifiers" by Sterling and Sobel appearing on page 122 of the March 1953 issue of ELECTRONICS, the resistor values in the plate circuits of the first pair of 6AK6's and in series with the 5R4GY 450-volt supply were omitted in Fig. 2. It is also noted that the above 6AK6's and the first 12AX7 have no direct plate supply voltage except for the IR drop in the cathode resistors of the 12B4. Is this correct?

PRENTISS B. ALGER
Cranford, New Jersey

(Editor's Note: The values for the plate resistors in the first 6AK6 stage are 39,000 ohms each. The 12AX7 stage plate supply is the cathode drop of the 12B4. Plate voltage for the first 6AK6's comes from the same source, and a dot at the intersection of the wire to the center of the unlabeled plate resistors and the cathode of the 12B4 will fix that part of the circuit. The resistor in series with the 450-volt supply is simply a current-limiting resistor and may be 22 ohms. An error in the explanation for the feedback phasing capacitors has also been noticed. These values should be adjusted for minimum ringing on square waves, not maximum as shown on the drawing.)

Credit

DEAR SIRS:

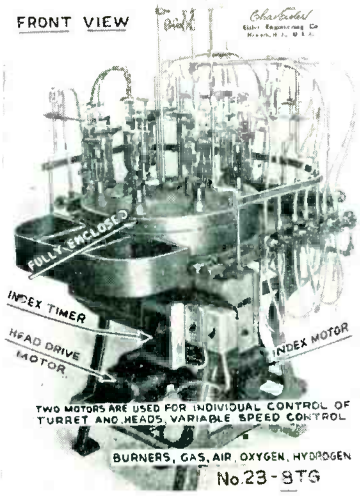
THIS is referring to my paper "High-Speed Number Generator Uses Magnetic Memory Matrices" which appeared on page 200 of the

ELECTRONIC GLASS WORKING EQUIPMENT

. . . For Radio, Television Tubes, Incandescent Lamps, Glass Lathes for Television Tubes

EISLER 8 HEAD AUTO INDEXING STEM MACHINE

FRONT VIEW



No.23-8TG

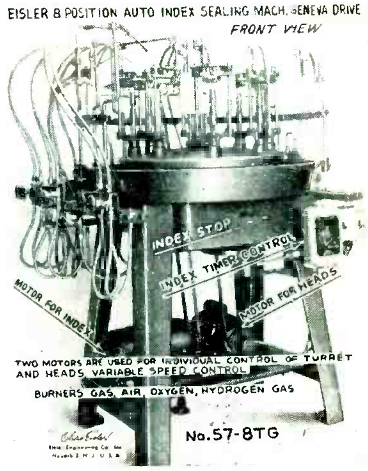
TURNTABLES ▶

We make over 100 types of turntables; tilting models and positioners.

More Eisler Stem and Sealing Machines are in use in the Electronics Industry than all other makes combined. There is a reason; they are simple, well-built, compact, last long, have good production, and are constantly being improved to give more production.

EISLER 8 POSITION AUTO INDEX SEALING MACH. GENEVA DRIVE

FRONT VIEW



No.57-8TG

We make Transformers, Spot and Wire Butt Welders, Wire Cutting Machines and 500 other items, indispensable in your production. Eisler Engineers are constantly developing New Equipment. If you prefer your own designs, let us build them for you. Write to Charles Eisler who has served The Industry over 33 years.

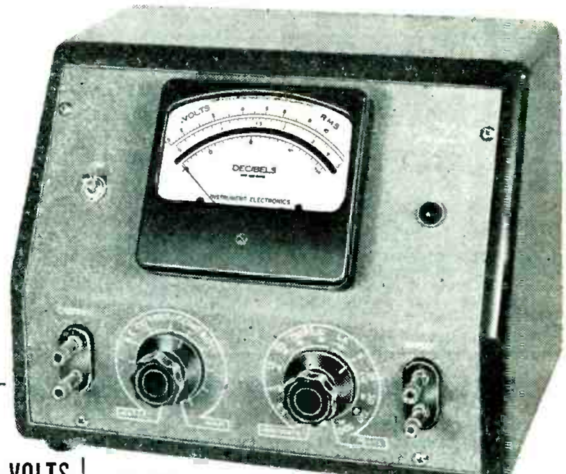
Dr. Charles Eisler, *President*

EISLER ENGINEERING CO., INC. 751 South 13th St., Newark 3, N. J. Near Avon Avenue

High Sensitivity . . Logarithmic

AC VOLTMETERS

SELF CONTAINED
ALL AC OPERATED
UNITS
NO PREAMPLIFIERS
NEEDED



These extremely sensitive and highly stable instruments serve simultaneously as voltmeters and high gain amplifiers. Built-in limiting circuit protects mirror scale indicating meter against all overloads (maximum input voltage on most sensitive range)

MODEL 47 ⟶
±2% 15C to 30 KC
50 MICROVOLTS to 500 VOLTS

Write for Complete Information

Mod.	Voltage Range	Frequency Response	Input Impedance	Approx. Feedback	Overlap. Scale	Amp. Gain
45	.0005-500	5C-1600KC	2 Megohms 12 MMF	22 DB	NO	1600
45B	.0005-500	10C-250KC	5 Megohms 12 MMF	39 DB	NO	1600
47	.00005-500	15C- 30KC	1 Megohm 15 MMF	29 DB	10 DB	23000
47B	.00005-15	15C- 30KC	50 Megohms 15 MMF	27 DB	NO	23000
53	.00015-500	10C- 250KC	5 Megohms 12 MMF	35 DB	10 DB	5300

Instrument Electronics Corp. 90 MAIN ST. PORT WASHINGTON, N. Y.

Want more information? Use post card on last page.

SIGNAL, NOISE AND RESOLUTION IN NUCLEAR COUNTER AMPLIFIERS

Just Published!

A simple theoretical and practical treatment of the signal to noise ratio of nuclear counters and associated amplifiers. Emphasizes ionization chambers, covers proportional and scintillation counters. **By A. B. Gillespie, Atomic Energy Research Establishment, England. 155 pp., 61 illus., $4.50.**

RADIO ANTENNA ENGINEERING

Provides guidance in designing both receiving and transmitting antennas used in point-to-point, ground-to-air, and military communications—as well as in broadcasting. Includes advanced designs suggested by very-high-frequency and ultra-high-frequency techniques, emphasizing their growing importance. Largely deals with custom-built antennas up to 30 megs. Shows how to choose a site, how to choose a working frequency, how to measure soil conductivity, etc. **By Edmund A. Laport, Chief Eng'r., RCA Int. Div., 563 pp., 386 illus., $10.00**

ELECTRONIC ANALOG COMPUTERS

Gives aid in the design and operation of electronic computers of the d-c analog type used as differential analyzers and equation solvers. Shows procedure for setting up problems that lessens the chief error of faulty assignment of scale factors. Gives samples of practical applications. Covers design of computer circuits, auxiliary components, and complete installations to meet specific needs. **By Granino A. Korn, Staff Engr., Lockheed Aircraft Corp., and Theresa M. Korn, formerly Engr., Boeing Aircraft Co. 378 pp., 70 illus., $7.00**

TELEVISION ENGINEERING

Second Edition

Covers the whole television process—from studio to receiver — clearly, and in detail. Treats TV technology, operating principles of TV systems, use of equipment. Provides practical working diagrams, complete with values of parts, tube types, etc. Explains color TV, intercarrier sound reception, distributed amplification, and many other phases. **By Donald G. Fink, Editor, *Electronics*. 2nd ed., 721 pp., 512 illus., $8.75**

SEE THESE BOOKS 10 DAYS FREE

McGraw-Hill Book Co.,330 W.42St.,NYC(36)

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon — same return privilege.)

☐ Gillespie—Signal, Noise, in Nuclear Counters—$4.50
☐ Laport—Radio Antenna Engineering—$10.00
☐ Korn & Korn—Elec. Analog Computers—$7.00
☐ Fink—Television Engineering—$8.75

(Print)
Name ....
Address ....
City .... Zone ..... State ....
Company ....
Position FL-8

This offer applies to U. S. only

Want more information? Use post card on last page.

May 1953 issue of ELECTRONICS. In my paper I omitted an acknowledgement which should have appeared.

The first such number generator was built by Wang Laboratories fulfilling a contract for Laboratory for Electronics, Inc., under a subcontract between L.F.E., Inc. and the University of Michigan, under prime contract No. AF30(602)-9 between the United States of America and the University of Michigan. Credit is due to Mr. B. M. Gordon and Mr. R. N. Nicola of Laboratory for Electronics, Inc. in their original suggestions of using dot sequential system and the possible use of magnetic cores in the system.

A. WANG
Wang Laboratories
Boston, Massachusetts

Bank TV

DEAR SIRS:

In the May 1953 issue of ELECTRONICS (p 20) you published pictures of the industrial television system installed at the New York Savings Bank. This is a Telescreen System for banks, designed and installed by our company.

WM. L. NORVELL
President
Telescreen Corporation
New Canaan, Connecticut

(Editor's Note: Mention of Telescreen's part in the New York Savings Bank installation was inadvertantly omitted from the article in question.)

More Trons

DEAR SIRS:

IN ADDITION to the "Tron" family listed in ELECTRONICS for May, 1950 (p 112), I herewith submit several additional relatives in the hope you have not met them.

Cheepatron — Replacement for phantastron.

Cymatron—Frequency multiplier.

Maxitron—General Electric X-ray generator.

Phasitron—Television antenna.

Polartron—National Union tube.

Solartron — Regulated power supply.

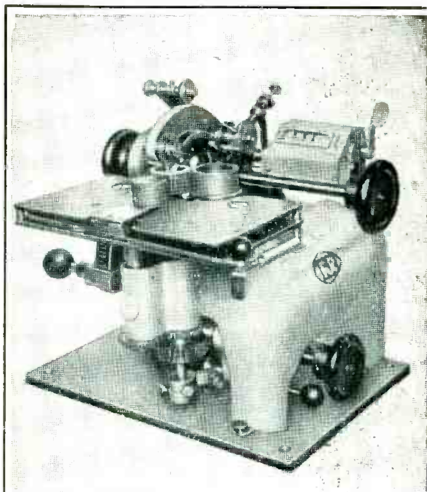
(Continued on p. 398)

DOES YOUR MIDWEST SALES PICTURE NEED RETOUCHING

We're looking for quality products in the Electronics Field that we can introduce to our extensive channels of distribution in the Midwest.

Complete servicing and warehousing facilities available. Modern display offices, centrally located. We are now in a position to add one or two quality products to our other well-established lines. If your midwestern sales are sagging, ask for details of our comprehensive program for revitalizing accepted products.

AMERICAN SOUND PRODUCTS
INCORPORATED
1303 S. Michigan Boulevard
CHICAGO 5, ILLINOIS



IMPORTED AUTOMATIC
TOROIDAL COIL-WINDING MACHINES

Designed and made in Germany. Available in 4 sizes for a minimum I.D. of 5/16", 7/16", 11/16" and 13/16" after winding. Rings are revolved automatically by an adjustable gearing. The feed is adjustable during operation. Coils can be wound continuously around 360° or in sectors.

Exclusive Distributor:

REX RHEOSTAT CO.
BALDWIN, L. I., N. Y.

Want more information? Use post card on last page.

www.americanradiohistory.com

McGRAW-HILL TECHNICAL WRITING SERVICE

TWS offers you a single INTEGRATED publishing service prepared to undertake a project from research and planning through finished manuscript and art, typesetting, mechanical preparation, printing and binding. Whatever the situation, whatever the type of literature you need, our editorial and art consultants can help you, bringing to your most specialized job the craft and skill of publishing experts.

WRITING EDITING ILLUSTRATING PRINTING

TO YOUR OWN OR GOVERNMENT SPECIFICATIONS

Whether you need an instruction book or service manual, to accompany your equipment, written to government specifications . . . . . . or product catalogues or training booklets . . . or annual reports . . . or company histories . . . our writing staff can do the job for you, our artists can create and execute the illustrations. And McGraw-Hill printing, binding, and paper resources are among the best in the country.

SAVE MONEY AND TIME

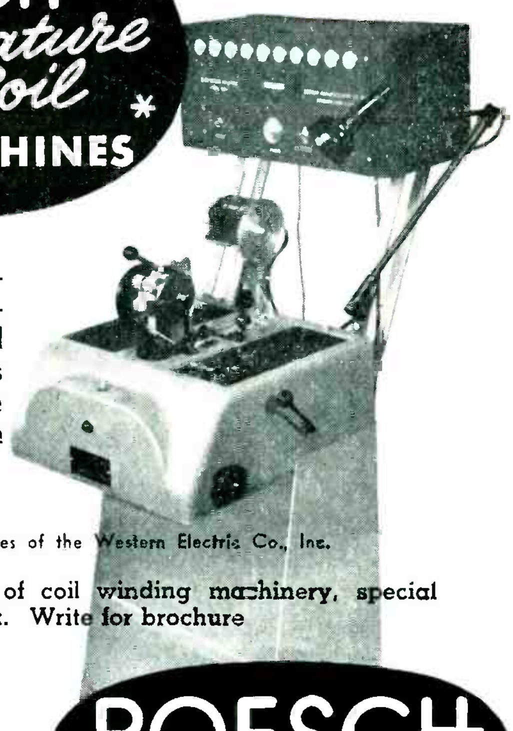
LET OUR STAFF BE YOUR STAFF FOR TECHNICAL and BUSINESS PUBLICATIONS

ASK OUR REPRESENTATIVE TO CALL

Write • Phone

Technical Writing Service
McGraw-Hill Book Co., Inc.
330 W. 42nd St., N. Y. 36, N. Y.
LOngacre 4-3000

BOESCH *Sub-Miniature Toroidal Coil* * WINDING MACHINES



Model SM-A designed especially for winding of subminiature sized coils. Finished windings up to 1" O.D. to as small as 1/16" nominal hole size. Wire range #34 through #44 AWG. Speed variable.

*Available to licensees of the Western Electric Co., Inc.

Designers and Builders of coil winding machinery, special machinery and equipment. Write for brochure

WORLD'S MOST VERSATILE WINDING MACHINES

BOESCH MANUFACTURING CO., INC.
DANBURY, CONN.

For the First Time Anywhere

POWER SUPPLIES WITH REGULATION AND STABILITY

MEASURED IN

PPM

PARTS PER MILLION

SERIES 400

ESPECIALLY FOR NUCLEAR WORK

- Regulation—100 PPM for line voltages 105V to 130V.
- Load Regulation—75 PPM from no load to full load.
- Stability—100 PPM for 3 hrs./500 PPM per day.
- Ripple—better than .01%—(negligible noise and bounce.)
- Transient—free for all line disturbances.
- Far more stable than batteries.
- Minimum warm-up time.

SPECIFICATIONS

Model 400B.	1000 to 5000 V.,	0–1 MA.	Negative side grounded.
Model 400C.	500 to 1500	0–1 MA.	Negative side grounded.
Model 400D.	1000 to 5000	0–1 MA.	Positive side grounded.
Model 400E.	500 to 1500	0–1 MA.	Positive side grounded

Models to your specific voltage requirements available on order.

Also

For wider voltage range and for higher output current, for even greater stability and for regulation to 20 PPM, we offer the 300 Series Precision Direct Current Power Supplies —Catalog literature available on request to Dept. NF-12.

jf

JOHN FLUKE ENGINEERING COMPANY

1111 W. NICKERSON STREET
SEATTLE 99, WASHINGTON

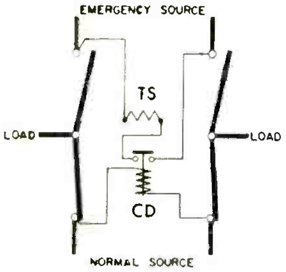
Represented by:
BURLINGAME ASSOC., New York, Boston, Wash., D. C.: HUGH MARSLAND, Chicago; GERALD B. MILLER CO., Hollywood, San Francisco, Albuquerque, Seattle; M. P. ODELL, Cleveland, Dayton; EARL LIPSCOMB ASSOC., Dallas, Houston; H. M. RICHARDSON & CO., Minneapolis, Minn.

www.americanradiohistory.com

Need to be sure ★ of **CONTINUOUS, ADEQUATE-VOLTAGE POWER?**

USE THIS ASCO COMBINATION

Automatic Transfer Switch with Close Differential Relay



When installing your emergency power supply

1. **Be sure of continuous power by installing an ASCO Automatic Transfer Switch to transfer the load to emergency should normal power fail.**
2. **Be sure of adequate-voltage power by equipping your ASCO Automatic Transfer Switch with ASCO Close Differential Relays, to provide for transfer and retransfer of the load on a small voltage differential.**

POINT 1 The best electronic equipment is useless without power; you need an emergency supply to prevent costly shutdowns. But even with this emergency source, unless automatic load transfer is provided, your equipment will be inoperative until the emergency power switch is located and manually thrown. During this "waiting period" your equipment is useless and time and money are wasted.

ASCO can eliminate this delay by supplying an Automatic Transfer Switch that will transfer in two to five cycles on small units and five to nine cycles on large!

Once the normal source is again in proper operating condition, the ASCO Transfer Switch will automatically restore the load to the normal source.

POINT 2 Where adequate-voltage power is important, ASCO Transfer Switch equipped with ASCO Close Differential Relays can provide transfer on a 5% differential in power supply voltage (less, if required).

Close differential relays are also available as unit devices for any application.

ASCO Electro-Magnetic CONTROLS

Our ideas on the automatic transfer of loads are discussed in a special free pamphlet. May we send you a copy?

Automatic Switch Co.

385-L LAKESIDE AVENUE ORANGE, NEW JERSEY

Want more information? Use post card on last page.

Trajectron—University of Michigan instrument.

JOHN H. HEWITT
Newton Highlands
Massachusetts

Bated Breath

DEAR SIRS:

IN *"Crosstalk"*, (col. 1, p 129, May 1953 ELECTRONICS) you make a most interesting and truthful statement, namely, "The public is not now waiting with baited breath for color".

Now, in view of the known facts, I don't want to argue with you about the actions of the public. However, the statement leaves me quite puzzled. Just how do you bait breath anyhow? With Scotch and soda, or what?

Seems like you didn't use the word you intended. *Bated* fits much better, and is defined as "to lessen by retrenching, deducting, or reducing—to abate—etc—as to bate one's breath". (Webster's New International Dictionary, Second Edition, Springfield, 1952, Vol. 1, p 230). Certainly this fits the context better than *baited*, which means carrying or having attached to it "anything, especially good, used in catching fish" (Webster, op. cit., p 205).

RONALD L. IVES
Williamsville, New York

IN THE "Crosstalk" department of ELECTRONICS (May 1953) the following sentence caught my eye:

"The public is not now waiting with baited breath for color".

Noah Webster and I hope you have a profitable session with your proof-readers, and we await (with bated breath) the *"Crosstalk"* section of the June issue.

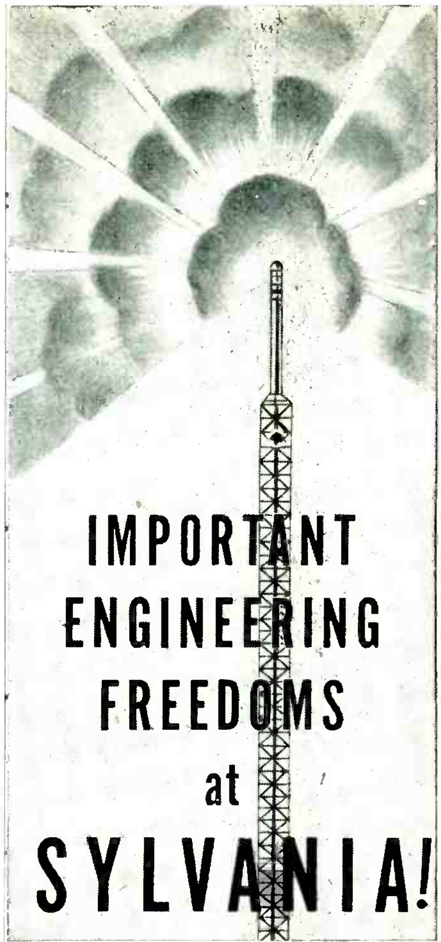
A. T. WILLIAMSON
Canadian Industries Ltd.
McMasterville, Quebec

RE *"Crosstalk"*, ELECTRONICS, May 1953, line 6. "The public is not now waiting with baited breath for color".

What kind of bait? Money? Worms?

With bated breath I await your reply.

JOHN H. MILLER
Newark, New Jersey



All too often, farsighted engineering ideas and aims are held in check by everyday job requirements. Engineers made of the right "stuff" hold a secret yearning to break the shackles of today — to think in terms of the possibilities of **tomorrow.**

Sylvania thinks that way, too — has thought so for years. As a result, Sylvania encourages its engineers to pioneer, develop, follow through on their ideas, write and speak on their chosen subject to gain professional recognition.

If you are looking for a stimulating **challenge that will last a lifetime** — investigate the splendid career opportunities with fast-growing Sylvania.

Send your resume to:

JOHN C. WELD
Supervisor of Employment
254 Rano Street, Buffalo 7, New York

DONALD BRADLEY
Personnel Supervisor
70 Forsyth Street
Boston, Mass.

SYLVANIA
ELECTRIC PRODUCTS INC.
RADIO AND TELEVISION DIVISION
254 RANO STREET
BUFFALO 7, NEW YORK

Want more information? Use post card on last page.

www.americanradiohistory.com

All business is specialized

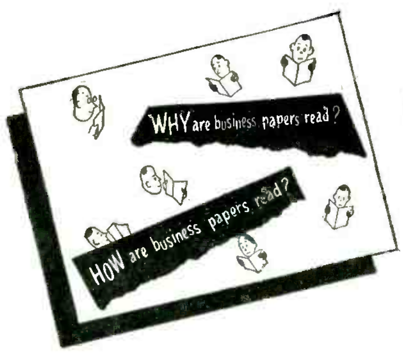
... and nothing specializes on your business like your business paper

You can sell suntan lotion on Broadway or Beacon Street, but this seagoing salesman can sell a whale of a lot more . . . because he *specializes.*

Your business is specialized, too. That's why it pays to keep up with your business paper. It specializes on business problems you meet every day. It helps you do a whale of a lot better job by keeping you posted on your whole field. You can *move ahead* when you know what's ahead; you can make quicker, surer decisions when you have a clear perspective on what's happening; and you get all this from your business paper.

Every page counts. The editors gather facts, weigh and interpret them. The advertisers line up new products, materials and equipment . . . tell you what they do and where to buy them. To know what's new that's important to you, read *every* issue—thoroughly! It will keep you one of the best informed people in your field.

This business paper in your hand has a plus for you, because it's a member of the Associated Business Publications. It's a paid circulation paper that must earn its readership by its quality . . . And it's one of a leadership group of business papers that work together to add new values, new usefulness, new ways to make the time you give to your business paper still more profitable time.



A copy of this quick-reading, 8-page booklet is yours for the asking. It contains many facts on the benefits derived from your business paper and tips on how to read more profitably. Write for the "WHY and HOW booklet." Room 2710.

McGRAW-HILL PUBLISHING COMPANY
330 West 42nd St., New York 36, N. Y.

ABC ABP

One of a series of advertisements prepared by THE ASSOCIATED BUSINESS PUBLICATIONS

www.americanradiohistory.com

PROFESSIONAL SERVICES

ANNIS ELECTRIC RESEARCH LABORATORY, INC.
CONSULTING — RESEARCH — DEVELOPMENT AND DESIGN OF RADIO AND ELECTRONIC EQUIPMENT
SPECIALIST
Military Radio Direction Finding Equipment and Directional Antennas
P. O. Box 581 Champaign, Ill. 140½ S. Neil St. Tel. 6-1780

CROSBY LABORATORIES, INC.
Murray G. Crosby & Staff
Radio - Electronic
Research Development & Manufacturing
Communications, FM & TV
Robbins Lane, Hicksville, N. Y.
Hicksville 3-3191

EDGERTON, GERMESHAUSEN & GRIER, INC.
Consulting Engineers
Research, Development and Manufacture of Electronic and Stroboscopic Equipment
Specialists in High-Speed Photography
160 Brookline Avenue Boston 15, Mass.

Eldico of New York, Inc.
Pioneers of Television Interference Elimination from Transmitters, Induction Heaters, Diathermy and etc.
Donald J. S. Merten & Engineering Staff
44-31 Douglaston Pkwy Douglaston, N. Y.
Bayside 9-8686

ERCO RADIO LABORATORIES, INC.
Radio Communications Equipment
Engineering - Design - Development - Production
Pioneers in Frequency Shift Telegraph
Garden City • Long Island • New York

HARRIS GALLAY
Consultant
Electronic Project Development for Industry
Day, Week and Duration of Project Services
Our Laboratory Facilities Optional
Plymouth 9-4237 60 Perry St., Belleville 9, N. J.

GENERAL LABORATORY ASSOCIATES, INC.
Specialists in Glass to Metal Sealing
Manufacturing and development facilities now available covering special vacuum and gas tube Development and Fabrication. We invite your inquiries.
Norwich, N. Y. Telephone Norwich 4-3264

GORDON ASSOCIATES, INC.
Government Contract Liaison and Consulting
Specializing in Signal Corps Electronic Requirements, Technical Manuals, Tabular List of Parts, Drawings.
L. Gordon, Pres. P. Treston, Ch. Engr.
157 Broad Street Red Bank, New Jersey Telephone Red Bank 6-2743

HANSON-GORRILL-BRIAN INC.
Products & Mfg. Development
ELECTRICAL - ELECTRONIC
HYDRAULIC - MECHANICAL
One Continental Hill Glen Cove, N. Y.
Glen Cove 4-7300

HIGHLAND ENGINEERING CO.
William R. Spittal & Staff
DESIGN, DEVELOPMENT AND MANUFACTURE OF TRANSFORMERS, CHOKES, ETC.
FOR THE ELECTRONIC, INDUSTRIAL & ALLIED FIELDS
Main & Urban, Westbury, L.I., N.Y.
WE-7-2983

HOGAN LABORATORIES, INC.
John V. L. Hogan, Pres.
Applied Research, Development, Engineering
Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers (Circle), Electro-sensitive recording media, Instrumentation.
155 Perry Street, New York 14. CHelsea 2-7855

THE KULJIAN CORPORATION
Consultants • Engineers • Constructors
Electronic Control
Specialists
Utility • Industrial • Chemical
1200 N. Broad St., Phila. 21, Pa.

MAGNETIC INDUSTRIES, INC.
Development & Manufacture
Servo Magnetic Amplifiers and Special Relays
2640 Huldy Houston 6, Texas

MEASUREMENTS CORPORATION
Research & Manufacturing Engineers
Harry W. Houck Jerry B. Minter
John M. van Beuren
Specialists in the Design and Development of Electronic Test Instruments
Boonton, New Jersey

Eugene Mittelmann, E.E. Ph.D.
Consulting Engineer & Physicist
High Frequency Heating—Industrial Electronics
Applied Physics and Mathematics
549 W. Washington Blvd. Chicago 6, Ill.
State 2-8021

NEW ROCHELLE TOOL CORP.
FOR CERTIFICATION OF INDUCTION AND DIELECTRIC HEATING EQUIPMENT IN ACCORDANCE WITH F.C.C. RULINGS
320 Main St., New Rochelle, New York
Phone NE 2-5555
Mobile Test Unit Available Entire U. S.

NIAGARA ELECTRON LABORATORIES
CONSULTATION - DESIGN - CONSTRUCTION
MFG. THE THERMOCAP RELAY
Specializing in solution of problems of electronic and electro-physical instrumentation for the research of analytical laboratory. Industrial plant problems also invited.
Andover, New York Cable Address: NIATRONLAB

MAURICE I. PARISIER & CO.
Communications Expert
International Engineering Consulting
RADIO BROADCASTING & COMMUNICATIONS
Planning & Installation Supervision
Communication Equipment for Armed Forces
1475 Broadway New York 36, N.Y. LOngacre 4-5131
Offices: Paris-Beunos Aires—Sao Paolo-Bombay

PICKARD AND BURNS, INC.
Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research, Development and Production of Special Electronic Equipment
240 Highland Ave. Needham 94, Mass.

ALBERT PREISMAN
Consulting Engineer
Television, Pulse Techniques, Video Amplifiers, Phasing Networks, Industrial Appliances
Affiliated with MANAGEMENT-TRAINING ASSOCIATES
3308-14th St., N. W. Washington 10, D. C.

JOSEPH RACKER COMPANY
Radar Consultants & Editors
Technical Manuals
Research and Development
140 Nassau Street, New York 38, N. Y.
Worth 4-1463

ROTRON RESEARCH CORPORATION
Research and Development
Fluid Dynamics and Heat Transfer, Exclusively Electronic Applications
Cooling Problems, Heat Exchangers, Fans, Turbines and Pump Designs.
Woodstock, N. Y Phone 2408

SKINNER, HARLAN AND IRELAND, INC.
Consulting Engineers
Specializing in Magnetic Materials and Their Application
1122 E. 23rd St. Indianapolis 7, Indiana

THE TECHNICAL MATERIEL CORPORATION
Communications Consultants
Systems Engineering
General Offices and Laboratory
121 Spencer Place, Mamaroneck, N. Y.

WHEELER LABORATORIES, INC.
Radio and Electronics
Consulting—Research—Development
R-F Circuits—Lines—Antennas
Microwave Components—Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N. Y. Great Neck 2-7806

WIHTOL LABORATORIES
Consulting - Research - Development
Electron tubes—Vacuum and gas tube manufacturing techniques-Glass techniques-Special purpose tubes
2333 Grey, Evanston, Ill. Un. 4-7896

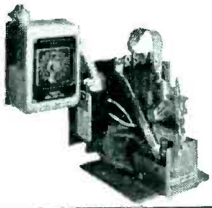
YARDNEY LABORATORIES, INC.
Research - Design - Development
Electro-Chemical Generators of Energy
105 Chambers Street Worth 2-3534, 35, 36
New York 7, N. Y.

www.americanradiohistory.com

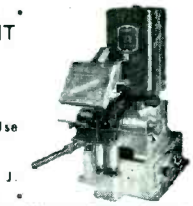
CONTACTS

FOR THE FIELD OF ELECTRONICS

A PRIVATE TECHNICAL PLATING SERVICE
offering PALLADIUM RHODIUM in flash, intermediate and heavy electrodeposits
Information regarding electroplated thicknesses upon request.
DANIEL D. ZIELIK
Brown's Lane Fairfield, Connecticut



EISLER MANUFACTURES COMPLETE EQUIPMENT
WELDERS FOR SPOT & WIRE BUTT
RADIO, TV TUBE EQUIPMENT & REPAIR UNITS
INCANDESCENT, FLUORESCENT MFG EQUIPMENT
NEON SIGN MAKERS EQUIPMENT, GLASS LATHES
ELECTRONIC EQUIPMENT, VACUUM PUMPS, Etc.
Wet Glass SLICING & CUTTING MACHINES for Lab Use
TRANSFORMERS, SPECIAL & STANDARD TYPES
EISLER ENGINEERING CO., INC.
751 So. 13th St. Newark 3, N. J.



Shorted Turn Indicator

Sensitive, rugged, non-shocking for unmounted coils; $150. f.o.b. HUNTINGTON BEACH, CALIF.
KARTRON

WALKIE-RECORDALL 8 lb. miniature BATTERY RECORDER-PLAYBACK
Continuous, permanent, indexed recording, up to 4 hrs., only 3c hr. Instantaneous, permanent playback. Picks up sound up to 60 ft. Records conferences, lectures, dictation, 2-way phone & sales talks; while walking, riding or flying. Records in closed briefcase with "hidden mike"! Write for Detailed Literature.
MILES REPRODUCER CO., INC.
812 BROADWAY Dept. E-8 NEW YORK 3, N. Y.

LARGE SHALLOW SOLDER POTS
with
UNIFORM DISTRIBUTION OF HEAT

Adjustable long-life thermostat.
Ceramic embedded heating elements.
Detachable dross tray
Unconditionally guaranteed for 6 months.
Standard models with temperatures to 1200° F.—also custom built.
Write for Bulletin

DEE SOLDER POTS
DEE ELECTRIC COMPANY
Melting Pots
1105 N. Paulina St., Chicago 22, Ill.

CRYSTALS FOR ALL PURPOSES

LOW FREQ.-FT 241A for SSB, latice filter, ½" spc. 54th or 72nd harm channels listed by fund. Fractions omitted.							SCR. 522 ½p ½"sp	BC-610 2 banana plugs ¾" spc.	
370	396	422	487	512	400	459	5520	2030	2390
372	397	423	488	513	440	461	5910	2032	2415
374	398	424	490	514	441	462	6370	2045	2435
375	401	425	491	515	442	463	6450	2052	2442 5
376	402	426	492	516	444	464	6470	2065	2532 5
377	403	427	493	518	445	465	6497 9	2105	2545
379	404	429	494	519	446	466	6522 9	2125	2557 5
380	405	430	495	520	447	468	6547 9	2131	3202 5
381	406	431	496	522	448	469	6610	2145	3215
393	407	433	497	523	450	470	7380	2155	3237 5
384	408	434	498	525	451	472	7390	2220	3250
385	409	435	501	526	452	473	7480	2258	3322 5
386	411	436	502	527	453	475	7580	2260	3510
387	412	437	503	529	454	476	7810	2280	3520
388	413	438	504	530	455	477	7930	2282 2	3550
390	414	481	505	531	456	479	$1.29 EA	2290	3570
391	415	483	506	533	457	480		2300	3580
392	416	484	507	534	458		200 or 500 KC IN FT 241 A HOLDER ½" SPC. $1.95 EA	2305	3945
393	418	485	508	536				2320	3955
394	419	486	509	537	99c each 10 for $9.00			2360	3995
395	420		511	538				$1.29 EA	
49c EA 10 for $4.50									

FT 243 ½" PIN SPC.

4190	6175	7806	1015	5740	5840	6273	6450	6600	7440	7650
5030	6206	7840	3735	5760	5850	6306	6473	6606	7506	7673
5485	6773	7873	5305	5773	5873	6325	6506	6640	7540	7706
6040	6873	7906	5677	5800	5906	6340	6540	6673	7573	7973
6073	7740	7940	5706	5806	5940	6373	6573	6706	7606	8240
6140	7773		5725	5825	5973	6406	6575	6740	7640	8273
49c EA 10 for $4.50			99c EA 10 for $9.00							

● Add 20¢ for each 10 xtals or less for postage and handling

Sun
PARTS DISTRIBUTORS, LTD.
520 TENTH ST., N.W. - WASHINGTON, D.C.

SUBCONTRACTING
MILITARY AND COMMERCIAL
Design, development and manufacture of Servomechanisms, Controls, Toroids, Saturable Reactors, Magnetic Amplifiers.
FIDELITY INSTRUMENT CORPORATION
1320 W. MARKET STREET
TEL. 7675 YORK, PENNA.

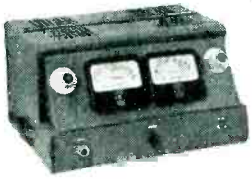
FLUXES
SODERING BRAZING & WELDING
ALLEN EST. 1909
L. B. ALLEN CO. INC. Chicago 31, Ill.
6751 Bryn Mawr Ave.

SUB-CONTRACTING
MILITARY and COMMERCIAL
receivers—test equipment
transmitters—controls
sub-assemblies
TELETRONICS LABORATORY, INC.
Westbury, L. I., N. Y. Westbury 7-1028

COILS
RF-IF Sub-assemblies
Production & Special Test Equipment
AN/APR-1, AN/APR-4 Receivers
JERRELL ELECTRONIC, INC.
1970 Neva Dr. Dayton 4, Ohio
ORegon 1351

WIDE RANGE DECADE RESISTOR
Especially designed for use in development and production laboratories where standardized RTMA resistor values are to be determined easily and quickly.
For descriptive literature write or wire . .
Rochester Electronics Co., Inc.
DEPT S-4 Box 227 PENFIELD, NEW YORK

use this
CONTACTS SECTION
to
- PROMOTE NEW USES
- PROMOTE NEW USERS
- GET NEW SALES OUTLETS
- REACH ALL BUYING INFLUENCES
- EFFECTIVELY ** ECONOMICALLY



HIGH VOLTAGE POWER SUPPLIES
Available in ranges from 2,500 to 25,000 volts D.C., with or without built-in meters. Regulated or unregulated types available. Delivery good on all standard models.
Send for free catalogue—Dept. E1
PRECISE MEASUREMENTS CO.
942 KINGS HIGHWAY, BROOKLYN 23, N. Y.
Phone ES 5-9435

Have you problems in -
Metal to Glass Seals?
NAME IT . . . WE'LL MAKE IT!
TERMINALS
HEADERS
END SEALS . . . SPECIAL ITEMS
QUALITY PRODUCTS CO.
337 Charles St., Providence, R. I.

www.americanradiohistory.com

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

$1.80 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
POSITION WANTED & INDIVIDUAL SELLING OPPORTUNITY WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
BOX NUMBERS count 1 line additional.

INFORMATION

DISCOUNT 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED OR FOR SALE Advertisements acceptable only in Displayed Style.

DISPLAYED—RATE PER INCH

The advertising rate is $16.10 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page. ELECT.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W. 42 St., N. Y. 36, for the *August issue closing July 2.* The publisher cannot accept advertising in the Searchlight Section, which lists the names of the manufacturers of resistors, capacitors, rehostats, and potentiometers or other names designed to describe such products.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

PROGRESSIVE EASTERN manufacturing engineers seeking Project Engineer, Electronics, BSEE or equivalent, minimum 7 years experience HF, VHF antennas. Background in microwaves and general circuitry very desirable. Many valuable benefits plus very liberal compensation to right man. Future unlimited. Please send complete information to P-8426, Electronics.

POSITIONS WANTED

ELECTRONIC ENGINEER, maintenance, teaching, and technical writing experience. Former Naval Officer, age 37. Desire administrative position on Long Island. PW-8379, Electronics.

EQUALITY CONTROL Engineer Electrical-Mechanical experienced precision work, statistics. PW-8473, Electronics.

DUTCH COMMUNICATIONS Engineer, graduate 1938 mechanical, aeronautical and radio engineering, single, desires responsible work overseas. Highly experienced in large communic. systems and broadcast in Europe, Middle East and South East Asia, thorough knowledge of five languages, adaptable to any situation, no objections against much travelling. PW-8467, Electronics.

MANUFACTURERS' REPRESENTATIVE

well-established in Chicago area and midwest, wants additional lines such as resistors, tubes, hardware and related items.

RA 8482, Electronics
330 W. 42nd St.,
New York 36, N. Y.

EXPERIENCED SALES-TECHNICAL REPRESENTATIVE

Interested In Additional Line of Electro-Mechano-Plastics Components To Offer Established Customers In N. J., N. Y., Area. Complete Office Facilities. Est., 1945.

JAMES L. FITZSIMMONS
39 Lackawanna Plaza Bloomfield, N. J.

When Answering BOX NUMBERS...

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

ELECTRONIC ENGINEERS

SENIORS: To act as a group leaders on design, development and production of radio, radar, television transmitters, receivers and test equipment.

SPECIALISTS: (2) Microwave circuitry and UHF plumbing, preferably with microwave test equipment design experience.

Must have minimum five years practical experience, including knowledge of Government specifications, airborne, ground and/or naval equipments. Excellent opportunity for advancement. Write, giving outline of education, experience, background and salary expected, to

Engineering Personnel Department
FREED ELECTRONICS AND CONTROLS CORPORATION
200 Hudson Street, New York 13, N.Y.
Manufacturers of

Radio and Television Receivers · Industrial Controls · *Freed-Eisemann* · Electronic Equipment · Nucleonics Instruments

ELECTRONIC INSTRUMENT DEVELOPMENT

Design-development engineers, having excellent technical ability, are needed for developing precision electronic laboratory equipment. Interesting and challenging work. This opportunity will be particularly attractive to those who wish to join a progressive company of moderate size located in eastern Massachusetts, very near M.I.T. and Harvard. The work is primarily for the civilian market.

SPENCER-KENNEDY LABORATORIES, INC.
186 Massachusetts Avenue Cambridge 39, Massachusetts

What is *Your* Problem?

Do you need competent men for your staff? Men to fill executive sales or technical positions?

Or are you one of the readers of ELECTRONICS seeking employment in any of these capacities?

Or are you looking for—or offering—a business opportunity of special interest to men in the industry served by this publication?

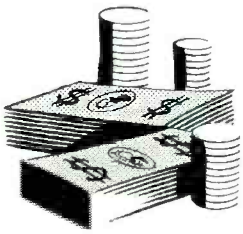
Or are you seeking buyers for surplus used equipment from your plant—or to buy such equipment from other plants?

The solution of any of these problems can logically be found *first* among *other* readers of—ELECTRONICS. You can get their attention—at small cost—through an advertisement here.

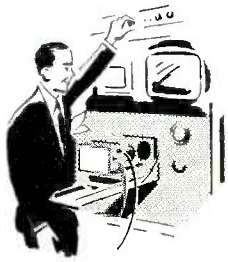
www.americanradiohistory.com

What means most to an Engineer?

PROFESSIONAL RECOGNITION



GOOD SALARY



UNEXCELLED FACILITIES

SUBURBAN LIVING

A Career at RCA offers all Four!

RCA offers opportunities now—real career opportunities—for qualified ELECTRONIC, COMPUTER, ELECTRICAL, MECHANICAL and COMMUNICATIONS ENGINEERS . . . PHYSICISTS . . . METALLURGISTS . . . PHYSICAL CHEMISTS . . . CERAMISTS . . . GLASS TECHNOLOGISTS.

Positions are open in research, development, design and application. Long range work in many fields is being carried on both for commercial developments and military projects for war and peace.

At RCA you'll work in an exciting professional atmosphere, with technical and laboratory facilities unsurpassed anywhere in the radio-electronic industry. You are in close and constant association with leading scientists and engineers. Individual accomplishment is not only recognized, it is sought out. Delightful suburban living is easily available for your family. And there's ample opportunity for income and position advancement.

Plus, Company-paid hospitalization for you and your family . . . accident and life insurance . . . progressive retirement plan . . . fine recreational program . . . modern tuition-refund plan at recognized universities for advanced study.

Join the team at RCA, world leader in electronic development, first in radio, first in recorded music, first in television. Rest easy in the knowledge that your future is secure, the rewards many and varied.

Positions Open In: **RESEARCH—DEVELOPMENT—DESIGN—APPLICATION**
in any of the following fields:

RADAR—Circuitry—Antenna Design—Servo Systems—Information Display Systems—Gear Trains—Stable Elements—Intricate Mechanisms

COMPUTERS—Digital and Analog—Systems Planning—Storage Technique—Circuitry—Servo Mechanisms—Assembly Design—High Speed Intricate Mechanisms

COMMUNICATIONS—Microwave—Aviation—Mobile—Specialized Military Systems

MISSILE GUIDANCE—Systems Planning and Design—Radar and Fire Control—Servo Mechanisms—Vibration and Shock Problems

NAVIGATIONAL AIDS—Loran—Shoran—Altimeters—Airborne Radar

TELEVISION DEVELOPMENT—Receivers—Transmitters and Studio Equipment

COMPONENT PARTS—Transformer—Coil—Relay—Capacitor—Switch—Motor—Resistor

ELECTRONIC TUBE DEVELOPMENT—Receiving—Transmitting—Cathode-Ray—Phototubes and Magnetrons

ELECTRONIC EQUIPMENT FIELD ENGINEERS—Specialists for domestic and overseas assignment on military electronic communications and detection gear.

Personal interviews arranged in your city.
Please send a complete resume of your education and experience to:

MR. ROBERT E. McQUISTON, Manager
Specialized Employment Division, Dept. 200H
Radio Corporation of America
30 Rockefeller Plaza, New York 20, N.Y.

RADIO CORPORATION of AMERICA

ENGINEERS

ELECTRONIC
SERVO
MECHANICAL

DESIGNERS

ELECTRONIC
MECHANICAL

"AC" OFFERS
A Challenge to Men of Resourcefulness

FIELD ENGINEERS

• For recent college graduates, here are positions with a challenge—

ASSIGNMENT — you will assist in the installation, operation, and maintenance of our equipment at aircraft plants and Air Force bases. The work will include liaison between AC and the customer, training of customer personnel, analysis of problems, and recommendations for improvements. In these positions you'll gain invaluable experience in all phases of both engineering and manufacturing.

YOUR BACKGROUND — your educational background can be in any of the fields of AE, EE, ME, Physics, or equivalent. To be successful in these positions you should have a definite interest in people as individuals and be willing to relocate to field assignments. Married men on regular assignment have their families with them.

TRAINING — regardless of your background, our theoretical and applied in-plant training (here in Milwaukee) will prepare you for these assignments.

In addition to your salary, you will receive a field allowance — and a substantial bonus if selected for overseas assignment . . . if you're looking for an opportunity with a "present" and a *future* write us for further facts.

We need men of high caliber, experienced in the field of airborne automatic electro-mechanical control equipment. You will be engaged in the manufacture and development of highly complex equipment of the most advanced type in a steadily expanding division of our company—a division with 20 years of successful operation in the precision instrument field. We offer many advantages to those who join our organization—
SALARY increases are based on merit and initiative . . . two weeks VACATION with pay . . . HOSPITALIZATION BENEFITS . . . LIVING and RECREATIONAL FACILITIES are among the best anywhere along Lake Michigan . . . POSITIONS ARE PERMANENT due to long-range manufacturing and development programs . . . in short—here at our "AC" Milwaukee plant you get small company advancement opportunities with large company employe benefits . . . EXPENSES incident to interviews are all absorbed by us.
For less experienced engineering graduates, we have a Junior Engineer Training Program which makes it possible for you to become acquainted with all phases of our company . . . you can also take advantage of educational opportunities for advanced degrees at Marquette University and the University of Wisconsin.
We answer ALL inquiries . . . write or apply

AC SPARK PLUG DIVISION
GENERAL MOTORS CORPORATION
1925 E. KENILWORTH PLACE • MILWAUKEE 2, WISCONSIN

Pleasant Working Conditions

So we're exaggerating a little! If you want to get technical about it (and you probably do) your life at our company won't be quite this cushy. We can promise this though—even the sky's not the limit for future opportunity. You work with a congenial group of engineers. People will listen to your ideas. The boss's door is always open.

Who you are—You're an Electronic or Mechanical Engineer. You're experienced in air communication and navigation circuitry and development. You have worked with low or high frequency circuits, instrumentation, component utilization or associated problems.

What you do now—Simple! Just contact:

Arthur E. Harrison, Vice President, Engineering
wilcox **Electric Company, Inc.**
Fourteenth & Chestnut, Kansas City 27, Mo.

ELECTRONICS ENGINEERS
WANTED
SOUTHERN CALIFORNIA

Attractive opportunities offered to Engineers experienced in and qualified to design aircraft flush antennas and radomes.

Complete modern facilities for laboratory testing and evaluation available.

Salary dependent upon experience and ability.

Contact Mr. J. C. Buckwalter,
Chief Engineer

DOUGLAS AIRCRAFT COMPANY, Inc.
LONG BEACH, CALIFORNIA

DESIGN RESEARCH DEVELOPMENT

key words to your employment opportunities at GOODYEAR AIRCRAFT . . . pioneer and leader in lighter-than-air craft . . . an established and growing company building an outstanding technical reputation

DESIGN ENGINEERING opportunities exist in the fields of airships, airplanes, and components, airframes, power-plant installations, controls, hydraulics, electronics systems, fuel cells, canopies, and wheels and brakes

DEVELOPMENT of missiles, jet aircraft, and helicopters, electric and electronics system, servomechanisms, fiber resin laminates, and many other projects present an urgent need for capable engineers

WELDING ENGINEERS, civil engineers, mechanical engineers with ability in metals fabrication, and industrial engineers experienced in time study are needed. Job opportunities also exist for technical editors and illustrators

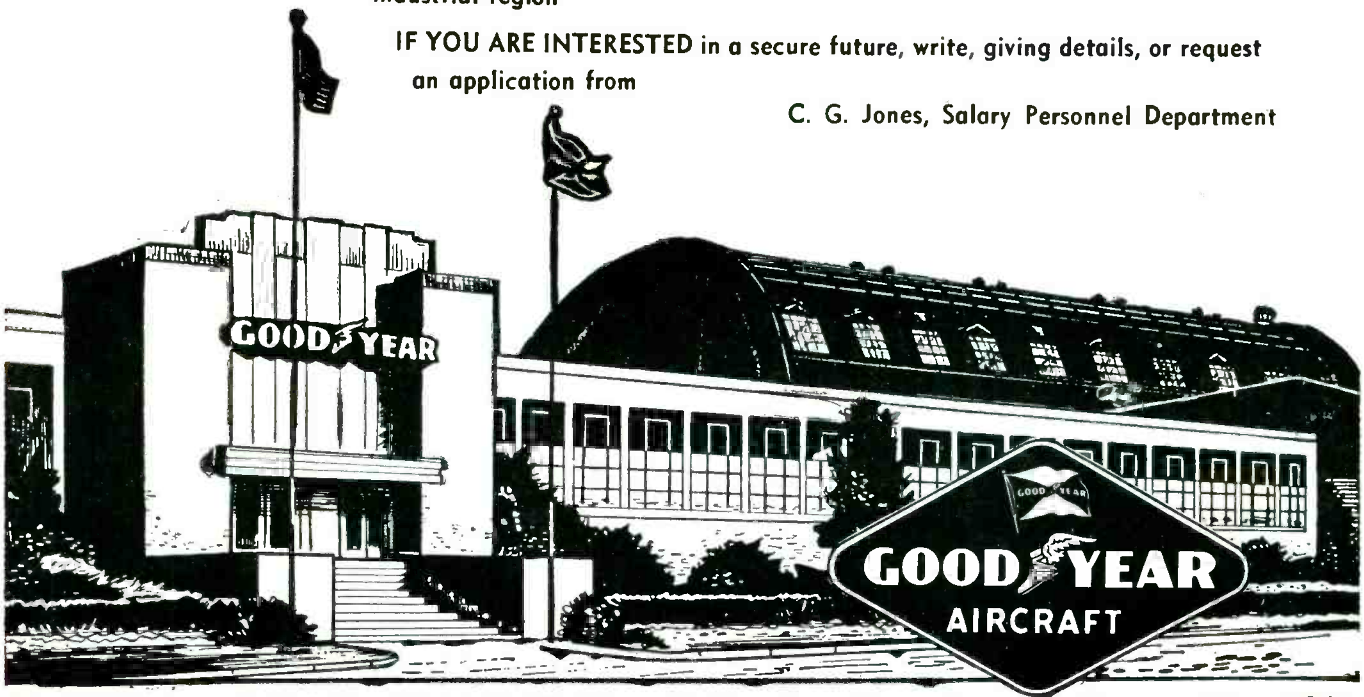
POSITIONS are open at several levels, and inquiries are also invited from recent graduates. Salaries are based on education, ability, and experience

PAID VACATIONS, free group life insurance, a good hospitalization plan, paid sick leave, company-sponsored pension plan, planned recreation, and free parking are among the facilities at the plant

A FRIENDLY CITY, Akron, Ohio, is located in the center of the midwestern industrial region

IF YOU ARE INTERESTED in a secure future, write, giving details, or request an application from

C. G. Jones, Salary Personnel Department



GOODYEAR AIRCRAFT CORPORATION, 1210 Massillon Road, Akron 15, Ohio

www.americanradiohistory.com

ENGINEERS

Unusual Opportunities for Men with Long-Range Plans

• We are one of the leading Electronics firms in the Chicago area and require Design and Development Engineers with from 3 to 5 years' experience. Positions also available at Project Engineer, Engineer and Junior Engineer levels.

We will consider men with the necessary experience and ability who are ready to take on the responsibilities of these openings. The men selected will be given intermediate and advanced level assignments in our well- equipped Television, Radio, and Government Equipment Laboratories.

We are located in the northwest section of Chicago where living and working facilities are second to none. We are within easy access of all shopping centers with convenient city transportation. Close by are many suburbs where one can live and commute back and forth in a short time—adjacent to all great centers of learning.

Our company has a long-range program of design and development in which you may participate . . . all positions are permanent.

• Our requirements concern experience in all phases of the development of monochrome and color TV receivers • color generating equipment • UHF systems • radio receivers (broadcast or military) • radar systems • and laboratory test equipment

We suggest you write Mr. Walter Wecker, Personnel Division, giving educational qualifications and related experience. Interviews will be arranged at your convenience.

Admiral Corporation 3800 W. Cortland St. Chicago 47, Illinois

to men who want the best

ENGINEERS, EE

1. Development of radio and radar components and systems.
2. Design of components for the magnetic deflection of Cathode Ray Tubes.
3. For component and system development work in airborne navigational equipment.

DESIGNERS

1. Electromechanical design of UHF and microwave systems.
2. Electromechanical navigational computers.

Kollsman provides excellent facilities for the design and development of America's finest aircraft instruments. In our modern radio communications group you'll find a congenial atmosphere in which you can do your best work. You'll be encouraged to advance as our progressive organization continues to grow.

At Kollsman you'll receive liberal benefits including paid life, hospitalization, surgical, accident and health insurance. Not to be overlooked is the convenient location in a quiet residential section only 20 minutes from the heart of New York City. Why not find out what Kollsman has to offer you?

KOLLSMAN INSTRUMENTS

KOLLSMAN INSTRUMENT CORP.
80-08 45th Ave., Elmhurst, L. I., New York

ENGINEERS

SYSTEMS RADAR SERVO COMPUTER

BACKGROUND:
Responsible positions open for top level development and project engineers with practical and research experience in:

Advanced Electronic Circuits and Systems
Microwave Radar
Microwave Receivers and Transmitters

Also Engineering Design and Analysis relating to fields such as:—

Analogue and Digital Computers
Servomechanisms
Communications
Navigation
Fire Control

MAXSON

Requirements emphasize advanced analytical and/or management experience on highly complex electronic and electro-mechanical systems.

Kindly send resume and salary requirements to

The W. L. MAXSON Corp.
460 W. 34th St., NEW YORK 1, N.Y.

www.americanradiohistory.com

ENGINEERS
AND
PHYSICISTS
BS—MS—Ph.D:

Responsible positions in mechanical, electrical or electronic engineering, physics or engineering physics for advanced development and design of special equipment and instruments. Prefer men with minimum of two years' experience in experimental research design and development of equipment, instruments, intricate mechanisms, electronic apparatus, optical equipment, servomechanisms, control devices and allied subjects. Positions are of immediate and permanent importance to our operations. Southwestern location in medium sized community. Excellent employee benefits. Reply by letter giving age, experience and other qualifications. All applications carefully considered and kept strictly confidential.

Ind. Rel. Manager
Research & Development Dept.

PHILLIPS PETROLEUM COMPANY
Bartlesville • Oklahoma

Electronic Research Opportunities

The Cook Research Laboratories, division of the Cook Electric Company one of the nation's foremost research organizations requires the services of several outstanding scientists.

STAFF ENGINEERS
ELECTRONICS
MECHANICS
AERODYNAMICS

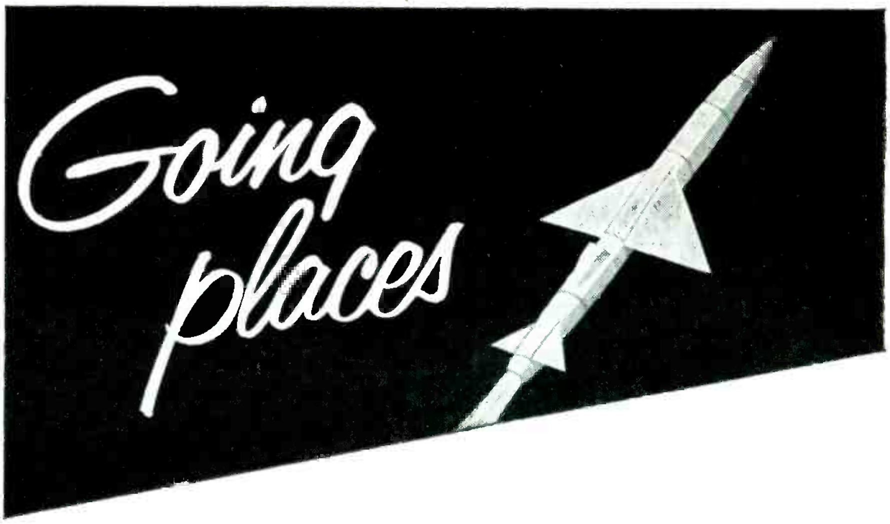
Openings also exist for top level personnel in the following fields.

RADAR & PULSE SYSTEMS
VHF-UHF DEVELOPMENT EXPERIENCE
DESIGN & PACKAGING
SERVOS
METEOROLOGICAL INSTRUMENTATION

EXCELLENT STARTING SALARIES
IDEAL WORKING CONDITIONS

A staff composed of a group of engineers and scientists eminently qualified in their respective fields and with whom you would be proud to be associated.

Contact or write Mr. D. M. HALLIDAY
COOK RESEARCH LABORATORIES
8100 N. Monticello Avenue
Skokie, Illinois



Engineers, physicists, designers, technicians—

Investigate the challenging new opportunities in the guided missile industry

BENDIX OFFERS EXCELLENT POSITIONS IN ITS WELL-ESTABLISHED GUIDED MISSILE PROGRAM

To men interested in the rapidly growing guided missile industry, an association with Bendix offers unusual advantages. For here at Bendix, guided missile work is not a side line, but a well-established program with over seven years of successful development and research backing up today's operations.

No finer engineering and production facilities are found anywhere in the industry, and the men responsible for the Bendix guided missile program are recognized leaders in their field. Job opportunities range from theoretical systems analysis, through product and test equipment design and development, to field test and flight evaluation.

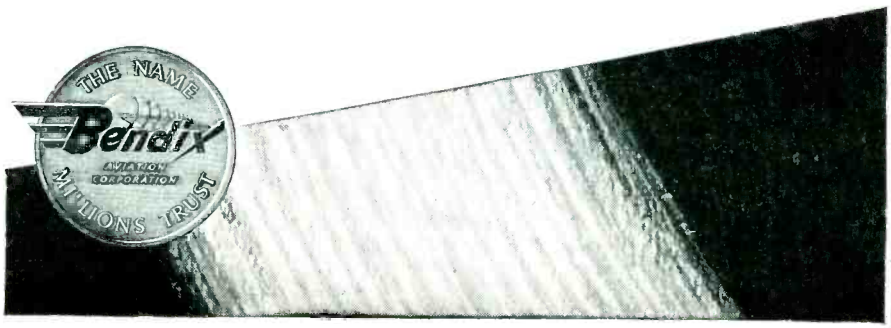
OPENINGS IN:

Aerodynamics	Hydraulics
Electronics	Mechanics
Microwaves	Servo Mechanisms
Dynamics	Structures

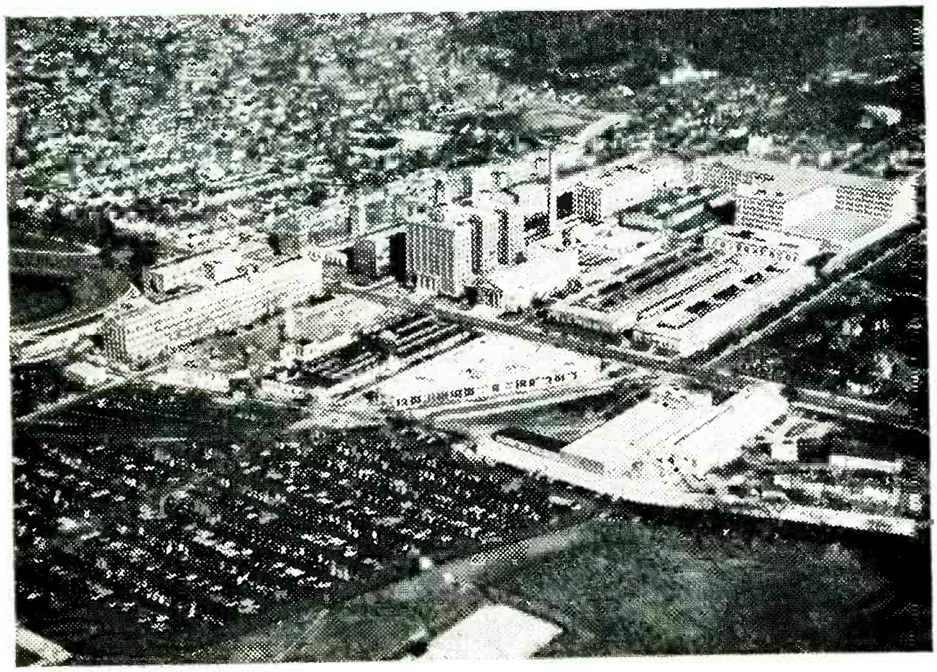
LET'S DISCUSS OUR MUTUAL INTERESTS

Write:

Employment Dept. Bendix Products Division
Bendix Aviation Corporation, 401 Bendix Drive
South Bend 20, Indiana



Exceptional Opportunities for...



electrical engineers

mechanical engineers

mechanical designers

•

in the field of electronic computers and associated equipment for use in business machines.

Write, giving education and experience to Employment Manager.

Reply to Department A.

THE NATIONAL CASH REGISTER COMPANY, Dayton 9, Ohio

---

microwave engineers

PROGRESS WITH A LEADER OFFERING ADVANCED ENGINEERING POSITIONS IN NEW AIR CONDITIONED PLANT

Country Surroundings —Big City Advantages Add Up To An Unlimited Future With

SYLVANIA'S ELECTRONICS DIVISION

A leader in the development and production of microwave components, Sylvania's expanding Electronics Division offers a few top microwave engineers an assured future.

Here, in New England's Greater Boston area, you will be next door to some of the country's most renowned technical centers of learning and research, yet you and your family will enjoy the serenity of country living.

ENGINEERING SPECIALIST

This is a top engineering staff position for a man who has the flair, ability and knowledge of a specialist who will be cognizant of and assist as an expert in all divisional microwave programs and problems of our four plants. The position offers top-rank professional activity covering invention, research, development, production and application in the microwave field. Products involved include semi-conductor devices, TR and ATR tubes, magnetrons, klystrons, and traveling wave tubes. Requirements for this position include advanced engineering or physics degree, or equivalent, and at least 5 years of solid experience in the microwave field.

MICROWAVE SPECIALIST

For advanced microwave investigations, particularly related to silicon crystal development, applications and improved evaluation and testing. Requires sound background in electromagnetic theory, waveguide circuitry, microwave mixer operation. An engineering or physics degree and 1 to 5 years of microwave experience are desirable.

Please send complete resume to:

Mr. Robert L. Koller

Sylvania Electric Products Inc., Electronics Division
Woburn, Mass.

SYLVANIA

WANTED
ENGINEER WITH EXPERIENCE IN
VHF OR UHF

Interesting creative work with the most resourceful and progressive firm in the field of television equipment.

This position is permanent. It will offer every opportunity for unlimited advancement and for developing a successful career. The plant is now housed in a newly-acquired larger building, only 22 miles from downtown New York City. The surroundings and atmosphere are stimulating and congenial.

Attractive Salary

Write stating qualifications.

BLONDER-TONGUE LABORATORIES
526-536 NORTH AVENUE
WESTFIELD, NEW JERSEY

www.americanradiohistory.com

Electrical Engineers and Physicists

- Radar Simulation
- Advanced Circutry
- Analog Computors
- Ballistics
- Mapping
- Telemetering

Senior and Junior Engineers

Join a Firm with a Future

Our future is bright . . . we're small but we're growing. We offer you the opportunity to grow with us . . . to gain individual recognition by working closely with technical management . . . to advance rapidly. You will work and live in a delightful suburban community . . . associate with other top-notch engineers, and with them, develop yourself by contact with a complete project, not just a segment of a project. If you are interested in allying your future with a firm with a future . . . *write*:

Industrial Research Laboratories
Hilltop and Frederick Roads
Baltimore 28, Maryland

HOUSTON, TEXAS

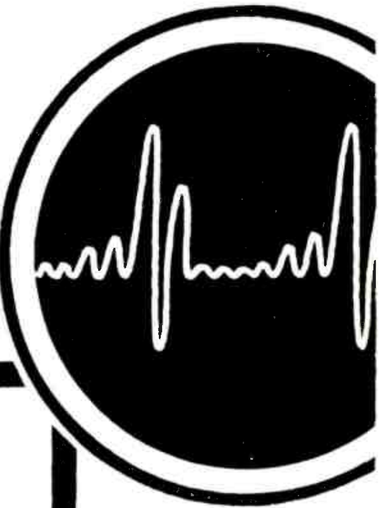
Precision equipment manufacturer needs qualified experienced engineer for audio and sub-audio transformer design and development. Experience with high, permeability alloys desirable. Knowledge of magnetic circuitry must be sufficient for development work on magnetic amplifiers. Salary commensurate with ability.

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.
P. O. BOX 13058, HOUSTON 19, TEXAS

ELECTRONIC ENGINEERS

FOR DESIGN & DEVELOPMENT WORK IN
RADAR
COMPUTERS
DIGITAL TECHNIQUES
with a young progressive company, send resumé of experience and education, with salary requirements, to

Electronic Engineering Company
of California
180 SOUTH ALVARADO STREET LOS ANGELES 4, CALIFORNIA
DUNKIRK 2-7353



SPECIAL OPPORTUNITIES FOR

SENIOR ENGINEERS

Convair in beautiful, sunshiny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in commercial aircraft, military aircraft, missiles, engineering research and electronics development. Positions open in these specialized fields:

Electrical Design	**Servo-mechanisms**
Mechanical Design	**Aerodynamics**
Structural Design	**Thermodynamics**
Structures	**Operation Analysis**
Weights	**System Analysis**

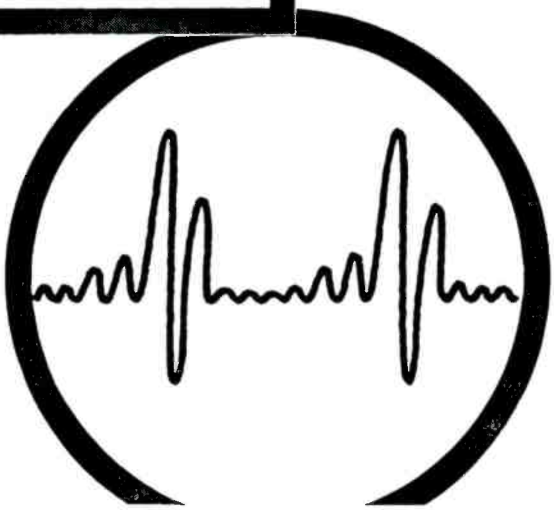
Generous travel allowances to those accepted. For free brochure, write Mr. H. T. Brooks, Engineering Dept. 900

CONVAIR

IN BEAUTIFUL

SAN DIEGO

3302 PACIFIC HIWAY
SAN DIEGO 12, CALIFORNIA



"An Unexcelled Opportunity For Professional Growth......"

ELECTRONIC ENGINEERS & PHYSICISTS

IN RESEARCH AND DEVELOPMENT

GUIDED MISSILES • RADAR • SOLID STATE PHYSICS • VACUUM TUBES • ELECTRONIC NAVIGATION • TELEVISION • MICROWAVES • ANTENNAS • RADIO • COMPUTERS • TRANSISTORS •

DIRECT INQUIRIES TO:
THE EMPLOYMENT DEPT.

CAPEHART-FARNSWORTH
CORPORATION
FORT WAYNE, INDIANA

AN IT&T ASSOCIATE

Bell Telephone Laboratories

has career openings for experienced

electrical engineers
mechanical engineers
physicists

For work on Guided Missiles, Radar, Fire Control and Underwater Systems in New Jersey *(20 miles from New York City).*

The company that has pioneered many of the major developments in the fields of communications and electronics now offers you an opportunity to join its staff. Here you will gain invaluable experience and great satisfaction through the challenging diversified nature of the work. To qualify, you must be a college graduate (preferably not over 40 years of age) with related experience of the following types:

Systems Engineering	Systems Development
Analysis	Fundamental Development
Coordination	Circuit Design
Evaluation	Mechanical Design
Planning	Equipment Development
Studies	Field Testing

Write, giving full details of education and experience to:

BELL TELEPHONE LABORATORIES Inc.
Employment Director, Box 2, New York 14, N. Y.

UHF-VHF
SENIOR ENGINEERS

WE ARE LOOKING FOR ENGINEERS FOR OUR ELECTRONIC RESEARCH AND DEVELOPMENT DIVISION.

THESE ARE THE REQUIREMENTS:

3 to 5 years genuine design and development experience, specializing in VHF and UHF measurements, and component and tuner engineering projects.

Good theoreticians, but with solid practical experience and excellent records of achievement. Prefer graduate Electrical Engineers.

THESE ARE THE ADVANTAGES:

A ground floor connection in the new research and development division of one of the oldest and most highly regarded manufacturers of radio and television components.

The opportunity to work in a fully equipped, completely modern research laboratory on permanent long range commercial projects.

To work directly with prominent electronic research director, who will encourage and give full consideration to your ideas.

To locate in one of the many desirable suburban residential communities adjacent to Philadelphia and within easy driving distance of the seashore.

ADDRESS REPLIES TO:

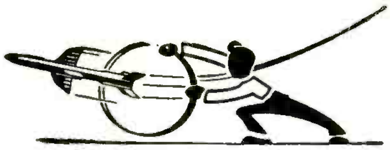
RADIO CONDENSER COMPANY
Davis & Copewood Sts.
Camden 3, N. J.

PROJECT ELECTRONIC ENGINEERS

Electronic engineers with minimum of 3 years research or developmental work in field of Electronic Control Systems needed immediately in a permanent capacity by rapidly expanding firm located near Dallas, Texas.

VARO MFG. CO.
Box 638 Garland, Texas

— ENGINEERS —
SEE OUR AD PAGE 353
Westinghouse



. . . *An invitation to*

Experienced

ELECTRONIC ENGINEERS
and
PHYSICISTS

We have several positions of technical leadership available in our growing Guided Missile Division. Applicants must have over four years experience and/or advanced degrees in either missile guidance systems, radar, servomechanisms, fire control computers, or U. H. F. techniques.

Our plant is located in beautiful suburban St. Louis, where you can enjoy the comforts of "county" living with easy access to "big city" shopping, entertaining, medical and educational facilities. Moving allowance for qualified applicants. Our Housing Representative will assist you in relocating.

Address replies to:

Technical Placement Supervisor
Box 516, St. Louis 3, Mo.

McDONNELL
Aircraft Corporation
ST. LOUIS 3, MO.

ELECTRICAL ENGINEERS

Several positions in our Research Development and Design Departments for men with E. E. degrees and one to five years' experience in electronic or electrical circuit design. Experience in instrumentation or in control circuits is preferred. Location in North Philadelphia, Pennsylvania. Excellent benefit programs and working conditions. Brochure available. Send resume to D. E. Whiteley, Employment Manager:

BROWN
INSTRUMENTS DIVISION
Minneapolis-Honeywell Regulator Co.
Wayne & Windrim Avenues
PHILADELPHIA 44, PA.

MICROWAVE ENGINEER

For production design and development of waveguide systems, klystron oscillators, attenuators, and echo boxes. Send resume to Personnel Manager.

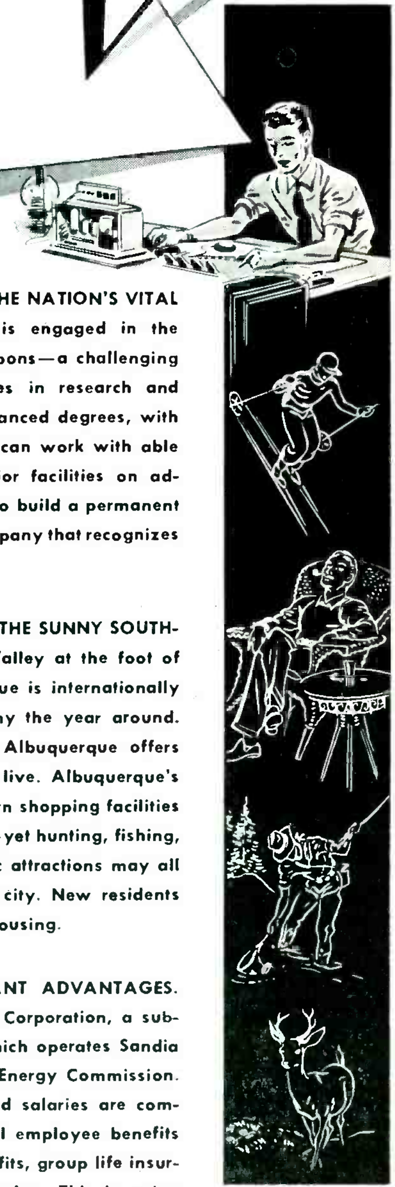
VECTRON, INC.
400 Main Street Waltham, Mass.

RADIO and TV ENGINEER

Interesting, permanent job, testing and analyzing TV sets, FM-AM receivers, high fidelity sound equipment, etc. in NYC lab. Degree and 3 yrs. experience in industry. Familiar with IRE test methods. Salary commensurate with ability and experience. Send resume.

P-8184, Electronics
330 W. 42 St., New York 36, N. Y.

- MECHANICAL ENGINEERS
- ELECTRONICS ENGINEERS
- ELECTRICAL ENGINEERS
- PHYSICISTS
- AERODYNAMICISTS
- MATHEMATICIANS
- TECHNICAL WRITERS



WORK ON THE FRONT LINE OF THE NATION'S VITAL DEFENSE PROGRAM. Sandia Corporation is engaged in the development and production of atomic weapons—a challenging new field that offers exciting opportunities in research and development to men with Bachelor's or advanced degrees, with or without applicable experience. Here you can work with able colleagues, eminent consultants and superior facilities on advanced projects of high importance—and also build a permanent career in a rapidly expanding field with a company that recognizes and rewards individual ability and initiative.

LIVE IN ALBUQUERQUE, THE HEART OF THE SUNNY SOUTHWEST. Located in the historic Rio Grande Valley at the foot of the Sandia Mountains, mile-high Albuquerque is internationally famous for its climate—mild, dry and sunny the year around. A modern, cosmopolitan city of 150,000, Albuquerque offers unique advantages as a place in which to live. Albuquerque's schools, churches, theaters, parks, and modern shopping facilities afford every advantage of metropolitan life—yet hunting, fishing, skiing and a multitude of scenic and historic attractions may all be found within a few hours' drive of the city. New residents have little difficulty in obtaining adequate housing.

ENJOY THESE OTHER IMPORTANT ADVANTAGES. These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates Sandia Laboratory under contract with the Atomic Energy Commission. Working conditions are excellent, and salaries are commensurate with qualifications. Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. This is not a Civil Service appointment.

Make Application to:

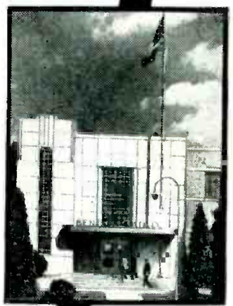
PROFESSIONAL EMPLOYMENT DIVISION

SANDIA
Corporation

SANDIA BASE • ALBUQUERQUE, NEW MEXICO

Engineers

Open this door to a bright future!



- TV RECEIVER DESIGN ENG.
- ELECTRONICS ENG.
- FIELD ENGINEERS
- TEST & INSPECTION ENG.
- COMPONENTS ENG.

You're needed to work on: Radar, G.C.A., Mobile Radio, Auto Radio, Airborne Communication & Navigation Equipment, Television, Antennas, Microwave Equipment, Servo Mechanisms and Guided Missiles.

You will benefit from high wages, a modern, air-conditioned plant, paid vacations and holidays, group insurance and a good chance for advancement.

Housing immediately available in the beautiful suburban and county areas that surround the Bendix Radio plant.

Write,
Wire or Phone
MR. E. O. COLE
Dept. J

Bendix Radio

DIVISION OF BENDIX AVIATION CORPORATION

Baltimore-4, Md. Phone: VAlley 3-2200

Makers of the World's Finest
Electronic Equipment

Engineers & Physicists

- Mechanical Engineers
- Servo Engineers
- Operations Research Analysts
- Electrical Engineers
- Chemical Engineers
- Physicists

The diversified research and development programs now in progress at

melpar, inc.

The Research Laboratory

of Westinghouse Air Brake Co. and its subsidiaries

offer excellent opportunities for professional achievement to qualified men.

MELPAR INC.

Write to Personnel Director,
MELPAR, INC., Dept. E-2
452 Swann Avenue
Alexandria, Virginia

AS THE MAN-POWER SHORTAGE

becomes more acute

You may be facing the problem of finding enough engineers or highly technical men to keep your production up to the new demands growing out of the defense effort.

In a recent advertisement, one of the leading aircraft manufacturers restated a well-known but seldom practiced principle: "a trained, experienced engineer in one specialty can be retrained in almost any other engineering specialty with a minimum of time and effort expended".

Engineers follow with intense interest the publication devoted to their particular field. And so they are gathered into convenient groups whenever you wish to reach them — as readers of America's industrial publications.

Let us help you select the proper publications in order to reach just the type technical men you need.

Classified Advertising Division

McGRAW-HILL PUBLICATIONS
330 W. 42nd St.
N. Y. 36, N. Y.

www.americanradiohistory.com

ENGINEERS:

TV COLOR TUBE OPPORTUNITIES

Leading Tube Manufacturer has several engineering positions opening in the West in design and development on color picture tubes. Write giving full resume to

P-8322, Electronics
68 Post St., San Francisco 4, Calif.

ELECTRONIC ENGINEERS

EE or ME degree, minimum 3 years' experience in research and development work involving microwave circuits and antennas, circuit development, servo-mechanisms, analogue computers or related equipment.

FIELD REPRESENTATIVES
A few openings for graduate engineers only with backgrounds similar to above. Continental U.S.A.

What You Can Expect at General Precision Laboratory

A progressive group of young, successful men, firmly established as designers and manufacturers of electronic equipment . . . a medium-sized staff in which you receive individual recognition . . . a policy of promotion-from-within that helps qualified men move ahead swiftly . . . a modern laboratory located in a pleasant suburban community ideal for family living.

Expenses will be paid for qualified applicants who come for interviews. Please submit complete resume to: Mr. H. F. WARE

GENERAL PRECISION LABORATORY
INCORPORATED
A Subsidiary of GENERAL PRECISION EQUIPMENT CORPORATION
63 BEDFORD ROAD, PLEASANTVILLE, NEW YORK

RESEARCH ASSISTANTSHIPS

Ph.D. candidates in chemistry and M.S. candidates in chemistry, electrical engineering (Electronics), chemical engineering, physics and geology are wanted by the Institute of Science and Technology, University of Arkansas, Fayetteville, Arkansas.

These positions provide part-time research duties with time for academic work toward advanced degrees. Stipends are up to $2,150 for 12 months. Nonresident fees are waived.

W. W. GRIGORIEFF, Director
INSTITUTE OF SCIENCE & TECHNOLOGY
UNIVERSITY OF ARKANSAS

WANTED

ELECTRONICS ENGINEERS

This established electronics manufacturer located in the heart of western New York requires men with design experience. Permanent positions available for senior and junior men with EE or ME degrees or equivalent experience. Fine cultural community in which to live with good schools, homes, and progressive associates. Please write to:

CHIEF ELECTRONICS ENGINEER
STROMBERG-CARLSON COMPANY
ROCHESTER 3, NEW YORK

ELECTRICAL ENGINEER

Large Gulf Coast Chemical Company has opening for graduate electrical engineer—25 to 35 years of age—communications experience desirable supervisory position—salary open.

P-8542, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

FOR SALE

(Additional For Sale Advertising on pages 414-432)

FOR SALE

GEN. RADIO—1105A FREQ. MEAS. EQUIP.
650A BRIDGE
1802 CRYSTAL GALVO
583 OUTPUT METER
Boonton—160A "Q" Meter
Measurements Co. #80, #656 Signal Gen.
ALL IN GOOD CONDITION. NO REASONABLE OFFER REFUSED.

FS-8469, Electronics
330 W. 42 St., New York 36, N. Y.

WE URGENTLY NEED

INDUCTION GENERATORS, ARMA, 1 B 400, 5 CPI's, 3 C 22's, 3 K 22's

ALSO WANT

Pulse Transformers, Pulse Networks, Selsyns and Synchros

ELECTRONICS, INC.
92 Broad St. Babson Park 57, Mass.

WILL BUY

All ART-13/type T-47A $200.00; ART-13/type T-47, $150.00; BC-348 unmodified $65.00, BC-348 modified $50.00; APN-9 $200.00; ARC-3 complete $600.00; R77 Receivers $300.00; ARC-1 $300.00; BC-312 $60.00; BC-342 $60.00.
Ship via Express C.O.D., subject to inspection to:

H. FINNEGAN
49 Washington Ave. Little Ferry, N. J.

WANTED

ART-13, ATC DY-17, APR-4, APR-5, APN-4, APN-9, ARC-1, ARC-3, RTA-1B, BC-312, BC-342, BC-348, GRC, TDQ, TS & I Test Equipment, Manuals. Will trade for new ham Equipment.

ARROW APPLIANCE CO.
Box 19 Boston, 1, Mass.
Richmond 2-0916; Lynn 8-3100

WE BUY

All kinds of surplus electronic equipment and components.

ELECTRONICRAFT, Inc.
27 Milburn St. Bronxville 8, N.Y.
BRonxville 2-0044

!! WANTED !!

IN ORDER TO SUPPLY GOVERNMENT AND INDUSTRIAL REQUIREMENTS, WE ARE PAYING TOP DOLLAR FOR ALL TYPES OF RADIO AND ELECTRONIC SURPLUS. WE SPECIALIZE IN TEST EQUIPMENT AND COMPLETE RADIOS, SUCH AS:

APA, APN, APQ, APR, APS, APT, ARB, ARC, ARN, ART, ATC, BC, DY, I, IE, LM, MG, PE, PU, SCR, TCS, TN, TS, and many others.

WE ESPECIALLY NEED: APA10, APN9, APR4, APS4, ARC1, ARC3, ART13, ATC, BC221, BC342, BC348, BC611, BC721, DY12, DY17, 1100, LM10 to LM18, MG149F, MG149H, PU14, R5/ARN7, R5A/ARN7, SCR718C, TCS, TN16, TN17, TN18, TN19, TN54, TS3, TS13/AP, TS33, TS35, TS45, TS75, TS76, TS102, TS147/UP, TS148/UP, TS173, TS174, TS175, TS250, TS251, TS323, (1CT, 1F, 1G, 5CT, 5DG, 5F, 5G, 6DG, 6G 115V. 60 c.p.s. Selsyns), and all types of Hewlett Packard, General Radio Co., Measurements Corp., Boonton Radio, Ferris, Leeds & Northrup, and other test equipment.

Please state accurate description, condition, and your lowest price. Explain modification, if any. We pay freight charges.

PURCHASING AGENTS, ENGINEERS, EXPORTERS, INDUSTRIAL BUYERS, DEALERS, AND INDIVIDUALS, Please send us your requirements.

NEW CATALOG NOW AVAILABLE.

PHOTOCON SALES
417 N. Foothill Blvd. SYcamore 2-4131
Pasadena 8, California RYan 1-6751

www.americanradiohistory.com

WRITE FOR OUR FREE BULLETIN
MORE GOOD ITEMS

GUARANTEED BRAND NEW

LECTRONIC RESEARCH

Receiving Tubes

Type No.	Price
OOA	$1.50
OA1	.67
OZ4	.59
OZ4A	.63
1A3	.71
1A5GT	.72
1A6	.72
1A7GT	.79
1B3GT	.99
1B4P	.79
1B5	.74
1C5GT	.85
1C6	.69
1C7G	.69
1D5GP	.69
1D7G	.69
1D8GT	.71
1E5GP	.71
1F4	.69
1F5G	.69
1F6	.71
1G4GT	.69
1G5G	.69
1G6GT	.69
1H4G	.89
1H5GT	.69
1H6G	.75
1H6GT	.79
1J5G	.74
1J6G	.69
1L4	.69
1LA4	.87
1LA6	.99
1LB4	1.01
1LC5	.81
1LC6	.93
1LD5	.93
1LE3	.93
1LH4	.82
1LN5	.74
1N5GT	.83
1N6G	.75
1P5GT	.69
1Q5GT	.99
1R4	.69
1R5	.79
1S4	.71
1S5	.69
1T4	.71
1T5GT	.71
1U4	.73
1U5	.77
IV	.65

Type No.	Price
1X2	.93
2A3	1.28
2A5	.79
2A7	.79
2B7	.79
2E5	.94
2X2	.50
2X2A	1.85
3A4	.65
3A5	.95
3A8GT	1.50
3B7	.57
3C6	1.15
3D6	.57
3LF4	.91
3Q4	.77
3Q5GT	.83
3S4	.77
3V4	.79
5AZ4	.54
5R4GY	1.59
5T4	1.91
5U4G	.59
5V4G	.98
5W4	.82
5X4G	.79
5Y3GT	.47
5Y4G	.71
5Z3	.87
5Z4	1.40
6A6	.82
6A7	1.05
6A8	.95
6AB4	.83
6AB7	.98
6AC5GT	1.19
6AC7	.85
6AC7W	3.25
6AD6G	.98
6AD7G	1.29
6AE6G	.89
6AF6G	.89
6AG5	.79
6AG7	1.45
6AH6	1.29
6AJ5	1.95
6AK5	.84
WE-6AK5	1.85
6AK5W	2.95
6AK6	.99
6AL5	.59
6AL5W	2.65
6AQ5	.72
6AQ6	.79
6AR5	.79
6AS5	.99
6AS6	2.25
6AS7G	4.25
6AT6	.63

Type No.	Price
6AU5GT	1.21
6AU6	.65
6AV6	.55
6B4G	1.25
6B5	1.20
6B7	.95
6B8	.75
6B8G	.75
6BA6	.65
6BA7	1.20
6BC5	.88
6BC7	1.10
6BD5GT	1.60
6BD6	.85
6BE6	.65
6BF5	1.10
6BF6	.83
6BG6G	1.89
6BH6	.95
6BJ6	.95
6BK7	1.60
6BL7GT	1.45
6BN6	1.59
6BQ6GT	1.26
6C4	.55
6C5	.70
6CB6	.79
6C6	.73
6C8G	.96
6CD6G	2.21
6D6	.88
6D8G	.83
6E5	1.10
6F5GT	.83
6F6	.99
6F6G	.87
6F7	1.05
6F8G	.91
6G6G	.99
6H6	.66
6H6GT	.66
6J5	.59
6J5G	.64
6J5GT	.55
6J6	.95
6J7	.99
6J7GT	.79
6J8G	1.28
6K5GT	.99
6K6GT	.65
6K7	.79
6K7G	.86
6L5G	1.06
6L6	1.87
6L6G	1.49
6L6GA	1.39
6L7	.99
6L7G	.85
6N7	.99

Type No.	Price
6N7GT	.89
6P5GT	.96
6Q7	.89
6R7	.79
6S4	.72
6S7	1.06
6S7G	.99
6SA7	.71
6SA7GT	.67
6SB7Y	1.04
6SC7	.93
6SD7GT	.94
6SF5	.83
6SF5GT	.80
6SF7	.75
6SG7	.75
6SH7	.75
6SH7GT	.75
6SJ7	.71
6SJ7GT	.69
6SJ7Y	.85
6SK7	.72
6SK7GT	.72
6SL7GT	.81
6SN7GT	.73
6SN7WGT	2.10
6SQ7	.65
6SQ7GT	.65
6SR7	.63
6SS7	.99
6ST7	1.05
6T7G	1.09
6T8	.98
6U5	.98
6U7G	.65
6V6	1.49
6V6G	.89
6V6GT	.67
6W4GT	.64
6W6GT	.88
6X4	.59
6X5GT	.59
6Y6G	.89
6ZY5G	.89
7A4	.76
7A5	.79
7A6	.75
7A7	.76
7A8	.78
7AD7	1.44
7AH7	1.08
7B4	.79
7B5	.79
7B6	.79
7B7	.79
7B8	.78
7C4	.45
7C5	.79
7C6	.79

Type No.	Price
7C7	.79
7E5	.79
7E6	.58
7E7	.83
7F7	.99
7F8	1.35
7G7	.89
7H7	.79
7J7	1.10
7K7	1.10
7L7	.97
7N7	.97
7Q7	.79
7R7	.94
7S7	1.11
7V7	1.11
7W7	1.11
7Y4	.73
7Z4	.79
10	.39
12A	.65
12A6	.64
12A6GT	.64
12A7	1.16
12A8GT	.77
12AH7GT	1.32
12AL5	.79
12AT6	.55
12AT7	.99
12AU6	.71
12AU7	.86
12AV6	.54
12AV7	.99
12AW6	1.20
12AX7	.99
12BA6	.69
12BA7	.95
12BD6	.99
12BE6	.66
12C8	.65
12F5GT	.79
12H6	.69
12J5GT	.55
12K8	.70
12Q7GT	.67
12SA7GT	.69
12SF5	.79
12SF5GT	.79
12SF7	.85
12SG7	.85
12SH7	.85
12SJ7	.71
12SJ7GT	.65
12SK7	.69
12SL7GT	.93
12SN7GT	.89
12SQ7GT	.68
12SR7	.79
12SR7GT	.89

Type No.	Price
12X3	.89
12Z3	.89
14A4	.97
14A7	.74
14B6	.74
14B8	.89
14C5	1.10
14C7	.93
14E6	.99
14E7	1.09
14F7	.89
14H7	.89
14J7	.89
14N7	.89
14R7	.89
14S7	.89
14W7	.89
14X7	.89
18	.89
19	.89
19T8	.99
22	1.16
24A	.89
25A6	1.16
25L6GT	.69
25Z5	.79
26	.79
27	.69
28D7	1.95
30	.70
30 Spec	.45
31	.54
32	.69
32L7GT	.87
33	.69
34	.69
35/51	.59
35A5	.72
35B5	.75
35L6GT	.67
35W4	[illegible]
35Y4	.72
35Z4GT	.69
35Z5GT	.55
36	.64
37	.69
38	.69
39/44	.59
41	.71
42	.79
43	.79
45	.79
45Z5GT	.89
46	.81
47	.99
50	1.09
50A5	.89
50B5	.69
50C5	.69

Type No.	Price
50L6GT	.63
50Y6GT	.92
53	.95
55	.99
L55B	.32
56	.69
57	.69
58	.69
59	1.24
70L7GT	1.29
71A	.79
75	.85
76	.69
77	.69
78	.79
79	.89
80	.59
81	1.41
82	1.19
83	1.11
83V	1.25
84/6Z4	.75
85	.79
89Y	.55
117N7GT	1.89
117P7GT	1.89
117Z3	.65
117Z6GT	.97
FM-1000	1.59

Transmitting and Special Purpose Tubes

Type No.	Price
OA2	$ .95
OA3	1.15
OA4G	1.25
OB2	1.10
OB3	1.19
OC3	1.10
OD3	.95
1B21A	2.65
1B22	2.50
1B23	9.60
1B24West	12.95
1B24Sylv.	18.95
1B24A	39.50
1B26	3.73
1B27	14.95
1B29	2.75
1B32	3.75
1B35	11.00
1B36	12.50
1B37	14.25
1B38	32.50
1B40	4.95
1B41	47.50

Type No.	Price
1B42	9.80
1B49	50.33
1B54	32.50
1H20	.88
1P21	35.00
1P23	4.10
1P24	1.27
1P29	2.66
1Q23	118.75
1S21	9.50
1Z2	3.75
2A4G	1.22
2AP1	8.95
2AP5	8.95
2B4	2.10
2B22	2.20
2C21	.65
2C22	.45
2C26	.39
2C26A	.49
2C33	4.95
2C34	.49
2C39	22.00
2C39A	29.00
2C40	12.00
2C42	23.75
2C43	17.75
2C44	1.20
2C46	21.50
2C51	5.75
2C53	11.75
2D21	1.55
2E22	1.85
2E24	4.10
2E26	2.85
2J21	8.75
2J22	8.95
2J26	24.75
2J27	22.95
2J31	27.00
2J32	36.50
2J33	39.50
2J34	27.00
2J37	13.70
2J38	17.50
2J39	36.50
2J40	34.50
2J48	49.50
2J49	65.00
2J50	39.50
2J54	67.50
2J56	148.50
2J61	45.25
2J66	165.00
2K23	37.50
2K25	28.50
2K26	105.00
2K28	29.50
2K29	27.50

Type No.	Price
2K33	265.00
2K33A	280.00
2K39	135.00
2K41	145.00
2K45	129.50
2K55	135.00
3AP1	8.95
3AP4	10.25
3B22/ EL-1C	2.60
3B24	5.20
3B24W	7.50
3B25	4.50
3H26	3.75
3B27	4.20
3B28	7.75
3BP1	5.75
3C22	89.50
3C23	9.65
3C24	1.85
3C27	6.95
3C31/ EL-C1B	3.95
3C37	32.50
3C45	12.95
3CP1	2.25
3D21	2.98
3DP1	4.85
3DP1A	6.75
3E29	13.75
3EP1	4.75
3FP7	2.90
3FP7A	6.95
3GP1	3.95
3HP7	3.95
3J31	145.00
4-125A	29.50
4A1	1.18
4AP10	4.40
4B22/ EL-5B	8.95
4B24	5.75
4B25/ EL-6CF	8.95
4C35	27.00
4E27	21.50
4J36	150.00
4J38	120.00
4J52	275.00
4X150A	36.00
4X500A	114.95
4X1000A	125.40
5AP1	5.95
5AP4	4.75
EL-C5B	3.95
5BP1	5.50
5BP4	5.50

COAXIAL CONNECTORS

83-1AC	$ .42	83-1RTY	$ .65	83-22R	$ .68
83-1AP	.30	83-1SP	.45	83-22SP	.80
83-1F	1.10	83-1SPN	.50	83-22T	1.95
83-1H	.12	83-1T	1.30	83-168	.12
83-1HP	.22	83-2AP	1.95	83-185	.12
83-1J	.73	83-22AP	1.40	83-765	.24
83-1R	.40	83-22F	2.10	83-776	.5
		83-22J	1.40		

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS IN STOCK UHF—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG-23B/U	$1.50	UG-58/U	$ .70	UG-101/U	$1.40	UG-185/U	$ .95	UG-261/U	$1.10
UG-12/U	.95	UG-23C/U	1.10	UG-58A/U	.90	UG-106/U	.5	UG-191/AP	.80	UG-262/U	1.10
UG-15/U	1.25	UG-24/U	1.30	UG-59A/U	2.15	UG-107B/U	2.75	MX-195/U	.75	UG-273/U	1.45
UG-18/U	1.25	UG-25/U	1.35	UG-60A/U	1.75	UG-108/U	2.60	UG-197/U	2.80	UG-274/U	2.30
UG-18B/U	1.05	UG-27/U	1.25	UG-61A/U	2.10	UG-109/U	2.60	UG-201/U	1.95	UG-275/U	5.50
UG-19/U	1.60	UG-27A/U	2.25	UG-83/U	1.75	CW-123A/U	.45	UG-203/U	.65	UG-276/U	2.75
UG-20B/U	1.60	UG-28A/U	2.95	UG-85/U	1.60	UG-146/U	1.95	UG-206/U	1.80	UG-290/U	.90
UG-21/U	.85	UG-29/U	.95	UG-86/U	2.25	CW-159/U	.60	UG-224/U	1.15	UG-291/U	.95
UG-21A/U	1.50	UG-29A/U	1.85	UG-87/U	1.40	UG-166/U	32.50	UG-236/U	3.85	UG-306/U	2.65
UG-21B/U	1.00	UG-29B/U	1.75	UG-88/U	.90	UG-167/U	3.75	UG-245/U	2.25	UG-349/U	2.65
UG-21C/U	1.05	UG-30/U	2.30	UG-89/U	1.10	UG-171/U	2.25	UG-246/U	2.35	MX-367/U	.85
UG-22/U	1.30	UG-34/U	9.75	UG-90/U	1.15	UG-173/U	.35	UG-251/U	2.75	UG-414/U	1.95
UG-22B/U	1.20	UG-36/U	12.50	UG-98/U	1.85	UG-175/U	.12	UG-255/U	1.95	UG-498/U	1.80
UG-22C/U	1.20	UG-37/U	17.50	UG-102/U	.80	UG-176/U	.12	UG-260/U	.85	UG-536/U	1.65
UG-23/U	1.20	UG-57B/U	1.85	UG-103/U	.68	UG-177/U	.24			UG-625/U	1.35

QUOTATIONS UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358	MC-277	PL-259A	L-325				
M-359	MC-320	PL-274	SO-239	93-C	49120	D-163950	ES-685696-5
M-359A	PL-258	PL-284	SO-264	93-M	4921A	D-166132	ES-689172-1
M-360	PL-259	PL-293	TM-[illegible]				

COAXIAL CABLE

Type	Price Per M Ft.	Type	Price Per M Ft.	Type	Price Per M Ft.	Type	Price Per M Ft.
RG-5/U	$140.00	RG-13/U	$216.00	RG-26/U	$475.00	RG-57/U	$325.00
RG-6/U	180.00	RG-17/U	[illegible]	RG-29/U	50.00	RG-58/U	60.00
RG-7/U	85.00	RG-18/U	900.00	RG-34/U	300.00	RG-58A/U	70.00
RG-8/U	100.00	RG-19/U	1250.00	RG-35/U	900.00	RG-59/U	60.00
RG-9/U	250.00	RG-20/U	1450.00	RG-54A/U	97.00	RG-62/U	75.00
RG-9A/U	275.00	RG-21/U	220.00	RG-55/U	110.00	RG-77/U	100.00
RG-10/U	240.00	RG-22/U	150.00				
RG-11/U	100.00	RG-22A/U	285.00				
RG-12/U	240.00	RG-24/U	675.00				

ADD 25% TO PRICES SHOWN FOR QUANTITIES UNDER 500 FT.

OIL FILLED CONDENSERS

MFD	VDC	Price
2	400	$ .55
5-5	400	1.65
1	600	.55
2	600	.69
2-2	600 R'd	1.65
3	600	.95
4	600	1.65
4	600 R'd	1.65
5	600	1.75
6	600	1.85
8	600 R'd	1.85
8-8	600	1.95
4-4-4	600	2.50
4 x 3	600	2.50
10	600	3.25
50	600	7.95
1	1000	.65
2	1000	.90
2	1000 R'd	.95
3.5-.5	1000	1.85
4	1000	1.95
6	1000	2.50
8	1000	3.25
1	1200	.85

MFD	VDC	Price
1-1-1	1200	$1.85
.1	1500	.69
3	1500	2.50
4	1500	2.95
.1-.5	2000	.95
.25	2000	1.50
.3	2000	1.30
1	2000	1.95
12	2000	8.95
1	2500	2.75
1-1	2500	3.85
32	2500	15.80
.5	3000	2.40
1	3000	3.40
2	3000	5.85
3 x .2	4000	2.95
2	4000	7.95
.2	5000	2.50
1	5000	5.75
2	5000	18.50
5	5000	29.50
.01-.03	6KV	1.65
1	6000	$9.95
.1	7000 R'd	1.79

MFD	VDC	Price
.1-1	7000	5.95
.1	7500	2.85
.5	7500	7.95
1-1	7500	26.50
.075-.075	8KV	6.50
1	10KV	29.50
.1	12KV	8.95
1	15KV	47.50
.25	20KV	19.95
1	20KV	54.00
1	25KV	85.00
.001	50KV	24.50

MFD	VDC	Price
.005	50KV	$34.50
.025	50KV	42.50
.2	50KV	85.00
.25	50KV	95.00
7.5	220VAC	1.95
20	236VAC	3.95
1-3	330VAC	1.95
12.75	330VAC	4.10
15	330VAC	4.50
5	440VAC	3.10
2.9	660VAC	3.50
7	660VAC	4.25
8	660VAC	4.50

OILMITES

MFD	V.	TYPE	Price
.02	600	OM-6002	$ .45
.05	600	OM-6005	.48
.1	600	OM-610	.51
.25	600	OM-625	.55
.5	600	OM-650	.60
1.0	600	OM-601	.85

PULSE TRANSFORMERS

UTAH OA-18 9278 9340 X124T-2 9280 9341 9262 9318 9350 UTAH

G.E.—K2464	AN/APN-9 (352-7251)
G.E.—K2468	AN/APN-9 (901756-501)
G.E.—K2469	AN/APN-9 (901756-502)
G.E.—K2744B	Westinghouse—132AW2
G.E.—68G627	Westinghouse—139DW2F
G.E.—68G828	Westinghouse—166AW2F
G.E.—68G929G1	Westinghouse—176AW2F
G.E.—80G13	Westinghouse—187AW2F
G.E.—80G152	Raytheon—UX-7350
Philco—352-7071	Raytheon—UX-5137
Philco—352-7149	Raytheon—UX-7361A
Philco—352-7150	Raytheon—UX-10066
Philco—352-7178	W.E.—D-161310
Philco—352-7190	W.E.—D-163247
Philco—352-7224	W.E.—D-163325
AN/APN-9 (352-7250)	W.E.—D-164661

FILAMENT TRANSFORMERS

INPUT—115 V., 50/60 CYCLES

Kenyon — 5V 60A $15.25
Kenyon — Input 105-125V — Sec. 5V 115A $19.50
Amertran — Input 105-125V — Sec. 5V. 190A. Insulation 35KV RMS test $29.50

INPUT—208/230 V., 50/60 CYCLES

GE 2.5 V.CT.@ 10A., Insul.-5KV Encl. Case. $2.10
GE 5V. CT. @ 7.5A; Insul.1.5 KV Open Frame 3.45
GE 5 V. CT. @ 7.5A; Insul.7KV Open Frame. 5.25
GE 5V.CT. @ 7.5A., Insul.-10 KV Encl. Frame 6.25
GE INPUT 190.5V.. 50/60 CYCLES; Sec.-4.3V. to 25.98V. by 6 taps Open Frame 7.95
GE INPUT 220V 60 CYCLES; Sec.-5V.CT., @ 7.5A., Insul.-5KV-Open Frame 4.60

VARIABLE TRANSFORMERS

Amertran—Type RH—Input 115V 400 cycles. Output —75-120V 6 Amp .... $6.95 ea.
Amertran—29144—Input 115V 60 cy 1 φ. Output—103-126V 2.17 Amp. .... $8.25 ea.
Powerstat-Superior 1226—Input 115/230 VAC 50/60 cy.—Output 0-270V 9 Amp 2.4 KVA .... $37.00 ea.

TRANSFORMERS

Westinghouse—Hipersil—Pri—115V 60 cy.—¾ KVA —Sec #1—240V @ 1.56A.; Sec #2—240V @ 1.56 A $18.75
G.E.—Hi Voltage—Pri—115V 60 cy.—Sec. 6250 V @ 80 MA.—12.5KV Insulation $18.50
Constant Volt. Transformer—Thordarson T-44193A—Input 95-135/190-270 VAC 60 cy. Output—115 VAC 350VA $52.50
Constant Volt. Transformer—Sola 30307—Input 95-125 VAC 60 cy. Output 115 VAC 250 VA... $49.00

Terms 25% cash with order, balance C. O. D. unless rated. All prices net F. O. B. our warehouse, Phila., Penna., subject to change without notice.

CABLE ADDRESS • "LECTRONIC PHILADELPHIA"

www.americanradiohistory.com

TUBE SPECIALS

STANDARD BRANDS ONLY

WRITE FOR OUR FREE BULLETIN
MORE GOOD ITEMS

Type No.	Price
5C22	47.75
5CP1	4.95
5BP7	9.50
5D21	19.50
5FP7	1.95
5HP1	5.50
5HP4	5.75
5J29	18.50
5JP1	26.50
5JP2	26.50
5JP4	26.50
5LP1	21.75
5LP5	19.75
5MP1	10.50
6-8B	.85
C6A	6.75
6AN5	3.30
6AR6	3.25
6C21	27.50
6C24	52.50
6F4	5.95
C6J	9.95
6J4	6.85
7-7-11	1.19
7BP1	8.65
7BP7	6.50
7BP12	14.95
7BP14	14.95
7CP1	14.95
9GP7	11.75
9LP7	4.50
10BP4	17.95
10FP4	22.50
10T1	.88
10Y	.39
12DP7	14.50
12GP7	18.50
12HP7	14.75
13-4	.80
13T4	.85
15E	1.95
15R	.65
FG-17/5557	4.95
REL-21	1.95
23D4	1.15
24G	1.85
HK-24	4.95
RK-25	3.82
FG-27A	8.25
FG32/5558	6.75
FG33	17.50
RK34	.49
35T	4.95
35T ION gauge	5.95
35TG	4.95
REL 36	.45
T-40	3.75

Type No.	Price
FG-41	122.50
RK-47	4.92
EF-50	.79
VT-52	.45
53A	5.60
RK59	2.44
SK-60	6.62
VT-62 Br.	1.15
RK-63	22.50
FG-67	14.80
VT-67	.48
RK-69	2.25
72	1.32
73	1.32
RK-75	3.50
75T	5.80
VR-75	1.15
VR-78	.64
FG-81A	3.95
VR-90	1.19
91	14.80
FG-95/5560	25.00
VT-98/Br.	19.50
C100A	2.30
C100E	2.30
100R	2.90
100TH	9.95
WE-101F	3.62
WE-102F	2.85
FG-104/5561	24.60
FG-105	19.50
VR-105	1.10
WE-113A	1.32
HY-114B	.75
WE-117A	.95
F-123A	7.75
WE-124A	3.80
F-127A	22.50
VT-127A	3.60
AB-150	12.50
VR-150	.95
FG-166	48.50
FG-172	29.50
FG-178	14.50
FG-190	12.15
HF200	16.50
L-200B	65.00
203A	7.40
203B	6.33
204A	47.50
CE-206	3.15
211	.95
WE-211D	12.50
WE-211E	12.50
212E	42.50
WE-215A	.24

Type No.	Price
217C	8.95
221A	1.95
227A/5C27	4.60
WE-231D	2.25
232CH	240.00
RX-233A	4.95
FG-235A/5552	94.50
WE-245A	2.35
WE-249B	3.50
WE-249C	3.50
250R	17.50
250TH	22.50
250TL	22.50
WE-252A	5.65
WE-254A	5.90
WE-257A	3.77
FG-271/5551	62.50
WE-274A	5.50
274B	2.85
WE-275A	6.95
WE-283A	4.25
WE-285A	5.57
WE-286A	7.90
WE-294A	5.75
304TH	8.75
304TL	8.75
307A	4.25
WE-309A	6.45
WE-310A	6.25
WE-313C	4.15
316A	.89
327A	4.25
WE-331A	9.75
WE-343A	185.00
WE-346A	2.75
WE-350A	6.95
350B	4.95
WE-356B	5.45
361A	4.75
368A	6.95
371A	.95
371B	.95
388A	2.95
393A	8.60
394A	4.50
WE-399A	4.70
410R	185.00
414	114.00
GL-415/5550	39.50
417A	16.95
434A	24.50
446	1.75
446A	1.95
446B	2.95
450TH	42.50
450TL	42.50

Type No.	Price
451	5.75
471A	2.65
473	156.75
481A	4.05
502A	1.67
503AX	1.25
506AX	1.25
507AX	1.47
527	17.50
530	17.20
531	7.50
532A	3.75
WL-533	19.50
559	2.20
561	3.50
575A	18.90
579B	13.50
KU610	12.50
HY615	.49
616	213.75
KU-623	39.50
624	43.20
KU627	19.80
KU-628	22.50
KU-629	11.70
632B	26.10
KX642	11.34
WL-652/5551	62.50
WL-654/659	82.00
WL-670A	8.70
WL-672	22.00
672A	31.50
KU-676	52.25
677	52.25
678	42.30
WL-681/5550	39.50
700A	24.50
700B	24.50
700C	24.50
700D	24.50
701A	6.95
703A	5.95
704A	.95
705A	2.25
706AY	45.00
706BY	45.00
706CY	45.00
706FY	45.00
706GY	45.00
707A	7.95
707B	14.90
708A	4.75
709A	3.85
710A	1.70
713A	1.45
714AY	10.75

Type No.	Price
715A	6.25
715B	8.95
715C	19.50
717A	1.47
718AY	45.00
718BY	45.00
720DY	95.00
721A	3.95
722A	2.25
723A	9.95
723A/B	18.50
724A	3.22
724B	3.22
725A	8.95
726A	14.50
726B	45.00
726C	65.00
730A	25.00
731A	2.45
788Y	1.40
800	1.75
801A	.45
803	4.95
805	4.50
806	24.50
807	1.65
808	2.65
809	2.95
810	10.95
811	3.60
812A	4.50
813	10.50
814	3.95
815	2.95
816	1.45
826	1.25
828	11.25
829	9.95
829A	11.95
829B	12.95
830B	2.95
832	7.95
832A	9.95
833A	39.50
836	4.10
837	1.45
838	3.75
841	.49
843	.59
845	5.75
845W	6.75
849	29.50
851	67.00
852	19.50
857B	198.55
860	4.95
861	22.50
864	.35
865	1.28

Type No.	Price
866A	1.48
866AJr./2B26	1.25
868	2.25
869B	125.40
872A	3.95
874	1.15
876	1.60
878	1.85
884	1.75
885	1.75
886	2.60
889RA	280.25
891	211.85
892	211.85
892R	343.90
893A	598.50
893AR	1092.50
895	902.00
895R	1235.00
902P1	9.95
905	3.50
917	3.15
918	1.65
919	1.95
920	3.74
923	1.35
924	2.97
925	2.16
926	2.61
927	1.85
928	2.57
931A	5.00
954	.39
955	.55
956	.49
957	.49
958A	.69
959	2.25
991	.45
1003	.90
CK-1005	.69
CK-1006	3.30
E-1148	.35
1201	.79
1203	.45
1291	.57
1294	.69
1299	.57
1602	2.25
1613	.89
1614	2.00
1616	1.07
1619	.39
1620	6.25
1622	2.25
1623	3.56
1624	1.90
1625	.39

Type No.	Price
1626	.30
1629	.30
1630	.95
1631	1.38
1632	.75
1636	3.10
1638	.70
1642	.65
1644	.95
1655	1.90
1665	1.80
1904	14.80
1960	.70
2050	1.70
2051	1.10
5516	7.70
5518	514.59
5549	362.60
5550	39.50
5551	62.50
5552	94.50
5553	251.70
5554	180.55
5555	351.50
5557	4.90
5558	6.75
5559	19.15
5560	25.01
5561	24.60
5581	2.00
5582	2.63
5583	2.90
5584	3.89
5588	117.68
5592	1204.40
5593	85.72
5604	513.05
5610	2.10
5611	115.09
5619	370.50
5621	13.20
5622	12.23
5623	13.25
5624	13.23
5626	22.03
5627	26.45
5628	25.46
5629	20.48
5651	2.78
5654	2.95
5663	1.86
5664	8.49
5665	50.00
5670	4.10
5671	1187.50
5674	85.75
5675	16.95
5683	8.49

Type No.	Price
5685	28.71
5686	3.68
5687	4.80
5691	8.55
5692	8.55
5693	6.95
5696	1.87
5713	173.48
5718	8.33
5719	8.33
5720	20.70
5725	4.16
5726	1.72
5727	3.43
5734	17.63
5736	152.00
5740	73.50
5741	83.30
5742	14.21
5743	13.72
5749	1.96
5750	2.45
5751	3.43
5763	1.72
5770	975.10
5771	532.14
5779	78.40
5786	76.44
5794	16.43
5796	13.06
5814	3.43
5822	135.85
5826	1274.00
5830	122.50
5840	10.54
5846	123.50
5855	75.46
5876	18.38
5879	1.72
5890	25.48
5893	19.50
5896	7.10
5899	10.53
5902	10.78
5915	1.18
5934	13.50
5936	1045.00
5939WA	43.20
5974	209.00
6005	3.68
6012	4.41
6026	2.89
6072	5.39
6082	5.19
6135	2.69
6136	3.19
6137	2.45
6159	4.80

Type No.	Price
6201	5.39
UX6653	.65
7193	.45
8003	12.60
8011	.87
8012	2.60
8013	2.75
8013A	4.90
8014A	55.00
8016	1.05
8020	1.25
8025	6.95
8025A	4.75
9001	1.50
9002	.95
9003	1.50
9004	.45
9005	1.95
9006	.35
189048	3.79
189049	3.79
199698	2.69

Crystal Diodes

Type No.	Price
1N21	$1.19
1N21A	1.69
1N21B	3.00
1N22	1.25
1N23	1.95
1N23A	2.75
1N23B	3.45
1N27	1.79
1N31	7.90
1N34	.66
1N34A	.90
1N38	1.50
1N39	6.10
1N40	8.50
1N41	9.85
1N42	18.00
1N43	1.45
1N45	.94
1N52	1.05
1N55	3.05
1N60	.55

CM EQUIPMENT

K Band RF Head RT-99/APS-32; (incl. 3J31 Magnetron, 2K33A Klystron, etc.) $650.00
Radar Transmitter T-85/APT-5 300-1600 MC. complete $175.00
AN/APR-4 Broad Band Receiver and Tuning Units TN-16 (38-95 MC), TN-17 (76-300 MC), TN-18 (300-1000 MC)
Ideal Lab Receiver—Prices on Request
10 CM Crystal Mixer—Type "N" Fittings....$19.50
10 CM Signal Generator I-138A............$185.00
10 CM Freq. Meter CW-60 ABM............$97.50
10 CM R.F. Load CG-97/AP............$22.50
3 CM R.F. Load—150W. Avg. Pwr. TS-108A/AP $32.50

"X" BAND ACCESSORIES

UG-81/U Waveguide to Co-Ax Adapter......$12.95
UG-163/U Adapter $2.85
AT-48/UP Pick-Up Horn Antenna............$9.95
Type "N" Mating Connectors Available

TYPE "J" POTENTIOMETERS $1.25 ea.

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
60	SS	5K	1/4"	50K	3/8"
60	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	1/2"
500	SS	10K	1/2"	250K	SS
500	1/2"	15K	SS	250K	3/4"
500	5/8"	15K	1/2"	250K	3/8"
650	1/2"	20K	SS	500K	SS
1K	SS	25K	SS	500K	1/4"
1K	1/2"	30K	1 1/8"	500K	7/16"
2K	3/8"	40K	SS	1 Meg	SS
2500	SS	50K	SS	2.5 Meg	SS
5K	SS	50K	1/4"	5 Meg	SS

DUAL "J" POTS—$2.95 ea.

50 SS	500 SS	10K SS	2.5 meg SS
50 1⅛"	1K SS	1 meg SS	5 meg SS
100 SS	2500 SS		1K/25K ⅜"

TRIPLE "JJJ" POTS—$3.95 ea.

100K/100K/100K ⅜"   K/150K/15K ⅜"

2 ϕ LOW INERTIA SERVO MOTORS

Diehl FPE-25-11—75V 60 cy. .11 Amp 4 Watts. Each $34.50
KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50
PIONEER—10047-2-A 26 volt 400 cycle with 40:1 reduction gear $14.50
PIONEER—CK 13 115 volt 400 cycle—includes damping signal generator (autosyn).......$47.50

TACHOMETER GENERATOR

Elinco type PM-IM.
DC Tachometer
Generator-New $27.50

SYNCHROS

ARMY ORDNANCE—NAVY ORDNANCE—COMMERCIAL

AY-101D	5D	6DG	X	2JD5E1	C-78248
1CT	5DG	6G	2J1F1	C-44968-6	C-78249
1DG	5F	7DG	2J1G1	C-56701	C-78254
1F	5G	7G	2J1H1	C-56776-1	C-78410
1G	5N	A	2J1M1	C-69405-2	C-78411
1HG	5SF	B	2J5A2	C-69406	C-78414
1SF	5SG	M	2J5D1	C-69406-1	C-78415
5B	6CT	N	2J5HA1	C-77610	C-78670
5CT			2JD5A2		C-79331

SYNCHRO CAPACITORS   SYNCHRO BLOWN FUSE INDICATORS
SYNCHRO OVERLOAD INDICATORS

FREE! 165 Page Navy Synchro Manual, When Requested, With Each Synchro Order

GENERATORS AND INVERTERS

Pioneer type 716-3A Generator (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400 cy. 1ϕ DC 30 Volts 60 Amps. Brand new............$38.50
Pioneer type 1235-3A Generator. Output-30 Volts DC 15 Amps. Brand New—Original Packing....$15.50
Pioneer 12133-1A Inverter—28VDC to 115VAC 400 cy 3 ϕ 250 VA 0.8PF-Volt. and Freq. Regulated. ea. $225.00
Pioneer 12137-1A Inverter—24VDC to 115VAC 400 cy 3 ϕ 250VA—Volt. and Freq. Regulated. ea. $225.00
PE-109D Inverter—13.5 VDC to 115 VAC 400 cy. 175 VA 1ϕ (new)............$79.50
PE-218 Inverters 28 VDC to 115 VAC 400 cy 1500 VA. (New) $49.50
Pioneer Type 800-1B Inverter—28VDC to 120V 800 cy 7 amp AC (used)............$22.65
G. E. Inverter—28 VDC to 120 VAC 800 cy 750 VA 1ϕ $39.50
ATR Inverter 6VDC to 110 VAC 60 cy 75W..$22.95
Pioneer type 12121-1A Inverter—Voltage and frequency regulated—24VDC 18 Amp input—AC output 115V 3ϕ 400 cy 250 VA 0.7 PF—(new) $225.00
Pioneer type 12116 Inverter—28 VDC to 115 VAC 400 cy 1 ϕ 50 VA............ea. $79.50
Pioneer type 12117 Inverter—28 VDC to 26 VAC 400 cy 1ϕ 6 VA............ea. $33.50
Leland 10563 Inverter—28 VDC to 115 VAC 400 cy. 3ϕ 115 VA............ea. $75.00

CERAMIC-CASED TYPE G MICA CONDENSERS

.09 MFD 1500 VDC G1............ea. $9.25
.02 MFD 3000 VDC G1............ea. 9.25
.004 MFD 6000 VDC G1............ea. 18.10
.00015 MFD 20000 VDC G3............ea. 24.50

GAMMA RADIATION SURVEY METER

Victoreen Model 247A—Range 0-2.5/25/250/2500 milli-roentgens Per hour

NEW $179.50

A.C. MOTORS

HAYDON SYNCHRONOUS TIMING MOTOR—110V 60 cy. - 2.2W - 4 RPM............EA. $2.29
AC/DC BRUSH TYPE SERIES MOTOR — 110V AC/DC - 0.3 Amp. 1/20 HP - speed 5000 RPM Rated - suitable for sewing machine, hi speed grinder, etc. - Dim. 2¾" dia. x 3¼" lg. Shaft ¼" dia. x ⅜" lg............EA. $2.95
SIGNAL ELECTRIC TYPE V512 Blower Motor - 115V - 60 cy. - 0.7 Amps. - Dim. 3" dia. x 3¼" lg. ....EA. $4.75
EAD TYPE J71-11 CAPACITOR INDUCTION MOTOR — 115V - 1 ph. - 60 cy. - 0.6 Amp. - MFD Capacitor - Dim. 3¼" dia. x 3⅛" lg. 3200 RPM - 1/75 HP - intermed. duty - uses 5 EA. $28.50
EAD TYPE LH711 NCJ-2 SYNCHRONOUS HYSTERESIS MOTOR — 115V - 1 ph. - 60 cy. - 1.0 Amp. - 1800 RPM - 1/50 HP - Cont. Duty - Uses 4 MFD. Capacitor - Dim. 3⅞" dia. x 4⅜" lg. ....EA. $37.50
BARBER-COLMAN PYAZ 4278 SPEED REDUCER MOTOR — 115V - 60 cy. - 31W - Gear Ratio 100:1 - 2 RPM - stall torque - 65 lb.-in. EA. $19.50
G.E.-MODEL 5SMY54H16 SYNCHRONOUS INDUCTOR MOTOR — 110V - 60 cy. - .36 Amp. - 75 RPM - 75 oz.-in. torque. Dim 4" dia. x 5¾" lg. - shaft ⅜" dia. x 1⅛" lg............EA. $22.50
HOLTZER-CABOT RBT-2505 AC Induction Motor - 115V - 60 cy. 3 ph. - 1725 RPM - 9W - Torque 2.5 in.-oz. ....EA. $5.25
DIEHL C78291-FP-83-3.1 or DIEHL C78318-FP-83-12 AC MOTOR — 115V - 60 cy. - 3450 RPM - .22 Amp.; 50V - 50 cy. - 2850 RPM - .48 Amp. - 1/40 HP - 3 ph. cont. duty - Dim. 4" dia. x 4½" lg. ....EA. $4.25

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST.   PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3

www.americanradiohistory.com

Buy TOP Radio-Electronic Values!

AIR TRIMMER CONDENSERS

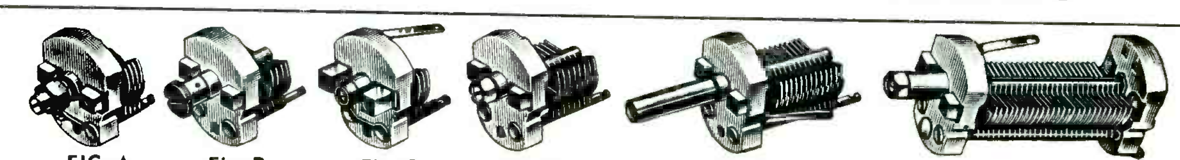


FIG. A Fig. B Fig. C Fig. D Fig. E Fig. F

STOCK NO.	CAPACITY Min.	CAPACITY Max.	MANUFACTURER'S NUMBER	FIGURE	SHAFT LENGTH	POST LENGTH	GROUND LUG	PRICE EACH
2937	2.5	7	Hamm 250034	D	5/16	3/32	Right	18¢
5716*	3	8	ASP 17A224	A	9/16	3/32	Top	25¢
5717	3	10	ASP 22G192	A	9/16	3/32	To Post	18¢
4090	2	15	ASP 482212	E	1"x1/4" D	3/32	Left	25¢
2939	3	15	ASP 217-2	C	5/16	1/4	Top	20¢
5718	3	15	Telrad 682070-30	D	5/16	3/32	Right	20¢
231	3	25	CAIM 481881	A	9/16	3/32	Left	25¢
5720	3	27	Hamm 11725-1	D	5/16	3/32	Right	25¢
5721	2.5	28	Comar M420864-6	D	5/16	3/32	Top	25¢
5723	3	29	ASP 22G190	A	9/16	3/32	To Post	25¢
5724	4.5	30	OB7751E-25	D	5/16	5/16	Right	30¢
5086	5	30	Hamm SBL-72265-3	B	1/2	3/32	Bottom	30¢
232	5	54	Hamm ESA682070-35	D	5/16	3/32	Left	40¢
5087	5	54	Hamm BL 72265-4	B	1/2	3/32	Right	40¢
236**	8	140	ASP 19A34504	D	5/16	3/32	To Post	55¢
6124	6	140	ASP 19A54023	E	5/8"	1/4"	D	75¢
5726	9	204	OAK 114M510	F	9/16	3/32	Top	95¢

* Double spaced plates.
** Adjusts both ends, some available w/dust cover.
Fig. A Round Shaft Screwdriver adj. w/locknut.
Fig. B Bakelite Knob Ins. Screwdriver adj.
Fig. C Round Shaft Screwdriver adj.
Fig. D Hexnut Screwdriver adj.
Fig. E ¼ Round Shaft.
Fig. F Double End Plate.

2 VOLT BATTERY

Signal Corps Type BB-54A 2 Volt 27 Ampere Hour Storage Battery. Non-Spillable Transparent Acid Proof Plastic Case has Built-in Ball Type Hydrometer. 3" x 4" x 5" High.

Stock No. 5458A — Price Each **$2.50**

304TL's EIMAC JAN 304TL's INDIVIDUALLY BOXED $10.95

HIGH VOLTAGE TRANSFORMER

21,000 volt 100MA. Half Wave oil filled. Maloney Electric Co.

Stock No. 5728A — Price Each **$300.00**

HIGH CURRENT FILAMENT TRANSFORMER

Primary 115 VAC 60 Cycle. Secondary 1.25 VAC at 100 Amp.

Stock No. 5783A — Price Each **$5.00**

FILAMENT TRANSFORMER

20 VOLTS TAPPED AT 14 VOLTS @ 20 AMPS. PRIMARY TAPPED IN 5 VOLT STEPS FROM 210 TO 240 VOLTS 50-60 CYCLE STANCOR SS10696. 4" x 5" x 5" HIGH.

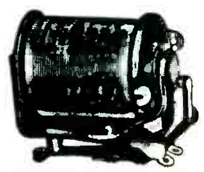
Stock No. 6292A — Price Each **$4.95**

MIL—T—27 FILAMENT TRANSFORMER

PRIMARY: 107.5; 112.5; 117.5; 122.5; 215; 225; 235 and 245 Volts 50/60 cycle SECONDARY: 6.3 Volts @ 5.3 AMPS and 6.3 Volts @ 3 AMPS. Ceramic bushings with solder lug terminals. Rated for continuous duty under MIL-T-27, Class "A" Grade I specs. Hermetically sealed case, 2¾" x 3½" x 3⅛" high.

Stock No. 6284A — Price Each **$3.50**

SENSITIVE RELAYS



MIDGET TYPE RELAYS

Automatic Electric Type R-45, 6500 ohm Coils. Normally open contacts except as noted.

Stock No.	Contacts	M. A.	Price Each
102152	S.P.S.T.	2.0	$1.25
102249	2.P.S.T.*	4.5	1.50
102264	3.P.S.T.	6.0	2.00

* 1 Norm. open-1 Norm. closed.

Same type and style as above, but has 24 V.A.C. coil. Intermittent duty. Will operate on 6 V.D.C. Continuous duty. Contacts: S.P.S.T.-N.O. and S.P.D.T.

Stock No. 102248A — Price Each **$1.25**

.01 MFD.—600 VOLT MICA CONDENSERS

Large quantities available in both CM-35 and CM-40 case sizes.

TOLERANCE	PRICE PER 1000
5%	$150.00
10%	125.00
20%	100.00

SIGNAL CORPS & NAVY TRANSFORMERS

Over 200,000 transformers, chokes etc. For Signal Corps and Navy Equipment. Send us your requirements, or ask for our catalog listing by Signal Corps Numbers. DON'T DELAY!

HEAVY DUTY SWITCHES

H&H 4.P.D.T. Toggle Switch. 5 AMP. @ 250 Volt. 10 Amp. @ 125 Volt. Single ¾" hole mount. Ball handle.

Stock No. 6203A — Price Each **$1.95**

CUTLER HAMMER TYPE 8905K628

4 Pole D.T. Neutral Center Toggle Switch. Luminous Tip—Bat Handle. 2 Hole Mtg.

Stock No. 6291A — Price Each **$1.95**

RECTIFIERS

A precision balanced copper oxide double bridge rectifier. Housed in a sealed metal container 1" x 1-¾" x 1" high. Tapped mtg holes in bottom. Discs have vaporized gold contact surfaces. Made by Bradley Labs. to W. E. spec. D 220005. Nominal input volts 10.5 V.A.C. 5 MA.

Stock No. 6283A — Price Each **$1.50**

THORDARSON AUDIO PASS FILTERS

Band pass 800 to 1200 cycles input 10000 ohms — Output 25000 Ohms Level 10DB

Stock No. T48500 — Price to: $5.50 ea.

6.3 VOLT FILAMENT TRANSFORMERS

Primary 115 Volt 60 Cycle 1600 Insulation Three 6.4 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.5 Amps.
6.3 Volts @ 1.1 Amps.

Horizontal Half Shell Mounting. 2¼" x 2 13/16" Mounting Centers. 2 13/16" x 3⅜" Core Size. 2½" above Chassis. Soder Lug Terminals—All Terminals Marked.

Stock No. 5254A — Price Each **$2.65**

TERMS:

Open Accounts to rated or Acceptable reference accounts. Others pre-payment of 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject to prior sale.

ORDER TODAY!

Radio Surplus Corp.

732 South Sherman Street
Chicago 5, Illinois
Phone: HArrison 7-5923

www.americanradiohistory.com

A LEADING SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

IMMEDIATE DELIVERY -- FULLY GUARANTEED

A. C. SYNCHRONOUS MOTORS

110 Vt. 60 Cycle

HAYDON TYPE 1600, 1/240 RPM
HAYDON TYPE 1600, 1/60 RPM
HAYDON TYPE 1600, 4/5 RPM
HAYDON TYPE 1600, 1 RPM
HAYDON TYPE 1600, 1 1/5 RPM
TELECHRON TYPE B3, 2 RPM
TELECHRON TYPE BC, 60 RPM
HOLTER CABOT, TYPE RBC 2505, 2 RPM, 60 oz. 1 in. torque.

SERVO MOTORS

PIONEER TYPE CK1, 2 φ 400 CYCLE
PIONEER TYPE 10047-2-A, 2 φ, 400 CYCLE, with 40:1 reduction gear.

D. C. MOTORS

BODINE NFHG-12, 27 VTS., governor controlled, constant speed 3600 RPM, 1/30 HP.
DELCO TYPE 5068750, 27 VTS., 160 RPM, built in brake.
DUMORE, TYPE EIY2PB, 24 VTS., 5 AMP., .05 H.P., 200 RPM.
GENERAL ELECTRIC, TYPE 5BA10AJ18D, 27 VTS., 110 RPM, 1 oz. 1 ft. torque.
GENERAL ELECTRIC, TYPE 5BA10AJ37C, 27 VTS., 250 RPM, 8 oz. 1 in. torque.
BARBER COLMAN ACTUATOR TYPE AYLC 5091, 27 VTS., .7 amp., 1 RPM, 500 in. lbs. torque.
WHITE ROGER ACTUATOR TYPE 6905, 12 VT., 1.3 amp., 1½ RPM, 75 in. lbs. torque.

AMPLIDYNE AND MOTOR

AMPLIDYNE, GEN. ELEC. 5AM31NJ18A input 27 vts., at 44 amp. output 60 vts. at 8.8 amp., 530 watts.
MOTOR, GEN. ELEC. 5BA50LJ32, armature 60 vts. at 8.3 amp., field 27 vts. at 2.9 amp. ½ H.P., 4000 RPM.

PIONEER AUTOSYNS 400 CYCLE

TYPE AY1, AY5, AY14G, AY14D, AY20, AY27D, AY38D, AY54D.
PIONEER AUTOSYN POSITION.
INDICATORS & TRANSMITTERS.
TYPE 5907-17, single, Ind. dial graduated 0 to 360°, 26 vts., 400 cycle.
TYPE 6007-39, dual Ind., dial graduated 0 to 360°, 26 vts., 400 cycle.
TYPE 4550-2-A, Transmitter, 2:1 gear ratio 26 vts., 400 cycle.

INVERTERS

WINCHARGER CORP. PU 16/AP, MG750, input 24 vts. 60 amps. outputs 115 vts., 400 cycle, 6.5 amp., 1 phase.
HOLTZER CABOT, TYPE 149F, input 24 vts. at 36 amps., output 26 vts. at 250 V.A. and 115 vts. at 500 V.A., both 400 cycle, 1 phase.
PIONEER TYPE 12117, input 12 vts., output 26 vts. at 6 V.A., 400 cycle.
PIONEER TYPE 12117, input 24 vts., output 26 vts. at 6 V.A., 400 cycle.
WINCHARGER CORP., PU/7, MG2500 input 24 vts. at 160 amp., output 115 vts. at 21.6 amp., 400 cycle, 1 phase.
GENERAL ELECTRIC, TYPE 5D21NJ3A, input 24 vts. at 35 amps., output 115 vts. at 485 V.A., 400 cycle, 1 phase.
LELAND, PE 218, input 24 vts. at 90 amps. output 115 vts. at 1.5 K.V.A., 400 cycle, 1 phase.
LELAND, TYPE D.A. input 28 vts., at 12 amp. output 115 vts. at 115 V.A., 400 cycle, 3 phase.

ENGINE HOUR METER

JOHN W. HOBBS, MODEL MI-277 records time up to 1000 hours, and repeats, operates from 20 to 30 volts.

VOLTAGE REGULATOR

LELAND ELEC. CO. TYPE B, CARBON PILE. Input 21 to 30 volts D.C. regulated output 18.25 vts. at 5 amp.
WESTERN ELEC. TYPE BC937B, input 110 to 120 volts, 400 cycle. Output variation 0 to 7.2 ohms at 5 to 2.75 amps.
WESTERN ELEC. TRANSTAT, input 115 vts., 400 cycle output adjustable from 92 to 115 vts., rating .5 K.V.A.
AMERICAN TRANS. CO., Transtat input 115 vts., 400 cycle output 75 to 120 vts. or 0 to 45 volts, rating .72 K.V.A.

SYNCHROS

1 F SPECIAL REPEATER 115 vts. 400 cycle.
2J1F1 GENERATOR, 115 vt. 400 cycle.
2J1F3 GENERATOR, 115 vt. 400 cycle.
2J1G1 CONTROL TRANSFORMER 57.5 vt. 400 cycle.
2J1H1 DIFFERENTIAL GEN. 57.5/57.5 vt. 400 cycle.
5G GENERATOR, 115 vt. 60 cycle.
5DG DIFFERENTIAL GEN. 90/90 vts. 60 cycle.
5HCT CONTROL TRAN. 90/55 vts. 60 cycle.
5CT CONTROL TRAN. 90/55 vts. 60 cycle.
5SDG DIFFERENTIAL GEN. 90/90 vts. 400 cycle.

ALL PRICES F. O. B. GREAT NECK N. Y.

TACHOMETER GENERATOR & INDICATOR

GENERAL ELECTRIC, GEN. TYPE AN5531-1, Pad mounting 3 phase variable frequency output.
GENERAL ELECTRIC, GEN. TYPE AN5531-2, Screw mounting 3 phase variable frequency output.
GENERAL ELECTRIC, IND. 8DJ13AAA, works in conjunction with above generators, range 0 to 3500 RPM.

D. C. ALNICO FIELD MOTOR

DIEHL TYPE FD6-23, 27 vts. 10,000 RPM.

GENERAL ELECTRIC D. C. SELSYNS

8TJ9-PAB TRANSMITTER 24 VTS.
8TJ11- INDICATOR, dial 0 to 360°, 24 vts.

RECTIFIER POWER SUPPLY

HAMMETT ELECTRIC MFG. CO. MODEL SPS-130. Input voltage 208 or 230 volts, 60 cycle, 3 phase, 21 amps. Output 28 volts at 130 amps. continuous duty, 8 point tap switch, voltmeter ammeter, therma reset all on front panel.

MISCELLANEOUS

PIONEER MAGNETIC AMPLIFIER ASSEMBLY Saturable reactor type, designed to supply variable voltage to a servo motor such as CK1, CK2, CK5 or 10047.
SPERRY A5 CONTROL UNIT, part No. 644836.
SPERRY A5 AZIMUTH FOLLOW-UP AMPLIFIER, part No. 656030.
SPERRY A5 DIRECTIONAL GYRO, part No. 656029, 115 vt. 400 cycle, 3 phase.
SPERRY A5 PILOT DIRECTION INDICATOR, part No. 645262 contains AY 20.
ALLEN CALCULATOR, TYPE C1, TURN & BANK IND., part No. 21500, 28 vts. D. C.
TYPE C1, AUTO-PILOT FORMATION STICK, part No. G1080A3.
PIONEER GYRO FLUX GATE AMPLIFIER, Type 12076-1-A, 115 vt. 400 cycle.

INSTRUMENT ASSOCIATES

363 GREAT NECK ROAD, GREAT NECK, N. Y.
Telephone GReat Neck 4-1147

Write for Catalog NE100

U. S. Export License-2140

Western Union address: WUX Great Neck, N. Y.

Reliance Specials

GEAR ASSORTMENT

100 small assorted gears. Most are stainless or brass. Experimenter's dream! ....Only $6.50

HAYDON TIMING MOTOR

1 R.P.M., 115 V., 60 Cycle...$1.95

TIMING MOTOR

8 RPM 115 V 60 cyc
E. Ingraham Co.

$1.79

400 CYCLE INVERTERS

Leland Electric Co.

#10800 in: 20-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 400 Cyc. 1 phase, 1500 V.A. 90 PF..............$29.50

3 AG FUSES

Amp.	Per 100	Amp.	Per 100	Amp.	Per 100
		3/4	$4.00		
1/8	$4.00	1	3.00	8	$3.00
3/8	4.00	4	3.00	10	3.00
1/2	4.00	5	3.00	15	3.00

3 AG FUSE HOLDERS (Finger) 25¢

RESISTORS

Type EB	½W	10%	6¢ ea.	$4.00 per C
EB	½W	5%	12¢ ea.	8.00 per C
Type GB	1W	10%	9¢ ea.	7.00 per C
GB	1W	5%	18¢ ea.	14.00 per C
Type HB	2W	10%	12¢ ea.	9.00 per C
HB	2W	5%	24¢ ea.	18.00 per C

AVAILABLE IN ALL STANDARD RMA VALUES

RAYTHEON PLATE TRANSFORMER

TYPE U8355A

PRI. 110V/220V/440V/60 cy.
SEC. #1 300V @ 4 AMPS
SEC. #2 300V @ 4 AMPS
1780 RMS TEST
9¾" x 9½" x 8½" HIGH................$19.95

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½"..$3.95 0-80 Amp. D.C. 2½"..$2.50
0-1 Ma D.C. 3½" DeJur..(Scale Reads 0-4 KV)..$5.75

SELENIUM RECTIFIERS

Full Wave 200 MA 115V..........................$1.70
Half Wave 100 Ma 115V..............................91

TS-10 SOUND POWERED HANDSET

Used, Excellent Condition

INCLUDES 6 FT CORD & CLAMPS — USES NO BATTERIES OR EXTERNAL POWER SOURCE ....$18.95 PAIR

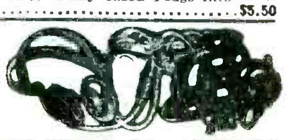
SPECIAL
FILAMENT TRANSFORMER

SEC. 5V 190A. PRI. 105-125 VAC. 60 cy. 1 phase. .97 KVA. 35 KV. RMS insulation test. 7" x 10" x 12"; weight 80 lbs. Ideal for use as spot welder.

Only.......................... $29.50

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A.C. Fully cased Plugs into octal socket $5.50

Sound Powered Chest Set RCA—With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40



POSTAGE STAMP MICAS
AVAILABLE IN ALL STANDARD RMA VALUES
PRICE SCHEDULE

5 mmf to 910 mmf.................5¢
.001 to .0013 mfd.................8¢
.0015 to .0056 mfd.................15¢
.0062 to .0091 mfd.................20¢
.01 mfd.................28¢

SILVER MICA

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	50	100	170	360	510	.001	.0024	.0047
18	51	110	180	370	525	.0011	.0025	.005
22	56	115	208	390	560	.0013	.0027	.0051
23	60	120	225	400	570	.0015	.0028	.0056
24	62	125	240	410	680	.0016	.003	.006
25	66	130	250	430	700	.0018	.0033	.0068
27	68	135	255	470	800	.0022	.0039	.0082
30	75	150	260	488	900	.0023	.004	.01
40	82	155	270	500				

Price Schedule

10 mmf to 700 mfd.................10c
.0011 mfd to .002 mfd.................20c
.0022 mfd to .0082 mfd.................50c
01 mfd.................95c

PULSE TRANSFORMERS

UTAH—9262 9278 9289 9318 9340 9350
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9800, KS9862, KS13161
GENERAL ELECTRIC—80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

AN CONNECTORS
See Our Ad February, 1953 Electronics
PHONE! WIRE! WRITE! YOUR NEEDS

GET ON OUR MAILING LIST

COAXIAL CABLE CONNECTORS

14c	$1.2	30c	70c	40c	12c
UG175/U	83-1F	83-1AP	83-1J	SO-239	HOOD

83-1AC	$0.42	PL-274	$1.10	UG-88/U	.90
83-1AP	.30	PL-275	2.10	UG-89/U	1.10
83-1BC	.35	SO-239	.40	UG-102/U	.80
83-1F	1.10	UG-13/U	1.70	UG-103/U	.68
83-1H	.12	UG-18B/U	1.05	UG-104/U	1.40
83-1HP	.22	UG-20B/U	1.60	UG-105/U	1.50
83-1J	.73	UG-21/U	.85	UG-106/U	.15
83-1R	.40	UG-21B/U	1.00	UG-107B/U	2.75
83-1RTY	.65	UG-21C/U	1.05	UG-146/U	2.00
83-1SP	.45	UG-21D/U	1.45	UG-167/U	3.75
83-1SPN	.50	UG-22/U	1.30	UG-175/U	.12
83-1T	1.30	UG-22A/U	1.60	UG-176/U	.12
83-2AP	1.95	UG-22B/U	1.20	UG-185/U	.95
83-2J	2.10	UG-23/U	1.20	UG-196/U	1.65
83-2R	1.65	UG-23B/U	1.50	UG-203/U	.65
83-22AP	1.40	UG-23C/U	1.10	UG-224/U	1.15
83-22F	2.10	UG-24/U	1.30	UG-255/U	1.95
83-22J	1.40	UG-27/U	1.25	UG-260/U	.85
83-22R	.68	UG-27A/U	2.25	UG-261/U	1.10
83-22SP	.80	UG-27B/U	2.95	UG-262/U	1.10
83-22T	1.95	UG-28A/U	2.95	UG-273/U	1.45
83-168	.12	UG-29B/U	1.75	UG-274/U	2.30
83-185	.12	UG-30/U	2.30	UG-290/U	.90
CW-123A/U	.45	UG-57B/U	1.85	UG-291/U	.95
M-358	1.30	UG-58/U	.70	UG-306/U	2.65
M-359	.30	UG-58A/U	.90	UG-414/U	1.95
M-359A	.65	UG-59A/U	1.90	UG-499/U	1.25
PL-258	.75	UG-83/U	1.75	UG-625/U	1.35
PL-259	.45	UG-85/U	1.65		
PL-259A	.50	UG-87/U	$1.40		

NEW COAXIAL CABLES

	Price per 1000 ft.		Price per 1000 ft.
RG 5/U*	$140.00	RG 22/U*	$150.00
RG 6/U	180.00	RG 22A/U	285.00
RG 7/U*	85.00	RG 24/U	675.00
RG 8/U*	100.00	RG 26/U	475.00
RG 9/U*	250.00	RG 29/U*	50.00
RG 9A/U	275.00	RG 34/U*	300.00
RG 10/U	240.00	RG 35/U	900.00
RG 11/U*	100.00	RG 41/U*	295.00
RG 11A/U*	150.00	RG 54A/U	97.00
RG 12/U	240.00	RG 55/U*	110.00
RG 13/U*	216.00	RG 57/U*	325.00
RG 17/U	650.00	RG 58/U*	60.00
RG 18/U	900.00	RG 58A/U*	70.00
RG 19/U	1250.00	RG 59/U*	55.00
RG 20/U	1450.00	RG 62/U*	75.00
RG 21/U*	220.00	RG 77/U*	100.00

Add 25% for orders less than 500 feet.
* No minimum order—other 250 minimum.

UNIVERSAL JOINT ALUMINUM

Includes Two 6-32 Set Screw Holes
¼" hole x ½" O.D.
1⅛" long 85¢

TYPE "J" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
100	SS*	2.5K	SS	100K	7/16
150	SS	3.0K	3/8	200K	SS
150	SS*	4.0K	3/8	250K	5/8
500	1/4	15K	3/8	250K	SS
1.0K	9/16	25K	SS	1.0 Meg	1/4
1.5K	5/16	75K	SS		
2.0K	1/4	100K	3/8		

SS: Screw-driver slot.
*: Split locking bushing.
$1.25 EACH

TYPE "JJ" POTENTIOMETERS

Ohms	Shaft	Ohms	Shaft	Ohms	Shaft
10K-10K	5/16	30K-10K	3/8†	90K-3K	1/4
15K-15K	SS				

† With switch.

PRICE—$2.50 EACH

JONES BARRIER STRIPS

2—140Y	$0.17	3—141W	$0.27	8—141¾W	$0.64
3—140¾W	.21	4—141	.24	9—141	.48
6—140	.28	5—141	.29	9—141Y	.71
10—140W	.59	5—141¾W	.41	3—142	.24
10—140¾W	.59	7—141¾W	.56	2—150	.43
3—141¾W	.27	8—141	.44	3—150	.60

TIME DELAY RELAY

Raytheon CPX 24166
1 Min. Delay. 115 V., 60 Cycle

2½ second recycling time spring return • Microswitch contact, 10A • Holds ON as long as power is supplied • Fully Cased • ONLY $6.50

TELEPHONE FIELD WIRE

W-110-B

½ MILE COIL....$7.95
1 MILE REEL....$14.95

PRECISION RESISTORS—¼ WATT—30¢

2	11	13.52	62.54	125	301.8	2,193
3.5	11.25	13.89	79.81	147.5	366.6	3,500
6.68	11.74	14.98	105.8	147.8	414.3	8,000
10.48	12.32	15.8	123.8	220.4	705	59,148
10.84	13.02	16.37				

PRECISION RESISTORS—½ WATT—35¢

.25	13.3	125	1,500	6,500	16,000	36,000
.334	25	130	2,200	6,650	16,700	37,000
.502	30	180	2,230	7,000	17,000	45,000
.557	46	210	2,250	7,300	20,000	46,000
.627	50	235	2,500	7,500	20,150	47,000
.76	52	260	2,850	8,000	25,000	50,000
1	55.1	270	3,427	8,500	26,500	54,500
1.01	65	298.3	4,000	8,800	30,000	59,000
1.53	66.6	400	4.285	10,000	32,700	68,000
2.04	75	723	4,300	12,000	32,888	79,012
5.26	87	750	4,451	14,825	33,000	80,000
11.1	97.8	855	5,000	15,000	33,300	100,000
13.15			5,900	15,750	35,888	

PRECISION RESISTORS—1 WATT—45¢

.2	4.3	13.52	38	2,200	10,000	55,000
.861	4.35	14	54.26	3,300	12,000	56,000
1.01	5.1	15	250	5,000	17,300	65,000
2.55	5.21	20	270	7,000	20,000	68,000
2.58	12	22	420	8,250	50,000	84,000
3.39	13.333	28	425	9,000		

PRECISION RESISTORS—1 WATT—60¢

100,000	130,000	260,000	348,000	590,000
105,000	132,000	270,000	500,000	600,000
120,000	150,000	296,000	520,000	645,000
128,000	240,000	320,000	522,000	700,000

PRECISION RESISTORS—2 WATT—75¢

4,385	6,000	10,000	19,977	23,000
5,000				

1 MEGOHM 1 WATT 1% $1.50

DIFFERENTIAL Used $4.95 New $9.95

115 V., 60 Cycle
#C78249

3⅜" dia. x 5⅝" long
Used between two C78248's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted).........$5.50
Mounting Brackets—Bakelite for selsyns, and differentials shown above..................35¢ pair

OIL FILLED CONDENSERS

MFD	V.D.C.	Price	MFD	V.D.C.	Price
5.2	50	$0.89	0.5	3,000	2.40
6	400	.85	2	3,000	4.50
3 x 3	400	1.00	2	4,000	7.95
4	500	.85	0.01	5,000	.95
1	600	.55	1	5,000	4.88
0.5-0.5	600	.40	0.03-0.03	6,000	1.50
2	600	.75	1	6,000	9.95
4	600	1.75	0.02-0.02	7,000	1.55
8	600	1.85	0.1	7,000	1.79
10	600	3.25	0.1-0.1	7,000	5.95
4 x 3	600	2.50	0.1	7,500	2.25
8-8	600	1.95	0.075-0.075	8,000	6.50
1	800	.60	0.15-0.15	8,000	6.95
1	1,000	.69	0.25	20,000	19.95
2	1,000	.95			
3	1,000	1.70			
1	1,500	1.45			
0.02	2,000	.65			
0.1-0.1	2,000	1.30			
0.1-0.5	2,000	.95			
0.5	2,000	1.65			
3	2,000	3.75			
8	2,000	7.95			
0.25	3,000	2.25			

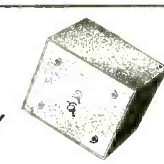
1 mfd
6,000
V.D.C.
G.E.
$9.95

OIL FILLED AC CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
7.5	220	$2.00	15	440	6.25
20	220	4.95	1	660	2.95
1	236	.49	2.9	660	4.35
4	236	1.60	3	660	4.45
8	236	1.95	4	660	4.95
3	330	1.45	5	660	5.45
4	330	2.25	6	660	5.95
20	330	6.75	8	660	7.50
25	330	7.50	0.2	750	.69
4.4	375	2.15			

1N34 Crystal Diode..79¢   1N43A (WE400A) $2.25

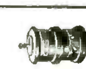
Choke
10 hy
400 MA
90 OHMS
HERMETICALLY SEALED



$4.88

2J1G1 SELSYNS $8.50

400 CYCLE BRAND NEW

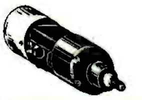


Minimum Orders $3   All orders f.o.b. PHILA., PA.

RELIANCE MERCHANDIZING CO.

Arch St., Cor. Croskey Phila. 3, Pa. Telephone Rittenhouse 6-4927

www.americanradiohistory.com



ALNICO FIELD MOTORS

(Approx. size overall . . . 3¾" x 1¼" diameter)
DELCO TYPE #5069600: 27.5 volts DC; 250 RPM **$19.95**

PM Motor, Delco Type #5069371; 27.5 volts; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½" diameter 0.125" **$15.00**

PIONEER GYRO FLUX GATE AMPLIFIER

Type 12076-1-A, complete with tubes **$27.50 ea.**

AC CONTROL MOTOR

A. C. SYNCHRONOUS MOTOR Type RBC 2505; Volts 115; Cycles 60; RPM 60; Mfg. HOLTZER CABOT ELECT. Approx. size: 2⅝" x 2⅝" x 2⅝" **$15.00 ea.**

400 CYCLE MOTORS

PIONEER: TYPE CK5 2 Phase; 400 cycles **$35.00 ea.**

EASTERN AIR DEVICES TYPE J49A: 115 V; 0.1A; 7000 r.p.m. Single phase 400 cycle ....**$17.50 ea.**

AIRRESEARCH: 115V; 400 CPS; Single phase 6500 RPM; 1.4 amp; Torque 4.6 in. oz.; HP .03 ....**$10.00 ea.**

EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles, 6000 RPM ....**$12.50 ea.**

EASTERN AIR DEVICES, TYPE J31B: 115 V. 400-1200 Cycle. Single Phase **$12.50 ea.**

AIRESEARCH: AC induction, 200 V; 3 Phase, 400 Cycle, 2 H.P.; 11,000 RPM; 8 amps. ....**$79.50 ea.**

AIRESEARCH: AC Induction. 200 V; 3 Phase, 400 Cycle, 12 H.P. 6500 RPM; 1.5 amps **$25.00**

Electric Motor: PNT—1400—A1—1A Serial No. 207, 208 V., 400 cycles, 3 phase Kearfott Co., Inc. ....**$17.50 ea.**

SERVO MOTOR 10047-2-A; 2 Phase; 400 Cycle, with 40-1 Reduction Gear

SMALL DC MOTORS

DELCO #5072000: 27.5 VDC; 11.75 rpm **$15.00**

DELCO #5068750: constant speed; 27 VDC; 160 RPM; built-in reduction gears and governor ....**$17.50 ea.**

J. OSTER: series reversible motor; 1/50th H.P.; 10,000 RPM; 27½ VDC; 2 amps;

SPERRY #806069: approx. size 1⅝" x 3¼" **$7.50 ea.**

(Approx. size....4" long x 1¼" dial.)

General Electric Type 5AB10AJ37: 27 volts, DC; 5 amps. 8 oz. inches torque; 250 RPM, shunt wound; 4 leads; reversible..**$15.00 ea.**

General Electric, Mod. 5BA10FJ33; 12 oz. inches torque, 12 V DC, 50 RPM, 1.02 amp. **$15.00 ea.**

General Electric-Type 5BA10AJ52C; 27 volts. DC; .5 amps. 8 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible **$15.00 ea.**

GENERAL ELECTRIC DC MOTOR Mod. 5BA10AJ64. 160 r.p.m.; 65 amp; 12 oz.-in. torque; 27V DC ....**$19.95 ea.**

2¼ H.P. MOTOR—Mfg. LEECE-NEVILLE Co: Type 1454-MO; 24VDC; 4000 RPM; 100 amp **$35.00**

DELCO FAN

DELCO FAN - TYPE S.S.P. 115 Volts AC, 50/60 cycle, six inch blades, rubber shock mounted. Noiseless, ideal for exhaust and cooling purposes. Complete with mounting as pictured. NEW . . . Original Cartons ....**$5.95 ea.**

RECTIFIER POWER SUPPLY

INPUT: 220 VAC; 60 Cycle; 3 PH. **OUTPUT:** 28 VDC, 130 amp........................**$249.00**

BLOWER

Eastern Air Devices. Type J31B; 115 volt; 400-1200 cycle; single phase; variable frequency; continuous duty; L & R #2 blower; approx. 22 cu. ft./min. **$15.00**

BLOWER ASSEMBLY

115 Volt, 400 Cycle, Westinghouse Type FL. 17CFM. complete with capacitor. New ....**$12.50 ea.**

SENSITIVE ALTIMETERS

Pioneer Sensitive altimeters, 0-35,000 ft. range . . . calibrated in 100's of feet. Barometric setting adjustment. No hook-up required...**$12.95 ea.**

INVERTERS

10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. ....**$69.50 ea.**

PE 218 LELAND ELECTRIC

Output: 115 VAC; Single Phase; PF 90; 380/500 cycle 1500 VA. **Input:** 25-28 VDC; 92 amps; 8000 RPM; Exc. Volts 27.5 **BRAND NEW** ....**$39.95 ea.**

PE 109 LELAND ELECTRIC

Output: 115 VAC, 400 cyc.; single phase; 1.53 amp.; 8000 RPM; **Input:** 13.5 VDC; 29 amp. **$69.50**

MG-0-75 ONAN

Navy Type PU/11 . . . **Output:** 115 VAC; 480 cyc.; single phase; 5.3 amp and 26 VDC @ 3.8 amp. **Input:** 115/230 VAC; 60 cyc.; single phase **$225.00**

MG 153 HOLTZER-CABOT

Input: 24 V, DC, 52 amps; **Output:** 115 volts —400 cycles, 3-phase, 750 VA. and 26 Volt— 400 cycle, 250 VA. Voltage and frequency regulated ....**$95.00 ea.**

PIONEER 12130-3-B

Output: 125.5 VAC; 1.15 amps. 400 cycle single phase, 141 VA. **Input:** 20-30 VDC, 18-12 amps. Voltage and frequency regulated ....**$89.50 ea.**

12116-2-A PIONEER

Output: 115 VAC; 400 cyc.; single phase; 45 amp. **Input:** 24 VDC 5 amp....**$90.00 ea.**

10285 LELAND ELECTRIC

Output: 115 Volts AC, 750 V.A., 3 phase, 400 cycle, .90 PF, and 26 volts, 50 amps. single phase, 400 cycle, .40 PF. **Input:** 27.5 VDC, 60 amps. cont. duty, 6000 RPM. Voltage and Frequency regulated......**$195.00**

10486 LELAND ELECTRIC

Output: 115 VAC; 400 Cycle; 3-phase; 175 VA; .80 PF. **Input:** 27.5 DC; 12.5 amp; Cont. Duty ....**$90.00 ea.**

PIONEER 10042-1-A

DC INPUT 14 Volts; **OUTPUT** 110 Volts; 400 Cycle 1-Phase; 50 Watt............**$90.00**

94-32270-A LELAND ELECTRIC

Output: 115 Volts; 190 VA; Single Phase; 400 Cycle; .90 PF. and 26 Volts; 60 VA; 400 Cycle; .40 PF. **Input:** 27.5 Volts DC; 18 amps; cont. duty, voltage and freq. regulated **$95.00**

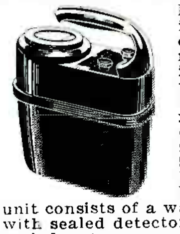
115 VOLT GENERATORS

Brand new Eclipse generators: 115 VAC; 9.4 amp; 1000 watts; single phase; 800 cycles, 2400-4200 rpm. DC output is 30 volts at 25 amp. Unit has spline drive shaft and is self-excited **$29.95**

MICROPOSITIONER

Barber Colman AYLZ 2133-I Polarized D.C. Relay: Double Coil Differential sensitive. Alnico P. M. Polarized field. 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc. .....**$12.50 ea.**

PORTABLE GAMMA SURVEY METER



Model 247B: For detecting and measuring higher intensities of Gamma radiations while obtaining discrimination against other radiations. Range switch permits selection on scales of zero to 50, zero to 500, zero to 5000, and zero to 50,000 milliroetgens/hour (MR/HR). Entirely self-contained, the unit consists of a watertight aluminum case with sealed detector assembly, hermetically sealed meter, vacuum tubes and circuit components with power supply of 1-45V dry battery and 1-300V dry battery. Dimensions are 10-¾" wide; 12-59/64" high; weight 12-¾ lbs. incl. batteries. Mfg. Victoreen Instrument Co. Original A.E.C. cost over $300. Buy it at a tremendous savings . . .
Brand New **$99.50**

Immediate Delivery

ALL EQUIPMENT FULLY GUARANTEED

All prices net FOB Pasadena, Calif.

BENDIX AIRCRAFT TYPE GENERATOR

Bendix-Eclipse Aviation; Type 1236 . . . Counter-clockwise rotation. Speed 2500-4500 RPM; 28.5 VDC @ 15 A. A Two-Brush ball bearing generator suitable for any application where 28 volt output is required. Field and armature taps for adjustment of voltage from 12 to 28 volts........**NEW 15.00**

G. E. GENERATORS

General Electric Type 5-ASB-31JJ3; 400 cycles out at 115 volts; 7.2 amps; 8,000 rpm.; size 6" long x 6" dia. ....**$99.50 ea.**

SINE-COSINE GENERATORS

(Resolvers)

Diehl Type FJE43-9 (Single Phase Rotor). Two stator windings 90° apart, provides two outputs equal to the sine and cosine of the angular rotor displacement. Input voltage 115 volts, 400 cycle..........**$30.00 ea.**

Diehl Type FPE-43-1 same as FJE-43-9 except it supplies maximum stator voltage of 220 volts with 115 volts applied to rotor ....**$25.00 ea.**

Arma Resolver Type 213014; equal in size to size 5 synchro; 55-60 cycle; single phase primary, 2 phase secondary.........**$79.50**

VOLTAGE GENERATORS (RATE)

ALNICO MIDGET D.C. VOLTAGE GENERATOR Type B-35-D **$17.50**

ALNICO MIDGET D.C. VOLTAGE GENERATOR Type B-44-D **$17.50**

A.C. GENERATOR: 67 V., 20 Cyc., 2-Phase, .015 Amps. Type PM-1, 1200 R.P.M...**$15.00**

SYNCHRONOUS SELSYNS

110 volt. 60 cycle, brass cased. approx. 4" dia. x 6" long. Mfg. by Diehl and Bendix.
Quantities Available.

REPEATERS ....**$20.00 ea.**
TRANSMITTERS ....**$20.00 ea.**

SYNCHROS

AUTOSYN MTR. KOLLSMAN Type #403; 32 VAC; 60 cycle; single phase......**$22.50**

AUTOSYN MTR., BENDIX Type #851; 32 VAC; 60 cycle; single phase..........**$22.50**

SYNCHRO TRANSMITTER, KEARFOTT Type R-212-1A-A Rotor; 26 Volts; single phase; Stator; 11.8 Volts; 3-phase; 400 cycle **$25.00**

MICROSYN UNIT, Type 1C-006-A...**$35.00**

IF Special Repeater (115V-400 Cycle) **$15.00 ea.**

2JIF 3 Generator (115-400 cyc.)..**$10.00 ea.**

5CT Control Transformer: 90-50 Volt; 60 Cy. ....**$50.00 ea.**

5F Motor (115/90Volt—60 cyc.).....**$50.00**

5G Generator (115/90 volt—60 cyc.) **$50.00 ea.**

5/DG Differential Generator (90-94 volts —400 cyc.) ....**$30.00 ea.**

TRANSMITTER, BENDIX C-78248; 115 Volt, 60 Cycle ....**$25.00 ea.**

Differential—C-78249; 115 Volt; 60 Cycle **$5.00**

5N MOTOR (115 Volts/60 Cycle).....**$22.50**

REPEATER, BENDIX C-78410; 115 Volt, 60 Cycle ....**$37.50 ea.**

REPEATER, AC synchronous 115 V., 60 cycle, C-78863 ....**$15.00 ea.**

REPEATER, DIEHL MFG. No. FJE 22-2; 115 Volt; 400 Cycle; Secondary 90 Volt **$27.50**

7G Synchro Generator (115/90 volt; 60 cycle) **$75.00**

6G Synchro Generator (115/90 volt; 60 cycle) **$60.00**

6DG Synchro Differential Generator (90/90 volt; 60 cycle) **$60.00**

2JF5J Selsyn Control Transformer: 105-55 Volts; 60 Cycle **$50.00**

5JD5HA1 Selsyn Generator: 115-105 Volts; 60 cycle **$50.00**

2JIF1 GENERATOR: 115—57.5 Volt; 400 cycle ....**$12.50 ea.**

2JIH1 DIFFERENTIAL GENERATOR: 57.5—57.5 Volt; 400 cycle..........**$12.50 ea.**

2JIG1 CONTROL TRANSFORMER: 57.5—57.5 Volt; 400 cycle ....**$7.50 ea.**

PIONEER AUTOSYNS

AY-1 ....26 Volt—400 Cycle.......**$6.95**
AY-5 ....26 Volt—400 Cycle.......**$7.95**
AY27D **$12.50**
AY6—26 Volt—400 cyc............**$4.95 ea.**
AY30D—26 Volt—400 cyc.........**$25.00 ea.**
AY14D **$10.00**
AY34 ....**$20.00**
AY20—26 Volt—400 cyc..........**$12.50 ea.**

PIONEER TORQUE UNITS

TYPE 12601-3-A: Contain CK5 Motor coupled to output shaft through 125.1 gear reduction train. Output shaft coupled to autosyn. follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15.1.**$70.00 ea.**

TYPE 12602-1-A: Same as 12606-1-A except it has a 30:1 ratio between output shaft and follow-up Autosyn ....**$70.00 ea.**

TYPE 12602-1-A: Same as 12606-1-A except it has base mounting type cover for motor and gear train ....**$70.00 ea.**

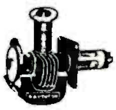
C and H Sales Company

BOX 356-X EAST PASADENA STATION • PASADENA 8, CALIFORNIA

COMMUNICATIONS EQUIPMENT CO.

MAGNETRONS

Type	Price	Type	Price
2J21	$8.75	2J39	$24.50
2J22	7.50	2J49	59.50
2J27	19.95	2J61	34.50
2J31	24.50	2J62	34.50
2J32	28.50	2J31	85.00
2J37	12.50	725-A	Write
2J38	16.50	730-A	24.50



QK 60, 61, 62—$85 ea.

KLYSTRONS

723A	$12.50	2K25/723A/B	$27.50
723A/B	19.50	417-A (Sperry)	17.50

SELSYNS

115 VAC 60 CYCLES 1 PHASE

1—Transmitter #C-78248
1—Differential #C-78249 } Per Set **$24.50**

Transmitter Units Only........$17.50 ea.

PULSE NETWORKS

15A—1-400-50: 15 KV, "A" CKT, 1 microsec. 400 PPS, 50 ohms imp. $37.50
G.E. #3E (3-84-810) 8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS, 50 ohms imp.; Unit 2, 8 Sections, 2.24 microsec. 405 PPS, 50 ohms imp $6.50
7-5E3-1-200-67P. 7.5 KV "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance 3 sections..........$7.50
7-5E4-16-60, 67P. 7.5 KV "E" Circuit, 4 sections 16 microsec. 60 PPS, 67 ohms impedance..........$15.00
7-5E3-3200-6FT. 7.5 KV, "E" Circuit, 3 microsec. 200 PPS, 6 ohms imp. 3 sections................$12.50
#755: 10KV. 2.2usec., 375 PPS. 50 ohms Imp...$27.50
#754: 10KV. 0.85usec., 750 PPS, 50 ohms imp..$27.50
KS8865 CHARGING CHOKE: 115-150H @ .02A, 32-40H @ .08A, 30,700V Corona Test, 21KV Test.$37.50
G.E. 25E5-1-350-50 P2T. "E" CKT, 1 Microsec. Pulse @ 350 PPS. 50 OHMS Impedance..............$69.50
KS9623 CHARGING CHOKE: 10H @ 75 MA, 380 Ohms DCR, 9000 Vac test $14.95
G.E. 6E3-.5-2000 50 P2T: 6 KV., "E" Circuit 0.5 usec /2000 PPS/50 ohms/2 sections $7.50

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp). Duty Ratio: .001 max. Pulse duration: 5, 1.0, 2.0 microsec. Input voltage: 115 v. 400 to 2400 cps. Uses: 1-715B, 4-829-B, 3-72's, 1-73. New ....Less Cover..$135
APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk pwr. out 35 KW Energy 0.018 Joules..............$49.00
TPS-3 PULSE MODULATOR. Pk. power 50 amp, 24 KV (1200 KW pk); pulse rate 200 PPS. 1.5 microsec. pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers, 115 v, 400 cycle input. New with all tubes $49.50

PULSE TRANSFORMERS

G.E. #K-2449: Line to magnetron: Pri: 50 ohms Z. 9.5 KV @ 80 Amp. Sec: 450 ohm Z: 28 KV @ 28 Amp. Peak pwr. 800 kw. (Pulse width: 1 usec @ 635 pps.) Twin bifilar secondary permits use of external filament transformer $62.50
UTAH X-151T-1: Dual Transformer, 2 Wdgs. per section 1:1 Ratio per sec 13 MH inductance 30 ohms DCR $7.50
UTAH X-150T-1: Two sections, 3 Wdgs. per section, 1:1:1 Ratio, 3 MH, 6 ohms DCR per Wdg....$7.50
68G711: Ratio: 4:1 6.7 Ohms, Pri: 0.23 Ohms sec.$4.50
TR1049: Ratio: 2:1 Pri. 220 MH, 50 Ohms, sec. 0.75H, DCR 100 Ohms..................................$6.75
K-901695-501: Ratio 1:1, Pri. Imp. 40 Ohm, Sec. Imp. 40 Ohms. Passes pulse 0.6 usec with 0.05 usec. rise $8.95
G. E. K.-2745 ....$39.50
Ray UX 7896—Pulse Output Pri. 5v. sec. 41v.....$7.50
Ray UX 8442—Pulse inversion—40v + 40v......$7.50
PHILCO 352-7250, 352-7251, 352-7287
RAYTHEON: UX8693, UX5986 ....$5 ea.
W.E.: D-166310, D-166638, KS 9800, KS9948.
UTAH #9262, with Cracked Beads, but will operate at full rated capacity.............................$5.00
UX 8693 (SCS #2Z9627-34); 3 Wdgs, 32 turns #18 wire. DCR is: .362/.372/.4 ohms. Total voltage 2500 vdc. $5.00
D-166173: Input: 50 ohms Z. Output: 900 ohms 3 Wdgs. Freq. range 10 kc-2mc. I/O AN/APQ-13 ....$12.50
K-2450: Pulse-inversion auto-transformer: primary 13 kv, 4 usec. Output: 14 kv @ 100 kw peak....$34.50
K-2748-A: Line to magnetron. Has magnetron well and provision for external fil. trans. $37.50

MICROWAVE COMPONENTS

"S Band," RG48/U Waveguide

POWER SPLITTER for use with type 726 or any 10 CM Shepherd Klystron. Energy is fed from Klystron antenna through dual pick-up system to 2 type "N" connectors ....$22.50 EACH
DIRECTIONAL COUPLER, Broadband type "N" Coupling. 20 db. with std. flanges, Navy #CABV 47AAN-2 ....$37.50
LHTR, LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated $49.50
BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each $47.50
MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated.......................$45.00
RT-39 APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR. cavity compl. recvr. & 30 MC IF strip using 6OK5 (2C40, 2C43, 1B27 lineup) w/Tubes.
721A TR BOX complete with tube and tuning plungers $12.50
McNALLY KLYSTRON CAVITIES for 707B or 2K28 $4.00
WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $32.50
AS14A AP-10 CM Pick up Dipole with "N" Cables $4.50
OAJ ECHO BOX, 10 CM TUNABLE..........$22.50
HOMERELL-TO-TYPE "N" Male Adapters, W.E. #D167284 ....$2.75
I. F. AMP. STRIP: 30 MC. 30 d.b. gain, 4 MC Bandwidth, uses 6AC7's—with video detector. A.F.C. less tubes $24.50
POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50
ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed $12.50
"E" or "H" PLANE BENDS, 90 deg. less flanges $7.50

⅞" RIGID COAX—⅜" I. C.

ROTARY JOINT. Stub-supported, UG 46/UG 45 fittings $27.50
10 CM STABILIZER Cavity, tunable, standard UG46/UG 45 fittings $45.00
RG 44/U RIGID COAX, stub support, 5 ft. sections, with UG46/UG45 connectors $12.50
RIGHT ANGLE BEND, with flexible coax output pick-up loop $8.00
RT ANGLES for above $2.50
SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00
RIGID COAX to flex coax connector..............$3.50
RT. ANGLE BEND 15" L. OA.......................$3.50
FLEXIBLE SECTION. 15 L. Male to female.....$4.25
⅞" RIGID COAX. BULKHEAD FEED-THRU..$14.00

X Band—RG 52/U WAVEGUIDE

UG 39 Flanges...$1.10
UG 40A/U Broadband Choke Flanges.............$1.65
1" x ½" waveguide in 5' lengths, UG 39 flanges to UG40 cover ....per length $7.50
Rotating joints supplied either with or without deck mounting. With UG40 flanges...........each, $17.50
Bulkhead Feed-thru Assembly....................$15.00
Pressure Gauge Section 15 lb. gauge and press nipple $10.00
Pressure Gauge, 15 lbs. $2.50
Directional Coupler, UG-40/U Take off 20 db..$17.50
TR-ATR Duplexer section for above..............$8.50
Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius. 90 deg. bend..............$4.50
Waveguide Section 2½ ft. long silver plated with choke flange $5.75
Rotary Joint choke to choke with deck mounting.$17.50
3 cm. mitered elbow "E" plane......................$12.00
90 degree elbows, "E" or "H" plane 2½" radius.$12.50
90 degree elbows, "E" or "H" plane 2½" radius.$3.00
45 degree twist $8.00
Microwave Receiver, 3 CM. Sensitivity: 10-13 µ Watts. Complete with L.O. and AFC Mixer and Waveguide Input Circuits. 6 I.F. Stages give approximately 120 DB gain at a bandwidth of 1.7 MC. Video Bandwidth; 2 MC. Uses latest type AFC circuit. Complete with all tubes, including 723A/B Local Oscillator $175.00
ADAPTER, waveguide to type "N", UG 81/U. p/o TS 12, TS-13, Etc. $27.50
ADAPTER, UG-163/U round cover to special btl. Flange for TS-45, etc. ....$2.50 each

APS-15 SPARE WAVEGUIDE PARTS

CU-73/APS-15A, SCS #2Z3265-73 right angle bend, E plane, 6½" x 10", with directional coupler on 6½" arm, type "N" takeoff 20 db coupling....$12.50 each
Z-607 Dwg. Symbol. Approx. 150 degree bend with 90 deg. twist. One end pick-up loop with press. fitting $6.50
Z-614: Philco 756-1142. CG124/APS-15A. Wave-selector: approx. 16" L. with 15 deg. bend at center (E-plane) 20 db coupling..............................$12.50
Philco 348-1425, 180 deg. bend, with pressure fitting $4.50
Z-609, Philco 348-1629. 13½" run, with bend & 90 deg. twist (on 3½" section) $6.75
Z-606: 8" run with 30 deg. bend (E-plane) one end $4.50
Philco 348-1427 E plane bend 11" x 6½"..........$6.50
CG1/APS-3 Philco 358-5212, S-curve 16" L with round contact flanges $5.75

RADAR TEST SETS

TS-56A/AP Slotted Line

Frequency Range and Characteristic Impedance
The Model TS-56A/AP Slotted Line is designed for operation over a frequency range of 300 to 675 megacycles. The slotted line has a characteristic impedance of 51 ohms.

Indicator
The indicator consists of a detector and meter which when mounted on the slotted line indicates the voltage along the line.
The indicator is divided into two separable units; the meter box and the resonator box. The meter box contains the meter, battery and all wiring. The resonator box contains the 957 tube, the probe and the tuning condenser in the resonant chamber.
The frequency limit as set by the resonant cavity of the indicator box is 340-690 megacycles.

Slotted Line
Since the length of the slot is 41.9 centimeters, no wave or wavelength greater than two times 41.9 centimeters can be used on the slotted line. This wavelength corresponds to a frequency of 358 megacycles. The slotted line has no upper frequency limits. However, the frequency limits of the complete unit are set by tuning range of the indicator box.

Cable
The cable supplied is the RG-8/U co-axial cable terminated by two Amphenol 93-M connectors. The nominal characteristic impedance of the cable is 52 ohms. The dielectric is stabilized polyethylene and the normal overall diameter is 0.405 inches.
The Amphenol 93-M connectors are provided with a special insert which is in the form of a shell that makes contact with the braid and the 93-M connector. The insert maintains the cable in on position and also provides electrical continuity between the slotted line and the cable.

Adapters
Two "Amphenol to Selectar" adapters are provided for use with an Amphenol 93-F connector (on end of slotted line) and a Selectar C-49195 connector. To connect a cable with a Selectar C-49195 connector to the end of the slotted line, the adapter must be used.

NEW, COMP. WITH ALL ACCESSORIES AND CARRYING CHEST... $235

TEST OSCILLATOR TS-47/APR

A. Function: The oscillator provides a calibrated high-frequency source for testing receivers. Unit can be operated from either an a-c or a d-c power source.
B. Electrical Characteristics:
Frequency Range: Two bands, 40 to 115 mc and 115 to 500 mc.
Signal Output: Sine wave of 1,000 cps modulated 50 percent, or a 70-mirosecond pulse with prf of 500 cps.
C. Specifications:
A-c Operation: 80, 115, or 230 volts at 50 to 2,600 cycles.
D-c Operation: 6.3 volts at 0.30 ampere (dial light off) and 202.5 volts at 0.016 ampere. Dial light draws 0.25 ampere. Four 1-½-volt and three 67.5-volt dry batteries are required.
Tube Complement
2 tubes 9002
1 tube 6X5GT
D. Signal Corps Stock No. 3F3910-47

Price, New................ $265

TS 268/UP Crystal Test Set for checking type 1N21, 1N21A, 1N22, 1N23, etc. Extremely compact, reliable, rugged. Operates from one flashlight cell. In portable wood case. New..$42.50

TS 270A/UP: Echo-Box for checking over-all performance of radar equipment operating in Sq Band. Brand new, complete with pick-up horn, spare crystals, cords, etc. P.O.R.*

SPERRY MICROLINE SX-12 Power Supply and Modulator, for operating 2K39, 2K41, 417A, etc. Operates from 115V, 60 Cy. Used. Excellent supplied with 2—417A Klystrons. P.O.R.*
* P.O.R. Price on Request

HIGH-POWER GEAR

TRANSTAT:
Type TH45BG: Input 130/260V. 50-60 cy. 1 ph. Output Range: 0-260V, 45A. Max. 11.7 KVA two-unit bank, parallel connected. Completely enclosed in cabinet with handwheel atop. Brand New **$325.00**

CIRCUIT BREAKER:
ITE Model KJ. Will handle 600 VAC at 115A. Break time adjustable from instant. to 10 minute. Break amperes adjustable from 115A to 1000% overload. Brand New **$15.00**

ALTERNATOR:
Louis-Allis Co. Type "AL", 198-C. Output 110/220V —1 ph, 60 cy. .9 P.F. 1200 RPM, completely self-regulating with built-in exciter. Brand new, original crates....... **$795.00**

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P. O. ALL MDSE. SUBJECT TO PRIOR SALE AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept E-8 Chas. Rosen Phone: Digby 9-4124

www.americanradiohistory.com

COMMUNICATIONS EQUIPMENT CO.

400 CYCLE TRANSFORMERS

(All Primaries 115V. 400 Cycles)

Stock	Ratings	Price
352-7102	6.3V/2.5A	1.45
M-7472426	1450V/1.0MA, 2.5V/.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A, P/O ID-39/APG-13	4.95
352-7039	640VCT @ 380MA, 6.3V/.9A, 6.3V6A 5V/6A	5.49
702724	9800/8600 @ 32MA	8.95
K59584	5000V/290MA, 5V/10A	22.50
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V0.9A, 6.3V 2.5A 6.3V/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/100/750V. @ .005A	7.45
352-7196	1140/1.25MA, 2.5V/1.75A, 2.5V/1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2X6.3VCT/6A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/806MA5V/3A, 6V/1.75A	4.25
352-7098	2500V/MA, 300, VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 63.V/.66A, 6.3VCT/21A	4.25
KS8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	650VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
352-7069	2-2.5V Wdgs. at 2.5A, Each Lo-Cap., 22Kv Test	5.95
352-7096	2.5V/1.75A, 5V/3A, 6.5V/6A, 6.5V/1.2A, P/O BC800	
352-7099	360VCT/20MA, 1500V/1MA, 2.5V/1.75A, 6.3V/2.5A, 6.3V/.6A, P/O BC-929	6.45
D163253	5200V/.002A, 2.5V/5A	5.35
M-7471957	2.5V/20A, 12KV Test	4.85
352-7179	250V/100MA, 6.5V/12ACT 5V/2A	3.45

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

- CTJ5-2-600VCT/.2A, 5V/6A $5.95
- CT-15A 550VCT .085A 6.3V/.6A, 6.3V/1.8A 2.85
- CT-164 4200V. .002A/12KV Test, 5VCT/3A/12KV Test, 6.3V/0.6A/5400V Test 12.95
- CT-341 1050 10 MA,—625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A 9.95
- CR 825 360VCT .340A 6.3VCT/3.6, 6.3VCT/3A 3.95
- CT-626 1500V .160A 2.5/12, 30/.100 .... 9.95
- CT-071 110V .200A 33/.200, 5V/10, 2.5/10 .... 4.95
- CT-367 580VCT .050 A 5VCT/3A 2.25
- CT-403 350VCT .026 A 5V/3A 2.75
- CT-931 585VCT .086 A 5V/3A, 6.3V/6A 4.25
- CT-456 390VCT 30 MA 6.3V/1.3A, 5V/3A 3.45
- CT-931 585VCT 86 MA 5V/3A, 6.3V/6A 4.95
- CT-442 525VCT 75 MA 5V/2A, 1 CT/2A, 50V/20 MA 3.85
- CT-720 550-0-550V/250 MA, 6.3V 1.8A 8.95
- CT-43A 600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A 6.49
- CT7-501 650VCT/200MA, 6.3V/8A, 6.3V/5A 6.49
- CT-444 230-0-230V/.085A, 5V/3A, 6V/2.5A 3.49

Filament Transformers—115V50-60 cps Input

Item	Rating	Each
FT-157	4V/16A, 2.5V/1.75A	$2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16 KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.95
FT-873	4.5AV/.5A, 7V/7A	2.19
FT-899	2x5V A 5A, 29KV Test	24.50

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45
STF-968	230V	2.5V/6.5A	3.50
STF-631	230V	2x5V/27A, 2x5V/9A	17.59

Special Plate Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STP-613	230V	230/.05A, 230V/.05A	$1.79
STP-409	220/440V	136VCT/3.5A	5.69
STP-815	240/440, 3ph	1310V/.67A, 6KV Test	27.50
STP-823	137V	222VCT/.3A	2.35
STP-08B	50V	2x750V/.001A	1.79
STP-945	210/220/230	550-0-550V/.3A	5.95

10 KW TRANSMITTER PARTS

1) Plate XFMR: Amertran 33134. Pri: 198/220/240V, 60 cy., 1 ph. Sec: 3650V, 16.7 KVA, 30 KV insulation. Oil Immersed.
1) Reactor, Modulation. Amertran 33153. 50 H @ 3.0 amps. DCR=80 ohms. Freq.—.03 cy. to 10 KC. Level: 63 DB. 40 KV Test. Impedance: 3000 ohms. A great value.
Both units (Trans & Choke) for **$695.00**

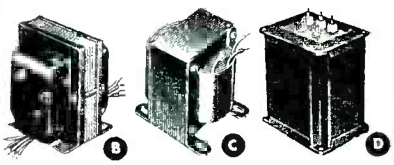
P-4 SYNCHROSCOPE

For observing Magnetron or Radar Modulator Pulses, Waveforms, Transients, etc. Designed by the Radiation Laboratory, this versatile scope has the following specifications:
Writing Speed: .04/0.1666/0.5/2 inches/ USEC
Local Oscillator: 500/1000/2000/4000 PPS
Trigger Gen. Output: 135V positive
Tube Line-up: 1—5LP1/ 2—2X2/ 1—5Z3/ 1—6SK7/ 2—6SL7 6—6SN7/ 1—7V7
P-4 Synchroscope, used, A-1 cond... **$125.00**

T-1 BOMBSIGHT PARTS

Main Servo Unit. Complete Mfr's. Pt. #1594486
Double Angle Servo Unit Assy. Pt. #1592448
Servo Motor Assy. Pt. #1590816
Write for prices

PLATE TRANSFORMERS



(All primaries are 110 v. 60 cps, single phase) DC ratings are approximate values obtained at output of a 2-section choke input filter using MV rect. tubes.

Stock	Volts A.C. RM.S.	Volts D.C.	Current (Mills.)	Fig.	Price
PT101	550-550	400	150	B	$6.43
PT157	660-660 550-550	500 400	250	B	8.42
PT158	1080-1080 500-500	1000 400	125 150	B	10.00
PT159	900-900 800-800	750 600	225		9.70
PT167	1200-1400 1175-1175	1200	300	C	24.10
PT168	2100-2100 1800-1800	1750 1500	300		30.58
PT062	2900-2900 2385-2385	2500 2000	300	D	47.04

*Simultaneous rating.

FILTER CHOKES

(Smoothing)

Type	Ind. (Hys.	Cur. MA.	DCR Ohms)	Test Volts	Fig.	Price
181	10	200	140	3000	B	$4.70
182	10	250	125	3000	B	6.47
183	8	300	80	3000	B	6.76
Swinging Input chokes						
187	4-16	150	210	3000	B	3.82
189	4-16	250	125	3000	B	6.47
190	3-14	300	80	3000	B	6.76

TELEVISION TEST GEAR

KAY MEGASWEEP. T.V. Align. Gen $215.00
KAY MEGAPIPPER T.V. Mark. Gen 85.00
KAY MEGAMARKER SR. Chan 2-13 Marker Gen 95.00
All Equipment is used, but excellent. Guaranteed to be in A-1 shape.

SELENIUM RECTIFIERS*

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp	$1 25	$2 10	$3 60	$7 50
2 Amps.	2 20	3 60	6 50	10 50
2½ Amps.	.....	.....	.....	13 00
4 Amps.	3 75		8 75	.....
5 Amps.	4 95	7 95	12 95	27 00
6 Amps.	5 50	9 00	14 00	33 00
10 Amps.	6 75	12 00	20 00	40 00
12 Amps.	8 50	16 00	25 50	50 00
20 Amps.	13 25	24 00	36 00	90 00
24 Amps.	16 00	31 00	39 50	98 00
30 Amps.	18 50	36 00	*Full Wave Bridge	
36 Amps.	25 50	45 00		

DYNAMOTORS

ALL BRAND NEW—ORIGINAL PACKING

TYPE	INPUT VOLTS	INPUT AMPS	OUTPUT VOLTS	OUTPUT AMPS	PRICE
PE 86	28	1.25	250	.060	$4.25
DM 416	14	6.2	330	.170	6.75
DM 33A	28	7	540	.250	3.95
BD AR 93	28	3.25	375	.150	7.50
23350	27	1.75	285	.075	3.95
B-19 PACK	12	9.4	275	.110	8.95
			500	.050	
DA-3A*	28	10	300	.260	6.95
			150	.010	
			14.5	5.	
5053	28	14	250	.060	3.95
PE 73 CM**	28	19	1000	.350	**
337	14	8	425	.160	7.95

* Replacement for PE 94.
** Price sent on request

INVERTERS

PE-218-H: Input: 25/28 vdc. 92 amp. Output: 115 v. 350/500 cy 1500 volt-amperes. New $44.50
PE-206: Input: 28 vdc. 38 amps. Output: 80 v 800 cy. 500 volt-amps. Dim: 13"x5½"x10½". New $22.50
NAVY CQR-211095: Input 22-30 VDC/75-60A. OUTPUT: 115V/400 CY. 1 KVA/8.7A. RPM: 4800. With coupling provision for motor. Brand New. Original packing $150.00

MOBILES! C. D. MEN! CAP!!

IDEAL DYNAMOTOR — CONVERTS EASILY TO SUPPLY UNIT DELIVERING

12 Volt Input— 610 V @ 150 MA 325 V @ 125 MA **OR** 6 Volt Input 300 V @ 90 MA 160 V @ 110 MA
Brand New with Conversion Data $3.75

VIBROPACK, Mallory Type G-556. Input 12 VDC. Out.: 225/250/275/300 VDC @ 100 MA. Brand New with 2 spare vibrators $12.50

VIBRATOR, -TR 1210. For use in industrial Inverters Delivering 115 Vac @ 100 Watts from 12 VDC $1.69

GN 35 HAND GENERATORS

BRAND NEW, IN ORIGINAL CARTONS. WILL DELIVER 8 V @ 2.5A AND 325-365 V @ 100 MA OR 10 V 1.25A AND 380-420 V @ 70 MA. LESS HAND CRANKS. A GREAT VALUE $17.50

This Month's Special

- ARC-3 PARTS
  - T-206 Output XFMR. #55320 .... $2.75
  - T-101 Mike XFMR. #55548 .... 1.50
  - T-102 Driver XFMR. #55545 .... 1.75
  - T-103 Audio XFMR. #55546 .... 1.75
  - T-104 Modulation XFMR. #55547 .... 3.25
  - T-105 Side Tone XFMR. #55544 .... 1.85
- Driver Transformer, for ART-13, T-202 .... 1.29
- Side-Tone Transformer, for ART-13, T-203 .... 1.19
- Modulation Transformer, ES-691025 for BC 456 1.19
- AN-104A Antennas for SCR 522 .... .95
- BC 929 Indicators, p/o APN-2 .... 32.50
- BC 451 Trans. Control Box, p/o SCR 274N 1.85
- C-30/ARC-5 Control Box 1.65
- FT-225-A Mounting Racks 1.65
- FT 227-A Shock Mount Racks 1.65

J-22/ARC-5 Junction Boxes 1.75
J-17/ARC-5 Junction Boxes 2.75
MD7/ARC-5 Modulators, all Tubes 5.95
MC 211 Right Angle Drives .... .21
BC 433G Compass Revrs., Used. Excellent 32.50
ART-13 Barometric Limit Switches 8.75
BC 306 Antenna Loading Unit for BC 375 .... 3.00
RL-7 Interphone Amplifiers, Used, Excellent. Less Tubes 3.75
SA-4A/APA-1 Motor Driven (28 VDC) Yagi-Antenna Switch 24.50
MT-36-C Ant. Loading Unit for TA-2J XMTR 35.00
A-62 Phantom Antennas, for use with Mobile XMTRS. 20-38 9 MC 40 Watts 3.95
RT-19/ARC-4 Trans-Receivers. 24 VDC. covers Amateur 2—Meter Band. Complete with Tubes and Crystals 39.50
Radar Trainer, Type 15-C. Consists of 4 separate XMTRS. Operating 380-500 MC., 1—Pulse Gen. 1—Power Supply, all Cables, 2 Inst. Books 215.00
Rubber Inserts. M-300 for HS-30 Headsets 3.25/M
BC 496A Dual Control Boxes (Receiver) for SCR 274N 1.35
T-30 Throat Microphones .... .69
National XS-3 Double-Bown Insulators. fits 2¾" Hole. All Hardware Included .... .65
IN-84 Double Cone Insulations .... 12 for $1.00

ARC-5 PLUGS

#5842	35¢	#7027	45¢
#5577	35¢	#7025	45¢
#PL 154	70¢	#PL 152	65¢
#PL 154A	70¢	#6418	35¢

C-114 Loading Coils .... .85
Overload Breaker: 500 MA @ 1000VDC Manual Reset. Heinemann AM 1610—.5 .... 1.45
Voice Coil & Diaphragm Assy. (Spares) for Beachmaster Speaker Assy. Will handle 50 W. Audio .... 45¢

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P. O. ALL MDSE. SUBJECT TO PRIOR SALE AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE. PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept E-8 Chas. Rosen Phone: Digby 9-4124

www.americanradiohistory.com

RADIO TUBES at New Low Prices

Type	Our Price	Type	Our Price	Type	Our Price	Type	Our Price	Type	Our Price
OZ4A	$.59	6AG5	.72	6K6GT	.54	12SR7	.69	805	3.50
1R5	.57	6AL5	.49	6K8G	.90	12SQ7	.56	808	1.75
1S4	.69	6AQ5	.54	6SG7	.67	35Z4GT	.59	830B	2.40
1T4	.61	6AX4GT	.94	6SK7 Met	.58	35Z5GT	.42	864	.29
1A5GT	.62	6B8G	.75	6SH7	.60	50L6GT	.50	866A	1.20
1B3GT	.93	6B8	.75	6SK7GT	.55	42	.64	9002	.80
1U5	.60	6BE6	.57	6SN7GT	.62	2E22	1.90	9004	.38
2X2	.56	6BQ6GT	1.05	6SS7	.80	5AP1	4.55	9006	.35
5T4	1.59	6C6	.59	6X5GT	.50	5BP1	5.00	2050	1.50
5U4G	.50	6H6 Met	.54	7Q7	.64	100TH	6.00		
6AB7	.83	6J5 Met	.50	12AU7	.65	357A	7.00		
6AC7	.82	6J5GT	.46	12SK7 Met	.55	803	2.75		

Purchasing Agents NOTE: all tubes are New, Standard Brands, Packed in original cartons. Immediate delivery. Terms 25% with order, balance C.O.D. Minimum order: Transmitting tubes $25.00, Receiving tubes—50 per type, or multiples of 50. Discounts on large orders. State quantity. Call or write today for detailed price list.

We are world-wide suppliers to Air lines, Government Agencies and the Radio industries.

METROPOLITAN OVERSEAS SUPPLY CORPORATION

1133 Broadway **New York 10, N. Y.** **Chelsea 3-1105**

Special Values!

RADAR INDICATOR

unit for conversion to test scope or for use as a modulation monitor. Less standard 5BP1 tube and controls. Complete with 7 tubes.

NEW $9.95

WRITE FOR PRICES

APS3 components
BC1306
PE237
BC433G
MG153
TN16, TN17, TN18,
BC1033
APS13
SCR269F & G
APR2
APR4 with tuning units
APR5
SCR625
SCR 508 crystal
350 ft. RG 54U cable
TS10
TS16
TS59
TS69
TS92
TS 100/AP
TS159/TPX
TS 184/AP313
TS251
EE8 Telephones
BC134
BC342
BC639 with RA52 Rectifier
SCR714 (BC1137)
Dynamotor DM28 (large quantity available)
BC376
RA42
CRT3
PM10
MN26Y
LP21LM
BC1277
BC1287
IE19A
MN26C

PLUGS

large quantity available—write for prices!

PL166 PL171 MC277 PL169
PL170 PL172 ART-13-U6U

Write for our new 1953 catalog!

Shipments FOB warehouse. 20% Deposit on orders. Minimum order $5.00. Illinois residents, add regular sales tax to remittance. *Prices subject to change without notice.*

R W ELECTRONICS
Dept. EL, 1712-14 S. Michigan Ave.
Chicago 16, Ill.
PHONE: HArrison 7-9374

TALLEN VALUES
PLUGS

PL 68 (W. E. Type 309) used	.25
W. E. Plug 310 used	.40
PL 68	$.90
PLP 170	2.50
PLQ 169	1.00
PLQ 171	1.00
PLQ 172	1.00
PL 172	1.00
Bias Meters 1-97A	6.50
P 4 Computers	150.00
E 78 Signal Generator	60.00
Antenna AT5/ARR-1	.50
Tuning Units for BC-610 NEW	12.50

MOTOR SALE

1/40 HP WITH SHAFT & FLANGE MTG.
115 V. 60 CY. 3450 RPM
50 V. 50 CY. 2850 RPM
$2.00 EA.

110 V. 2 POLE 60 CY. 1 PHASE
OILITE BEARINGS 1750 RPM
1½" SHAFT FOR DISPLAY MECHANICS
WITH MOUNTING BRACKET
.60 EA.

LIP MICROPHONES

MC 419 NEW .35

60,000 Used Headsets on sale 1.00 each
HS 18—HS 30—HS 38

Pressurizing Kit—Hand Pump—Dehydrator Cyl., 30 lbs pressure, Gauge and Hose Brand NEW....$4.50

CRYSTALS
25,000 Pieces in FT. 241 Holders
New @ $.10 each

Recorder for underwater sound equipment	$60.00
Transmitter—Aircraft T9/APQ-2, 115v. 400 cy. 26 VDC NEW	$20.00
Radar Transmitter T-26/APT-2, 115v. 400 cy. 200 Watts NEW	$30.00
Corner Radar Reflector NEW	$5.00
R5/ARN-7 Type Certificated	$250.00
TS125 Test Set, complete, NEW	$125.00 ea.
TS10 Test Set, NEW	$20.00 ea.
TS16 Test Set, NEW	$20.00 ea.

TALLEN CO., INC.
159 CARLTON AVE.
BROOKLYN 5, N. Y.
TRIANGLE 5-8241

Your Best Source For JAN Type Tubes

OB3/VR90	.95	9GP7	7.50	860	3.75
OC3/VR105	.95	10T1	.75	865	.95
OD3/VR150	.85	10Y	.39	866A	1.10
1B22	2.00	FG17	4.00	872A	3.25
1B26	2.25	RK60/1841	1.75	876	.70
1P23	4.00	RK72	.85	884	1.50
2C21	.35	100TH	6.75	918	1.50
2C26	.25	VU111	1.00	931A	3.95
2C39A	19.75	120A W.E.	5.00	954	.35
2C40	7.25	121A W.E.	2.50	955	.35
2C42	17.50	F123A	7.00	957	.35
2C46	15.00	F127A	15.00	958A	.55
2C51	5.25	211/VT4C	.49	1003	.75
2D21W	2.25	231D	2.00	1005	.50
2E22	1.75	250TH	20.00	1006	3.00
2E24	3.75	304TL Eimac	6.75	1007	.85
2E30	1.65	307A	3.25	1613	.80
2J22	6.75	309A	5.00	1616	.85
2J26	13.75	310A W.E.	5.00	1619	.25
2J31	22.50	311A	6.00	1624	1.25
2J32	22.50	313C	3.00	1625	.30
2J33	22.50	327A Eimac	3.95	1626	.30
2J34	22.50	371B	1.50	1629	1.00
2J54	50.00	394A	3.00	1641	1.75
2K22	35.00	417A	7.00	1644	.50
2K23	27.50	471A	2.00	2051	.90
2X2/879	.45	507AX	1.25	5670	3.25
3AP1	5.00	559	1.25	5726	1.75
3B26	3.50	WL681/685	32.50	7193	.40
3BP1	4.00	705A	1.50	8011	.85
3C24/24G	1.75	707A	7.00	8013A	4.00
3C31/C1B	3.00	715A	4.50	8020	1.25
3DP1	3.50	715B	7.50	9001	1.00
3DP1A	5.50	715C	19.50	9002	.80
3E29	12.50	717A	.80	9003	1.25
3GP1	3.50	721A	1.75	9004	.25
5C22	40.00	801A/VT62	.29	9006	.25
5NP1	4.00	813	9.25	Crystal Diodes	
C6J	5.75	814	2.25	1N21	1.00
6C21	18.00	829B	9.25	1N23A	2.50
7BP7	5.00	837	1.20	1N23B	2.75
		843	.50	1N26	6.75

Write For Our Special Prices on Receiving Type Tubes and others not listed
Rated Firms send P.O. F.O.B. N.Y.C.

ALLIED ELECTRONIC SALES
74 Cortlandt St., New York 7, N. Y.
Telephone BArclay 7-5839, 5840

CARRIER EQUIPMENT

Western Electric CF-1A 4-channel carrier telephone terminals.
EE-101-A 2-channel 1000/20 cycle carrier ringers.
CFD-B 4-channel carrier pilot regulated telephone terminals complete with four channels 1000/20 cycle ringing.
CFD-B 4-channel pilot regulated telephone repeaters.
C-42-A V. F. telegraph in from 2- to 12-channel terminals.
FMC 1 or 2 channels carrier telephone terminals, automatic regulation, duplex signaling each channel. Carrier frequencies above 35 KC. Ideal for adding channels above type "C".
Complete engineering and installation services offered.

RAILWAY COMMUNICATIONS, INC.
Raytown, Missouri
Telephone: FLeming 2121

X-RAY

All types for industrial and experimental application. Tubes, cables and components.

MEDICAL SALVAGE CO., INC.
217 E. 23rd St., New York 10, N. Y.
Murray Hill 4-4267

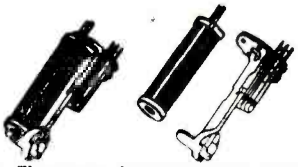
POWER TUBES REBUILT

UNIVERSAL VACUUM TUBE CORP.
137 Alexander Ave., Yonkers 2, N. Y.

www.americanradiohistory.com

SEE OUR PREVIOUS ELECTRONICS ADS FOR LISTINGS OR WRITE FOR CIRCULARS

TELEPHONE TYPE RELAYS



These relays have been standardized so that coils and frames of most manufacturers can be interchanged without affecting adjustments. A wide variety of applicable combinations are thus possible from a comparatively small number of relays.

Listed below are frames and coils from our stock. They may be purchased separately. However, a complete relay consists of coil and frame. In ordering complete relays specify which coil with which frame, i.e.: F101 with K117.

Representative completed relays are also listed with voltage and current ratings. Values are indicative of sensitivity that may be expected from similar combinations.

CLARE, 6500 ohm, 8maDC,3 makes (3As) #R276 ..... $4.25

5035A7 AUTOMATIC, 1300 ohm, 8maDC, SPST n.o. (1A), #103 ..... $1.75

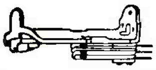
CLARE K101, 6500 ohm, SPDT, 2 ma DC. Fast Action #175 ..... $4.25

A18258 BENDIX (Cook 102) 8-12 VDC, Copper Slug, Slow Release, SPDT, 200 ohm, Part of SCR 522, #R365 ..... $2.49

R5229A1 AUTOMATIC 6VDC, 3PST n.o. (3As), 75 ohms. Slow Release, #412 ..... $2.50

R5024A1 AUTOMATIC 1300 ohm, 20maDC, SPST n.c. (1B), #413 ..... $2.95

FRAMES



(For Cost of Relay Add Price of Frame to Price of Coil)

Stock No.	Contacts	Price each	Stock No.	Contacts	Price each
F101	1A	1.25	F111	1B, 2A	1.75
F102	2A	1.50	F114	1B, 3A	2.00
F103	3A	1.75	F133	1B, 1C	1.75
F104	4A	2.00	F108	1B, 1A, 1C	2.00
F127	8A	3.00	F131	1B, 9A, 1C	4.00
F128	12A	4.00	F107	2B, 1A	1.75
F106	1A, 1B	1.50	F135	2B, 1C	2.00
F107	1A, 2B	1.75	F112	2B, 2A, 2C	3.00
F108	1A, 1B, 1C	2.00	F136	2B, 3A, 1C	2.75
F109	1A, 1C	1.75	F121	5B, 1C	2.75
F110	1A, 2C	2.25	F122	1C	1.50
F111	2A, 1B	1.75	F123	2C	2.00
F137	2A, 1C	2.00	F109	1C, 1A	1.75
F112	2A, 2B, 2C	3.00	F137	1C, 2A	2.00
F129	2A, 2B, 6C	5.00	F117	1C, 5A	2.75
F114	3A, 1B	2.00	F133	1C, 1B	1.75
F136	3A, 2B, 1C	2.75	F135	1C, 2B	2.00
F115	3A, 2C	2.75	F108	1C, 1A, 1B	2.00
F117	5A, 1C	2.75	F136	1C, 3A, 2B	2.75
F120	1B	1.25	F121	1C, 5B	2.75
F132	2B	1.50	F110	2C, 1A	2.25
F134	3B	1.75	F115	2C, 3A	2.75
F106	1B, 1A	1.50	F112	2C, 2A, 2B	3.00

SPECIAL CONTACT ARRANGEMENTS

We can supply any contact arrangement up to 20 contact leafs (10 form A or 10 form B; or combinations; or 6 form C) for a nominal extra charge. To compute cost of custom made frame add: 1.00 for blank frame plus .50 fo reach form C, plus .25 for each form A or B and 2.00 as the nominal extra charge Thus a frame with 2A, 3B, 1C would cost 1.00 + .50 + .75 + .50 + 2.00 = 4.75.

COILS

(For Cost of Relay Add Price of Coil to Price of Frame)

Stock No.	Ohms	Price each	Stock No.	Ohms	Price each
K101	0.75	1.25	K108	900	1.75
K131	5.0	1.25	K109	1000	1.75
K102	12	1.25	K136	1200	2.00
K156	50	1.25	K111	1300	1.75
K132	175	1.25	K137	1425	2.25
K153	300	1.50	K138	1500	2.25
K154	400	1.50	K139	1600	2.25
K104	450	1.50	K112	2000	2.25
K105	500	1.50	K140	2300	2.50
K133	600	1.50	K155	2500	2.50
K134	700	1.50	K113	3000	2.50
K107	750	1.50	K116	6500	2.75
K135	800	1.75	K118	40,000	3.25

SLOW-ACTION COILS

SLOW-MAKE			SLOW-RELEASE		
Stock No.	Ohms	Price each	Stock No.	Ohms	Price each
K122	33	1.50	K149	3.9	1.50
K146	125/1300	2.50	K123	75	1.50
K147	500/1500	2.50	K124	200	1.50
K148	1300	2.00	K150	800	2.00
K146	1300/125	2.50	K151	1000	2.00
K147	1500/50	2.50	K152	1300	2.25
			K127	2500	2.50

A-C COILS

Stock No.	Voltage	Price each
K119	6VAC	1.75
K121	110VAC	2.60

DUAL COILS

Stock No.	Ohms	Price each	Stock No.	Ohms	Price each
K141	50/2000	2.25	K145	1000/1000	2.25
K142	125/1300	2.25	K106	1100/500	2.00
K143	200/1000	2.00	K142	1300/125	2.25
K106	500/1100	2.00	K144	1800/500	2.50
K144	500/1800	2.50	K141	2000/50	2.25
K143	1000/200	2.00			

A = Normally Open; B = Normally Closed; C = Double Throw.

ADVANCE RELAYS

Type No.	COIL Volts	COIL Ohms	CONTACTS Circuit	CONTACTS Amps	Stock No.	Price Each
400	115AC		DPDT(2C)	10	R530	6.95
455	20ma	1800	DPST(2A)	10	R535	2.95
951B	6DC	115	SPST(1A)	10	R526	1.95
951C	24DC	270	SPST(1A)	20	R527	5.25
964B	115AC		DPDT(2C)	10	R528	3.50
964B	220AC		DPDT(2C)	10	R529	3.75
K1504A	220AC		DPDT(2C)	5	R531	2.95
K1604A	12½ma	6500	DPDT(2C)	5	R532	2.95
1713A	30ma	1000	4PDT(4C)	5	R533	4.95
1813A	115AC		4PDT(4C)	5	R456	4.95
1916A	24DC	160	5PDT(5C)	5	R535	2.95

ACCESSORIES FOR TELEPHONE TYPE RELAYS

Clare	CR1	Molded Bakelite Cover	#CR1	.90
Clare	BR2	Long Relay Bracket	#BR2	.20
Clare	BR4	Short Relay Bracket	#BR4	.15

FERRULE AND OTHER

WIRE WOUND RESISTORS

AT A FRACTION OF MANUFACTURERS' ORIGINAL COST!

IMMEDIATE DELIVERY

From Our Wide Assortment from 0.2 Ohms to 15 Megohms.

ENAMEL • GLASS
FIXED • ADJUSTABLE

New and in Perfect Condition. Nearly all made to JAN Specifications.

Send us your requirements. We have 250,000 wire wound resistors in a large variety of sizes in stock. Complete listing available upon request.

CAPACITORS

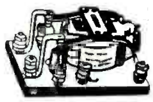
TRANSMITTING TYPE 4

MFD	WVDC	Test	Color	Price each
.00003	1200	2500	Y	.30
.00008	1200	2500	Y	.30
.00011	2500	5000	Y	.50
.001	600	1200	Y	.25
.001	1200	2500	B	.35
.001	1200	2500	Y	.40
.002	600	1200	B	.30
.002	1200	2500	Y	.45
.003	600	1200	Y	.35
.004	2500	5000	Y	.80
.01	600	1200	Y	.35
.01	1200	2500	Y	.45
.02	600	1200	Y	.45

TERMS:—All Prices F.O.B. Our Plant. Rated Firms. Net 10 Days: All Others Remittance with Order.

LEACH RELAYS

(Many Others in Stock)



Type No.	Coil No.	Volts D.C.	Ohms	Circuit	Stock No.	Price Each
604		12	40	2C, 1A	R536	7.50
1010	356C	22.5	325	1A	R212	1.50
1016	357D	24	375	1A	R286	1.50
1024	356A	24	265	3A	R537	2.25
1024A1	356A	24	265	2A	R214	2.25
1025SNBF	357CX	24	425	2B	R216	2.00
1054B	356A	24	265	2A	R253	2.25
1027	354	6	24	2C	R538	2.95
1028-434	359	20ma	1550	1A, 2B	R539	2.95
1037	361	2ma	10,000	2C	R540	4.50
1054B	356A	24	265	2A, 1B	R541	2.25
1077BF	355D	24	160	2C	R213	3.25
1154	371BL	50AC	...	2A	R215	2.25
1204	355	12	95	2A	R217	2.25
1204	356A	24	265	1A	R218	2.00
1220DE	354	6-12	24	1A(d.b.)	R542	1.95
1220DE	355	12-24	95	1A(d.b.)	R543	1.95
1224DE	355	12	95	2A	R219	2.25
1251	366	2.4	4	1A	R220	2.00
1251	354D	12	67	1A	R221	2.00
1251	361	120	10,000	1A	R222	3.70
1253DLW3	(2)355D	24	160(ea)	2 x 2C(d.b.)		
(2SPDT Relays on one base)					R544	5.25
1254A	355	12	95	1A	R248	2.00
1257WC	354D	12	67	2C	R249	3.25
1257M	372D	24	250	1C	R250	3.00
1257DEWBF	355DL	24	160	2C	R545	3.95
1257WC	354D	11-15	67	2C	R548	3.00
2 X 1251SR	368SR	6	16(ea)	2X1A(d.b.)		
1252	368	6	16	1B(d.b.)		
2 Slow Release plus 1 Normal Relay on 1 Base					R546	5.25
1254N	355	12	95	1A(d.b.)	R547	2.50
2024DE	354C	12	42	4A	R251	3.25
2024DE	355D	24	160	4A	R252	3.25

LEACH LATCHING RELAY

Type No.	Amps	Volts D.C.	Ohms	Circuit	Stock No.	Price Each
2406DN	356A	24	265	1A, 1B	R285	4.50
Release	356A	24	265	1A		

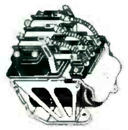
LEACH SOLENOIDS

Type No.	Amps	Volts D.C.	Ohms	Circuit	Stock No.	Price Each
B5R		24	153	1A	R549	2.95
1204-1		24	153	1A	R550	2.95
B8		7.5-29	6.5	1A	R551	2.95
5023CG17	50	24	100	1A,1B	R282	5.00
5030CSP	50	12	25	1A	R125	2.50
5058	200	24	10	1A	R283	6.00
7064-12C	50	12	40	1A	R284	2.25

AIRCRAFT SOLENOID CONTACTORS

All types B2: B2A; B4; B4A: B5; B5A: B5B; B6A: B6B: B7A: B7B: B8: B9: B11: 1204-1: 1204-3, etc. available from stock in quantities in popular makes at low prices. SEND US YOUR REQUIREMENTS.

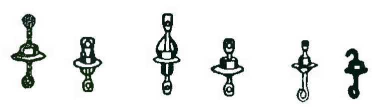
G. M. LABORATORIES RELAYS



DUAL COIL 10AMP CONTACTS

Type No.	Coil Volts D.C.	Coil Ohms	Circuit	Price Each
12792-1	18-24	100	3PDT(3C)	2.25
12885-1	24	300	1A, 1B, 2C	3.25
12700	1.0	1 1/2	1A	1.95
12897-1	24	300	DPDT(2C)	2.75
12917-1	8ma	2200	1B	2.00
13016	24	300	4PDT(4C)	3.95
13020	24	500	2A, 1B	2.25
12666	48	750	3C	3.95

KOVAR GLASS TO METAL SEALS HIGH-VOLTAGE FEED THRU



Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory cost.

SAMPLE KIT 96 Seals (8 ea. 12 types) — 5.00 postpaid in USA

LAB KIT 500 Seals (20 types) — 15.00 postpaid in USA

Orders Under $10 Remittance With Order, Plus Approximate Shipping Charges (overage will be returned.)

324 CANAL ST., N.Y.C., 13, N.Y. WAlker 5-9642

Universal general corp.

COAXIAL CABLES:

RG-8/U (SPECIAL) 51.5 ohms. Same size as RG-8/U. Prices: 1 to 100 ft. @ 8¢ per ft.—100 to 500 ft. @ 7½¢ per ft.—500 to 1000 ft. @ 7¢ per ft. —1000 ft. rolls @ 6½¢ per ft.
RG-34/U—71 ohms, 145 ft. length............$15.00

PE-103 DYNAMOTOR

With Filter Base and Cables, 6 or 12 VDC input; output 500 VDC 160 MA....NEW: $39.95—USED: $29.95

INVERTERS

5D21 NJ3A—27 VDC input; output 110 Volt 400 cycle, 1 Phase 485 VA....................$39.50
PE-109D—Input 13.5 VDC 29 A; output 115 V 400 cycle, 1 Phase 1.53 Amps....................$59.50
PU-7/AP—Input 28 VDC 160 A; output 115 V 21.6 A 400 cycle 2500 VA....................$89.50
PE-118—Input 28 VDC 100 A; output 115 V 400 cycle, 1 Phase 1500 VA..............Used: $14.95
PE-218—Input 28 VDC 100 A; output 115 Volt 400 cycle, 1 Phase 1500 VA..............Used; $24.95 NEW: $49.95
PE-115 or PE-206—Input 28 VDC 36 A; output 80 Volts 800 cycle 7.2 Amps........Like New: $12.95
TYPE 800-1-0—Input 28 Volts 62 A; output 115 V 7 Amps, 1 Phase 800 cycle............Used: $39.95 NEW: $69.95

BLOWERS

115 Volt 60 cycle BLOWER (pictured) - approx. 100 CFM Dis. 2¼" intake; 2" outlet. Quiet running Motor size: 2½"x3¼". NEW — not Gov't surplus.
Order No. 1C939 **$8.95**
DUAL BLOWER—Same as RN-520 above, except has blower assembly in each side of motor. Order No. 1C880....................$13.95
COMPACT TYPE—108 CFM. motor built Inside squirrel case. 4-½" Intake: 3-⅜" x 3" Dis. Complete size: 4-¼" W. x 9-⅜" H x 8-⅛" D. Order No. 2C067....................$14.50
FLANGE TYPE—140 CFM, 3-½" Intake: 2-½" Dis. Complete size: 8-½" W x 7-¼" H x 6-¾" D. Order No. 1C807....................$13.95
FLANGE TWIN—275 CFM. 4-½" Intake: 3-¼" x 3" Dis. Complete size. 11-¾" W x 9-⅜" H x 8-1/16" D. No. 2C069....................$21.95

TRANSFORMERS AND CHOKES:

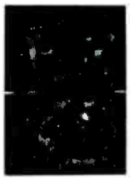
400 TO 2600 CYCLE

PLATE TRANSFORMER—Primary: 0-80-115 Volt 400-2600 CPS Max. VA 785; Sec.: 2000-0-2000 .3 Amps. Ins. 9000 Volts, Thermador #CS-5626 $19.95
FILAMENT TRANSFORMERS:
Primary: 0-80-115 Volt 400-2600 CPS Max. VA 35; Sec.: 2.5 Volts 10 Amps. Ins. 5000 Volts. Thermador #CS-8751 ....$6.95
Primary: 0-80-115 Volt 400-2600 CPS Max. VA 100; Sec.: 5 Volts 15 Amps. Ins. 5000 Volts. Thermador #CS-8750 ....$9.95
FILTER REACTOR—Inductance 2 Hy. DC current, 0.3 Amp. Ins. 5000 Volts....................$6.95

TRANSFORMERS—100V. 60 Cycle Pri.

5 VOLT CT-25A—10,000 V. Ins. OPEN FRAME—6" x 5" x 4-½".......$7.95
Sec. Two 12 V. 4 A. Windings—gives 12 V. 8 A or 24 V. 4 A............$5.95
Sec. 24 Volt ½ Amp. ..$1.50
Sec. 24 Volt 1 Amp. ...$1.95
Sec. 24 Volt 6 Amp. ...$5.95
Sec. 6-24 or 30 Volts 8 Amp. $5.95

MOTORS:



24 VOLT DC 1/10 H P

2800 RPM Reversible Motor, Size: 5-¼" x 3-½". Shaft Size: 1" x ¼". Emerson #186-0412 — Price............$5.95
GEAR HEAD for above motor. Ball Bearing Geared Shaft. 10 to 1 reduction **Price: $5.95**
COMBINATION: Motor and Reduction Gear $10.00
24 VAC OPEN FRAME—20 RPM Double Shaft Back Gear Motor with Disengage Clutch. Shaft size: 1-½" x 3/16" ....Price: $6.95
24 VAC OPEN FRAME—3 RPM Back Gear Motor. Shaft size: ⅝" x 3/16"................Price: $5.95
24 VDC REVERSIBLE—5000 RPM with Magnetic Brake. Flange Mount Spline Shaft—size: ⅝" x 3/16". Motor: 4" L. x 2-½" Dia. GE Motor only #5BA25AJ32A ....Price: $8.95
24 VOC AIRWAY MOTOR—Model #Z-350. Approx. 5000 RPM. Motor size: 2-½" x 1-⅝". Shaft size: ½" x ¼"....................Price: $4.95
26 VOLT 60 CYCLE—60 RPM Synchronous Cramer Motor #1147. Shaft size: 1" x ⅛"............$1.95
110 VDC 1/70 HP. 1550 RPM. Motor size: 4" x 2-½". Shaft size: 1" x 3/16". Redmond #157..$4.95
6 VDC 1/20 HP. 4000 RPM. Motor size: 5" x 3". Shaft size: ¾" x ¼". Redmond #E-56..Price: $4.95
12 VDC 1/30 HP. 4500 RPM. Motor size: 3" x 2-½". Shaft size: 1" x 3/16". Delco #5047520........$4.95

24 VDC REVERSIBLE

MOTOR—3.7 RPM, 40 lb. Torque. Motor Size: 5-½" x 4-1/32" x 3-5/16". Shaft Size: 21/32" x 5/16". Also operates 24 VAC. Philco No. 441-1008 ....$5.95
27.5 VDC—6000 RPM, 1.5 oz. in. Shaft Size: 1-⅛" x ¼". Motor Size: 2-½" x 1-½". No. 5069-267 ....$6.95
27VOC—1-10 HP—3500 RPM. Shaft Size: ⅝" x ¼". Motor Size: 4" x 3-½", Air Assoc. No. EE-763 $6.95
80 VDC—1/50 HP—3000 RPM. Shaft Size: ⅜" x ¼". Motor Size: 5" x 3". G.E. No. 5 PN38HA10..$8.95
28.5 VDC—1/35 HP—2200 RPM. Shaft Size: 1-½" x ¼". Motor Size: 4-½" x 3-¾". Electrolux No. 16876 ....$5.95

ADDRESS DEPT E • All Prices Are F.O.B., Lima, Ohio • 25 Deposit on C.O.D. Orders

FAIR RADIO SALES • 132 SOUTH MAIN ST. LIMA, OHIO

CRYSTALS!

In FT 241-A Holders—½ in. Pin SPC. These are designated 54th Harmonic MC freq. Listed by fundamental freq. with fractions omitted.

370	392	414	437	459	481	505
372	394	416	438	461	483	507
374	396	418	440	462	485	509
375	398	420	442	464	487	511
377	400	422	444	466	488	512
379	401	424	446	468	490	514
381	403	425	448	470	492	516
383	405	427	450	472	494	
385	407	429	451	474	496	
387	409	431	453	475	498	
388	411	433	455	477	501	
390	412	435	457	479	503	

5 CRYSTALS............................Assorted ONLY $2.75
10 for $4.50; 20 for $8.50
COMPLETE SET!!!!!—80 crystals covering above basic freq. including a 500 Kc. crystal. Lowest Price ever offered. COMPLETE SET............ **$14.50**

SPECIAL 500 Kc. Crystal............................$1.25
200 Kc. Crystal............................2.25
1000 Kc Crystal............................3.25
All above crystals sent postpaid in U. S. only. Also available in complete sets for SCR-608 SCR-528. SCR-628 and TRC. Foreign, wholesale and dealer inquiries invited. Write for LARGE QUANTITY DISCOUNTS.

Attention! Aircroft, Mariners, Hams!
SCR-183 12 V. RECEIVER & TRANSMITTER

Covers 210 398 Kc and 2,500 7,700 Kc. with plug-in tuning unit. TRF RECEIVER can be used as a radio compass. Has built-in loop input B plus 250 V. @ 60 mils. Internally modulated TRANSMITTER uses 350 V. EASILY CONVERTED TO 6 V. TRANSMITTER. Has built-in 2" Rd. 1.5 amp. R. F. meter. THINK OF IT! This combo covers low freq. for aircraft, marine band, and 80, 75, 40 meter mobile OR fixed ham bands. By converting coils (not the set!) can cover 20 and 10 meters too! EXCELLENT CONDITION! Complete with 12 V. Dynamotor. Look at prices and parts:
Xmtr. with coil..........$6.95 Rec. with coil..........$6.95
2 control boxes.......... 2.00 Tuning Head.......... 1.00
Flex cable.............. 1.50 Rack and shock mount.. 1.00
12 V. dynamotor supplies B plus to xmtr. and rec........ 5.95
Regular Value $25.35. The Whole Deal Complete with FREE Schematic. Only.. **$15.95**

BUYERS! We have largest stock in U. S. Complete line for export, wholesale, dealers, aircraft and industry.
SELLERS! We pay top prices for new and used radio gear. **Write for free catalogue!**
All orders F.O.B. Los Angeles. 25% deposit required All items subject to prior sale.

COLUMBIA ELECTRONIC SALES
524 South San Pedro St. Los Angeles 13, Calif.

SOLA
CONSTANT VOLTAGE TRANSFORMERS

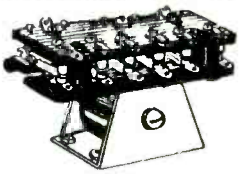
500 VA..................50.00
95-125/115 V

western engineers
ELK GROVE, CALIFORNIA

RELAY SPECIALISTS
AUTHORIZED FACTORY DISTRIBUTORS
STRUTHERS-DUNN POTTER & BRUMFIELD

100,000 RELAYS

ALL TYPES



SIX POLE DT ALLIED....................$6.95
SIGMA 4F 8000 OHM COIL................$6.86
SIGMA 5R DUAL 100 OHM COIL...........$4.95
SIGMA 5RJ 7500 OHM COIL...............$5.95

RADIO DEVELOPMENT & SALES CO.
323 ATLANTIC AVE. • ULSTER 5-0488 • BKLYN. 1, N.Y.

CHECK AND COMPARE OUR COMPLETE STOCKS

The following is just a partial list of the current electronic and aircraft equipment now in our warehouse. Write for complete information. Prompt replies to all inquiries.

RC-103 & AN/ARN-5 ILS
New in original cartons. Complete. Consists of all accessories, plus AS-27A, RR89B/ARN-5 and BC-733D. Modified to flag alarm.

TBS 4 & 5, NEW, COMPLETE
IE-17 TEST SET
AN/ARN-7 COMPLETE
SCR-269 COMPLETE
AN/ARC-1 VHF EQUIPMENT

BC-611 & BC-721 HANDIE TALKIES, Plus SPARE PARTS
Quantity available

AN/ART-13 EQUIPMENT

ATC XMTR	T-47A/ART-13 XMTR
T-47/ART-13 XMTR	CU-24 ANT. LOAD
CU-25 ANT. LOAD	DY-11 & 12 Dynam't'r
MT-283 MOUNT	0-16 LFO
MT-284 MOUNT	ATC DYNAM'T'R
SA-22 ANT. LOAD	C-87 CONTROL BOX

AN/APG-13-A RADAR
Absolutely complete, brand new

AN/APN-2	MG-153
SCR-729 New	APS-2, 3, & 15 Components
TA2J-24	AN/ARC-5 VHF
RTA-1B	SCR-274 & ARC-5
BC-1016	Command Equipm't
APA-6 INDICATOR	R-4/ARR-2 Receivers
APA-11 INDICATOR	BC-640 VHF XMTR
APA-17 RADAR	SCR-510
HS-33 HEAD SETS, NEW	SCR-522
MG-149F & H	MG-153

SPARE PARTS

SCR-720	SCR-522
SO-7	AN/ART-13
AN/ARN-7	AN/ARC-1
SCR-269	BC-611

SCR-718
Altimeter equipment—complete

To insure the finest of service and quality of merchandise, we have just recently put into operation our own reconditioning and function-testing plant, complete with all facilities.

WANTED
ART-13 CFI UNITS, ART-13 BC-788 1-152 BC-348 Q & R
TOP DOLLAR PAID

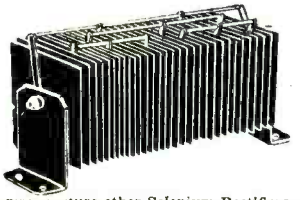
EXPORT INQUIRIES INVITED
We carry an unusually large stock of Airline Equipment. Test Equipment, Radar Sets, etc. Write for our low prices and complete information. We furnish immediate answers to all inquiries. Write today!

V & H ELECTRONIC INDUSTRIES INC.
2033 West Venice Blvd.—Dept. E-25
Los Angeles 6, California
Phone: REpublic 3-1127

www.americanradiohistory.com

DIRECTRON SELENIUM RECTIFIERS

Buy Direct From M'facturer



We can manufacture other Selenium Rectifiers, Selenium Rectifiers Supplies, XFMRS., & Chokes.

Full-Wave Bridge Types

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	$1.35	$2.15	$3.70	$7.50
2 Amps.	2.20	3.60	5.40	10.50
2½ Amps.	.....	.....	6.00	13.00
4 Amps.	4.25	7.95	12.95	25.25
6 Amps.	4.75	9.00	13.50	33.00
10 Amps.	6.75	12.75	20.00	40.00
12 Amps.	8.50	16.25	20.50	45.00
20 Amps.	13.25	25.50	38.00	79.50
24 Amps.	16.25	32.50	45.00	90.00
30 Amps.	20.00	38.50	.....	.....
36 Amps.	25.00	48.50	.....	.....

New Selenium Rectifier Transformers

PRI: 115 V., 60 cycles in.
SEC: 9, 12, 18, 24, and 36 volts
Continuous Ratings

4 Amps	$8.75
12 Amps	16.75
24 Amps	35.75
30 Amps	45.00
50 Amps	59.75

New Selenium Rectifier Chokes

4 Amps.—.07 Hy.—.6 ohm	$7.95
12 Amps.—.01 Hy.—.1 ohm	$14.95
24 Amps.—.004 Hy.—.025 ohm	$29.95

FILTER CAPACITORS

Capacity	W. Voltage	Ea.
500 MFD.	50 V.	.98
1000 MFD.	12 V	.40
1000 MFD.	65 V.	3.25

PARTIAL LISTINGS OF TUBES AND DIODES IN STOCK

OA2	.90
OB2	1.00
OD3-VR150	.98
1A7GT	.80
1AD4	1.85
1AE4	.90
1B3GT	.80
1B23	8.00
1B27	12.50
1L4	.60
1N21B	1.95
1N23A	2.25
1N23B	2.95
1N34A	.75
1N44-400B	1.21
1N45-400C	1.39
1N47	4.95
1N48(GE)	.55
1N52	.75
1N54(Syl.)	.77
1N54A	.90
1N64	.75
1N69	.60
1N70	1.25
1N81	1.00
1X2A	.90
2C39A	17.75
2C40	6.50
2C51	3.95
2C52	5.50
2E24	2.50
2E26	3.50
2E30	1.95
2J22	6.50
2J32	29.95
2J34	25.25
2J39	40.00
2J55	68.00
2K25	27.00
2K45	85.00
2X2	.50
3A4	.59
3AP1	9.00

3B28	7.50
3BP1	4.75
3BP11	9.50
3C23 (GE)	7.95
3C24-24G	1.35
3C27	7.50
3C33	9.00
3D6-1299	.50
3DP1-S2	6.50
3E29-829B	8.95
3FP7	1.75
3Q5GT/G	.99
4B24	4.50
4D22	19.25
4D32	19.25
4X150A	25.50
5A6	2.75
5D21 (WE)	14.75
5R4GY	1.25
5U4G	.55
5V4G	.95
5W4	.95
5X4G	.85
6AB7	.98

6AL5	.50
6AQ5	.55
6AS5	.70
6AT6	.60
6AU6	.59
6AV6	.49
6B8	.70
6BE6	.55
6BQ6GT	1.20
6BZ7	1.35
6C4	.45
6CB6	.45
6F4	3.50
6F6-M	.69
6F8-G	.85
6G6-G	.85
6H6	.70
6J5GT	.45
6J6	.62
6J7	.70
6K4 (Sylv.)	3.59
6K4A	3.50
6K6GT	.59
6K7 Mtl.	.60

• Vacuum Capacitors 50 MMF.—20 KV . . . $9.50

• W.E. Steel ¼" Panels 10½" x 19"—New— $1.00

6AC7	.77
6AG5	.70
6AG7	1.25
6AH6	1.00
6AJ5	1.30
6AK5	.65
6AK6	.98

6L5-G	.49
6L6-G	1.19
6L6GA	1.20
6L6 Mtl	1.95
6L7	.80
6N7 Mtl	.75
6Q7GT	.80

6S7 Mtl	.98
6SD7	.79
6SG7	.72
6SJ7	.69
6SK7GT(Syl)	.62
6SL7GT	.60
6SN7GT	.70
6V6GT	.55
6W4GT	.55
6W6GT	.85
6Y6-G	.88
6X5GT	.54
7A7	.69
7B7	.85
7A8	.69
7C5	.69
7C6	.69
7C30	85.00
7F7	.69
7BP7	3.95
7H7	.72
12A6	.50
12AT7	.75
12AU7	.62
12AV6	.49
12AX7	.79
12AY7	2.35
12BA6	.57
12BD6	.75
12BE6	.57
12BH7	1.15
12SA7	.75
12SF5	.70
12SG7	.80
12SH7	.63

12SJ7	.69
11SK7	.79
12SL7	.65
12SN7GT	.70
12SQ7GT	.63
12SR7	.60
14F7	.80
25AV5	1.25
25BQ6GT	1.00
25L6GT	.65
25Z6	.67
28D7	1.50
35B5	.49
35C5	.49
35L6	.69
35-T(Eimac)	2.75
35Z5GT	.49
50C5	.50
101-F(WE)	1.00
117Z6	1.00
F-123A	6.50
211	.75
250TH	17.00
FG-271/5551	55.00
274A & B	3.00
275-A(WE)	3.00
304-TH	7.75
304-TL	8.75
310-A (WE)	3.95
311-A (WE)	6.50
328-A (WE)	5.00
359-A (WE)	4.00
371-B	.35
373-A (WE)	4.00

374-A (WE)	3.50
387A (WE)	2.50
403-B (WE)	7.50
407-A (WE)	5.00
408-A (WE)	2.75
417-A/5842	5.95
418-A	5.95
464A/2C43	7.95
700-D	40.00
707-A	5.00
707-B	9.95
CK-710	1.00
715-A	5.00
717-A	.88
725-A	4.95
726-C	78.00
803	3.70
805	2.95
806	19.50
807	1.57
811	2.90
811-A	3.50
812	2.70
812-A	3.50
813	9.95
814	3.75
816	1.25
829-B	12.95
832-A	8.50
837	1.45
838	2.95
841	.40
843	.55
860	3.95
861	15.00

866-A(JAN)	1.20
866-A	1.55
869-B	70.00
872-A	3.95
955	.35
991/NE16	.50
NE48	.50
1613	.75
1616	.70
1622(6L6M)	1.95
1625	.35
1626	.18
1632	.70
2050 (RCA)	1.35
2051	1.00
5514 (Hyt.)	4.50
5516 (Hyt.)	4.50

5528/C6L	12.00
5608-A	3.95
5634	4.50
5636	5.20
5637	3.00
5638	3.00
5651	2.25
5654	1.75
5663	.80
5670	3.50
5678	1.75
5686	3.00
CK-5744	2.25
5732	3.95
5751	2.95
5838	3.00
5840	8.00

CK-5886	3.00
5800 (Vict.)	6.50
5814	2.65
5844	3.00
5910	.75
5995	3.50
8005	4.95
8020	2.20
9001	1.20
9002	.85
9004	.35
9006	.30
AX9903	17.75
SD-917A	3.00
SN-980D	3.00

• Vibrapacks—6 Volts Input—Mallory 350 V. @ 125 MA. Out—New $9.95

• W.E. Chokes—New—Herm. Sealed.—KS-9476—8 hy. @ 300 MA. $5.00
KS-13063—4 to 7 hys.—200 to 700 MA. 42 ohms average $7.75

• New Erco 4 Channel Ship-To-Shore Marine Transmitter—Receivers—F.C.C. Approved —Write

BARRY ELECTRONICS CORP

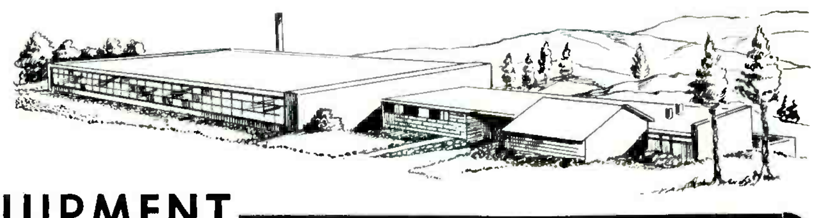
136-C LIBERTY STREET • NEW YORK 6, N. Y.

Terms: F O B-N Y C—25% Deposit with order—or send full remittance to save C O D charges—Rated Firms (D.&B.) Net 10 days—All merchandise guaranteed. CABLE: BARRYLECT, N. Y. Phone: REctor 2-2562

A NEW BUILDING

IMPROVED FACILITIES

for the manufacture of



WESTON TEST EQUIPMENT

DUMMY LOAD TS-90B/AP AVAILABLE NOW

Weston Laboratories, Incorporated is pleased to announce the availability of the new dummy load TS-90B/AP. These precision 50 ohm loads provide a means for terminating high power pulse modulators and for dividing the output by 50 for the purpose of measuring and viewing the output pulse with an oscilloscope. Capable of standing 500 watts of average power at a peak voltage of 5000 volts, these units are exceptionally well built with special components for unusually long life. Furnished with instructions from stock.

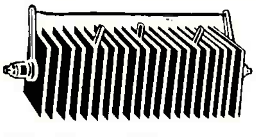
Other desirable pieces of test equipment include:

AN-APA-10
AN-APR-1
AN-APR-4
AN-TSM-4
AN-UPM-13
AS-23
AT-67
AT-68
AT-39
AT-48
BE-67
BC-221*
BC-376
BC-438
BC-439
BC-638
BC-639
BC-906D
BC-918B
BC-923A
BC-936A
BC-949/A
BC-595-TU
BC-1060A
BC-1066A
BC-1201A
BC1203
BC1236/A
BC-1255/A
BC-1277
BC-1287A
1-48B
1-49
1-56
1-61B
1-83A
1-86A
1-95A
1-96A
1-97A
1-98A
1-106A
1-114
1-115
1-117
1-122
1-126
1-130A
1-134B
1-135
1-137A
1-139A
1-140A
1-145
1-147
1-153A
1-157A
1-167
1-168
1-177
1-178
1-186
1-196A
1-198A
1-203A
1-208
1-212
1-222/A
1-223/A
1-225
1-233
1-245
1E-21A
1E-36
1F-12/C
1S-185
1S-189
LAD
LAE-2
LAF
LM*
LU-2
LU-3
LZ
ME-6/U
OA
OAA-2
OAK
OAW
P4
P4E
SG-8/U
TAA-16WL
TS-1ARR
TS-3A/AP
TS-8A/U
TS-10A/APN-1
TS-11/AP*
TS-12/AP*
TS-13/AP*
TS-14/AP
TS-15B/AP
TS-16/APN
TS-18
TS-19
TS-23/AP
TS-24/APM-3
TS-24/APR-2
TS-26/TSM-1*
TS-27/TSM
TS-32A/TRC-1
TS-33/AP
TS-34/AP
TS-35/AP
TS-36/AP
TS-39/TSM
TS-45/APM-3
TS-46/AP
TS-47/APR
TS-51/APG-4
TS-55/AP
TS-56/AP
TS-59
TS-60/U
TS-61/AP
TS-62/AP
TS-63/AP
TS-65A/FM2-1
TS-69A
TS-76-APM-3
TS-78/U
TS-87/AP
TS-89/AP*
TS-90*
TS-92/AP
TS-96/TPS-1
TS-98/AP
TS-100/AP
TS-101/AP
TS-102/AP*
TS-108/AP*
TS-110/AP
TS-111/CP
TS-117/GP*
TS-118/AP
TS-125/AP*
TS-127/U
TS-131/AP
TS-138
TS-142APG
TS-143/CPM
TS-144/TRC-6
TS-146
TS-147/AP*
TS-148/UP*
TS-153
TS-155
TS-159-TPK
TS-164/AR
TS-170/ARN-5
TS-173/UR
TS-174/U
TS-175/U*
TS-182/UP
TS-184/AP
TS-189/U
TS-192/CPM-4
TS-194/CPM-4
TS-195/CPM-4
TS-197/CPM-4
TS-198/CPM-4
TS-203/AP
TS-204/AP
TS-205AP
TS-207
TS-210/MPM
TS-218/UP
TS-220/TSM
TS-226A
TS-230B
TS-232/TPN-2
TS-239B
TS-250/APN
TS-251
TS-257/AWR
TS-263
TS-268B*
TS-270A
TS-281/TRC-7
TS-285/GP
TS-293
TS-297*
TS-301/U
TS-303/AG
TS-311/FSM-1
TS-323
TS-324/U
TS-328
TS-338
TS-359A/U
TS-363/U
TS-375
TS-377/U
TS-389/U
TS-418
TS-419
TS-421/U
TS-433/U
TS-465/U
TS-480/U
TS-505
TS-589/U
TS-615/U
TS-616/U
TS-617/U
TS-620/U
TSX-4SE
TSS-4SE
TVN-8SE
TUN-8HU
TTX-10RH

WESTON LABORATORIES, INC. HARVARD, MASS.

Cable: WESLAB Tel: HARVARD 250—AYER 300—TWX 193

SELENIUM RECTIFIERS

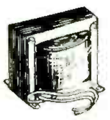


FULL WAVE BRIDGE TYPES

D.C. AMPS.	0-26 VAC 0-20 VDC	0-52 VAC 0-40 VDC	0-130 VAC 0-100 VDC	0-156 VAC 0-120 VDC
.5	.....	.....	$ 9.85	$11.40
1.0	.....	.....	15.50	18.15
2.0	$5.55	$10.10	20.50	23.95
4.0	7.45	13.95	29.65	36.00
6.0	8.00	14.65	30.40	37.00
8.0	9.65	18.20	42.00	49.60
12.0	10.25	19.05	43.85	51.80
15.0	17.40	32.80	.....	.....
22.5	18.20	34.30	.....	.....

RECTIFIER TRANSFORMERS

All Primaries Tapped
110-125 Vac 60 Cycles



SEC. VOLTS	AMPS	PRICE
18 VAC tapped at 9V.	10	$9.95
	35	35.00
	70	60.00
36 VAC	2	$5.95
	5	7.80
	10	12.95
	20	28.50
	35	45.00

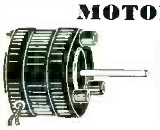
HI-AMP CHOKES

5 AMPS	.03 HY	.2 OHM	$7.95
10 AMPS	.015 HY	.06 OHM	13.95
20 AMPS	.007 HY	.03 OHM	28.50

FILTER CAPACITORS

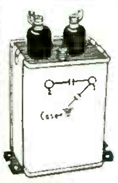
W.V. D.C.	Cap. Mfd	Price	W.V. D.C.	Cap. Mfd	Price
12	3000	$1.50	50	500	.95
15	1000	.75	50	1000	1.95
15	2000	1.25	50	2000	3.50
15	4000	2.50	150	200	1.75
18	1000	.90	200	500	3.25
18	2000	1.45	200	1200	6.50
25	1000	1.50			
35	2000	2.00			
35	3000	2.25			

MOTOR SPECIAL



Diehl Cat #FB2101-6 115 Vac 60 Cycles 0.4 Amps. 1800 RPM 4-Pole Shaded Type. Shaft ¼" x 1" Long. Ball Bearing. Cast Frame. Shpg. Wt. 6 Lbs. Brand New............ $4.50

OIL CAPACITOR

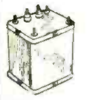


2 x .15 MFD 8000 V.D.C. Use both section in parallel for .3 MFD or in series for .075 MFD. Cat #26F381.................... 99c
Lots of six in orig. carton.....$5.00

MISCELLANEOUS

Grain-O-Wheat bulbs, type 319A, 3 volts Doz....$1.00
Selenium Rect., Bridge. 36VAC-28VDC 2 Amp... 4.95
Circuit Brkr, 10 Amp, thermal, push-to-reset... .40
APC 140 MMFD, screwdriver adjust .... .20
Thordarson Choke 10 Hys. 55 Ma. Fully Cased.. .65
Fuse, 1/40 Amp. 8AG....................Doz. .50
Oil Capacitor, 8 MFD 660VAC KGM6080...... 3.00
Phase Inverter, FTR MC-413-A w/tubes....... 3.00
Oil Capacitor, .5 MFD 400VDC, Rect. Case..... .10
Shaft Coupling, ceramic, ¼" to ¼"........... .15

FILTER CHOKE



50 Hys. 40 ma. 1780v. RMS Test. Raytheon Type U7402. Dimen. 3½" x 3½" x 3¼". Shpg. weight 6 lbs.........$1.50

Minimum order $5.00. All prices are FOB shipping point. Send check or MO. We will ship transportation charges collect. Rated concerns send P.O., Terms Net 10 days.

GATES ELECTRIC

63 WEST BROADWAY
New York, N. Y. Phone WO 2-7587

We have one of the largest stocks of special purpose tubes in the United States for immediate shipment. We sell tubes only and consequently each order receives individual attention from tube specialists. We sell only new tubes, standard brands, either JAN or commercial specifications depending on stocks on hand.

OA2	.92	2V3G	.89	250TH	16.50	811A	3.50
OA3/VR75	1.02	2X2	.45	250TL	16.50	812	2.70
OB2	.95	3AP1	8.95	285A	6.95	812A	3.50
OB3/VR90	.94	3B7/1291	.39	286A	5.75	814	2.95
OC3/VR105	.94	3B22	2.49	304TH	7.75	826	.75
OD3/VR150	.85	3B28	6.25	304TL	8.75	830B	2.60
1B22	1.98	3B29	8.95	307A	5.95	832A	8.50
1B26	2.25	3C24/24G	1.10	316A	1.25	836	4.75
1B27	12.25	3C28	4.95	327A	6.95	837	1.45
1B29	2.45	3CP1/S1	1.49	328A	3.95	838	2.95
1B32	2.50	3D6/1299	.35	329A	5.95	841	.59
1B36	6.95	3E29	13.95	331A	3.25	843	.39
1B56	34.50	3FP7	1.49	353A	4.25	860	3.75
EL1C	2.49	4AP10	3.95	357A	14.95	861	14.75
1D8GT	.89	4B28	2.95	371B	.95	864	.75
1L4	.59	4-125A	22.00	388A	1.49	866A	1.39
1N21B	2.50	4-250A	32.00	394A	4.75	869BX	49.50
1N23A	2.50	4E27	18.95	417A	8.50	872A	3.95
1N23B	3.49	4J42/700A	24.50	450TH	48.75	876	.95
1N34	.90	5AP1	3.49	450TL	49.50	879	.49
1N34A	1.00	5C30/C5B	3.75	530	16.75	923	1.25
1N35	2.20	5FP7	1.50	531	5.75	931A	4.50
1N38	1.75	C5B	3.75	532A	2.50	954	.35
1N38A	2.20	5R4GY	1.25	533	16.95	955	.35
1N39A	4.70	C6A	5.75	559	1.10	956	.69
1N48	.65	6AK5	.65	615	.39	957	.35
1N51	.50	7BP5	14.95	700A	24.50	958A	.65
1N52	1.30	7C4	.29	701A	4.50	E1148	.33
1N54	1.05	7E5/1201	.39	702A	2.00	CK1005	.75
1N54A	1.45	10Y	.45	703A	3.49	1291	.39
1N55	2.90	12A6	.49	704A	.89	1294	.59
1N55A	4.30	24G	1.10	705A	1.49	1299	.35
1N56	1.05	30 Spec.	.49	706AY-DY	39.50	1608	3.95
1N56A	1.45	RK34	.30	706EY-GY	39.50	1616	1.95
1N58	1.45	35T Eimac	2.75	707A	4.25	1619	.35
1N58A	1.80	45 Spec.	.30	707B	9.95	1625	.39
1N63	2.90	VT52	.19	708A	2.75	1626	.39
1N64	.65	VT62	1.25	710/8011	.49	1629	.35
1N65	.70	FG81A	3.49	713A	.95	1636	2.95
1N69 JAN	.90	RK60	2.49	715A	3.39	1641	2.49
1N70 JAN	2.40	RK73	.69	715B	4.50	1642	.49
1N71	7.20	REL5	16.95	715C	13.75	7193	.39
1N72	.95	VT90	.49	717A	1.25	8001	18.95
1N75	2.50	VT98	16.95	718BY	45.00	8011	.49
1N81 JAN	1.95	100TH	7.75	721A	2.25	8012	2.95
1N109	.65	VU111	.69	722A	1.50	8013A	3.95
1N111	4.30	HY114B	.95	723AB	9.95	8020	2.95
1N112	3.40	VT127	1.75	724B	1.75	8021	2.95
1N113	3.95	F128A	89.50	725A	5.95	9001	1.20
1N114	3.25	204A	36.75	800	1.75	9002	.85
1N115	1.80	205B	1.49	801A	.39	9003	1.25
1N125	1.05	206	95.00	803	3.75	9004	.29
1N133	.95	211	.75	805	3.25	9005	1.90
1N135	.90	211 VT4C RCA	1.75	807	1.59	9006	.25
2N37	9.70	217C	6.95	808	2.50	6 AMP TUNGAR	
2N38	7.20	245A	2.35	811	2.90	BULBS	2.95

MARITIME INTERNATIONAL COMPANY

11 STATE STREET NEW YORK 4, N. Y.
Phone: DIgby 4-3192 Cable Address: FOXCROFT

LOOKING FOR HARD-TO-FIND PARTS & EQUIPMENT?

Just a partial list of our present stock:

- BC-348 • BC-342 • ART-13
- ARC-3 • APN-9 • LM
- BC-221 • BC-611
- VARIOUS TEST EQUIPMENT

NEW EXPORT DIVISION
FOR ALL FOREIGN ORDERS

Prompt attention to all inquiries—all languages

Atten: Schools, Labs, Hams!
WE PAY MORE
FOR RADIO PARTS & EQUIPMENT
Cash in on your surplus equipment—or we'll trade for something you really need. Write today!

Write for FREE Surplus Catalog.

HARJO SALES CO

4109 BURBANK BLVD.
P. O. Box 1187
Magnolia Park Station
BURBANK, CALIFORNIA
Cable: HARJO

GLASS TUBING

PYREX - NONEX - URANIUM
BULBS & CYLINDERS
WRITE FOR FREE MONTHLY LIST
HOUDE SUPPLY COMPANY
PHONE KEYPORT 7-1286
M. R. #1 Box 86X Keyport, N. J.

NATVAR—YELLOW VARNISHED CAMBRIC

CLEARANCE SALE

Cloth

5000 Lin Yds. .005"—37" wide at 45¢ yd.
8500 Lin. Yds. .007"—37" wide at 40¢ yd.

Seamless Bias Tape

2500 Gross Yds. .005" & 300 Gross Yds. .007" both ¾" x 72 yds. at $1.70 per Gross Yd.

Samples on Request.
Quantity Discounts
All Prices F.O.B. your plant.

J. M. HIRSCH CO.
622 Washington St., San Francisco 11, Calif.

HARPER TUNNEL KILN

Model VM 912180—CCK 48, continuous car type, 48 feet long tunnel, overall length of 65 feet with two resistor chambers, 15 feet in length. Complete with transformer, recording controllers and Globar elements. Purchased in 1951 and used briefly.

M. SHERMAN
Carboloy Department of General Electric Co.
P. O. Box 237, Roosevelt Park Annex
Detroit 32, Michigan

www.americanradiohistory.com

SPECIAL PURPOSE TUBES

C1A	$6.25	3DP1A	5.00	RK-73	1.00	310A	4.50	706AY	30.00	812	2.00
1B22	1.75	3E29	10.50	FG-81A	3.00	311A	4.75	706FY	30.00	813	9.00
1B24	7.75	3EP1	3.50	FG-95	16.50	313C	2.25	706GY	30.00	814	2.50
1B35	8.00	3FP7	1.00	100TH	7.00	316A	1.00	707A	4.50	815	3.50
2AP1	6.75	3GP1	3.00	F-128A	65.00	323A	11.25	707B	9.50	829A	7.50
2C40	5.75	3JP12	15.00	VT-158	50.00	328A	4.25	708A	2.75	829B	9.00
2C43	8.75	3KP1	9.75	FG-172	18.75	329A	6.00	709A	2.75	832	6.00
2C44	1.00	4C27	12.75	FG-190	9.00	348A	4.50	714AY	5.25	832A	7.50
2E22	1.75	5BP1	3.50	203A	4.50	349A	6.50	715A	3.50	833A	30.00
2J22	5.25	5BP4	3.50	204A	37.50	353A	3.25	715B	4.50	836	2.50
2J26	11.25	5CP1	3.50	F-207	180.00	354A	15.00	715C	13.75	837	1.00
2J27	11.25	5CP7	7.00	212E	32.00	355A	10.50	719A	18.25	838	2.50
2J31	20.25	5D21	13.75	WL-218	35.00	368AS	5.25	721A	2.00	846	65.00
2J32	22.50	5FP7	1.50	221A	1.50	375A	10.50	722A	1.50	849	22.50
2J33	20.25	5FP14	12.25	F-232CH	180.00	394A	3.00	723A/B	13.50	860	2.75
2J34	18.75	5JP1	16.75	250R	7.00	417A	6.00	724A	2.00	861	10.00
2J38	9.00	5JP4	16.75	250T	10.00	GL-434A	9.75	724B	2.00	866A	1.00
2J50	15.75	5JP11	16.75	250TH	13.50	446A	1.00	725A	4.75	872A	2.25
2J55	63.75	5J23	30.00	250TL	11.25	446B	2.25	726A	10.50	878	1.50
2J56	122.50	5J29	9.00	253A	11.75	450TH	40.00	726B	35.00	884	1.25
2J61	30.00	5J30	29.50	267B	8.75	450TL	35.00	728CY	25.00	902-P1	4.75
2X2A	1.25	5R4GY	1.00	271A	7.25	GL-451	3.00	728DY	25.00	918	1.25
3AP1	6.00	6C21	18.25	272A	5.25	464A	6.00	728EY	25.00	927	1.00
3BP1	3.75	6CF	12.75	274B	2.25	WL-530	12.75	728GY	25.00	931A	3.75
3B24	4.25	C6L	9.00	276A	7.50	575A	10.50	730A	18.75	CK-1006	2.75
3B26	2.75	7BP7	4.50	282A	10.25	700A	12.50	803	3.00	1622	1.50
3C23	8.75	9LP7	2.25	286A	6.00	700D	12.50	805	2.25	1624	1.00
3C24	1.25	12DP7	10.75	304B	5.75	701A	4.50	807	1.25	2050	1.00
3C31	2.50	12GP7	13.50	304TH	6.00	702A	2.00	808	2.00	8012	1.50
3D21	2.25	RX-21	2.75	304TL	5.00	703A	3.50	810	7.50	8013	2.00
3DP1	3.00	RK-60	1.50	307A	3.25	705A	1.25	811	2.25	8025	3.50

- Receiving tube quotations upon request
- Usual terms apply

western engineers

ELK GROVE, CALIFORNIA

GEORGE WHITING, OWNER

- Unconditional guarantee extended
- Subject to prior disposition

WANTED
ARC-1, 3, ART-13, BC-342, 348, APS-10, 15, TS-13, 35, 146, 147, 148, 174, 175, 263 ETC. ALL SCR, BC, AN, TS. ALL TUBES.

RADALAB

1964 Webster Ave., Bronx 57, N. Y.
TEL: WE 3-3232-3

TERMS—Minimum order $25.00 all prices FOB New York City. 25% deposit with order, balance COD. Rated firms open account. Prices subject to change without notice.

RADAR

APS-15A&B

Complete sets available checked out.

APS-3

Complete sets avail. checked out..$1050.00

APS-4

Complete sets avail. checked out..$1050.00

APN-2

Complete sets avail. checked out
SCR729 also avail.

ASD

3CM search & nav. radar compl. sets avail. $1000.00

APS-10 3cm lightweight navigational & search radar 5" PPI
UPN-4 3cm portable radar beacon
APR-1 38-1000mc receiver
APR-4 38-4000mc receiver
APR-5 1000-6000mc receiver
APT-5 300-1300mc Trans.
SCR-522 100-156mc Xmit-Rec.
SCR-555 18-65mc long range direction finder
SCR-536 Handi-Talkies
BC-312 and **BC-342** 1.5-1.8mc Receivers

Many other airbourne, ground and marine military equipment available. "WRITE"

TUBES ALL FULLY GUARANTEED

OA2	$.89	845	5.40
OB2	.95	866A	1.40
1B24	9.75	869BX	52.50
1P21	29.75	872A	3.25
2C40	9.25	884	1.80
2C42	8.50	931A	5.25
2C43	12.95	958A	.75
2J41	WRITE	959	2.95
2K25	30.00	1603	5.15
2K28	31.50	1624	1.40
2K50	WRITE	5516	5.25
3C45	14.95	5643	7.25
3D21A	4.69	5651	2.65
3DP1	3.50	5654	1.95
3DP1/S2	5.95	5670	4.00
3E29	11.75	5672	1.40
3J21	WRITE	5676	3.30
5LP1	14.75	5687	3.95
6C21	19.75	5691	7.65
6J4	5.90	5692	7.65
100TH	8.95	5693	6.50
211	.96	5702	2.95
250TH	16.50	5703	1.89
250TL	16.50	5704	2.40
304TH	7.90	5718	6.50
304TL	7.90	5719	8.65
307A	6.25	5726	1.69
703A	3.95	5814	2.75
705A	1.85	5876	16.50
707A	7.95	6005	4.35
707B	15.95	8005	6.40
715B	9.25	8020	1.10
715C	19.75	8025	4.75
721A	2.80	9001	1.40
723A/B	18.75	9003	1.50
725A	7.40	FG17	3.50
726A	14.50	FG32	11.75
803	3.75	FG57	17.50
805	4.25	FG97	22.50
807	1.69	FG105	17.50
811	2.95	FG172	35.00
813	10.50	OA3/VR75	.97
814	2.95	OB3/VR90	.89
815	3.75	OC3/VR105	.95
829B	11.75	OD3/VR150	.98
832	7.95	WL676	49.50
832A	9.40	WL677	45.00
833A	39.50		

Complete stock of receiving tubes available

TEST SETS

TS-3/AP S band power, freq. meter.$215.00
TS-13/AP 3 CM sig. gen. power meter, freq. meter 110 v. 60 cycle.
TS-14/AP 10 CM sig. gen. power meter, freq. meter. 110v 60 cycle........$650.00
TS-34/AP portable syncroscope.....$290.00
TS-35/AP 3 CM sig. gen. power meter, freq. meter 110v 60 cycle.
TS-45/AP 3 CM sig. gen. and freq. meter.
TS-61/AP 10 CM echo box.
TS-62/AP 3 CM echo box.
TS-125/AP 10 CM precision power meter.
TS-148/UP 3CM spectrum analyzer.
TS-226/AP 300-1000 MC power meter.
I-100 radio compass test set.
I-208 V.H.F. field radio test set.
BC-221 freq. meter Mod. $175.00
Unmodulated $125.00
IE-19 100-156MC test set.
IE-36 SCR 522 test set...............$40.00
TSX-4SE spectrum analyzer.

SPECIAL

K-band 23,000, 24,000 MC RF heads using 2K50 klystrons and 3J21 packaged magnetron and magic TEE AFC mixer very late type. Also K-band complete dual-scanner antenna system. TS-259A/AP K-band sig. gen. power meter, freq. meter also available. Write

X and K-band Wave Guide Components

Slotted lines, term., adapt., crys. mounts, etc. in stock. SEND YOUR REQUIREMENTS.

WRITE FOR OUR CATALOGUES

www.americanradiohistory.com

FOLLOW **ARROW** FOR
MILITARY ELECTRONICS

EE-99 PHONE AMPLIFIER Booster amp. for voice frequency. Battery operated. Complete with 12 V. power supply. New. $24.50

Radar

APR-4 New. Complete	APT-3	RC-224
APR-5	APT-4	RC-266
APS-4 New. Complete	Mark 16	RT34/APS13
APS-6 New. Complete	MD4/AP2	T-85/APT-5
APT-1 APT-2	MD5/APS3	PP-104/APT-5
	MD22/UPN2	MD38/APQ13
	RC-184IFF	
	RC-211	

TS-159/TPX

Can be used as frequency meter. 150-200 MC. Separate 30 MC. output. Unit is crystal controlled. 2" meter has two scales: 0-50 and 0-500 VDC. Operates from 110 V. 400 cyc. Easily converted to 110 V. 60 cyc. Complete, new, with schematic. Only **$69.50**

Test Equipment

Complete Line

DuMont 224-A Oscilloscope		TS127/U
1-77 Hickok Tube Checker		TS131
1-208 FM Signal Generator		TS-148/UP
RPC Model 614 Multimeter		TS170/ARN
Hewlett Packard 200-C		TS-173/UR
1-198	TS-23/APN	TS-174/UR
BC-638	TS-24A	TS175/UR
BC-1255	TS-28/UPN	TS182/UP
CWI-60ABJ	TS27/TSM	TS184A/AP
1E-36	TS-33	TS204/AP
1-95	TS34/AP	TS-218
1-96-A	TS-35/AP	TS251
1-122	TS36/AP	TS323/UP
1-130A	TS-45A	1-146
1-139	APM-3	TS-268/U
1-145	TS-59/APN	Boonton Mod. 78B Sig. Gen.
1-212	TS61/AP	
1-222	TS89	Boonton Type 102F Sig. Gen.
TS-3A/AP	TS92	
TS10A/APN	TS100/AP	LAD Sig. Gen.
TS12/AP	TS-102	LAE-2
TS-12 Spare Parts Kit	TS111/CP	LAVOIE Freq. Meter: 300-600 Mc.
	TS-118/AP	
TS16/APN	TS126	
TS19/APQ		

HEWLETT-PACKARD #205

RECEIVERS—TRANSMITTERS

ARC-1	PE-125AX	RTA/1B
ARC-3	R-9/APN-4	SCR-522
R-4/ARR-2	BC-733-D	TA2J-24
ID-6/APN-4	R-57/ARN	R-89/ARN
MP-10G	BC-788-A-AM-C	R-1/ARR-1
BC-640	BC-639	RM-25
RM-26	SCR-284	SCR-536
SCR-540	MN-26 Complete Installation	

SCR-561 Equip.
Motorola Model Fstr-250
EE 89 phone amplifier

FLUXMETER

Used to calibrate field strength of magnets from 500 to 4000 gauss and indicate polarity. Probe has gap of 1¼". Beautifully built in hardwood case with hinged cover. Instructions for operation on under side of cover. Size 12¾ x 9 x 6 in. for lab and school use. New. An exceptional value at. **$29.50**

MANUALS! We have up-to-date collection of Radar and Radio MAINTENANCE MANUALS. Write for complete list.

GOVERNMENTS, AIRLINES AND INDUSTRIALS!
Send for FREE Catalogue No. 112 for complete list of Military, Industrial and Aviation Electronics. WE HAVE THE LARGEST INVENTORY OF SUCH EQUIPMENT IN THE UNITED STATES.

EQUIPMENT WANTED!

ARROW SALES INC.

Mailing Address: P. O. BOX 3878-E, N. HOLLYWOOD, CALIF.
Office-Warehouse: 7460 VARNA AVENUE, N. HOLLYWOOD, CALIF.
POplar 5-1810 • STanley 7-6005 • Cable Address: ARROWSALES

WHEN YOU ORDER WELLS COMPONENTS...

HERE'S WHAT YOU GET

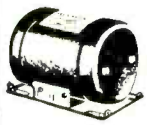
1. IMMEDIATE DELIVERY FROM STOCK (in any quantity)
2. FINEST QUALITY OF FAMOUS BRANDS
3. GENERALLY LOWER PRICES
4. RETURN PRIVILEGE FOR FULL CREDIT IF NOT SUITED TO YOUR REQUIREMENTS

The valuable service Wells provides to the industry is being used by many of our greatest manufacturers as a matter of course.

Our vast stock (the world's largest) may contain just the components you need to fill urgent orders — at a substantial savings in time and cost.

ADEL CLAMPS • ANTENNAS, Insulators, Mast Sections • BINDING POSTS • BLOWERS • CABLE ASSEMBLIES • CHOKES • COILS • CONDENSERS Oil Filled, Bathtub, Hearing Aid, Transmitting Micas, Silver Micas, Ceramic, Variable, Trimmer • CRYSTALS • FILTERS • FUSES & MOUNTINGS • GENERATORS • GROUND RODS • HEADSETS • I.F. COILS • JACKS • JACK BOXES • KEYS, Telegraph KNOBS • LAMPS • LORD MOUNTS • LUGS MOTORS & BRUSHES • PLUGS • RECTIFIERS Selenium, Copper Oxide, Meter, Diode • RESISTORS—All Types • SELSYNS • SOCKETS • SWITCHES Aircraft, Micro, Switchettes, Toggle • TIMERS • TUBING—Flexible • TUNING SHAFTS • TRANSFORMERS All Types • VIBRATORS • WALKIE TALKIES

DYNAMOTORS



OVER 100,000 NEW DYNAMOTORS IN STOCK!

DM 32A — DM 53A — PE 86 — PE 101C
DM 33A — D 101 — PE 94, etc.
Large quantities of brushes for all types of dynamotors and motors.

Write us for quotations. Advise us your requirements.

A complete Signal Corps stock number listing of items in our stock. Write for listing No. SG-200. (For government agencies and contractors only.)

Manufacturers and distributors—write for new Condenser Catalog C-10 now available.

Write, Wire, Phone Your Requirements
all phones: **SEeley 8-4143**

WELLS SALES, INC.

833 W. CHICAGO AVE., DEPT. SL, CHICAGO 22, ILL.

BG-645 TRANSMITTER-RECEIVER

15 Tubes 435 To 500 MC

Set can be modified to use for 2-way communications, voice or code, on following bands; ham band 420-450 mc. citizens radio 460-470 mc. fixed and mobile 450-460 mc. television experimental 470-500 mc. 15 tubes tubes alone worth more than sale price!): 4—7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs.

BRAND NEW, $49.50 each

CONVERSION DIAGRAM INCLUDED!

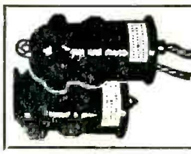
PE-101C DYNAMOTOR for above BC-645 .... **$4.85**
UHF ANTENNA ASSY, for above BC-645 .... **$2.45**

BC-221 FREQUENCY METER

Reconditioned. PERFECT! Complete with tubes and crystal **$129.50**

SCR-274N COMMAND & ARC-5 EQUIPMENT

Type	Excellent USED	BRAND NEW
BC-453 Rcvr 190-550 Kc	$28.50	$44.50
BC-454 Rcvr 3-6 Mc	12.50	24.95
BC-455 rcvr 6-9 Mc	12.95	17.95
BC-456 Modulator	3.75	5.75
BC-457 Xmtr 4-5-3 Mc	18.50	29.50
BC-458 Xmtr 5.3-7 Mc	9.75	37.50
BC-459 7-9.1 Mc	19.95	24.50
BC-450 3-rcvr control box	1.49	2.45
BC-451 Xmtr control box	1.25	1.95
3-Receiver rack	1.79	2.95
2-Transmitter rack	1.59	3.25
Single Transmitter rack		3.25



SELSYN 2J1G1

Operates from 57½ V 100 cycles. Suggested wiring for 110 V 60 cycle included. New, tested. Price Each..... **$4.50**

DYNAMOTORS

TYPE	INPUT Volts	OUTPUT V @ A	Excellent USED	BRAND NEW
PE-86	28	250 @ .06	$ 2.95	$ 5.50
DM-28	28	224 @ .07	5.50	10.50
PE-101C	12/24	400 @ .13	2.75	4.85
PE-103	6/12	500 @ .16	22.50	34.50
PE-94	28	300 @ .2	4.95	7.95
DM-32	28	250 @ .06	4.75	8.50
DM-21	14	235 @ .09		16.50
BD-77	12	1000 @ .35		27.50

HEADSETS

	Excellent USED	BRAND NEW
HS-23 high impedance	$2.95	$4.75
HS-33 low impedance	2.45	5.75
HS-30 low imp (featherwt)	1.49	2.45
H-16/U High imp (2 units)	......	4.95
CD-307A cords, PL55 plug and JK26 jack. 8' long	......	1.19

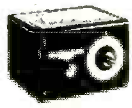
HANDSETS

TS-9	NEW	$7.95
TS-11	NEW	8.95
TS-13	NEW	8.95
TS-15	NEW	8.95

MICROPHONES

	Excellent USED	BRAND NEW
T-45 Lip Mike, navy type	......	$1.45
T-30 Throat Mike	.49	.88

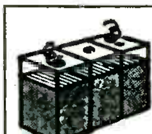
NATIONAL TURRET TV BOOSTER



Model TVB-2B BRAND NEW **$10.00**

FACTORY CARTON Lots of 6, ea.
Lots of 3, each... $10.95 Single Lots... $11.95

J-38 TELEGRAPH KEY $1.19



WILLARD 6-VOLT MIDGET STORAGE BATTERY

3-amp Hr. Brand new. 3¾" x 1-13/16" 2¾". Uses standard electrolyte **$2.65**

WILLARD 2-VOLT STORAGE BATTERY

20 AMP. HR. BRAND NEW **$2.69**
1-QUART ELECTROLYTE FOR ABOVE—ENOUGH FOR TWO CELLS.... BOTTLE **$1.45**
7-PRONG 2-VOLT VIBRATOR, FOR PORTABLE AND FARM SETS (GE LB530).... **$1.49**

Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G&G RADIO SUPPLY COMPANY

51 Vesey St. New York 7, N Y Ph. COrtland 7-4605
7123 Bryn Mawr Ave. Chicago, Ill.

SAVE ON TUBES BRAND NEW TUBES GUARANTEED TUBES

OA2	$0.95
OA3/VR75	1.10
OB2	1.35
OB3/VR90	1.09
OC3/VR105	1.00
OD3/VR150	.90
1B22	2.00
1B23	8.95
1B24	9.50
1B26	2.30
1B27	12.50
1B32/532A	2.98
1B38	29.50
1B42	17.50
1N21B	2.50
1N22	1.25
1N23B	3.49
1N26	7.50
1N34A	.79
1N38	1.50
1N47	4.50
1N54	.89
1N55	2.75
1N58A	1.25
1N60	.60
1N63/K63	2.39
1N69	.89
1N70	2.49
VS-2	9.50
2AS16	4.25
2C21/1642	.69
2C39	19.95
2C39A	22.00
2C40	7.25
2C42	19.95
2C43	14.95
2C44	1.19
2C46	19.95
2C51	4.50
2C52	4.95
2D21	1.25
2D21W	2.49
2E22	2.75
2E24	3.50
2E26	2.95
2J21A	7.95
2J22	6.95
2J26	14.95
2J27	14.95
2J31	27.50
2J32	29.50
2J33	27.50
2J34	25.00
2J36	89.00
2J42	149.50
2J48	24.50
2J49	85.00

2J55	85.00
2J56	149.00
2J61	39.50
2J62	35.00
2K22	32.50
2K25	28.50
2K26	69.50
2K28	32.00
2K29	23.95
2K34	150.00
2K41	125.00
2K45	110.00
2K48	110.00
3B23	4.05
3B24	4.75
3B26	3.50
3B28	6.50
3B29	12.50
3B29	2.50
3C22	72.50
3C23	9.95
3C24/24G	1.50
3C27	3.75
3C33	9.95
3C45	12.50

4J29	149.50
4J30	199.50
4J31	99.50
4J34	149.50
4J41	99.50
4J52	200.00
4-65A	15.00
4-125A	22.50
4X150A	22.50
4X500A	75.00
C5B	7.50
5AP1	4.50
5BP1	4.50
5BP4	4.50
5CP1A	14.50
5C22	42.00
5D21	18.50
5FP7	1.95
5FP14	16.50

SPECIAL! Vacuum Capacitors

VC 50-15	$ 7.50
12 mm. 32,000 v	$10.00
50 mm. 32,000 v	$12.50
100 mm. 20,000 v	$14.50

3D22	10.95
3E29	11.95
3FP7	1.95
3GP1	3.95
3HP7	3.95
3JP1	12.50
3K30	250.00
4B24	6.95
4C27/CV92	17.50
4C28	35.00
4C35	22.00
4J21	129.50
4J22	129.50
4J23	129.50
4J26	129.50
4J27	129.50
4J28	129.50

5HP1	4.50
5HP4	4.50
5JP1	22.50
5JP2	19.95
5JP4	22.50
5JP5	27.50
5J23	39.50
5J26	write
5J29	11.95
5J30	39.60
5J33	Write
5NP1	5.95
5T4	1.50

C6L/5528	2.50
6AN5	3.30
6AN6	2.90
6AS6	2.30
6AS7G	4.50
6BF7	2.50
6BL6	69.50
6BM6	69.50
6C21	24.50
6F4	4.50
6AL5W	1.75
6J4	5.25
6K4	3.50
6SU7GTY	2.69
6X5WGT	1.80
7C23	69.50
12AY7	2.00
12DP7	16.95
12GP7	25.00
12HP7	13.50
15R	.69
FG 17/5557	3.95
RX 21	6.50
FG 32	12.95
35TG	5.95
RK47	4.95
EF50	.75
52HAP7	Write
FG57/5559	write
RK60/1641	2.25
RK65/5D23	29.50
HY69	4.50
RK72	1.20
RK73	1.20
75T	6.95
75TL	8.95
83V	1.10
FG95/5560	22.50
VT98	19.95
98R	5.95
100TH	9.50
FG-104/5561	29.50
FG-105	19.00
VU-111	.95
HF120	9.95
122	2.95

F-123A	7.75
VT-127A	2.75
FG172	29.50
HF200	14.50
204A	49.50
211/VT4C	.95
217C	4.95
221A	1.95
RX233A	3.50
FG-235A	65.00
250R	8.95
250TH	16.50
250TL	15.00
FG253A	89.50
274B	3.25
304TH	7.95
304TL	7.95
307A/RK75	4.25
310A	4.95
310B	12.95
316A	1.25
327A	4.50
331A	10.95
343A	8.50
350B	3.95
368AS	6.00
371B	.75
374B	3.95
388A	1.49
394A	3.95
417A	8.50
434A	15.00
446A	1.19
446B	3.50
450TH	44.50
450TL	44.50
451	3.95
464A	10.95
469	13.95
471	2.25
527	11.50
WL530	16.95
531	5.75
CK536AX	.95
559	1.19
575A	3.95

KU 627	17.50
KU676	39.50
WL677	39.50
700/B/C/D	16.50
702A	2.75
703A	4.75
705A	1.50
706AY	39.50
706BY	39.50
706CY	29.50
706FY	39.50
706GY	39.50
707A	7.95
707B	13.50
708A	3.95
713A	.95
715A	6.75
715B	8.00
715C	18.00

YOUR SURPLUS WANTED
We Pay Highest Prices!

5 FIGURE VEEDER ROOT COUNTERS MODEL S-1 only **95¢**

Size ¾" wide x 1-5/16" long. Dovetail mounting—removable lever.

717A	.90
719A	24.50
720AY	249.50
720BY	249.50
720DY	249.50
721A	2.95
722A	1.95
723A	9.95
723A/B	16.95
724B	2.75
725A	7.50
726B	45.00
726C	69.50
730A	25.00

801A	.39
802	3.95
803	3.75
805	3.25
807	1.59
807W	9.95
808	2.95
809	2.95
811	2.90
813	10.95
814	2.75
815	3.50
826	1.95
828	9.95
829	8.95
829B	9.95
830B	2.75
832	7.95
832A	9.50
833A	39.50
836	3.45
837	1.45
838	3.98
849	24.50
851	49.50
852	17.50
860	4.50
861	19.95
865	.98
866A	1.50
872A	3.25
874	1.10
878	1.95
884	1.40
889R-A	139.50
905	3.25
923	1.25
931A	5.50
954	.33
955	.49
956	.49
957	.49
958A	.69
959	2.45

CK1005	.69
CK1006	3.49
K1069P7	Write
1613	.89
1616	.90
1619	.39
1624	1.45
1625	.39
1626	.39
1629	.39
1642	.69
1644	.89
2050	1.40
2051	1.10
5516	5.50
5586	175.00
5611	115.00
5635	8.95
5637	4.00
5643	Write
5646	8.95
5651	2.75
5654	2.00
5656	14.95
5657	299.00
5670	4.30
5672	1.29
5676	1.29
5687	3.75
5694	2.60
5702	2.95
5703	1.30
5704	2.50
5718	6.95
5719	8.95
5750	3.10
5787	6.00
5814	2.75
5844	4.50
5876	14.95
5904	write
5963	1.20
6005	4.50
6026	2.25
6111	9.95
8005	6.95
8012	1.95
8014A	55.00
8020	1.25
8025	4.75
8025A	4.75
9001	1.25
9002	.98
9003	1.50
9004	.69
9005	1.50
9006	.49

All Prices F.O.B. Los Angeles, subject to change without notice. Minimum order $3.00

jsh SALES CO.
ELECTRONICS
Dept. E-27
7552 Melrose Ave.
Los Angeles 46, California

Thousands of other types in stock. Send us your requirements.

AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations!

We will buy any Electronic Material at top prices. SCHOOLS—unload your dusty surplus for cash or credit.

ENGINEERING ASSOCIATES

434 PATTERSON ROAD — DAYTON 9, OHIO

IN STOCK

FOR IMMEDIATE DELIVERY

BRAND NEW

JAN-C-25 CAPACITORS

CP53—CP54—CP55
CP61—CP63—CP65
CP67—CP69

Every "E" & "F" Characteristics Item Listed In Jan-C-25

ALSO

CP70 CAPACITORS

"E" & "F" Characteristics
600 and 1000 Volts
"B" and "E" Terminals

O'DEL ELECTRONICS CORPORATION

293 WEST BROADWAY
NEW YORK 13, N. Y.
CANAL 6-4700

WHOLESALE ONLY

ELECTRONIC COMPONENTS
AIRCRAFT EQUIPMENT
HYDRAULICS

RADIO & ELECTRONIC SURPLUS
13933-9 BRUSH STREET
Detroit 3, Mich. TO 3, 3403

T47A/ART-13 TRANSMITTERS
BC-610-E TRANSMITTERS
BC-312, BC-342, BC-348 RECVRS.
BC-221 & LM FREQUENCY METERS

ALLTRONICS
BOX 19, BOSTON 1, MASSACHUSETTS
Richmond 2-0916, LYnn 8-3100

RELAYS

Quantity lots received too late for detailed listing

Leach # A957-7220A	C-H #6041-H17C
Leach # 1027-BF	Advance 1713
Leach # 1254-2L	Auto-lite WSG-4005
Leach # 1257	Auto-lite WSL-4001
Leach # 2024-188	Chapin RE-800-1-10
Leach # 77108-D24	Cook # 114
Leach # 7202-24	Hart 694-R10
Guardian 32439	Hart 694-R15A
Guardian G33557	M-H 405437BH
Guardian 35901	and many others

METERS

DC Microamps, 0-50, Simpson 3" rd @	$11.85
DC Microamps, 0-200, Simpson 4" square @	10.95
DC Milliamps, 0-1, Simpson 4" sq @	9.75
DC Milliamps, 0-1, Simpson 3" rd @	8.70
DC Ammeters, 0-2; 0-10; 50-0-50; Simpson 3" rd each @	8.70
DC Voltmeters, 0-5; 0-10; 0-25; 0-50; 0-100; 0-150; Simpson 3" rd each @	8.85
AC Voltmeters, 0-3; 0-10; 0-50; Simp 3" rd each @	8.85
AC Voltmeter, 0-150; 0-300; Simpson 3" rd each @	9.60
AC Voltmeter, 0-500, Simp. 3" rd with resistor @	13.50
AC Ammeters, 0-3; 0-5; 0-10; 0-15; Simps 3" rd each @	8.10

We specialize in meters, test instruments, etc. All makes, all types, all sizes. Let us know your needs.

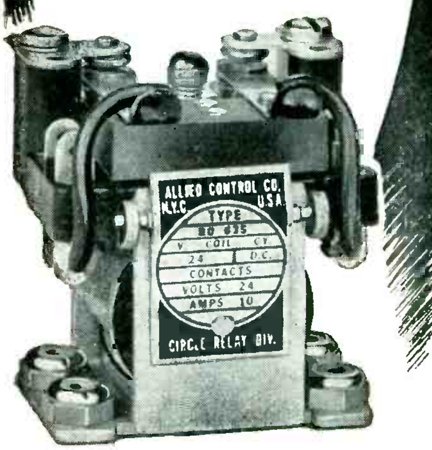
MARITIME SWITCHBOARD
Instruments and Accessories
336 CANAL ST, NEW YORK, 13, N. Y.
WOrth 4-8216 (7)

www.americanradiohistory.com

RELAYS

Our stock of more than a million relays — in over a thousand different types — is the world's largest. Don't delay your production for want of large or small quantities of relays of any type.

Telephone, wire or write for quotations.

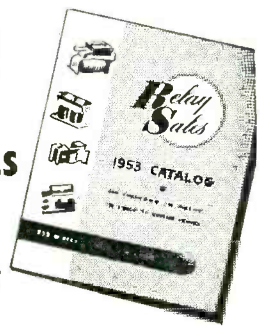


NEW AND MORE COMPREHENSIVE

1953 RELAY SALES CATALOG

NOW READY

Be sure to send for your copy



Relay Sales

Telephone

SEeley 8-4146

833 W. CHICAGO AVE.

DEPT. 4, CHICAGO 22, ILL.

INDEX TO THE SEARCHLIGHT ADVERTISERS

AUGUST, 1953

This index is published as a convenience to the readers. Care is taken to make it accurate but ELECTRONICS assumes no responsibility for errors or omissions.

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

www.americanradiohistory.com

POWER RHEOSTATS

ohms	W	Ea.	ohms	W	Ea.	ohms	W	Ea.
.1	150	4.89	50	50	2.10	500	100	3.60
.5	25	1.98	60	25	1.86	500	150	4.63
.5	50	2.34	75	25	1.86	500	300	6.93
.5	150	4.89	75	50	2.10	750	25	1.86
1	50	2.34	75	75	3.25	750	150	4.90
2	50	2.34	80	50	2.10	1000	25	2.10
2	100	3.86	100	25	1.86	1000	50	2.22
2	300	6.93	100	50	2.10	1200	225	6.41
3	100	3.86	100	100	3.60	1200	300	6.93
3	225	6.41	125	25	1.86	1250	50	2.22
5	25	1.86	150	50	2.10	1250	150	4.90
5	50	2.10	175	25	1.86	1500	25	2.10
5	100	3.86	185	25	1.86	1500	50	2.22
5	150	4.63	200	25	1.86	1600	50	2.22
6	25	1.86	200	100	3.60	1800	150	5.15
6	50	2.10	200	150	4.63	2000	25	2.10
6	75	3.25	225	50	2.10	2000	50	2.22
7	25	1.86	250	25	1.86	2250	150	5.15
7.5	75	3.25	250	50	2.10	2500	50	2.22
7.5	225	6.41	300	50	2.10	2500	100	3.71
8	50	2.10	300	75	3.25	2500	150	5.15
10	25	1.86	300	100	3.60	3000	25	2.22
10	50	2.10	350	25	1.86	3000	100	3.71
10	100	3.60	350	100	3.60	5000	25	2.22
12	25	1.86	350	150	4.63	5000	50	2.34
12	50	2.10	370	25	1.86	7500	50	2.34
15	25	1.86	378	150	4.63	7500	100	4.40
15	75	3.25	400	25	1.86	10000	50	2.50
15	100	3.60	400	75	3.25	10000	100	4.75
20	50	2.10	500	25	1.86	15000	25	2.75
22	50	2.10	500	50	2.10	20000	150	6.98
25	25	1.86	500	75	3.25			
50	25	1.86						

Specify Type Shaft Required—⅛" S5 or Knob Type
(Special Prices to Quantity Users)

HIGH POWER TR. MICA

G-1 TYPE		.0005	10KV	.006	10KV
.0001	6KV	.00065	10KV	.015	7KV
.00015	6KV	.001	10KV	.25	1.6KV
.0002	6KV	.002	10KV	**G-4 TYPE**	
.0004	6KV	.03	2KV	.00025	30KV
.0008	6KV	.045	2KV	.0006	35KV
.001	6KV	**G-3 TYPE**		.0025	25KV
.01	4KV	.0001	20KV	.0039	20KV
.032	2KV	.00015	20KV	.0075	15KV
.04	1KV	.00025	20KV	.01	15KV
.051	1.5KV	.0004	20KV	.01083	12KV
.08	1.5KV	.00045	15KV	.03	8KV
.09	1.6KV	.00047	20KV	.056	5KV
G-2 TYPE		.0005	20KV	**OTHERS**	
.0001	10KV	.00095	5KV	.000155	30KV
.00015	10KV	.001	20KV	.0004	30KV
.0002	10KV	.0012	20KV	.000533	30KV
.0003	10KV	.00124	15KV	.001	30KV
.000375	10KV	.0015	20KV	.007	15KV
.004	5KV	.0051	10KV	(Many Others)	

TRANSMITTING MICAS TYPE "4" and "9"

mfd.	wv	type	ea.	mfd.	wv	type	ea.
.0001	600	4	.36	.0015	600	4	.36
.003	600	4	.36	.00162	600	4	.42
.00005	600	4	.29	.002	600	4	.39
.00005	2500	9	.57	.002	1200	4	.72
.0001	600	4	.29	.0025	600	4	.39
.0001	2500	9	.57	.003	600	4	.43
.00015	600	4	.36	.004	600	4	.45
.0002	600	4	.29	.005	1200	9	.99
.00025	600	4	.29	.0047	600	4	.47
.0005	600	4	.29	.005	2500	9	1.86
.0005	2500	4	.75	.006	600	4	.54
.0005	2500	9	.77	.01	600	4	.65
.0006	2500	9	.85	.01	1200	9	1.41
.0007	600	4	.36	.02	600	4	.92
.00075	600	4	.36	.02	1250	9	2.12
.0008	600	4	.36	.025	600	4	1.08
.0009	600	4	.36	.03	300	4	.99
.001	600	4	.36	.03	600	4	1.34
.001	1200	4	.54	.043	600	4	1.75
.001	1200	9	.57	.05	300	4	1.19

Many other Sizes in stock

TYPE "J" POTENTIOMETERS

TYPE "J" $1.25 TYPE "JL" $1.50 TYPE "JJ" $2.95

ohms	ohms	ohms	ohms	ohms
150*	4000†	80K†	500-500*†	130K-130K*
200†	5000*†	100K*†	600-600†	150K-150K†
200*	6500*†	125K*	1500-1500*	100K-200K†
300†	9000†	150K†	2000-2000*†	250K-250†
400*†	10K*†	165K†	2000-50K*	300K-300K†
500*†	12K†	250K*	2200-25K	350K-350K*
600†	15K*†	300K†	5000-35K†	2meg-2meg†
650*†	20K*†	400K*	25K-10K†sw	25K-25K*†
750†	25K*†	1meg*	2000-20K†	10K-10K*†
1000*	30K*†	1meg†	25K-10K†	1meg-1meg†
1400†	50K*†	2meg*†	7K-1meg†	5K-5K*†
1500*†	60K*	3meg*	300K-15K†	400K-400K†
2000*†	75K†		25K-400K†	500K-500K†
			1meg-500K†	50K-50K*†

Type "JJJ" $4.95

20K-200K-20K†	750K-750K-750K†
45K-27K-2.5K ¼sh	800K-800K-800K†
700K-700K-700K†	1meg-1meg-1meg†

(*) ⅛" screwdriver slotted shaft. (†) Knob type shaft. (*†) Both types.

Many other Hard-To-Get items available for Immediate delivery from our large inventory. Send us your requirements and let us quote.

New MICA listing now ready.

A. MOGULL CO.

17 Warren St., N. Y. 7, N. Y.
Phone: WORTH 4-0865-6

Genuine TELECHRON Motors

2 RPM.....$2.90
3 RPM..... 3.90
4 RPM..... 3.90
3.6 RPM... 3.15
1 RPM..... 3.95
60 RPM ... 4.30
3 R.P. Hr.. 2.85
1 R.P. 12 Hr 4.25

1800 RPM SYNCHRONOUS Motor; 115 volts AC. 18 watts 1¼ lbs.; 2"x3"x2".... $4.50

Hand Cranked A.C. Generators Removed from Ancient Telephones { 2 bar..$4.50; 3 bar..$5.50; 5 bar..$6.50 }

Polarized Bell or Buzzer Works on Magneto or 115 volt A.C. $1.50

Complete 2 Station Magneto Ringer Telephones. Incl. Batteries—wire.... $17.50

ZENITH Motorized Remote control made for T.V. but ideal for opening doors—windows—Turntables—Gadgets—Tuning Radios. Complete with Transformer 16 ft. cable and reversing button. A few more left........................ $8.95

NE-2	1/25 Watt NEON Pigtail lamp. 10 for $1.00. 100 for..	$7.50
NE-16	¼ Watt NEON lamp D.C. Bayonet Base. 10 for.......	$3.00
NE-21	¼ Watt NEON lamp S.C. Bayonet Base. 10 for......	$2.50
NE-48	¼ Watt NEON lamp D.C. Bayonet Base. 10 for.......	$2.00
NE-30	1 Watt NEON lamp Med. Screw Base. 10 for........	$2.50
AR-1	2 Watt ARGON lamp Med. Screw Base. 10 for........	$3.00
NE-40	3 Watt NEON lamp Med. Screw Base. 10 for........	$3.50
#313	28 volt .2 Amp. Pilot lamp Miniature Bay. Base. 10 for	$2.80
#1820	28 volt .1 Amp. Pilot lamp Miniature Bay. Base. 10 for	$2.00
#49	2 volt .06 Amp. Pilot lamp Min. Bayonet Base. 10 for	$1.00
1¾ volt	Transformer made for #26 tube filament. Will light 30 of the above #49 lamps.....	$1.50
#C1256	6 volt Automobile lamp D.C. but no pins to hold it in socket. 20 for.........$1.00 Special—100 for	$3.50
#1800	1.35 volt .06 Amp. Pilot lamp Miniature Screw Base 10 for	$1.00
#112	1.1 volt Flashlight lamp single pen-lite Battery. 20 for	$1.00

HAYDON SYNCHRONOUS TIMING MOTOR

110 v. 60 cycle 30 RPM... $2.60
110 v. 60 cycle 1/10 RPM.. $2.35
110 v. 60 cycle 1 RPM..... $2.85
220 v. 60 cycle 2 RPM.... $1.65

New Sound Powered HAND SET TELEPHONES. 50' Flex. Rubber covered cable FREE. Pair $19.00

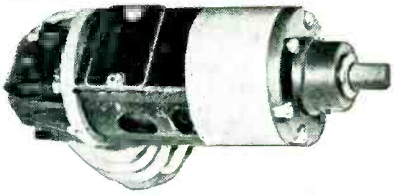
ALL PRICES F.O.B. N. Y.

EST. 1923 **BLAN** EST. 1923

64A Dey St. New York 7, N. Y.

Perhaps the smallest reversible GEARED-MOTOR in the world

Delco-PM-Permanent Magnet Alnico Field Motor #5071895 some with 11/16" gear, some with smooth ¼" shaft. 250 RPM, 27 volts, 100 ma. Speed depending on the voltage. Designed to be used in bombsights, automatic pilots, etc. Cost at the factory $26.10. Delivery 4 months. OUR PRICE, Immediate Delivery!! $17.50



Packaging for parcel post costs money; it costs no more to pack two motors in the same box, so you can take advantage of our

SPECIAL COMBINATION ½ Price OFFER

1st motor....$17.50, 2nd motor....$8.75

2 MOTORS AT FRACTION OF FACTORY COST................$26.25

Also have #5067127

Clamps to hold motor: $1.50 ea.

Subject to prior sale

GRAIN OF WHEAT LAMPS

#322 3 V. .19 amp
#328 6 V. .2 amp.
100 for $25.00 10 for $3.00

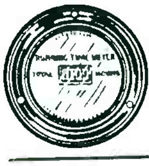
MARKTIME 5 HOUR SWITCH

A 10 amp. timing device. Pointer moves back to zero after time elapses. Ideal for shutting off radios and TV sets when you go to bed. Limited supply at this special PRICE $4.90

Also available in 15 min., 30 min., 1 hr. at $5.90

10 Seconds to 24 Minutes Timer

A hand wound electric TIMING SWITCH, Pointer moves back to ZERO and shuts off RADIO—TV—Electric Mixer—Photographic Devices—Time Delay etc. Furnished with Calibration Chart and Pointer Knob. Biggest bargain we ever had... $1.25



3" Round Elapsed Time Meter $12.50
General Electric $15.50
Westinghouse Square $16.00

REDMOND Powerful 5" Blower or Ventilator 115 volts AC 60 cycles 18 watts. For Kitchen — Laboratory. Heat or Cold or Chemicals....$7.50

A Miracle Switch that will not leave you in the Dark. Delayed Action Light Switch $1.95

CONNECTORS IS OUR BUSINESS

WORLD'S MOST COMPLETE STOCK

Types in stock: AF, AN, AP, ARC, BN, BNC, C, CLT, CN, CUF, D, DPB, DPD, E, F, FK, FM, FT, FW, GK, HN, IOH, IK, JJ, JK, LC, LF, LK, LN, M, MC, N, NK, P, PJ, PL, PM, PYE, RF, RFK, RGK, RNK, RTC, RWK, S, SF, SK, SKL, SO, U, UG, UHF, WK, XL, ZA.

HAROLD H. POWELL CO.

2104 Market St. LOcust 7-5285
Philadelphia 3, Pa.

WE BUY AND SELL GOVERNMENT SURPLUS

electronic components, units, wire, etc.

Your Inquiries Invited

LAPIROW BROS.

1649 Hoffner St. Cincinnati 23, Ohio
Kirby 1285

4 PDT RELAY

24 VDC midget 425 ohm. $2.95

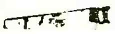
Above frame also in:—280 ohm @ $2.75, 12 V.D.C. 70 ohm @$2.25; DPDT:—12 V.D.C. 120 ohm @ $1.95, 6 V.D.C.—18 ohm—$1.95; SPST. No Double Break 5.3 V.D.C.—15 ohm $1.95

RELAY 3 POT 24 vdc 250 ohm Clare Type K.$ 2.75
CONNECTOR 15 pin Amphenol #26-151.... .69
S BAND CONVERTER Navy CG-46ABW 10 cm 99.50
ISOLATION XFORMER 35 watts 115v...... 2.45
SYNCHRO MOTOR IFS 115/90 v 400 cycles 14.95
MOTOR 400-1800 cyc 115v EAD J31C...... 9.95
SILVER TRIMMER Erie TS2A 1.5-7, 7-45 .36
LINK MOBILE XMTRS #25UFM 30-40 MC 59.50
TRANSISTOR or 5 pin submini socket..... .15
BIRTCHER CLAMPS 926A, 926B, 926C.... .25
PL-144, SO-124, PL-68, AN-3106-10s-2s, 83-1H.
300-3500 cycle 1400 w variable freq. electronic generator, 220v 60 cy. input. CML #1400
2% .002 Silver Mica—3AG fuses—Switches—J Pots

All above New, Guaranteed.
Partial list only. Write for Bulletin.

EMPIRE ELECTRONICS CO.

409 Ave. L, Brooklyn 30, N.Y. Cloverdale 2-2411



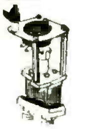
GENUINE SWEDISH CROSSCUT SAWS
FIRST QUALITY

STOCK NUMBER	SIZE	TEETH PER/IN.	REG. PRICE	"TAB" PRICE
701-20-10	20"	10 PT	$9.00	$3.95
701-24-10	24"	10 PT	9.75	4.15
701-24-8	24"	8 PT	9.75	4.15
701-26-8	26"	8 PT	10.85	4.25
701-26-6	26"	6 PT	10.85	4.25
701-26-10	26"	10 PT	10.85	4.25
701-28-8	28"	8 PT	10.85	4.35
701-28-6	28"	6 PT	11.50	4.70
701-30-6	30"	6 PT	11.00	4.50

UHF ANTENNAS

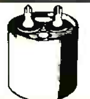
Microwave Antenna AS125/APR 1000 to 3400 MC W/UG58U Terminal. Inbuilt Hi Pass filter Flange mtg Special....$5.98
Mobile Whip Ant 6 ft.. Spring Steel. Broad response. with antenna, matching Base....$2.89
UHF Antenna 12" 30CM AT5/ARRI. usable Citizen & Ham band. insul coax Terminal. Mobil mounting—39c; 4 for $1.00
PL-259 plug for above antenna....65c

MICROWAVE



Klystron Mts Assy (723AB) & Coupling to 2 Type "N" Co-Ax Fittings. As Shown $9.98; 2 for $18.00
1 Microsecond Delay Line "Millen" $2.95; 4 for $10.00
Microwave Lighthouse Assy —P/O RT39 APG5 & 15. osc and Tr Cavities. Tunes 24-2700 MC. **SPECIAL** $20.00; 2 for $36.00
Variable Attenuator 3CM. Vernier ADJ. RND Choke to Straight Flange 1"x½"....$39.95
X Band Adaptor UG39 to UG40 Choke to Plane Flange Sperry Lab Dsgn....$1.69; 4 for $6.00
X Band Straight Wave Guide Per/Ft....$2.
AN/APS10 Modulator Assembly. **New** Mfgrd **G. E.** Design #ML-766 3911-G1. Includes 2J42 & Magnet 3C45 & (2) 3B24....$198.00

CONDENSER SPECIALS



2 MFD 330 VAC
1000 VDC **25¢**
STD MFGR Lots of 10
Smaller Quantities Each....49c: 3 for $1.25
2MFD 600VDC Porcelain Insulators With Adjustable Mounting Clamp....3 for $1.50

FEDERAL "ITT" SELENIUM BATTERY CHARGER RECTIFIER
10-0-10 Volts (CT) 100 Amp (Fan Cooled). Replace Your Old inefficient Sulphide Rect. with the New Selenium Types. **SPECIAL**..$11.98

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery.

Current Cont.	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1 Amp	$1.35	$2.15	$3.74	$7.50
2 Amp	2.20	3.60	5.40	10.50
4 Amp	4.25	7.95	12.95	25.25
6 Amp	4.75	9.00	13.50	33.00
10 Amp	6.75	12.75	20.00	40.00
12 Amp	8.50	16.25	25.50	45.00
20 Amp	13.25	25.50	39.00	79.50
24 Amp	16.25	32.50	45.00	90.00

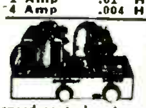
Full Wave Rect & Trans. 115V/60cy inputs.
up to 14VDC at 12 amps....$23.98
up to 28VDC at 12 amps....31.98
up to 28VDC at 48 amps....129.00
C "TAB" fast delivery SPECIALS

RECTIFIER XMFRS
8—12—9—CT—9—12—18V/4Amp....58.75
8—12—9—CT—9—12—18V/12 Amp....16.75
18-12-9-CT-9-12-18V/24 Amp....35.75
8V/2A....$1.98: 3 for $5.49

RECTIFIER CHOKES

4 Amp	.07 Hy	.6 Ohm	$7.95
2 Amp	.01 Hy	.1 Ohm	14.95
4 Amp	.004 Hy	.02 Ohm	29.95

DC POWER-SUPPLY



0 to 12VDC 2 AMP Variable DC supply—inpt. 115v/60 cy. Usable LAB supply, filament D.C. platin. battery charging, model railroad includes voltage or speed control and center off reversing sw. Ideal for two "HO" loco's....$10.95; 2 for $20.00

FILAMENT TRANS.
6.3V/2AMP $1.08; Two for....$1.98
2.5V/2A @ 79c, 2 for $1.49, 10 for....6.49
2.5VCT/10A 5KVINS....3.59
5VCT/10A/12KV INSUL G.E.....4.98
5V/115A CSD KENYON HVINS....16.95
7.5VCT/12A CSD KENYON 15 KVINS...10.95
24V/1.25A CSD @ $1.98 Two for....3.49
2X12V/2A or 24V/2A @ $3.89 Two for....6.98

TRANSFORMERS

All 115 V 60 Cyc Input TV & CR Pwr Xmfr up to 20" tubes. Hi VOLTS to 20 KV (w/quadrupler ckt.) 5000V/5MA 300 VDC/275Ma Full-Wave; 6.4V/10.3A, 5.4V/8A, 2.5V/3A Hypersil Core. Oil Impreg. $6.49: Two for $12.49;
2500V for CRT, 6.3V/.6A 2.5V/1.75A CSD Kenyon Hvins. 4/BC412 Replmnt....$7.98
1000VCT/45MA, 795 VCT/80MA 360VCT/55MA 3X5V/3A, 6.3VCT/1A, 6.3VCT/.3A CSD HVINS CAN BE USED 2X RATING....$4.98
950VCT/100MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A WESTERN ELECT....$5.49
300V/35MA, 2X2.5V/2A,15 XCLENT 1800V DBLER TWO 2X2 FIL WNDGS....$2.25
840VCT/110MA, & 530VCT/21MA, 2X5V/3A, 6.3VCT/1A, 6.3VCT/.3A....$3.45
780VCT/250MA, 5V/6A, 12.6V/5.5A....$7.95
770VCT/200MA, 5V/6A, 12.6V/5.5A....$6.95
770V/2.5MA, 2.5V/3A, HVINS HMSLD includes FILTER PARTS 4/scope....$3.69
700VCT/120MA, 2X6.3V/3A, 6.3V/1A Price....$3.98: Two for....$7.25
700VCT/100MA, 2X6.3V/1.5A, 5V/2A, Isolation Winding 120MA....$3.49
680VCT/200MA, 5V/3.5A, 6.3V/4A, 78V/1A $4.39: 3 for $12.
600VCT/50MA, 6V/3A, 6V/1.5A, 5V/1A....$2.49
500VCT/60MA, 6.3V/4A, HSLD....$2.98
420VCT/90MA, 6.3V/1.9A, W/INPUTS 6, 12, 24, 115VDC & 115 & 230 VAC @....$1.49

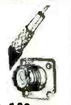
FILTER CHOKES

12Hy/80ma/3KVins....2.25
10Hy/75ma....1.25
10Hy/125ma/UTC/Csd/H'Sld/1 KVins....1.49
50Hy/125ma/Csd/H'Sld....2.29
12Hy/300ma/5KVins....4.95
20Hy/300ma or 15Hy/400ma/12KVins Kenyon....8.95
13.5Hy/1Amp/17KVins/Raytheon....39.95
Dual 2 Hy/300ma USN....95c: 2 for 1.49
6Hy 175ma 250 Ohm....$1.49: 2 for 2.49
10 Hy 100ma Freed....1.39

866A KIT AND XFORMER
2 Tubes, Sckts, xfmr input 115v 60cys. outpt. 2.5vct.10A/Hv insul. **SPECIAL**....$4.98

"TAB"
THAT'S A BUY

STORAGE BATTERIES
36 Volt WILLARD Mini-BRAND NEW 8 oz Designed Portable Equip. Models...98c; 4 for $3
FOUR 36V BATTERIES w/Acid*....3.35
2V 20AH Willard PLUS 2V. Vibrator....2.98
2V 20AH Batt. W/Vib. & Acid*....3.59
6V/6AH Willd NT6/BB214U....2.98
6V/6AH Batt. W/Acid*....3.25
6V/40AH Willard....6.98
6V/40AH Batt. W/Acid*....9.25
* Acid is shipped in Bottles. R'Exp only

"AN" CONNECTORS


70% OFF LIST
EXTRA 10% QUANTITIES OF 100

AN3102-10S-2P	23c	AN-3108-22-4S	$1.32
AN3101-12S-3S	52c	AN3102-22-4S	89c
AN3102-12-5P	29c	AN3102-36-9S	2.95
AN3108-14S-5P	45c	AN3057-4	25c
AN3108-14S-7S	69c	AN3057-12	30c
AN3108-16S-4P	67c	GK-C8-21 1/2B	1.15
AN3062-20	55c	GK-9-32S	66c
AN3102-20-26P	72c		

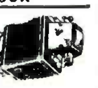
Others in Stock. Write for Qty Price

CRYSTAL DIODES

IN23B Sylvania $1.89 Lots of 10
Smaller Quantity, Unit Price $2.25
1N21....85c; 6 for $4.00
1N21A....$1.55; 5 for $7.00
1N21B....$2.89; 4 for $10.00
1N27....$1.55; 5 for $7.00
1N46....69c; 5 for $3.25

SELSYNS
2J1H1 GE Selsyns....Each $6.95
2J1F3 GE Brand New 115V/400 cy. ea....9.75
C78248 Sync. Trans. 115/60 cy $39.95; 2 for 75.00
C78249 Sync. Diff. 115V/60 cy $12.95. 2 for 25.00
Sync. Repeater 115/60 cy Type 11-4..2 for 99.80
Bendix Autosyns AY1 & AY5....2 for 6.95
Bendix AY20 New Orig Crtns....12.98
OTHER TYPES IN STOCK

DYNAMOTORS



INPT 6VDC, Output 200V/100ma, or 12/24V Output 500V/50ma 'P' Magnt. As Illustrated.. 6.95
INPT 28VDC/1.4A Output 250V/60ma....3.69
DA3A 28V/10.5A out 300VDC/260ma 150VDC/10ma. 14.5vdc/5amp....6.75
PE94 Plate Supp., Uses DA3A (SCR522)....8.98
PE97 Plate Supp., Less Tubes....9.98

POTENTIOMETERS—Type J

10 ohm Type J ⅛" shaft. $.93
200 ohm Type J ⅜" Slotted shaft....93c; 12 for $10.00
1000 ohm Type J ¼" shaft....93c; 12 for $10.00
2000 ohm Type J ½" shaft....93c; 12 for $10.00
3500 ohm Type J ⅜" shaft....93c; 12 for $10.00
5000 ohm Type J ⅜" shaft....93c; 12 for $10.00
25K ohm Type J ⅛" Slotted shaft....93c; 12 for $10.00
50K ohm Type J ⅜" shaft....93c; 12 for $10.00
100K ohm Type J ⅜" shaft....93c; 12 for $10.00
1 meg Type JJJ (Triple) 1⅜" shaft....3.69
ALL SIZES & TYPES IN STOCK

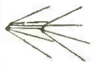
YOU PICK THEM **39¢** Lots of 10 **WHILE THEY LAST**
ELECTROLYTIC CONDENSERS

20MF/25VDC	2X15MF/350VDC
20MF/450VDC	2X20MF/25V,30MF/450V
25MF/300VDC	40MF/250V, 20MF/25V
50MF/350VDC	3X100MF/35VDC
100MF/25VDC	30/15/10MF/250VDC

ALL SIZES & TYPES

★ SPECIALS ★ SPECIALS ★
Powerstats & Test Equipment
(N) New & (LN) Like New
Type 20/0-135V/3 Amp/LN....$10.98
Type 116U/0-135V/7.5 Amp LN....17.49
Type 1126/0-135V/15 Amp LN....42.98
Type 1226/0-270V/9 Amp LN....42.98
Simpson Model 260 **VOM** LN....34.98
Hickok 600A Mutual Tube CHKR LN..142.98
GE ST4A Sweep Generator (N)....300.00
GE ST5A Marker Generator (N)....325.00
GE ST2A Oscilloscope (N)....275.00
HF-1 Oscilloscope (N) Special....79.95

TELEVISION ANTENNA



VEE CONICAL Broad Response All Channel. Powerful for Fringe Areas....$8.95
TV CONICAL ANTENNA All Channel, Sturdy Incids 8 elements & 100 ft. Twinex....$5.25
DOUBLE-V Ant. All Channel, Sturdy Cons. W/Mtg Clamps & 100 ft. Twinex....$4.49
WINDOW CONICAL ANT. All Channel, Hvy Const. Mounts outside window....$3.95
5 FOOT Interlocking Mast Sections, Hvy Duty, rustproof....85c 2 for $1.49

RHEOSTAT SALE
15 ohm 25W w/knob....$1.49; 2 for $2.49
20 ohm 50W Model J....1.98; 2 for 3.50
60 ohm 50W w/knob....2.25; 2 for 3.98
100 ohm 50W Model K....1.98; 2 for 3.50
200 ohm 25 Model D....1.49; 2 for 2.49
250 ohm 25W....1.19; 3 for 2.98
300 Ohm 225W Model P....2.98; 2 for 5.00
350, 500, 5000 ohm Slotted shaft, 25 watt....79c; 3 for 2.00

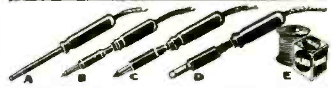
TUBES
"TAB" TESTED & GUARANTEED
PRICES SUBJECT TO CHANGE
WRITE FOR COMPLETE TUBE LISTING

OA2	$0.95	3C45	12.89	6SF5	.77	FG172	29.00	811	2.90
OA2/VR75	1.04	3D6/1299	.69	6SF7	.73	211/VT4C	1.25	812	2.70
OB2	1.37	3D21A	4.98	6SG7	.72	RX215	9.95	813	12.49
OB3/VR90	1.09	3D22	13.95	6SH7	.61	250TH	18.97	814	2.97
OC3/VR105	1.15	3D23	4.90	6SJ7	.70	250TL	17.75	815	5.97
OD3/VR150	.90	3E29	14.95	6SK7GT	.69	304TH	8.90	826	.95
1B3/8016	.81	4C35	22.25	6SL7GT	.69	304TL	8.90	829	11.49
1B21/471A	2.85	EL5BHD	16.98	6SN7GT	.70	388A	1.49	829B	12.45
1B22	2.20	5C21/C6J	9.89	6SQ7GT	.63	WL417A	8.95	832	8.97
1B23	9.90	5C22	42.05	6SR7	.65	417A/5842	18.50	832A	9.65
1B24	9.45	5C30/C5B	3.95	6SS7	.75	GL434A	12.69	833A	39.45
1B26	2.45	5D21	19.50	6ST7	.98	446A	1.05	836	4.75
1B27	12.75	5D23/RK65	36.50	6V6	1.39	446B	3.89	837	1.45
1B32/532A	3.90	5J29	12.40	6V6GT	.57	450TH	49.97	849	29.45
1B35	9.15	5R4GY	1.55	6W4GT	.57	450TL	52.00	860	4.90
1B37	16.98	5R4GYW	1.75	12AK5	1.98	460/HF200	15.95	865	1.29
1B38	29.95	5T4	2.49	12AL5	.75	GL471A	2.69	866A	1.50
1B41	49.95	5U4G	.69	12AT6	.89	CK501X	1.26	872A	3.29
1B42	18.00	5V4G	1.10	12AT7	.81	CK501AX	2.20	917	2.59
1B46	1.98	6AG5	.79	12AU6	.72	CK502AX	1.49	925	1.69
1B53	49.95	6AG7	1.39	12AU7	.63	CK503AX	1.49	927/CE25	1.49
1B56	38.50	6AH5G	1.49	12AV6	.49	CK505AX	1.79	CK1005	.85
1B58	175.00	6AH6	1.22	12AV7	.98	CK506AX	1.49	CK1027	2.98
1B60	69.75	6AJ5	1.40	12AW6	1.79	CK509AX	1.79	5635	12.21
1B63	50.00	6AK5	.74	12AX4GT	1.20	CK512AX	1.45	5637	6.89
1B63A	75.00	6AK5W	2.98	12AX7	.79	CK522AX	1.29	5640	12.21
1L4	.69	6AK6	1.05	12AY7	2.79	CK525AX	1.29	5641	7.93
1L6	.98	6AL5	.54	12AZ7	1.49	CK526AX	1.49	5643	12.21
1P21	33.00	6AL7GT	1.29	12BA6	.59	CK528AX	1.49	5644	12.21
1V2	.70	6AN5	2.90	12BA7	.79	CK529AX	1.79	5646	12.21
1X2A	1.29	6AQ5	.55	12BD6	1.23	GL530	22.00	5651	2.35
2C36	27.00	6AQ5W	3.98	12BE6	.59	CK531DX	1.89	5654	2.79
2C39	21.00	6AQ6	.81	12BF6	.85	531	6.98	RK5657	350.00
2C39A	29.50	6AQ7GT	1.29	12BH7	1.29	CK532DX	1.89	5663	1.85
2C40	7.29	6AR5	.79	12BY7	1.35	WL532	3.98	5670	5.30
2C43	17.75	6AR6	2.98	12BZ7	1.25	CK533AX	1.29	CK5672	1.29
2C43/464A	9.49	6AS5	.79	12SA7GT	.69	CK534AX	.99	CK5678	1.89
2C44	1.20	6AS6	2.43	12SC7	.80	CK536AX	.99	5687	5.49
2C51	5.49	6AS7G	4.65	12SF5GT	.72	CK537AX	3.04	CK5702	3.49
2D21	1.26	6AT6	.63	12SF7GT	.49	CK538DX	.98	CK5703	1.29
2E31	1.49	6AU5GT	1.10	12SG7	.83	CK539DX	2.19	5812	2.99
2E36	1.49	6AU6	.59	12SH7	.63	CK541DX	1.99	5814	3.64
2E43	1.49	6AV5GT	1.29	12SJ7GT	.59	CK543DX	.99	5840	12.34
2G21	1.49	6AV6	.49	12SK7	.72	CK544DX	.99	8020	1.25
2J31	27.00	6AW6	1.89	12SL7GT	.65	CK546DX	1.99	Xtal Diodes	
2J31A	79.95	6B4G	1.23	12SN7GT	.75	CK547DX	1.98	1N21A	51.55
2J32	37.00	6BA6	.63	12SQ7GT	.63	CK571AX/		1N21B	2.89
2J33	27.00	6BA7	1.27	12SR7	.63	5886	2.49	1N22	1.25
2J34	27.00	6BC5	.63	FG17	3.95	CK573AX/		1N23	1.35
2J36	108.00	6BC7	1.23	19T8	1.09	6029	3.49	1N23A	2.20
2J37	12.70	6BD5GT	1.65	19V8	1.62	WL579	10.49	1N23B	2.25
2J38	11.75	6BD6	.83	24G/3C24	1.90	WL579B	12.98	1N25	4.98
2J39	44.00	6BE6	.59	25BQ6GT	1.19	WL652	65.00	1N26	8.75
2J42	187.00	6BF5	.98	25L6GT	.69	WL673	117.00	1N27	1.55
2J48	24.25	6BF6	.65	25Z5	.79	WL676	39.95	1N34	.64
2J49	67.25	6BF7	2.55	25Z6GT	.99	703A	4.75	1N34A	.90
2J50	21.25	6BG6G	1.39	FG27A	8.70	705A	1.98	1N35	1.65
2J52	249.50	6BG7	1.98	28D7	1.95	707A	7.90	1N38	1.43
2J55	85.00	6BH6	.63	FG32/5558	13.85	707B	13.50	1N38A	1.29
2J56	149.00	6BJ6	.69	35Z5GT	.59	715A	6.00	1N41	8.95
2J61	49.95	6BK7	2.15	50L6GT	.69	715B	11.90	1N42	16.95
2J62	49.45	6BL7GT	1.45	RK61/XFG1	3.05	715C	24.00	1N43	1.73
2K22	39.45	6BN6	1.79	80	.69	717A	.90	1N44	1.24
2K23	39.45	6BN7	1.69	81	1.69	718BY	48.45	1N45	1.45
2K25	28.49	6BQ6GT	1.20	82	1.19	718CY	48.45	1N46	.69
2K25/723AB	24.90	6BQ7	1.65	82V	1.39	719A	28.50	1N47	4.00
2K28	29.00	6BY5G	1.59	83	1.45	721A	2.49	1N48	.55
2K33	259.00	6C21	29.45	83V	1.79	722A/287	2.45	1N51	.45
2K35	389.95	6CB6	.69	84/6Z4	.99	723A	11.95	1N52	1.39
2K41	126.00	6CD6G	1.69	FG95/5560	24.85	723A/B	25.00	1N54	.89
2K42	145.00	6D4	2.70	FG98	19.95	724A	3.95	1N54A	1.15
2K48	120.00	C6J/5C21	9.89	100TH	7.83	724B	3.45	1N55	3.10
2X2	.49	6J4	6.66	FG104	37.98	725A	8.49	1N57	.89
3B22	2.70	6J5GT	.47	FG105	17.64	726A	21.97	1N58	1.19
3B23/RK22	4.95	6J6	.63	117L/M7GT	1.59	726B	45.00	1N58A	1.15
3B24	6.97	6K4A	6.45	117N7GT	2.49	726C	79.95	1N60	.60
3B25	4.50	6L6	2.09	117Z6GT	1.19	801A	.45	1N61	2.07
3B26	3.70	6L6G	1.35	117Z7GT	1.49	803	3.89	1N63/K63	2.49
3B28	7.90	6L6GA	1.35	F123A	7.90	805	3.90	1N64	.69
3C22	89.00	6L6GAY	2.29	VT127A	3.90	807	1.65	1N69	.98
3C23	9.90	6SA7GT	.63	VXR130	4.75	808	2.59	1N86	1.15
3C31/C1B	3.45	6SC7	.90	CV148	4.98	809	2.43	1N87	1.15
3C33	14.98	6SD7GT	.80	FG166	49.00	810	9.95	1N88	1.1

METER BUYS

0-30 VDC"AN"..1.49; 2 for 2.49
0-60 ADC "AN" Type Mtg Less Shunt....2.95; 2 for 5.00
0-15 VAC GE 2½ Rnd 800cy 1.29
0-150 VAC/W stghs/2½ Rnd 3.49
0-150 VAC/25-125cy/3½" Square RA35/Wstgh....5.98
0-1 MADC Wstghs 3½" Sq RA35 LN....6.49
0-50 Microamps Weston 301 3½" Sq....13.98
0-500 MADC/2½"; Rnd Triplett 221T....4.98
VU-20 + 3 Weston 301 3" Sq. L.P. $41....14.98
0-120 MA RF 3½" Rnd Weston 301....12.98

CHROME VANADIUM SPEED DRILLS
29 Drills Chrome Vanadium Speed Steel. Top Quality for Machinists or All Purpose Use. 1/16 to ½ by 64th's. W/"Huot" Drill Index....$9.69
DRILLS, 60 Pcs 1 to 60 C.V. W/Index....7.98
DRILLS, 13 Pcs 1/16" to ¼" C.V. W/Index 2.69
DRILLS, 12 Pcs 1/16" to ½" C.V.....3.49
1/4" Speed Electric Drill with Jacobs Worm-gear Chuck & 60 Pcs Drills & Index....22.00
1/2" Speed Electric Drill with Jacobs Worm-gear Chuck & 29 Pcs Drills & Index....39.00



ESICO Soldering Irons 120V AC/DC

FIG.	TYPE	PRICE
A.	55 Watt/⅛ Tip/11⅛ Lng/.38 Lbs.	1.25
A.	60 Watt/¼ Tip/12" Lng/.38 Lbs.	1.91
B.	100 Watt/⅜ Tip/12" Lng/.5 Lbs.	2.55
B.	130 Watt/⅜ Tip/12" Lng/.75 Lbs.	3.17

ESICO INDUSTRIAL IRONS AC/DC
Similar to American Beauty types as shown

C.	61A60/60W/⅛ Tip/7" Lng/2.5 oz.	3.20
C.	#38/Am. Beauty 3138/100W/⅛ Tip	5.29
C.	#58/Am. Beauty 3158/200W/⅜ Tip	6.30
D.	#78/Am. Beauty 3178/300W/7/8 Tip	8.18
D.	$98/Am. Beauty 3198/550W/1⅛ Tip	10.08

Solder one Lb. .062 Roll Regular....1.29
With any soldering iron. Special....90c
WRITE FOR QUANTITY PRICES

AUDIO COMPONENTS

Western Electric Push-Pull Pentode Output Transformer 197A. Rated 10 Watts for 6V6's or 6AQ5's. Excellent Freq. Response Flat 30 to 15,000 Cycles. Secondary 600 Ohm.
"TAB" Special...$3.49; 2 for $5.98
UTC Varimatch line to voice coil or line, 30 Watt New **$1.98; Six for $10.**
XFMR HMT-SLD UTC Super Electric 3 Wdg. 600 Ohm Ct & 400 Tapped 250 & 150 Ohm. Can be Used Mike to Grid, Line to Line & Line to Grid.
Special 49c....10 for $4.49; 100 for $25.00

MICA CONDENSERS

Fig.	MFD	WVDC	PRICE
A	.03	600	69c; 5 for 2.39
A	.02	600	69c; 5 for 2.25
A	.015	2500	1.75; 2 for 3.00
B	.01	600	56c; 3 for 1.20
B	.01	1200	69c; 3 for 1.49
B	.008	600	39c; 3 for 1.00
A	.005	2500	1.19; 3 for 2.95
B	.004	600	49c; 3 for 1.10
B	.002	1200	58c; 3 for 1.25
A	.002	2500	98c; 3 for 2.25
A	.001	1200	55c; 3 for 1.20
C	.00075	5000	2.98; 2 for 5.00
C	.0007	3000	89c; 3 for 2.39
A	.0004	2500	39c; 6 for 1.95
A	.0001	600	25c; 5 for 1.00
C	.0001	3000	89c; 3 for 2.00
C	.0001	5000	1.49; 4 for 5.00
C	.00005	8000	39c; 4 for 1.00

KITS AND COMPONENTS
Oil Condensers Assorted....5 for $1.25
Electrolytics Assorted....5 for 1.25
Silver & Mica Cndsrs....15 for 1.25
Controls, Popular Values....5 for 1.25
Resistors, ½ & 1W....100 for 1.25
Vitreous W W Resistors....8 for 1.25
Sockets, Asstd. 8, 7, 5, 4P....12 for 1.25
Iron Core Slug & Screw....50 for 1.25
Knobs, Asstd. w/Insert....10 for 1.25
"TAB" Special **YOU PICK 'EM** **$1.00** Lots of 5

RELAY SPECIAL

SPST Mini Size 115VAC 3A CTS....98c; 3 for $2.75
SPDT Mini Size 115VAC 3A CTS....$1.39; 3 for $3.75
SPDT 24 VDC/5A CTS
ALLIED....98c; 6 for $5
SPNO 115VAC/15A CTS S'Dunn....$1.98; 2 for $3.50
DPDT & SPNO 12 VDC/10A CTS....$2.25; 2 for $3.75
DPDT Clare SK5010, Octal Base, 18-28V 2A Contacts, Nitrogen Sld. New Stock....$2.98

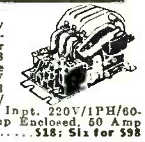
INFRARED SNOOPERSCOPE
SEE IN DARK TUBE

Image-Converter Tube HiSensitivity simplified design 2" dia Willemite screen—Resolution up to 350 lin/in. Complete data & tube....**ea. $4.98; 2 for $9.4**
Snooperscope Pwr Supply
1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram **115V/60cy** Oper....$6.98

LINEAR SAWTOOTH DC POTENTIOMETER KS15138

Electric power is supplied through 2 fixed taps 180° apart. 2 rotating taps, and take off brushes are provided for output voltage. Varying position of the brushes, varies the output voltage in accordance with a linear sawtooth wave. Special.... **$3.95**
WRITE FOR ADDITIONAL INFO

CONTACTOR



G CR2811C22AQ Heavy Duty Electric Starter, Transmitter or Motor Starter Switch. For Single or 2 or 3 Phase Appl. Rated 1 Phase 3HP/110V, 7½ HP/220V 10 HP/600V. Rated 2 or 3 Phase 7½ HP/110V, 15HP/220 V, 25HP/600V Control Inpt. 220V/1PH/60-Cy. Contacts rated 45 Amp Enclosed, 50 Amp 5Open. **SPECIAL**....$18; Six for $98

THAT'S A BUY **"TAB"** THAT'S A BUY
Dept. 8E 111 Liberty Street, New York 6, N. Y., U. S. A. PH. RECTOR 2-6245

Money Back Guarantee (Cost of Mdse. Only) $5 Min. Order FOB N Y C. Add Shpg. Charges or 25% Dep. Tubes Gtd. via R-Exp. only. Prices Subject to Change Without Notice.

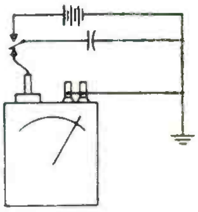
www.americanradiohistory.com

INDEX TO ADVERTISERS

New

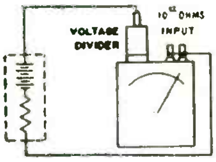
Vacuum Tube Electrometer has many uses

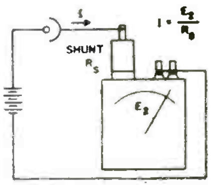
Here is an exceptionally versatile dc voltmeter, and a few of its many uses. The Keithley Instruments Model 200 Electrometer has an input resistance of over 10^{14} ohms shunted by 6 mmf; 2 and 20 volt scales, with input currents of 5×10^{-14} and 5×10^{-13} ampere respectively. Accuracy is within 2% full scale, or within 5% of the reading at low values.



EXCEPTIONALLY FAST WAY to check capacitor leakage—by direct measurement of voltage decay. Also easily measured: piezoelectric potentials, vacuum tube electrode potentials, electrostatic fields.

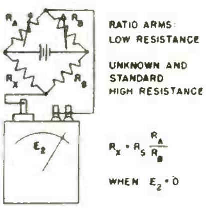
POTENTIALS OVER 20 VOLTS—Model 2002 Voltage Divider has 100: 1 ratio, clips over guard ring of HI terminal. Thus, dc circuit potentials up to 500 volts, such as the open circuit voltage of this high impedance source, are read directly.





CURRENTS AS LOW AS 10^{-14} ampere are measured directly with Model 2001 Electrometer shunts. Available with resistances from 1.0×10^6 up to 1.0×10^{12} ohms. Typical uses: photocell currents (shown), ion chambers, capacitor and insulation leakages.

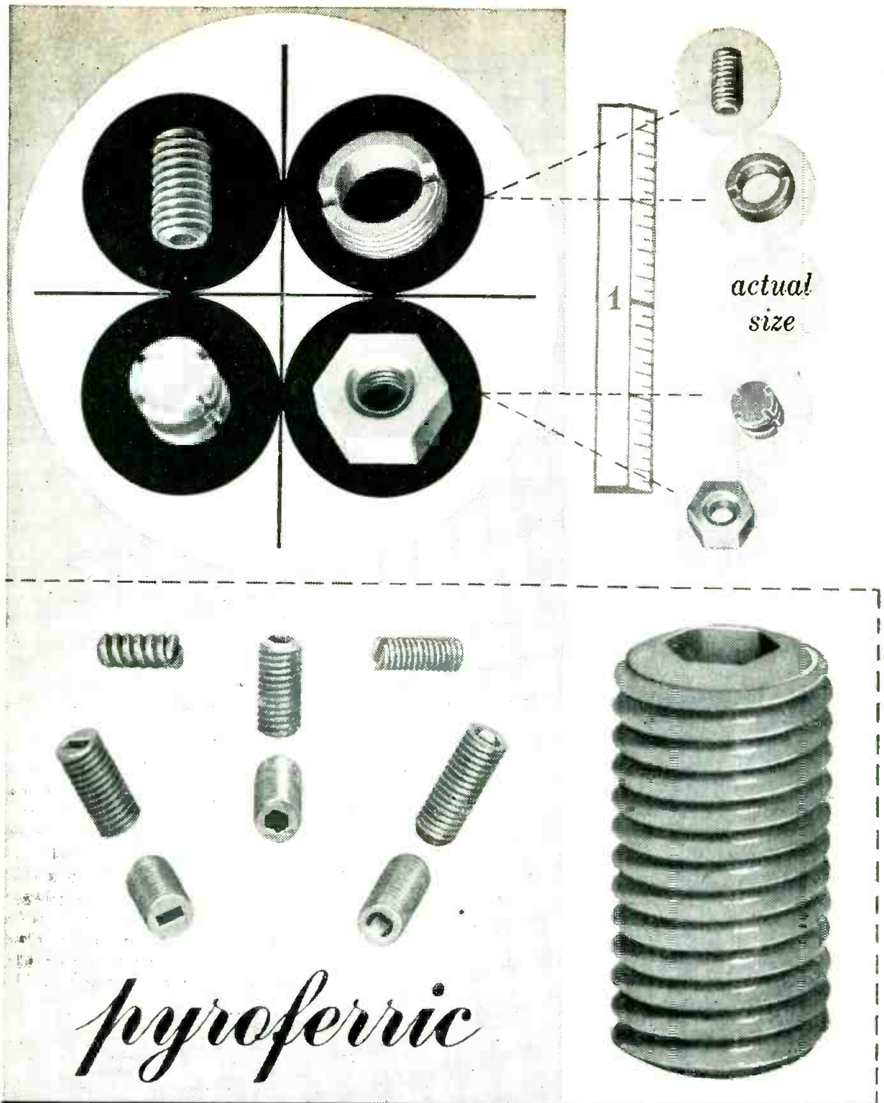
RESISTANCES UP TO 10^{16} OHMS are easily measured with Wheatstone Bridge circuit diagramed, or by measuring current resulting from known applied voltage. Typical uses include: standardizing resistors, measuring insulation samples.



For complete literature on the Model 200 Electrometer, write

KEITHLEY INSTRUMENTS
3868 Carnegie Avenue
Cleveland 15, Ohio

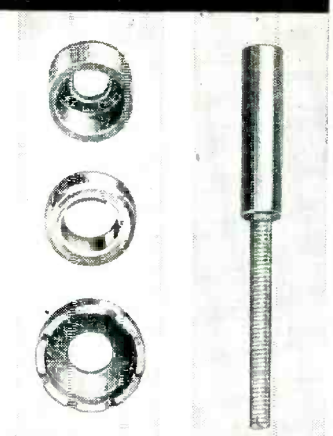
Want more information? Use post card on last page.

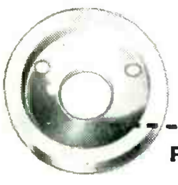


iron cores

PYROFERRIC IRON CORES are scientifically manufactured, under strictest quality controls to close electrical and mechanical tolerances.

PYROFERRIC services are available for the engineering of your core production requirements . . . your letterhead request will bring you M.P.A. Data Sheets and tables which give complete information including recommended sizes and tolerances, as well as a cross-referenced index of manufacturers' material designation.





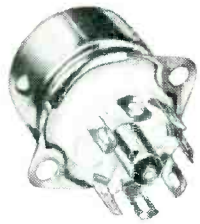
PYROFERRIC

PYROFERRIC BLDG. BRONX BOULEVARD at 216th St., N.Y.C. 67

www.americanradiohistory.com

Answer to VHF, UHF and Microwave Requirements

TEFLON* INSULATED CHEMELEC COMPONENTS



7-PIN MINIATURE TUBE SOCKETS

9-PIN MINIATURE TUBE SOCKETS

CRYSTAL SOCKETS

9-PIN CONNECTORS

STAND-OFF INSULATORS

FEED-THROUGH INSULATORS AND TERMINALS

- **LOW LOSS FACTOR** — Less than 0.0005.
- **STABLE DIELECTRIC CONSTANT**—2.0 (60 cycles to 30,000 megacycles).
- **HIGH SURFACE RESISTIVITY**—3.5 x 10^{13} ohms. Won't carbonize under arcing or DC plate.
- **WIDE SERVICE TEMPERATURE RANGE** —110° F to +500° F.
- **ZERO WATER ABSORPTION**—ASTM Test.
- **DURABLE** — withstands thermal and mechanical shock and vibration in assembly and service.
- **CHEMICALLY STABLE**—Inert, non-gassing, immune to corrosive atmospheres, fungi, oils, solvents.

Write for Catalogs: Miniature Tube Sockets, No. SO-428; 9-pin Connectors, No. CN409-M; Crystal Sockets, No. CS-441; Stand-off Insulators, No. TE-401; Feed-Through Insulators and Terminals, No. CF-400.

UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION
CAMDEN 1, NEW JERSEY

Representatives in Principal Cities Throughout the World

*du Pont's trademark for its tetrafluoroethylene resin.

Want more information? Use post card on last page.

www.americanradiohistory.com

PRECISION
SERIES EV-10A
VTVM-Megohmmeter

TRUE ZERO CENTER VTVM
7" FULL VIEW METER
with DIRECT PEAK READING HIGH FREQ. SCALES
Plus Standard 1000 Ohms per Volt Functions

59 Ranges to: 6000 Volts, 2000 Megohms 12 Amperes, + 77DB

D.C. VTVM ranges to ±60 KV when used with TV-4 High Voltage Safety Test Probe.

RANGE SPECIFICATIONS
- ★ **EIGHT ZERO-CENTER VTVM RANGES:** ±3, ±12, ±60, ±120, ±300, ±600, ±1200, ±6000 volts D.C.
- ★ **HIGH INPUT RESISTANCE—** 13⅓ megs. to 600 V., 26⅔ megs. at 1200 V., 133⅓ megs. at 6000 volts.
- ★ **FOUR DIRECT PEAK READING RANGES:** 0-3-12-60-120 peak volts. (Requires Series RF-10A High Frequency Probe described below.
- ★ **SIX OHM and MEGOHMMETER RANGES:** 0-2000-200,000 ohms. 0-2-20-200-2000 megohms.
- ★ **EIGHT EXTRA A.C.-D.C. VOLT RANGES** at 1000 Ω/V. for routine circuit testing. 0-3-12-60-120-300-600-1200-6000 volts.
- ★ **EIGHT D.C. CURRENT RANGES:** 0-300 microamperes. 0-1.2-6-30-600-1200 MA. 0-1.2 Amperes.
- ★ **EIGHT DB RANGES:** —20 to + 77 db. Calibrated for 1 MW., 600 ohms zero db.

IMPORTANT FEATURES
- ★ Voltage Regulated-Bridge Type Circuit.
- ★ True Zero-Center VTVM—Simultaneously indicates both voltage and polarity.
- ★ Rotary Range and Function Selectors.
- ★ Recessed 6000 volt Safety Jacks.
- ★ Shielded Coax Test-Cable Connectors for both D.C. and R.F. probes.
- ★ Electronic-Bridge Ohm-Megohmmeter. Uses 2 self-contained 1.5 V. batteries.
- ★ Extra-large 7" Rectangular PACE Meter. 200 microampere, ±2% sensitivity.
- ★ 1% Film Type and Wire-Wound Resistors.

EV-10A (MCP) In black ripple finished, heavy gauge steel case. Size 10½" x 12" x 6". Complete with coaxial circuit isolating test probe, shielded ohmmeter test cable, standard test leads, ohmmeter battery and manual.....$99.75

SERIES RF-10A R.F. Probe

Accessory for Series EV-10A above; affords direct high frequency peak voltage measurements. Employs 9002 miniature tube.....$14.40

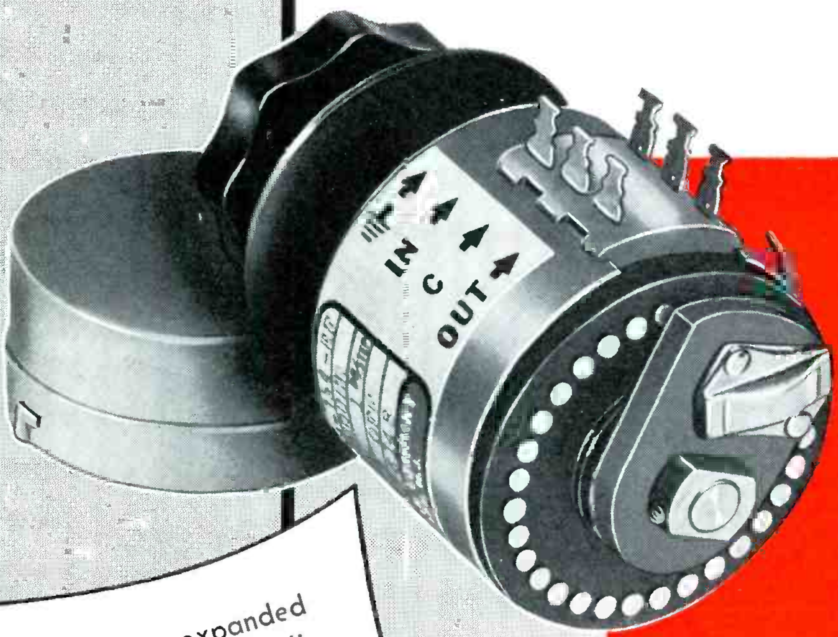
PRECISION APPARATUS COMPANY, INC.
92-27 HORACE HARDING BLVD., ELMHURST 13, N. Y.
Export Division: 458 Broadway, New York 13, U.S.A. • Cables—Morhanex
In Canada: Atlas Radio Corp., Ltd., 560 King Street, W., Toronto 28

Want more information? Use post card on last page.

This Index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

THESE ARE THE REASONS

WHY DAVEN IS THE LEADER IN THE AUDIO ATTENUATOR FIELD



LA-130 Series,
Ladder Network
30 Steps, 1 3/4 Diameter

1. **"KNEE-ACTION" ROTOR** . . . gives positive contact and low contact resistance under all conditions.
2. **BRASS CASE OF 2-PIECE CONSTRUCTION** . . . gives excellent shielding and allows more compact equipment design.
3. **"LOCK-TITE" DUST COVER** . . . designed to withstand severe vibration and at the same time allow easy accessibility.
4. **ENCLOSED ROLLER-TYPE DETENT MECHANISM** . . . gives positive indexing, but does not increase depth of unit.
5. **LOW-LOSS MOLDED TERMINAL BOARD** . . . has high resistance to leakage.

Greatly expanded production facilities enable Daven to make delivery from stock on a large number of standard attenuator types.

Write for complete catalog data.

THE DAVEN CO.

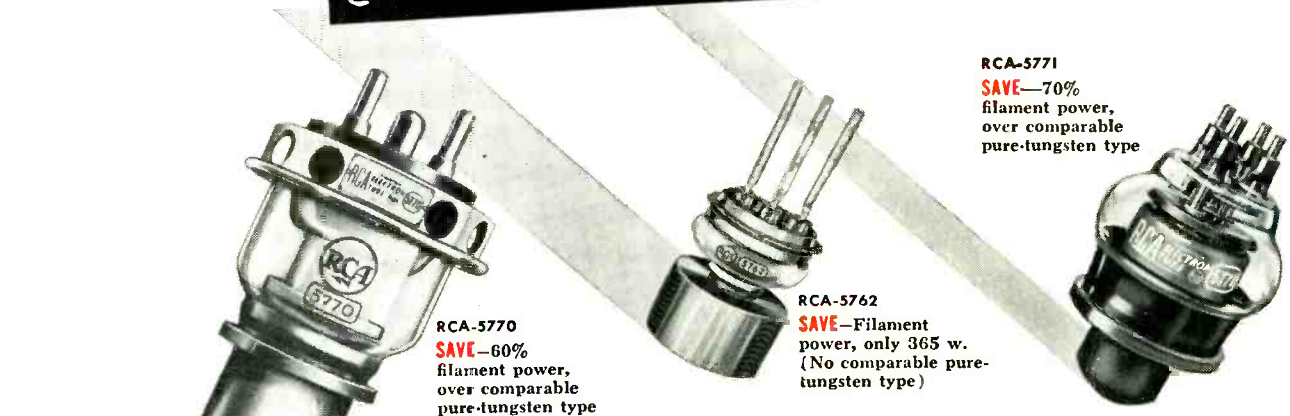
WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

191 Central Ave., Newark 4, N. J.

www.americanradiohistory.com

SAVE POWER

...with RCA *thoriated-tungsten filament* tubes



RCA-5771
SAVE—70% filament power, over comparable pure-tungsten type

RCA-5762
SAVE—Filament power, only 365 w. (No comparable pure-tungsten type)

RCA-5770
SAVE—60% filament power, over comparable pure-tungsten type

RCA-5671
SAVE—60% filament power, over comparable pure-tungsten type

Designed specifically for industrial, communication, and broadcast services, these high-power tubes can save hundreds of dollars a year in filament power—can cut initial equipment power costs substantially.

For instance • RCA-5770 takes 150-kw input up to 20 Mc, yet this triode requires only 3.1 kw of filament power—*saves 60% over the comparable pure-tungsten-filament type* • RCA-5671 takes 100-kw input up to 10 Mc. This air-cooled triode requires only 3.1 kw of filament power—*saves 60% over the comparable pure-tungsten-filament type* • RCA-5771 takes 60-kw up to 25 Mc. This triode requires only 1275 watts of filament power—*saves 70% over the pure-tungsten-filament type* • RCA-5762 takes 5.5-kw input up to 110 Mc. This VHF triode *takes only 365 watts of filament power!*

Consider these important features for the equipment you design. For additional technical information write RCA, Commercial Engineering, Section 42HR, Harrison, New Jersey. For application assistance, simply call your nearest RCA Field Office:

(EAST) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J.
(MIDWEST) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill.
(WEST) Madison 9-3671, 420 S. San Pedro St., Los Angeles, Cal.

IN PRODUCT IMPROVEMENT **RCA** *NEVER STANDS STILL*

RADIO CORPORATION of AMERICA

ELECTRON TUBES HARRISON, N. J.

www.americanradiohistory.com