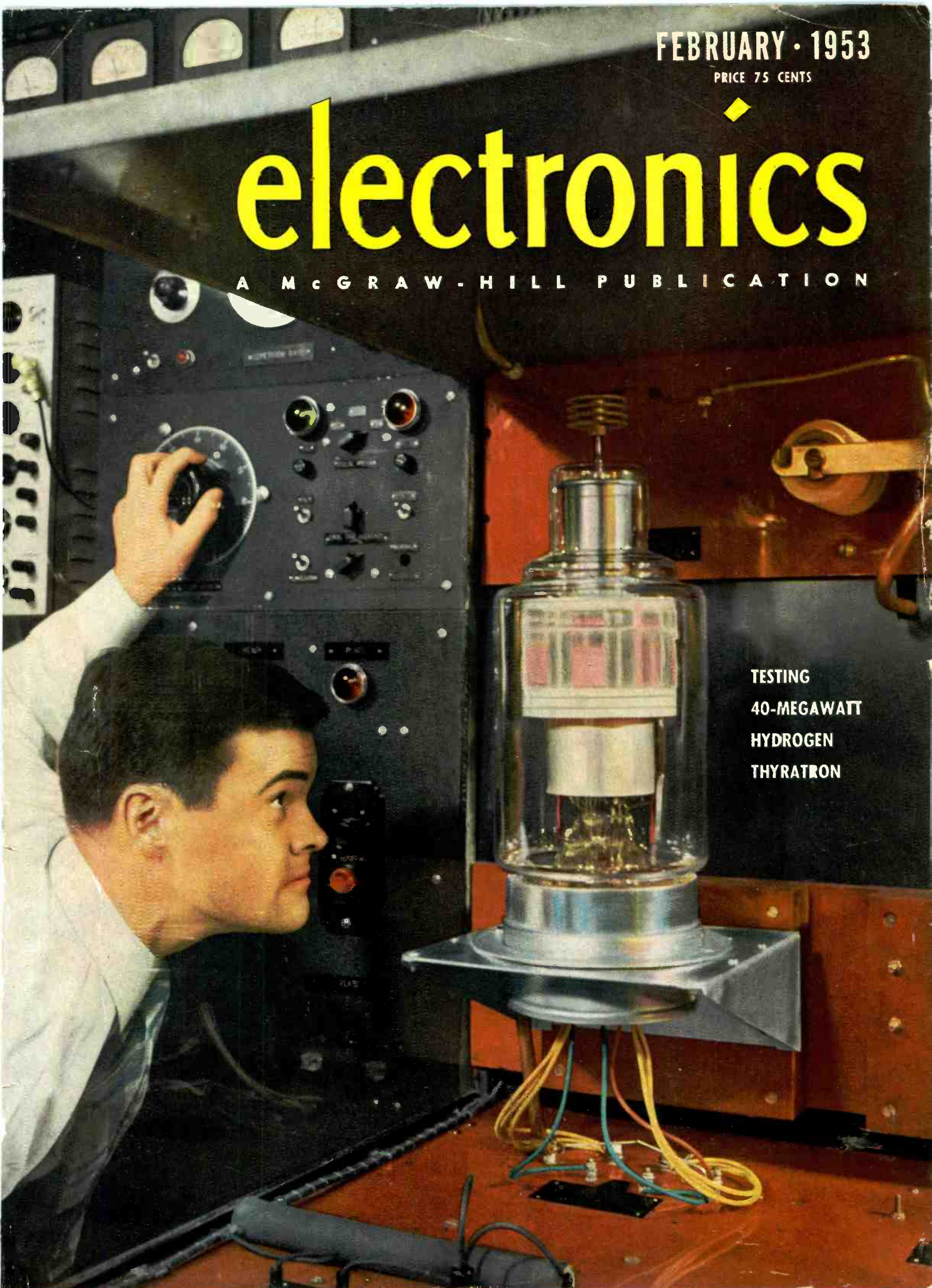
FEBRUARY · 1953
PRICE 75 CENTS

electronics

A McGRAW-HILL PUBLICATION



electronics

FEBRUARY • 1953

A McGRAW-HILL PUBLICATION

TESTING 40-MEGAWATT HYDROGEN THYRATRON—Designed for pulsing radar magnetrons, a VC 1257 hydrogen thyratron undergoes tests at Chatham Electronics, Newark, N. J. Stem contains hydrogen generator and hot filament arrangement to maintain gas pressure (see p 158) .... COVER

February, 1953 ELECTRONICS Vol. 26, No. 2

Member ABC and ABP

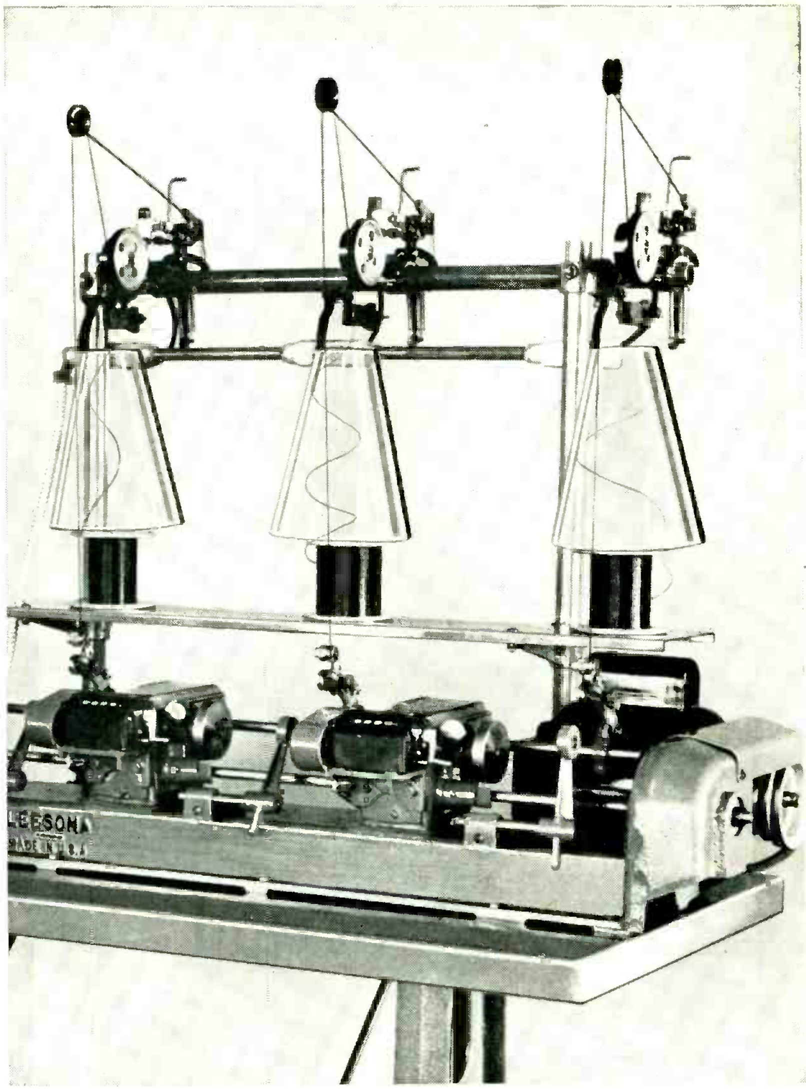
Published monthly with an additional issue in June by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. **Publication Office, 99-129 North Broadway, Albany 1, N. Y.**

Executive Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd 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.

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.

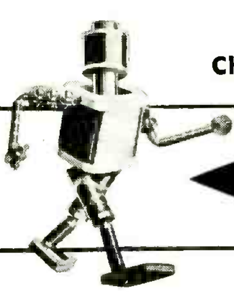
Wherever it has been put to work the result has been greater operator and machine efficiency. The operator can supervise several heads simultaneously. Winding and handling time can be synchronized so that there is no unproductive waiting time.

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

THIS INTERESTING QUARTERLY WILL BE MAILED FREE TO ANY PART OF THE WORLD

AUSTRALIA
Messrs. Watson Victor Limited,
9-13, Bligh Street,
Sydney, N.S.W.

BELGIUM
Paul Groeninckx,
4-6, Avenue Hansen-Soulie,
Brussels.

CANADA
The J. W. Ellis Industries,
42, Lombard Street,
Toronto.

DENMARK
Ditz Schweitzer,
Norre Voldgade, 48,
Copenhagen, K.

FRANCE
Jacques Pérès Fils,
4, Avenue de l'Opéra,
Paris 1.

HOLLAND
Geo. C. F. Kauderer,
Muiden.

INDIA
Adair, Dutt & Co. (India) Ltd.,
5, Dalhousie Square,
Calcutta.

ITALY
Ing. Silvio Garrone,
Piazza Della Marina, 1.
Rome.

NEW ZEALAND
Richardson, McCabe & Co. Ltd.,
P.O. Box 792,
Wellington.

NORWAY
J. L. Nerlien A/S,
Nedre Slottsgt. 13,
Oslo.

SOUTH AFRICA
Johnson & Phillips South Africa (Pty.) Limited,
P.O. Box 552,
Germiston.

SWEDEN
Ingeniorsfirma Hugo Tillquist,
Nybrokajen 7, Postbox 7026,
Stockholm 7.

SWITZERLAND
Camille Bauer,
Dornacherstrasse 18,
Basel.

U.S.A.
Muirhead & Co. Ltd.,
Elmers End, Beckenham,
Kent, England.

TECHNIQUE IS ALSO PUBLISHED IN FRENCH. IF THIS EDITION IS REQUIRED, MARK YOUR COUPON ***"EDITION FRANÇAISE"***

FILL IN THIS COUPON AND MAIL TO US OR OUR AGENTS

(SEE LIST ABOVE)

Please mail me, free of charge, the quarterly journal of instrument engineering **"technique"** *published by Muirhead & Co., Limited.*

NAME ____________________
POSITION ____________________
COMPANY ____________________
ADDRESS ____________________
____
____

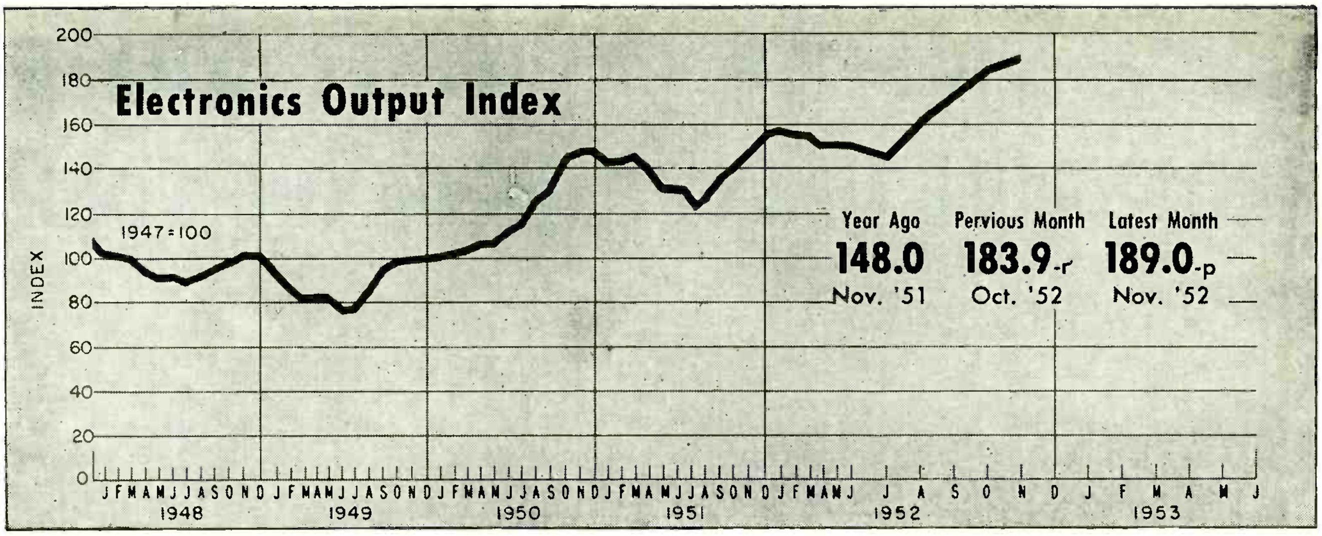
ELECTRONICS 74

MUIRHEAD & Co. Ltd.

PRECISION ELECTRICAL INSTRUMENT MAKERS
BECKENHAM · KENT · ENGLAND
Telegrams and Cables: MUIRHEADS ELMERS-END

PRECISION
MUIRHEAD
ELECTRICAL INSTRUMENTS

Want more information? Use post card on last page.



FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago Nov. '51	Previous Month Oct. '52	Latest Month Nov. '52
Television sets	415,332	724,117	780,486-p
Home sets	477,734	314,459	389,853-p
Clock Radios	————	180,841	185,639-p
Portable sets	64,111	113,552	153,503-p
Auto sets	206,069	163,494	195,200-p

RECEIVER SALES

(Source: RTMA)		Oct. '52	Nov. '52
Television sets, units	————	847,219	803,327
Radio sets (except auto)	————	580,077	486,800

RECEIVING TUBE SALES

(Source: RTMA)	Nov. '51	Oct. '52	Nov. '52
Receiv. tubes, total units	32,710,369	41,880,318	36,942,664
Receiving tubes, new sets	20,405,712	29,132,068	25,898,849
Rec. tubes, replacement	8,539,275	8,791,404	8,568,037
Receiving tubes, gov't.	1,371,886	3,105,005	1,712,080
Receiving tubes, export	2,393,496	851,841	763,698
Picture tubes, to mfrs.	460,566	862,431	754,060

BROADCAST STATIONS

(Source: FCC)	Dec. '51	Nov. '52	Dec. '52
TV Stations on Air	108	116	129
TV Stns CPs—not on air	0	114	144
TV Stns—Applications	475	836	812
AM Stations on Air	2,331	2,374	2,391
AM Stns CPs—not on air	77	139	133
AM Stns—Applications	304	250	251
FM Stations on Air	637	626	616
FM Stns CPs—not on air	13	14	14
FM Stns—Applications	8	9	12

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Nov. '51	Oct. '52	Nov. '52
Aeronautical	31,415	33,630	34,187
Marine	33,700	37,914	38,166
Police, fire, etc.	9,969	11,772	11,956
Industrial	11,233	15,090	15,347
Land Transportation	5,362	5,346	5,427
Amateur	99,292	116,102	117,069
Citizens Radio	674	1,788	1,803
Disaster	28	80	87
Experimental	452	519	503
Common carrier	835	1,032	1,020

TV AUDIENCE

(Source: NBC Research Dept.)	Year Ago Dec. '51	Previous Month Nov. '52	Latest Month Dec. '52
Sets in Use—total	15,176,200	19,751,200	20,439,400
Sets in Use—netw'k conn.	14,363,700	19,720,900	20,408,500
Sets in Use—New York	2,720,000	3,180,000	3,230,000
Sets in Use—Los Angeles	1,065,000	1,270,000	1,320,000
Sets in Use—Chicago	1,060,000	1,290,000	1,325,000

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Nov. '51	Oct. '52	Nov. '52
AM/FM—ABC	$3,220,760	$2,887,571	$2,612,761
AM/FM—CBS	$5,257,454	$5,817,930	$5,419,533
AM/FM—MBS	$1,583,291	$2,304,804	$2,172,485
AM/FM—NBC	$4,315,646	$4,230,576	$4,073,971
TV—ABC	$1,911,243	$1,453,811	$1,368,552
TV—CBS	$4,605,506	$6,754,231	$6,525,176
TV—DuMont	$847,373	$995,376	$1,026,566
TV—NBC	$6,535,907	$7,805,668	$7,957,417

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Oct. '51	Sept. '52	Oct. '52
Prod. workers, electronic	257,500	297,100-r	307,100-p
Av. wkly. earnings, elect.	$63.87	$66.90-r	$67.80-p
Av. wkly. earnings, radio	$60.41	$63.24-r	$63.45-p
Av. weekly hours, elect.	41.5	41.5	41.8-p
Av. weekly hours, radio	40.9	41.2	41.2-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)	Dec. '51	Nov. '52	Dec. '52
Radio—TV & Electronics	265.6	321.9	322.7
Radio Broadcasters	252.6	300.3	304.4

Quarterly Figures

INDUSTRIAL EQUIPMENT ORDERS

(Source: NEMA)	Year Ago 3rd '51	Previous Quarter 2nd '52	Latest Quarter 3rd '52
Dielectric Heating	$210,000	$510,000	$320,000
Induction Heating	$4,060,000	$2,410,000	$1,760,000
Welding Control	$1,280,000	$1,480,000	$1,810,000
Other Electronic Control	$720,000	$1,020,000	$920,000

INDUSTRIAL TUBE SALES

(Source: NEMA)	3rd '51	2nd '52	3rd '52
Vacuum (non-receiving)	$8,420,000	$12,110,000	$10,580,000
Gas or vapor	$2,620,000	$3,150,000	$2,950,000
Phototubes	$270,000	$480,000	$570,000
Magnetrons and velocity modulation tubes	$3,740,000	$9,830,000	$8,500,000

p—provisional; r—revised; e—estimated

INDUSTRY REPORT

TV Manufacturers Get Set For 1953

New models are introduced as companies forecast banner sales for this year

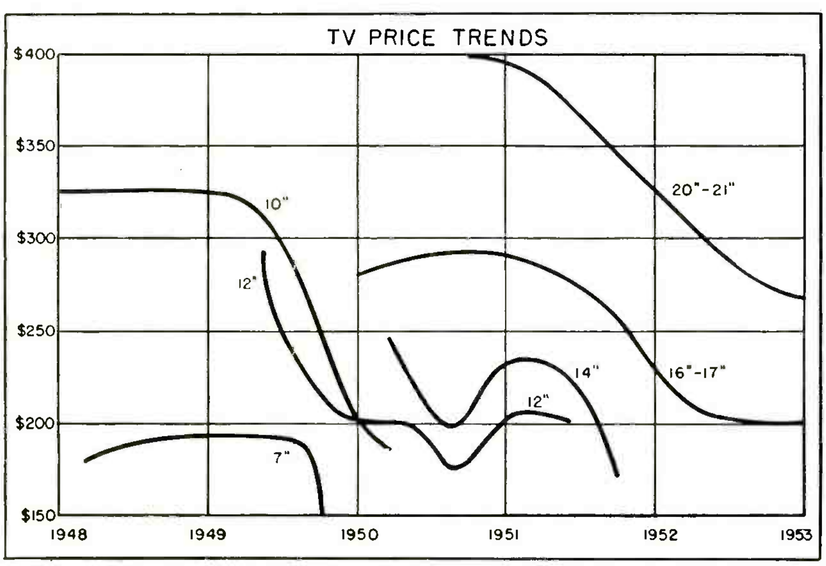
CHRISTMAS rush for tv sets was hardly over before the television receiver industry began introducing new tv sets for 1953 and predicting top sales for the new year. Nearly every set manufacturer introduced new tv models during January. Many of them displayed complete new lines of as many as 30 sets. Radios were also in the limelight as industry leaders predicted that nearly 8 million would be sold this year.

▶ **One Line**—Many tv receiver manufacturers endorse the idea of one line a year and carried 1952 sets into 1953. Manufacturers such as Admiral, DuMont and GE added only a few new models to their 1952 receivers at January showings. Some manufacturers brought out complete new lines however. They feel that it will be some time before the industry as a whole is able to give the one-line-a-year policy a real try. They believe that too many new developments are still in the making, that these could not be held back even if sales were at a peak.

▶ **New Sets**—Actually, new merchandise introduced last month was not far different from 1952 receivers. Prices were pretty much in line with last year's. Some were a little higher and some lower. More 21-inch and 27-inch sets were displayed and fewer high-priced radio-tv-phonograph combinations were in the lines. Provisions for uhf were stressed and new uhf tuners and converters were introduced. Most major tv manufacturers incorporated built-in uhf-vhf antennas in their sets.

▶ **Predictions**—With 1953 merchandise ready to roll, leading manufacturers looked at the year ahead and came up with a highly optimistic picture. They saw from 75 to 200 new tv stations coming on the air in 1953, bringing tv entertainment to 5 million more families and tv sales of at least 1.5 million sets in these new markets alone.

Gains were also predicted for replacement and second-set sales. It was estimated that nearly half of the sets now in use have screens smaller than 16 inches in size and that more than 4 million sets are at least 3 years old. Total production of at least 6 million receivers was expected by most manufacturers. Many predicted that the tv industry would reach a going rate of $6 billion in 1953.



History of television in United States is portrayed dramatically by these curves, showing how average list price of cheapest table model television receiver (with each picture tube size) varied during growing years of new industry. As prices tobogganed, smaller-size screens were dropped one by one

Transistors Replace Hearing Aid Tubes

Users pay extra for units but save on a much lower annual battery cost

ANNOUNCEMENTS of transistorized hearing aids have been coming in thick and fast in the past few weeks. This comes as no surprise, because of the transistor's inherent high efficiency and ability to operate at low voltages.

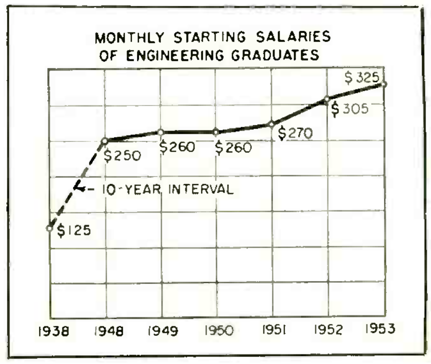
First to show a working model was Sonotone, with a 3-oz. unit using two subsubminiature tubes and a junction-transistor output stage. Tubes are used in the input and driver stages because of their low noise characteristics. With this design a B battery is still required, but B-battery drain has been cut more than 80 percent by the transistorized output circuit.

Other hearing aid manufacturers, some of whom are oldtimers in the business, and some of whom are new, are coming up with all-transistor amplifiers completely eliminating the need for a B battery. Maico has a three-transistor unit "on the market", and Acousticon has one ready to go. Most popular transistor appears to be Raytheon's CK718, which is similar to their mass-produced CK721.

▶ **Market**—A vivid picture of the potential market for hearing aids was painted by Sonotone president Irving Schachtel, who said "Today in America, 15 million people have hearing deficiencies, and 3 to 5 million need some sort of hearing aid to get along in the social and business worlds. Of these, only one million are now using hearing aids."

Prices for transistorized hearing aids range anywhere from $75 to $250 and more. At the higher price this figures to be around $75 an ounce.

This evaluation makes transistor hearing aids considerably more valuable than their equivalent weight in just about anything we can think of.



Survey of 176 industrial concerns by Northwestern University shows the steady rise in salaries for engineers just out of college. Of the companies, 69 thought salaries were too high, 97 thought they were in line, 10 didn't answer.

Combatting Shortages of Engineers

Trends include farming out routine engineering work, deferring retirements

To ease the strain on their engineering staffs, 55 percent of the electronic manufacturing firms responding to a recent survey are farming out some of their work to engineering consulting firms; 31 percent of these companies use drafting contract firms, 26 percent use research organizations, 20 percent use retired engineers and 9.8 percent use non-citizen engineers.

▶ **Consultants**—The job-shop type of engineering consultant firm performs the complete engineering job of translating a manufacturer's idea or rough design into a finished package ready for the production line. In contrast, the service-type of consulting firm sells man-hours of engineers who work closely with the manufacturer's engineers. The chief drawbacks noted here are that premium rates are sometimes charged for scarce engineering talent, and the outside consultants "take too much of our own engineers' time".

▶ **Retired Engineers**—Where retirements are being deferred to keep engineers on the job longer, a less strenuous work schedule is usually provided. Engineers eligible for retirement may thus come in four days a week the first year, three days a week the next year, two days a week the next, and then on a limited one-day or several-hour schedule or purely on a consulting basis. Use of retired engineers depends greatly on the individual's ability, physical and mental condition.

Relaxation of hiring standards is helping, too. Of the firms reporting, 26 percent have relaxed age standards, 28 percent educational requirements, 39 percent requirements in experience and 19 percent have relaxed standards on physical condition.

▶ **Part-Time Profs**—To a lesser extent, college engineering professors and instructors are being used for part-time jobs and counseling work. This has the long-term advantage of providing the additional pay incentive needed to encourage graduates to enter teaching. For the academic year, the average salary for an instructor is only $3,151 and for professors $5,980. Starting salaries in the teaching professions average about $250 a month, which is well below that offered by private industry.

▶ **Source of Figures**—*How to Improve The Utilization Of Engineering Manpower*, a 56-page report prepared by the National Society of Professional Engineers, 1121 15th Street N. W., Washington 5, D. C. and available from the society at $2 a copy.

Army And Navy Call For Increased Output

Army and Navy procurement officials are urging electronic contractors to step up production because fiscal year 1951 funds, made available in July, 1950, will expire June 30, 1953.

A large percentage of electronics equipment for Army and Navy is bought with so-called "one year appropriations" that allow one year to obligate the money and two years to spend it for items delivered.

Of the total funds available for electronics, only about one third has been spent to date. Air Force officials claim that this is a good record considering that the lead time has been approximately 24 months, is now about 20.

Deliveries of Air Force electronic equipment since Korea have multiplied about ten times, as compared to over-all military elec-

(Continued on page 8)

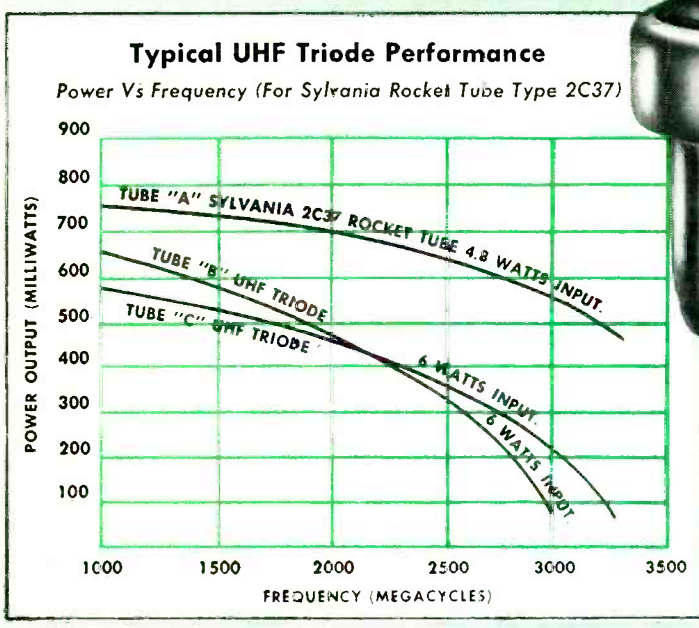
Here's how to get

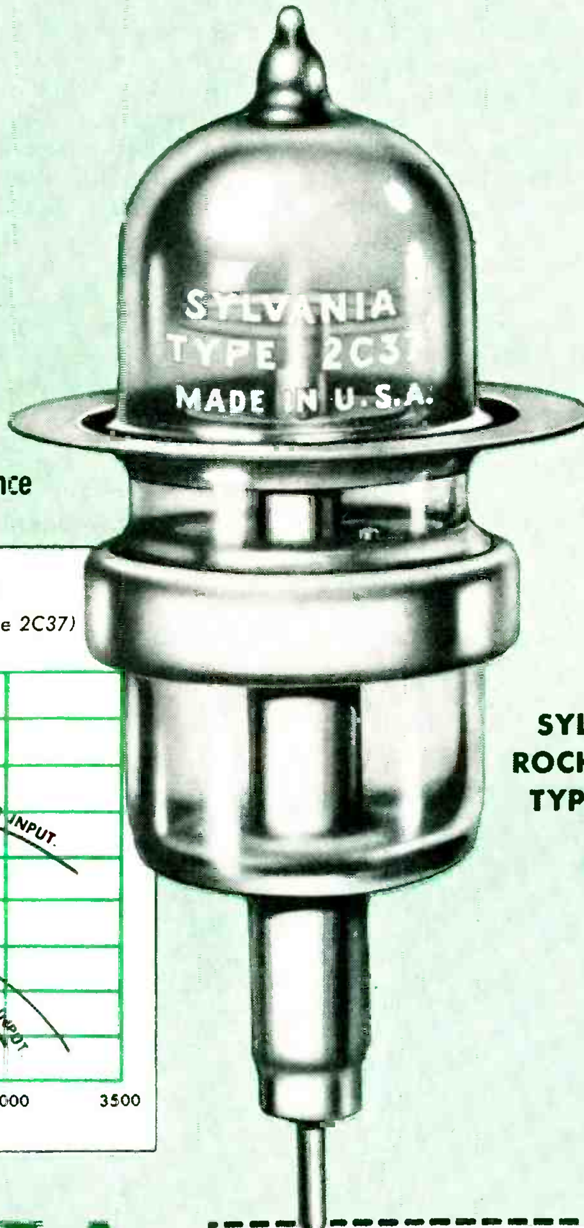
GOOD USABLE POWER AT UHF

Sylvania Rocket Tube Type 2C37 supplies 450 Mw at 3300 Mc.

Because of their high power throughout the UHF spectrum, Sylvania rocket tubes are especially recommended for service as pulsed oscillators, cw oscillators, rf amplifiers and frequency multipliers . . . this is one more reason why it will pay you to specify SYLVANIA.

Compare Sylvania Rocket Tube's Performance





SYLVANIA ROCKET TUBE TYPE 2C37

SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Sylvania Electric Products Inc.
Dept. 3E-1002, 1740 Broadway, N. Y. 19, N. Y.

Please send me latest data sheets concerning Sylvania Rocket Tubes

Name ____________________

Street ____________________

City ____________ Zone ______ State ________

Want more information? Use post card on last page.

tronics which have multiplied approximately 8 times. No dip or stretch out is anticipated in electronic items for the next two years.

If contractors do not get payments from the U. S. before June 30, there is likely to be considerable delay in getting settlements. Money not expended returns to treasury.

Bing's Mirror To Reflect in December

Device for magnetic tape recording of video signals is readied for production

BING CROSBY money has helped develop the machines used for all types of commercial sound recording work.

Not content with being able to hear himself sing, Crosby apparently wants to see himself act on television. The only mirror presently available is the kinerecording, in effect a special motion picture made from the images on a picture tube.

▶ **Cutting Out Steps**—Engineers have long dreamed of putting video signals on magnetic tape to be played back through the equivalent of a television receiver rather than a movie projector. The same tapes, played into a television transmitter, would eliminate the camera and film projector for recorded shows.

Until recently, it has been possible to record frequencies only up to the limit of normal human hearing (around 15,000 cycles). This requires a tape speed of 15 inches a second. To record television signals with a frequency range up to about 4,000,000 cycles, Crosby's engineer John T. Mullin had to speed his tape up to 100 inches a second.

▶ **Splitting the Picture?** — Although technical information has been frozen for the next six or eight months, it is known that today's tape pictures are inferior to present tv programs but capable of improvement. Since the magnetic tape used is an inch wide (sound recorders use quarter-inch tape) engineers think the Crosby technique is to split up the picture frequencies and record strips of frequencies separately but simultaneously, combining them in the reproducing equipment. Half-inch tape will be used in the next prototype model.

Production models are promised in November or December at about $60,000.

Der Bingle, electronic gadgets (background), magnetic tape recorder and friend represent the essentials of a recorded video program. Tape cost is estimated at $80 a half hour as against $150 for kinescope film

RTMA Picks Up Ball On TV Interference

Manufacturers set up task committees for receivers, transmitters and coordination

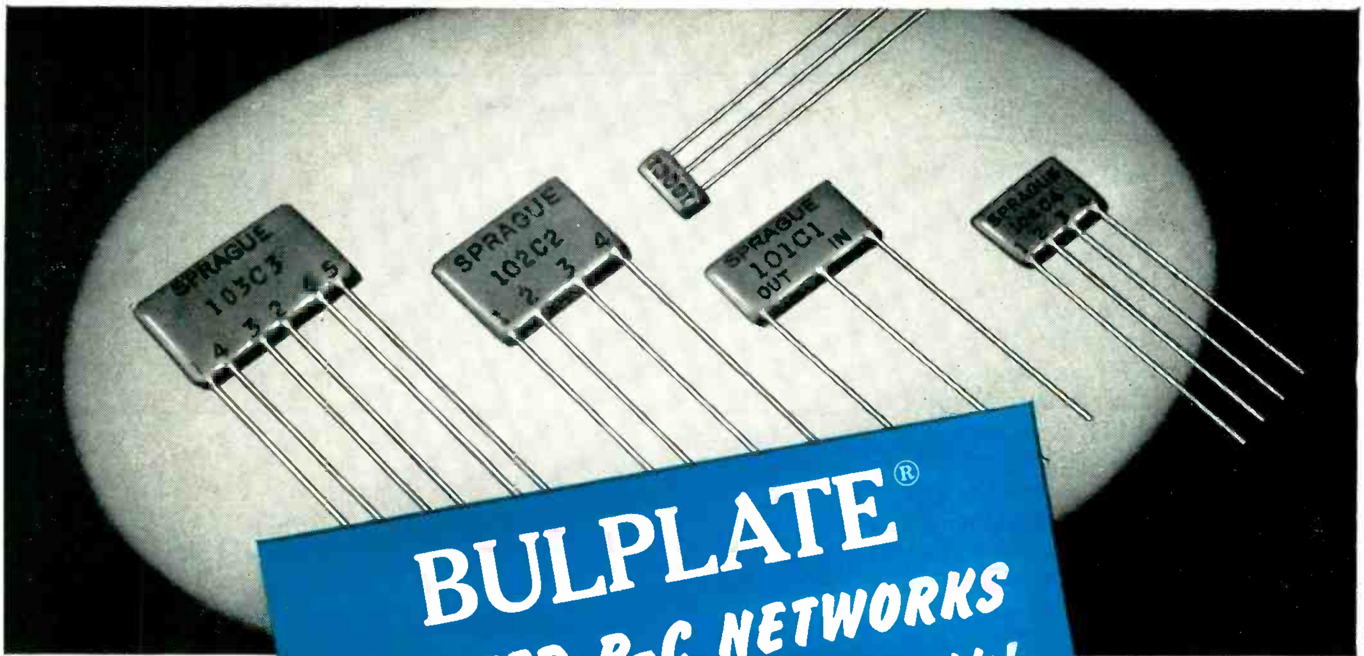
AT a recent meeting in New York City, W. R. G. Baker, director of the engineering department of the Radio and Television Manufacturers Association, advised television receiver makers to clean house before FCC is tempted to step into control of their product through back-door legislation.

By far the bulk of discussion centered on problems of receiver interference, although machinery was also set up to deal with infrequent transmitter spurious signals.

▶ **Who Hits Whom**—Degradation of television service by radiation from other sets in the neighborhood is serious enough. When local oscillator signals leak out strong enough and far enough to distort VOR airport navigation (as has happened) FCC begins to have legal grounds for requesting that each receiver come under its jurisdiction.

Although RTMA has set up certain standards that should improve reception and limit radiation, these are presently more often honored in the breach than in the observance. Among them is a recommendation for an intermediate frequency of 41.25 mc (ELECTRONICS, p 22, Jan. 1953). But some manufacturers have had

(Continued on page 10)



BULPLATE®

PRINTED R-C NETWORKS

Can save you money, time, trouble!

Printed circuits like those shown here offer important advantages in radio and TV production—fewer parts to purchase, inspect, handle, and stock; fewer soldering operations and quicker assembly with minimal wiring errors; faster and easier inspection; greater compactness; and lighter weight. And usually they cost less than the individual capacitors and resistors they replace!

BULPLATE Printed Circuits are a logical outgrowth of Sprague-Herlec BULPLATE Multiple Ceramic Capacitors, first to use the active dielectric as a supporting medium for printed wiring. The printed resistor elements of these plates have proved to be highly stable, another important Sprague contribution.

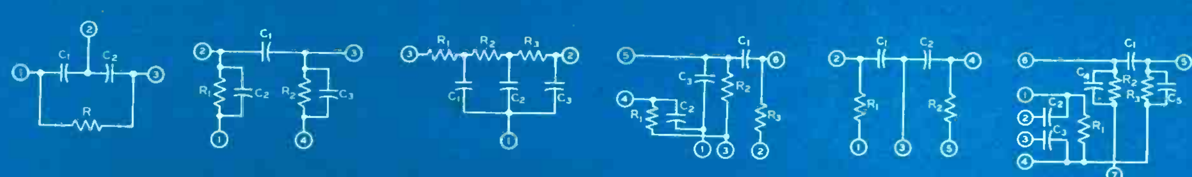
Thousands of BULPLATES are now in use in radio, television, and military electronics. Are you overlooking a winning bet for your production?

And remember—if you have a special problem on a network which must perform a certain circuit function, Sprague will design it for you.

Write today for Engineering Bulletin 650 to Sprague Electric Company, 35 Marshall Street, North Adams, Mass.

TYPICAL RADIO AND TV BULPLATE CIRCUITS

Diode Filter | Triode Coupling | Vertical Integrator | Pentode Coupling | I-F Filter | Audio Output



SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

Export Division, Cable SPREXDIV, North Adams, Mass.

Want more information? Use post card on last page.

to ship out relatively expensive wave traps because of interference from land mobile two-way radio systems operating near this frequency.

▶ **Committee Plans**—Working in cooperation with the Joint Technical Advisory Committee (which includes the Institute of Radio Engineers) RTMA has appointed a committee on receivers charged with responsibility for limiting oscillator radiation and establishing target dates. Another group will perform a similar function in the transmitter field. A third committee will coordinate the work of the other task groups and keep them in touch with JTAC, IRE and FCC.

One practical stumbling block for both receiver and transmitter control is lack of inexpensive measurement equipment, particularly for the new uhf channels.

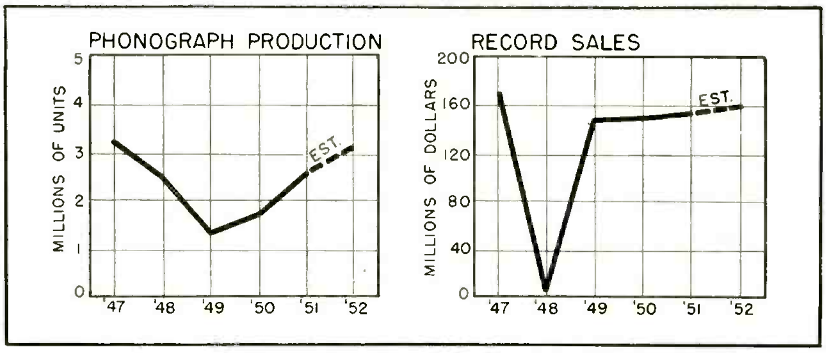
Small Fields Lighted By Pilots in Flight

Radio-controlled field lights are turned on by pilot as plane approaches airport

PILOTS who are forced to make emergency landings in small airports at night do so at extreme risk because most small fields are unlighted and unattended during hours of darkness.

An electronic system for making these fields safe for night use is now being used at Kingman, Arizona in connection with operation of the Bonanza Airlines. A pilot may turn on the field lights by pressing the 'talk' button of his regular vhf transmitter three times at half-second intervals from as far as 100 miles from the field. Lights are turned off by five similarly-transmitted signals.

Bonanza's radio-controlled lighting system is being studied for possible application to other commercial runs, and suggestions have been handed the CAA that a special frequency be set aside for controlling field lights.



TURNTABLE output and disk sales increase as . . .

Phonograph Field Makes New Gains

Volume climbed to 5-year peak in 1952; further increases are expected this year

RECORD PLAYERS and records are continuing to grow as an important segment of the electronics industry. Although phonograph and record statistics vary with the source, all figures indicate a rising sales trend, as shown in the charts.

Indications are that production of phonographs and sales of phonograph records in 1952 reached the highest point since 1947. It is estimated that between 3 and 4 million phonographs were produced last year and that the dollar volume of records was between \$157 and \$200 million. Continued growth for both products is forecast for 1953.

▶ **Phonographs**—The total number of turntables in use in the U. S. has risen steadily since the war from an estimated 12 million in 1947 to about 26 million at the end of 1952. Of nearly 22 million phonos in use at the end of 1951, about 8 million were capable of playing 45-rpm records and 7 million could be used for 33⅓-rpm records.

Despite the increased production of phonographs, fewer of them are being sold in tv and radio receivers. Only 10 percent of all tv models now on the market are equipped with phonographs and even less have a phonojack. According to RTMA figures, the percentage of tv sets produced with phonographs dropped from 14.1 percent in 1947 to 6.2 percent in 1951. Fewer radio sets incorporate phonographs. In 1950, 277,100 table-model radio-phonographs were produced as against 235,177 in 1951. Console radio-phonographs declined from 844,100 in 1950 to 463,713 in 1951. New lines just introduced are continuing the trend but sales of self-contained phonographs are evidently more than able to take up the slack.

▶ **Records**—Phonograph record sales have increased along with turntable output since 1947. With the exception of 1948 when a musicians' work stoppage occurred, dollar volume of records has climbed steadily even with disruptions caused by the introduction of new speeds. Final figures for 1952 are expected to show that more than 170 million U. S. records of all speeds and types were produced, representing over \$160 million in retail sales.

Breakdown of record sales in 1952 is expected to show a continuation of the sales trend toward the 45-rpm and 33⅓-rpm record speeds. In 1949 the percentage of total sales accounted for by each speed was: 78 rpm, 88 percent; 33⅓ rpm, 8 percent; 45 rpm, 4 percent. In 1951 the percentages were: 78 rpm, 66 percent; 33⅓ rpm, 16 percent; 45 rpm, 18 percent.

▶ **Future**—Phonograph manufacturers who were hindered by a

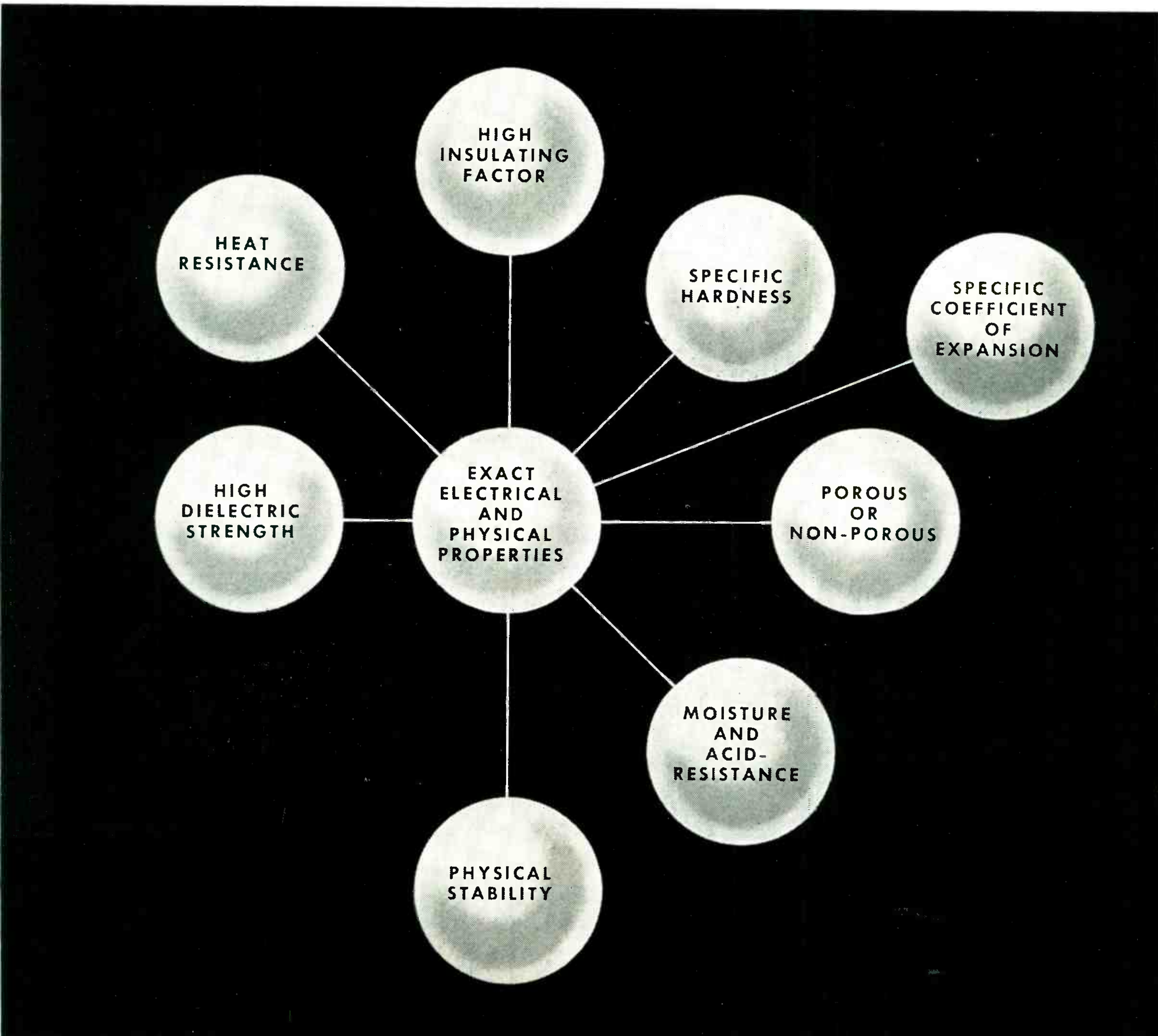
(Continued on page 14)

What do these names mean to you?

These Centralab Engineered Ceramics solve electronic and industrial production problems . . . hold promise of wonders to come!

FOR MORE INFORMATION ON HOW THESE CENTRALAB ENGINEERED CERAMICS CAN OFFER YOU BIG SAVINGS, **SEE NEXT TWO PAGES**

If your product requires you can make it better with

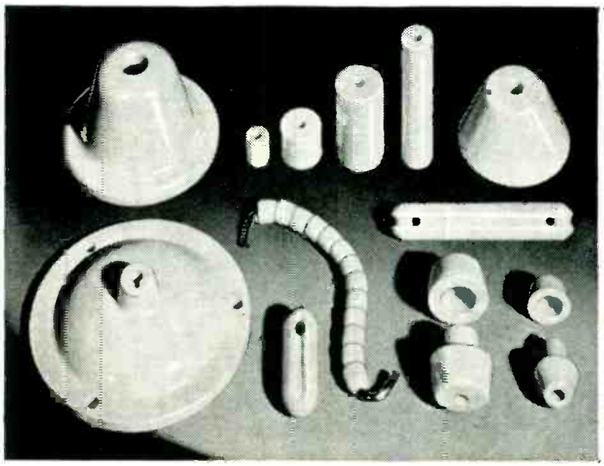


THERE'S a Centralab Ceramic material to match your individual requirements — electrically . . . physically . . . structurally. These materials are unique. We can extrude, mold or press them. What's more, Centralab Ceramics can be worked the same as metal—drilled, turned, ground or tapped. In addition, they can be metalized. Every Centralab Ceramic has some of the properties shown above, and they meet all JAN-I-8 and JAN-I-10 specifications, without exception.

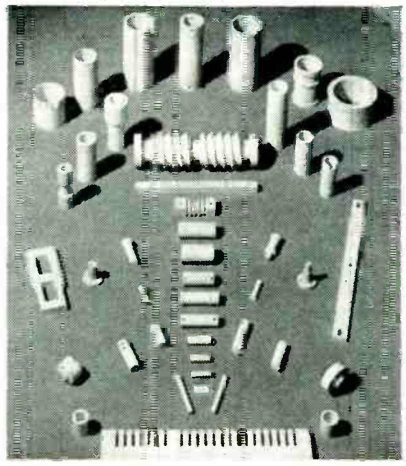
Centralab is the leader in ceramic development — making fine ceramics since 1928. Metalized ceramic material for close tolerance application was a CRL first. We have a complete staff of engineers, physicists and chemists ready to help you develop better product design through the use of Engineered Ceramics. Write for full technical details.

any of these properties, CRL Engineered Ceramics!

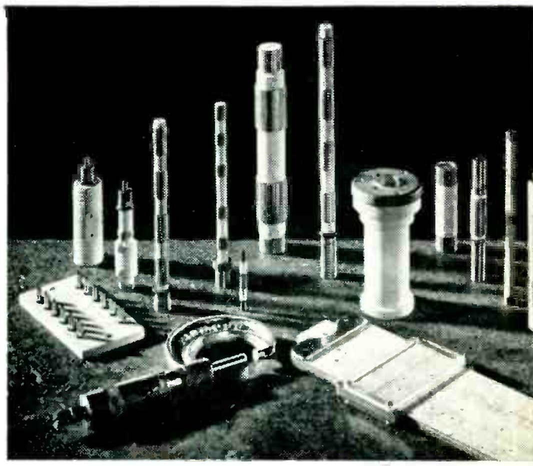
Here are examples of special Centralab Ceramics produced for structural, electrical and electronic use



Note the Standoffs illustrated, upper center. Made to government specifications, they are available commercially at a price lower than most standard units. Note the many types of specialty items.

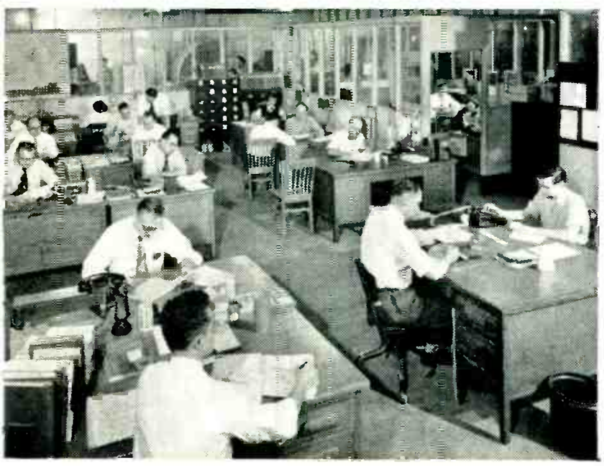


Specialty items include forms for coils and various electronic components, such as variometer rotor and stator bars, heater coils, etc. Commercial units are available in Grade L-5 and L-6 Steatite if required.

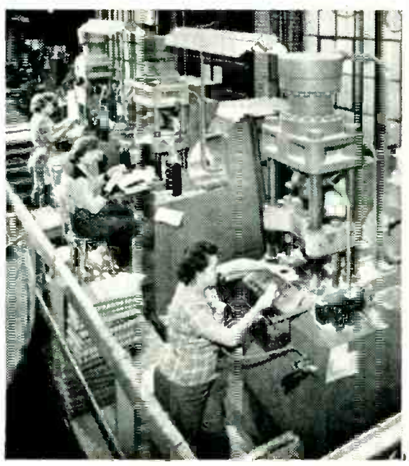


Many different ferrous and non-ferrous metals can be applied to ceramic bodies, combining the desirable properties of the metal plus the dielectric strength and other unique properties of ceramics.

FULL Centralab design and production facilities are available to meet your exact need



Centralab engineers constantly improve CRL Ceramics searching for new materials . . . developing more economical production methods. Consult Centralab on your problems.



Production operations — including mixing, molding, drilling, tapping and stamping are mechanized. This assures uniform quality, fast operation, low costs.

There's a quality inspection for Centralab Ceramics after each major operation. Modern methods are used to insure maintenance of unusually high "Average Quality Level."

Centralab CRL ®

A Division of Globe-Union Inc. • Milwaukee 1, Wis.
In Canada, 635 Queen Street East, Toronto, Ontario

CENTRALAB, A Division of Globe-Union Inc.
914 East Keefe Avenue, Milwaukee 1, Wisconsin

Please send me full technical information on Centralab Engineered Ceramics.

Name..

Address..

Company.. Title.................

lack of motors in 1952 due to sparse steel supplies feel that, with additional steel allocations by NPA, this year will be one of their best. Action of CBS who will soon begin selling a higher priced hi-fi phonograph, and Emerson, who takes over Webster-Chicago, seems to substantiate this forecast. It is also reported that Zenith will bring out a new hi-fi phonograph this year.

Record manufacturers see new volume highs for 1953 and are preparing for them. Through RIAA (Record Industry Association of America) they plan to run a test sales campaign and market survey to determine the long-range effect on record sales of increased sales of phonographs. The results of the test and survey may lead to changes in phonograph record advertising and promotion.

Top Management Reviews Its Paychecks

Higher net sales helped to up executive salaries but taxes and living costs also rose

COMPENSATION of principal executives in the radio and television industry increased substantially between 1949 and 1951, reflecting an even healthier increase in net sales for firms they represented. However, higher income taxes and rising costs tempered the effects of both, according to a study made by the National Industrial Conference Board of company reports to the Security and Exchange Commission.

▶ **Set Manufacturers**—The study shows that between 1949 and 1951 the net sales of 10 representative radio and television receiver manufacturers increased an average of 38 percent. In 1949 they ranged from $6.1 million to $396 million, while in 1951 the span was from $12 million to $599 million. For the same companies the total officers' payroll rose 24 percent during the period. Total executive payroll ranged between $57,000 and $1.6 million in 1949. In 1951 the range was between $93,000 and $2.1 million.

As a percentage of sales, top management salaries represented 0.5 percent of total net sales in 1949 and 0.6 percent in 1951. For individual set makers the percentage ranged from 0.4 percent to 1.4 percent in 1949 and from 0.3 percent to 1.2 percent in 1951.

▶ **Parts Manufacturers**—Management salaries also rose substantially in radio and television parts companies, according to the SEC report study. Between 1949 and 1951 the net sales of 8 leading parts manufacturers increased over 100 percent and total officer salaries during the three-year period rose 35 percent. In 1949 the net sales of these firms ranged from $600,000 to $15.5 million, while in 1951 the span was from $1 million to $33 million. Total pay to parts company officials ranged from $54,000 to $310,000 in 1951. The bracket was $11,000 to $70,000 in 1949.

Total executive salaries for the parts companies surveyed represented as a percentage of net sales 1.5 percent in 1949 and 1.6 percent in 1951. For individual parts companies, the percentage ranged from 0.7 percent to 5 percent in 1949 and from 0.7 percent to 5.4 percent in 1951.

▶ **Top Man**—The highest-paid executive in each of the radio and television set manufacturing firms surveyed received a salary in 1949 ranging from $18,800 to $200,000. The top salary of $200,000 didn't change in 1951 but the lowest salary reported increased to $25,000. Although bonus reports were incomplete, figures available indicate that they also increased substantially. A bonus high of $120,700 was reported in 1951. In 1949 the high was $49,300.

Among the radio and tv parts manufacturers surveyed the salary of the highest-paid executive in each of these firms ranged from $11,000 to $70,000 in 1949. In 1951 the spread was from $32,000 to $79,300. Executive bonus checks remained relatively stable.

▶ **Costs**—The average executive who earned $50,000 in 1949 had a net after taxes of $33,000. In 1951 his take-home-pay from the same amount was $31,100. The cost of living as measured by the Consumer's Price Index also had its effect. It stood at 161.3 in 1949 but by 1951 had risen to 174.5.

THE MAN says "three" and the proper light lights to show. . . .

Robot Responds To Spoken Numbers

Digits from 1 through 0 are made into patterns, matched with memory standards

AN EXPERIMENTAL UNIT in Bell Labs responds to spoken numbers by lighting the proper light for each digit from 1 to 0. The response is accurate when circuits are adjusted to the individual voice, if enunciation is clear. Signals could equally well perform other functions, such as operating dial mechanisms.

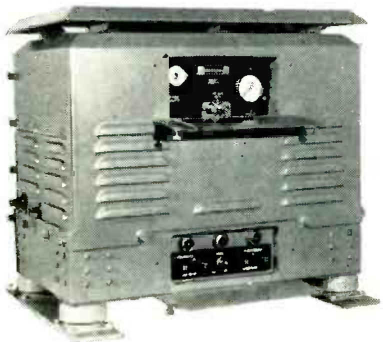
In this developmental stage the engineers are cautious, putting customer vocal dialing somewhere in the future. But they hope Audrey—the 'automatic digit recognizer'—can be taught to respond to additional sounds, perhaps even say a few words on command.

▶ **Audrey's Nerves**—Circuits and relays used in modern dial systems were used in the unit's construction. The voice sounds are sorted into electrical categories which conform to sound wave patterns.

(Continued on page 16)

SHOCK AND VIBRATION NEWS

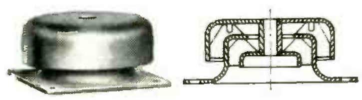
Builder Claims Smooth Performance and Quiet Operation thru the use of Barrymounts in Dehydrator



The 2-way protection given by Barrymounts is applied in AUTO-DRYAIRE® dehydrators as a design feature of these automatic pressurizing units for high-frequency transmission lines.

In this service, Type C-2000 Barrymounts prevent transmission of air-compressor vibration to the supporting surface. They also cushion the mounted apparatus to protect active parts, piping, and controls within the dehydrator from external shock and vibration.

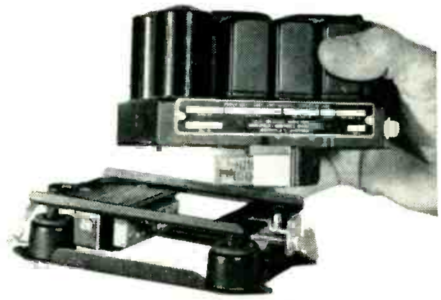
The maker of AUTO-DRYAIRE®, Communication Products Company, Inc. of Marlboro, N. J., states: "We have used Barry Isolators for several years. The excellent service they have rendered in our equipment is the primary reason for their continued use."



Type 2000 Barrymount

Barry "cup" mounts are satisfying a wide variety of needs in industrial, mobile, and marine service. Ask our Field Engineering Department for help with YOUR vibration problems. FREE CATALOG 504-B tells about these and other vibration isolators.

Miniaturized Vibration Isolators Help Cut Space and Weight in Fuel-Gauge Power Unit



70% size reduction and 50% weight reduction — with no loss of performance — is the effective miniaturization obtained in the new Minneapolis-Honeywell aircraft-fuel-gauge power unit. Miniature, air-damped Barrymounts, Type 6465, helped M-H engineers in this achievement.

These vibration isolators, in which size and weight have been cut while operating characteristics have been maintained, will help you redesign for miniaturization.

Check these useful features of miniaturized Barrymounts.

Light weight — only 5/16 ounce each.

Small size — 1" diameter 11/32" loaded height.

Resonant frequency — 9 cps

Transmissibility at resonance — 3

Wide load range — 0.1-3 pounds

4 different styles available — for plate or stand-off mounting.

Write for data sheets 605 and 606 giving details of dimensions and load ratings.

FREE CATALOGS

- 523-A — Air-damped Barrymounts for aircraft service; also mounting bases and instrument mountings.
- 509-A — ALL-METL Barrymounts and mounting bases for unusual airborne applications.
- 504-B — Shock mounts and vibration isolators for marine, mobile, and industrial uses.
- 607 — How to cut maintenance costs by using Barrymounts with punch presses.

THE **BARRY** CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

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

These categories are matched, in a memory cell, against electronically-drawn standard reference patterns. When the electrical pattern of the spoken number matches the standard pattern, the proper light flashes.

Voice-operated devices have been used for years in transoceanic telephony, but until now none of them have had to distinguish between different words. The key to Audrey's success is the visible study of speech patterns done in Bell Labs on the sound spectograph and similar machines.

Electronics Surplus Is Still Big Business

Obsolete and overstocked supplies continue to pour out of warehouses

FAR FROM PETERING OUT with dribbles of World War II equipment, the electronics surplus industry is growing, according to the Institute of Surplus Dealers, Inc.

At the recent surplus show in New York, Eugene P. Connolly, the Institute's president, guess-timated a $25,000,000 volume this year in surplus electronic gear. And Connolly thinks it will never end. Surplus, he says, is here to stay, a part of our economy and a pretty large part at that.

▶ **Organization**—The Institute has compiled a list of 2,200 dealers across the country, but there are many more not listed or disguised under other business operations.

A manufacturer looking for surplus supplies has two ways to go. He can watch the ads in publications and surplus dealers' circulars, or he can write to the Institute (673 Broadway, New York City). He may find what he wants but, if he doesn't, that is no sure indication the surplus goods are not there. Surplus dealers by and large aren't electronics men; they don't know a 6V6 from a megawatt.

Television Expands Overseas

Sets abroad top 2.4 million, 21 countries have service; Latin America best US market

TELEVISION is making significant progress abroad. Stations are on the air in 21 foreign countries and regular service is scheduled for seven more by the end of the year. Sets in use total 2.4 million, up 50 percent over 1951 figures. Ganging-up 10 or 15 people to a set is common and the viewing audience is estimated at 24,450,000.

Latin American countries have shown great interest in television and this area is potentially an important market for American manufacturers. Picture standards are in general the same as in U. S. Elsewhere, Japan has adopted our standards and is planning a tv network that may include 30 stations or more. However, fourteen Japanese-electronic firms reportedly are gearing up for mass production of tv receivers. Japan looms as a competitor rather than customer in the world market.

▶ **Cuba**—Fourth in number of sets in use, Cuba has complete television coverage. Two competitive networks cover the island and 100,000 sets are in use. Havana has two stations, with a third planned for 1953. Ten additional stations are planned.

▶ **Mexico**—Mexico, with five stations on the air, has only 40,000 sets in use. One major problem is the 50 and 60-cps power service in Mexico City. A heavy import duty on finished sets has been partially circumvented by shipping chassis to assembly plants in Mexico. Some manufacturers have considered making sets in Mexico for export elsewhere in Latin America to take advantage of the favorable tariffs between Mexico and other Latin American countries. Spain enjoys similar tariff advantages and this may be one reason why a large U. S. tv manufacturer will operate from there.

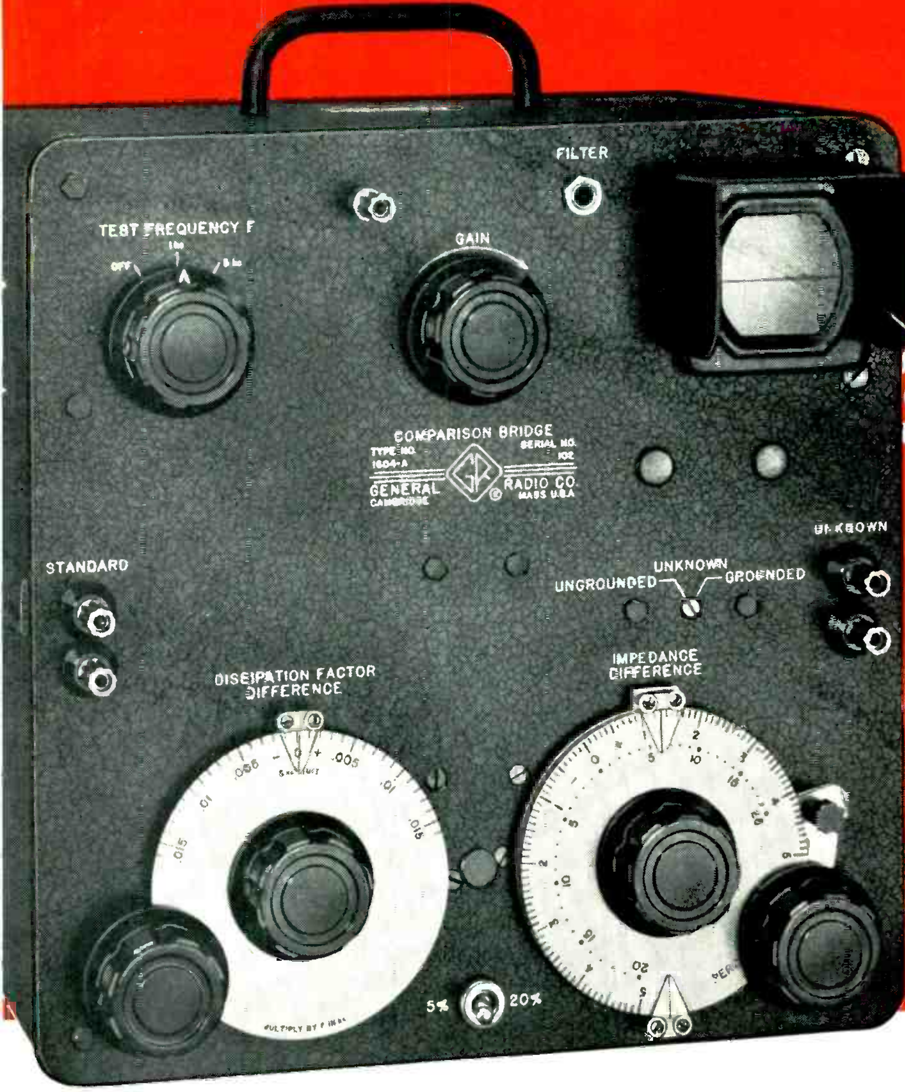
Television Status Around the World

Country	Standards	Sets in Use	Transmitters on	const*	plan.
Albania	625/25/8 mc				
Argentina	625/25/6	12,000	1		5
Australia	625/25/7.5(?)				1
Austria	(tv forbidden by occupation rules)				
Belgium	625/25/7	3,000			5
	819/25/14				
Bielorussia	625/25/8				
Bolivia	525/30/6(?)				
Brazil	525/30/6	45,000	3	4	9
	625/25/6				
Bulgaria	625/25/8				
Canada	525/30/6	150,000	2		5
Chile	525/30/6				2(?)
Colombia	(contract for Bogata cancelled)				
Cuba	525/30/6	100,000	2	1	10
Cyprus	(British equipment reportedly on order)				
Czechoslovakia	625/25/8			1	
Denmark	625/25/7	500	1		1
Dominican Republic	525/30/6	500	1		
Egypt	(French demonstrated temp. station 5/51				
Finland	625/25/7				
France	441/25/6				
	819/25/14	55,000	3	1	5
Germany (East)	625/25/(?)	300	1		
Germany (West)	625/25/7	2,000	5		3
Great Britain	405/25/5	1,655,446	5		2
Guatemala	525/30/6(?)				3(?)
Hungary	625/25/8				
India	(seriously interested)				
Israel	(seriously interested)				
Italy	625/25/7	4,000	2	1	10
Japan	525/30/6	3,000		1	10
Luxembourg	625/25/7				
Mexico	525/30/6	40,000	4	2	6
Morocco	819/25/14			1	3
Monaco	819/25/14				
Netherlands	625/25/7	7,000	1		5
Nigeria	(British equipment reportedly on order)				
Norway	625/25/7				
Pakistan	(seriously interested)				
Poland	625/25/8			1	
Rumania	625/25/8				
Saar	625/25/7				
	819/25/14			1	
Spain	625/25/7	125		3	
Sweden	625/25/7	100		1	4
Switzerland	625/25/7				3
Tanganyika	(British equipment reportedly on order)				
Thailand	(money available, bids submitted)				
Tunisia	819/25/14				
Turkey	625/25/7			1	
Ukraine	625/25/8				
U. S. A.	525/30/6	18,500,000	129		144
Uruguay	(bids for station recently cancelled)				
U. S. S. R.	625/25/8	77,000	3		
Venezuela	625/25/6		1	2	
Vatican City	625/25/7				1
Yugoslavia	625/25/7			1	2

* Experimental station, station testing or under construction.

▶ **Brazil**—Beset with foreign exchange troubles, Brazil, nonetheless, is showing great interest in tv. An electronics industry has already taken root in the Sao Paulo area and television sets may soon be manufactured internally. Radio sets and components are now

(Continued from page 18)



New!

GR COMPARISON BRIDGE

for Rapid and Accurate **Impedance and Dissipation Factor** *Measurements*

TYPE 1604-A
COMPARISON BRIDGE . . . $335.00

The Type 1604-A Comparison Bridge is a unique, direct-reading impedance measuring device which materially reduces test and measuring time. It enables the rapid and precise measurement of both impedance and dissipation factor of capacitors, resistors and inductive components. A component of a production lot or an appropriate standard is used for comparison against the unknown.

In operation, "Impedance Difference" and "Dissipation Factor Difference" dials conveniently and accurately indicate the degree by which these characteristics differ from those of the selected standard. For real high-speed sorting, the cathode-ray-tube indicator is easily calibrated at the desired tolerance and used to give an instantaneous visual "go no-go" indication. The instrument is completely self-contained; it includes a bridge circuit, internal 1 kc and 5 kc oscillators, a high-gain non-linear amplifier terminated in a CRO visual detector, and an internal power supply.

The Type 1604-A Comparison Bridge —

★ is ideal for checking ganged potentiometers, condensers and inductors that must track each other to very close tolerances

★ is extremely useful for precisely setting and checking the tap of center-tapped windings or for comparing two windings on the same core.

★ permits rapid and reliable adjusting of one variable component to the value of another . . . the approach to balance is continuously and instantly indicated

★ can be used to measure directly small capacitors in the 1 $\mu\mu f$ range.

★ In laboratory, shop or production line the Comparison Bridge will prove invaluable for adjusting, selecting and pairing components within given tolerances.

FEATURES

Two IMPEDANCE DIFFERENCE Ranges — *0 to ±5% range for accurate comparisons — 0 to ±20% for checking components within the common ±10% and ±20% tolerances*

Accuracy of Impedance Measurements

	Resistance	Capacitance	Inductance
1 kc:	$2\Omega - 20M\Omega$	$50\ \mu f - 50\ \mu\mu f$	$500\ \mu h - 250\ h$
5 kc:	$4\Omega - 4M\Omega$	$2\ \mu f - 50\ \mu\mu f$	$200\ \mu h - 10\ h$

For these impedances, accuracy is ±0.1% for the 5% switch position.

DISSIPATION FACTOR DIFFERENCE — **Range** ±*.015 at 1 kc;* ±*0 75 at 5 kc*; **Accuracy at** *1 kc: ±(.0005+2% of impedance difference)*; *5 kc: ±(.0025+2% of impedance difference)*

CRO Visual Detector — *horizontal band of light is used as the indicator — highly non-linear detector amplifier keeps indication on scope over wide ranges of unbalance — continual resetting of gain control is eliminated.*

Zero Adjustment — *adjustable index mark on scope can be offset and locked to compensate for deviation of the standard from the desired nominal value — permits use of any component as a standard*

Dimensions — *12" x 14¼" x 10"*; **Net Weight** — *22½ lbs.*

GR GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

90 West St. NEW YORK 6 · 920 S. Michigan Ave. CHICAGO 5 · 1000 N. Seward St. LOS ANGELES 38

Admittance Meters ☆ Coaxial Elements ☆ Decade Capacitors ☆ Decade Inductors ☆ Decade Resistors ☆ Distortion Meters ☆ Frequency Meters ☆ Frequency Standards ☆ Geiger Counters ☆ Impedance Bridges ☆ Modulation Meters ☆ Oscillators ☆ Variacs ☆ Light Meters ☆ Megohmmeters ☆ Motor Controls ☆ Noise Meters ☆ Null Detectors ☆ Precision Capacitors ☆ Pulse Generators ☆ Signal Generators ☆ Vibration Meters ☆ Stroboscopes ☆ Wave Filters ☆ U-H-F Measuring Equipment ☆ V-T Voltmeters ☆ Wave Analyzers ☆ Polariscopes being made. Manufacture of electron tubes including crt's is envisioned.

Brazil has 45,000 sets in use, three transmitters on the air, nine planned and four under construction. The city of Rio de Janiero may soon become operator of the hemisphere's first educational tv station. Brazilians are enthusiastic about television and projection receivers are frequently seen in public places, parks and even vacant lots.

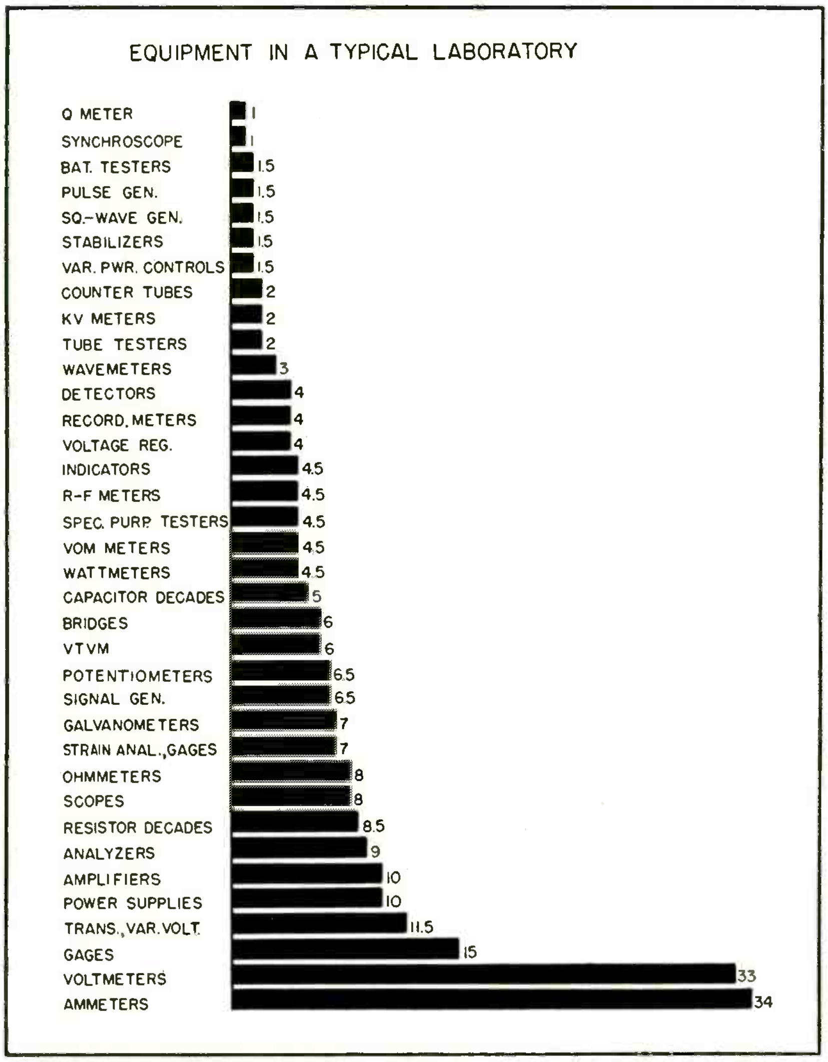
▶ **Elsewhere**—Argentina imported 9,293 tv sets during the first eight months of 1953. No additional transmitters are contemplated. There is presently only one station, in Buenos Aires.

Venezuela has a high standard of living and a large market is expected here despite different picture standards. Two stations in Caracas should be on the air by now. A third is scheduled for late 1953.

Television transmitter deals recently fell through in Uruguay and Colombia.

U. S. manufacturers of tv transmitting equipment have reported serious inquiries from El Salvador, Peru, Costa Rica, Republic of the Philippines, New Zealand and Union of South Africa. Inquiries of a more casual nature have been received from Honduras, Formosa, Indonesia, Malaya and Greece.

Average Laboratory Uses 254 Instruments



Survey by ELECTRONICS of 459 laboratories in 10 different classifications shows they contain 116,395 instruments. Identity of 36 types is shown above. Remaining types average less than one and include field-strength meters, spectrometers, sweep calibrators, colorimeters and radiation meters

Financial Roundup

MERGER action by two major manufacturers, along with profit reports and security transactions of other companies in the field, highlight the current financial picture of the electronics industry.

Board of directors of Webster-Chicago and Emerson Radio have recommended merger of the two companies. After approval by stockholders of both companies, Emerson will issue 337,500 shares of its capital stock for the 450,000 shares of Webster-Chicago now outstanding, which is in the ratio of ¾ share of Emerson for 1 share of Webster-Chicago. These shares will be in addition to the 1,935,187 presently outstanding shares of capital stock of Emerson, which will remain unchanged. After the merger, Webster-Chicago will be operated as a division of Emerson.

▶ **Profit Reports**—The following companies issued net profit statements for the first 9 months:

Company	1952	1951
AT&T*	$22,819,780	$30,949,435
Avco	6,647,079	7,660,372
Minnesota Mining	11,442,337	11,427,754
Reliance Electric	1,816,140	1,727,215
Remington Rand**	9,557,404	9,836,491

*Net operating income for 10 months
**Earnings for 8 months

▶ **Securities Sold**—Aerovox purchased for cash the entire outstanding stock of Acme Electronics of Pasadena. It will be operated as a wholly-owned subsidiary.

Radioactive Products sold 52,176 shares of class A convertible stock at $1.25 per share. The proceeds were added to the company's working capital to facilitate increased volume.

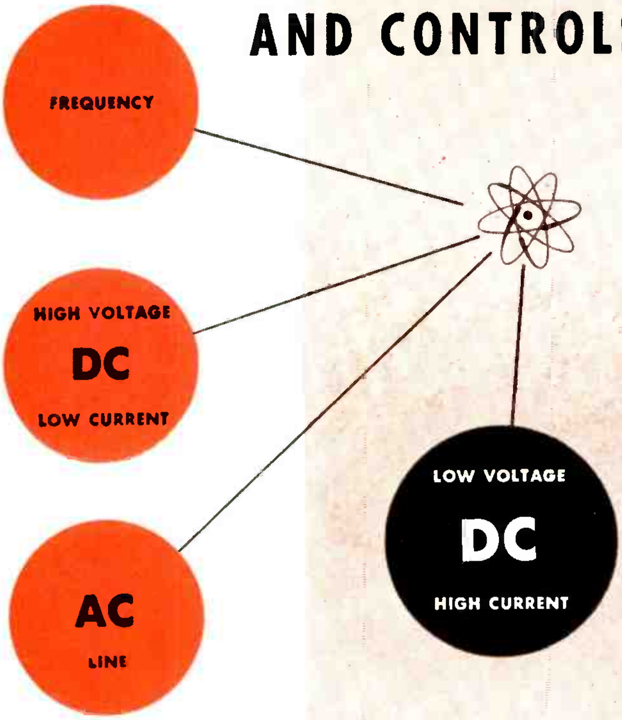
Kentucky Coal Deposit Ups Germanium Supply

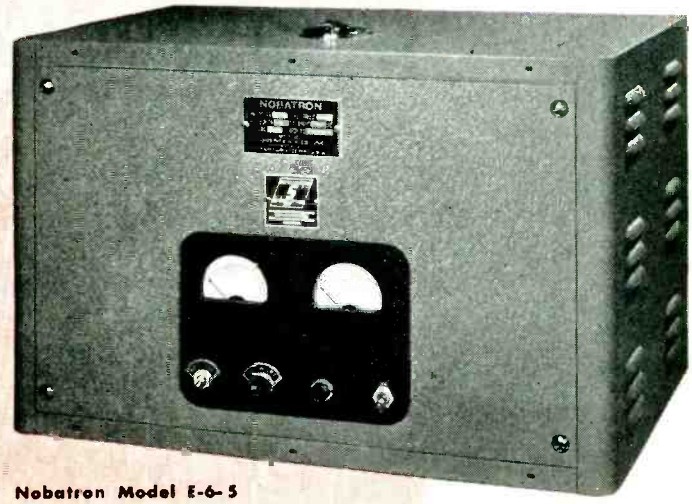
GERMANIUM for transistors and crystal diodes has been found in coal ash from an eastern Kentucky deposit. Although the new source may increase substantially the amount of germanium available,

(Continued on page 20)

SORENSEN

REGULATES AND CONTROLS *electronically*





Nobatron Model E-6-5

The NOBATRON* maintains stabilized DC voltage under changing line and/or load conditions.

A complete line of catalog models are available, with output voltages of 6, 12, 28, 125, and 200 VDC, from 5 to 350 amperes.

Sorensen Nobatrons eliminate battery and generator troubles. They combine high regulation accuracy with maximum dependability and minimum maintenance.

All models are attractively finished. Most can be furnished either for relay rack mounting or in cabinets for bench-top use. Most units are metered; all are adequately protected against overload by suitable fuses and breakers.

COMMON NOBATRON SPECIFICATIONS

Input voltage range	95-130 VAC, single ϕ, 50-60 ~ High-current units 208/115, 3ϕ, 4-wire, wye.
Output voltage range	Adjustable ± 10% with rated accuracy, — 25% with lesser accuracy.
Regulation accuracy	± 0.2% from 1/10 to full load.
Ripple voltage	1% RMS. Time constant 0.2 seconds.

* Reg. U. S. Pat. Off. by Sorensen & Co., Inc.

WIDER OUTPUT VOLTAGE RANGE MODELS

Nobatron-RANGERS* are designed to meet the demand for power supplies similar to the Nobatron but with wider output voltage ranges.

Nobatron-RANGERS are continuously adjustable over extended output ranges, yet provide regulation accuracies of ±0.25% against line and/or load. Other specifications are identical to those of the standard Nobatrons.

Three models are available, the SR-30, SR100, SR-2. Capacities, respectively, are 3 - 30 VDC at 3 - 30 amperes, 3 - 135 VDC at 1 - 10 amperes, and 100 - 300 VDC at 1 - 10 amperes.

Investigate NOW the cost of a NOBATRON installation versus the overall cost of less satisfactory DC sources.

OTHER SORENSEN ISOTRONIC PRODUCTS INCLUDE:

B-NOBATRONS (high-voltage, low-current DC Supplies)
FREQUENCY CHANGERS
VARIABLE AUTO TRANSFORMERS
SATURABLE CORE REACTORS
AC LINE REGULATORS

SPECIFY **SORENSEN**

For Complete Information Write

SORENSEN & COMPANY, INC.
375 Fairfield Avenue
Stamford 1, Conn.

demand is expected to keep its price firm at $350 a pound.

Germanium production has been running about 1,000 pounds annually; demand may reach 15,000 pounds when transistor production swings into high gear. Original source for the increasingly important material was smoke from zinc furnaces.

Automatic Pilot Speeds River Barges

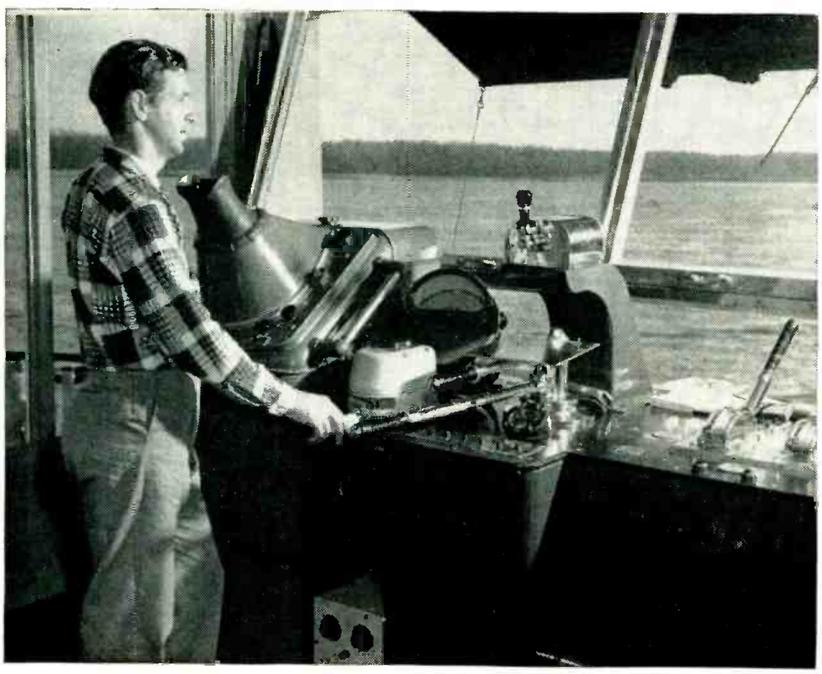
AT FIRST glance, an automatic pilot for a tugboat seems about as useful as lace curtains at the windows of the pilot house. But when the seconds and minutes saved by its use add up to hours or even days less for a given trip the idea begins to make sense.

Sperry Gyro, which claims a preponderance of the hundred-odd radar installations on tugs plying the Mississippi-Ohio rivers system, has been working for at least two years on a gadget that will tie radar to the rudder. The final result is a control that can be hung on the outside of the radar console or in any other convenient small space. Linkage between the two, so far, is via the pilot.

▶ **Steady as You Go**—The pilot's control is a small housing not unlike the throttle of a Diesel locomotive. With the handle in the lower circular slot, he can steer the tug electronically by means of a magnetic amplifier in a box mounted nearby. By moving the handle upwards into the top slot, the last course setting is held with the help of a gyrocompass. Movement of the handle corrects to any new desired course.

Pushing a 1,000-foot string of barges up the Mississippi is slow work at best, sometimes as slow as a knot an hour. Even a good pilot is likely to oversteer a little, especially at night. Whenever he does, he must turn his rudder in the other direction. And while steering, he slows his progress. With the automatic pilot, it may be possible to cut a fifteen-day trip to ten days.

On the Hudson River-Champlain Canal system there is one skipper who saves two hours out of every twenty-four with the new device.



Modern Mark Twain can either steer or automatically hold a course with this new electronic pilot. Big-boat skippers can use it instead of shouting to the helmsman from the radar screen

'Automation' Comes To Modern Industry

Feedback loops built into complex controls presage automatic industrial production

BUILT INTO FUNCTIONING PLANTS, servomechanisms based on the feedback principle are operating complex industrial processes faster and better than men can.

In all applications the principle is the same—A continuous measurement of the work being done is compared with instructions set into the control instrument's 'memory'. Deviation, the so-called 'error signal', is fed back to the controls, continuing or decreasing the work until the goal is reached. Then the control shuts the machine off, or starts the cycle over again.

By extending this principle, whole sequences of operations can be done at amazing speeds and accuracies.

▶ **Existing Applications**—A new Ford plant in Cleveland operates entirely by 'automation'—automatic industrial production—and 250 men do twice the work 2,500 men did before. One instrument balances crankshafts, by automatically controlling drilling and grinding operations.

In continuous-strip production, such as steel, paper and rubber, servomechanisms control the strip width, continuously readjusting machines to maintain a tolerance impossible with old methods involving sample caliper measurements.

Television Assumes Role in Cold War

East and West stations vie in divided Berlin; relay spans Red Zone

REGULAR television broadcasting in Germany has opened a new battlefield in the propaganda war for men's minds. Programs are now

(Continued on page 22)

Select the right
KROHN-HITE OSCILLATOR
in the ULTRA-LOW FREQUENCY RANGE

REMEMBER: All KROHN-HITE OSCILLATORS provide sine and square wave simultaneously

- COMPACT and LOW PRICED

price $350^{00}

model **400-A**

SPECIFICATIONS: **FREQUENCY RANGE:** 0.009 to 1,100 cps., continuously variable in five decade bands.
FREQUENCY ACCURACY: Calibration ±2%, drift is less than 1% including warm-up and less than .05% for ±10% change in line voltage.
SINE WAVE OUTPUT:
VOLTAGE: 30 volts maximum, adjustable continuously with a logarithmic output control calibrated from .01 to 10 rms. volts.
AMPLITUDE: Varies less than ±1 db over entire range from 0.009 to 1,100 cps. and less than ±0.25 db for ±10% change in line voltage.
POWER: 25 mw maximum across 1,000 ohms.
DISTORTION: Less than 1% at any output level setting.
HUM: Less than 0.1% at any output level setting.
SQUARE WAVE OUTPUT: 10 volts peak to peak maximum.

- STANDARD RACK MOUNTING
- SINGLE ENDED OR BALANCED OUTPUT

price $375^{00}

model **400-C**

SPECIFICATIONS: **FREQUENCY RANGE:** 0.009 to 1,100 cps., continuously variable in five decade bands.
FREQUENCY ACCURACY: Calibration ±2%, drift is less than 1% including warm-up and less than .05% for ±10% change in line voltage.
SINE WAVE OUTPUT:
VOLTAGE: 30 volts maximum, adjustable continuously with a logarithmic output control calibrated from .01 to 10 rms. volts.
AMPLITUDE: Varies less than ±1 db over entire range from 0.009 to 1,100 cps. and less than ±0.25 db for ±10% change in line voltage.
POWER: 100 mw maximum across 1000 ohms.
DISTORTION: Less than 1% at any output level setting.
HUM: Less than 0.1% at any output level setting.
SQUARE WAVE OUTPUT: 10 volts peak to peak maximum.

- WIDE RANGE
- ULTRA-LOW DISTORTION
- EXCELLENT AMPLITUDE CONSTANCY

price $950^{00}

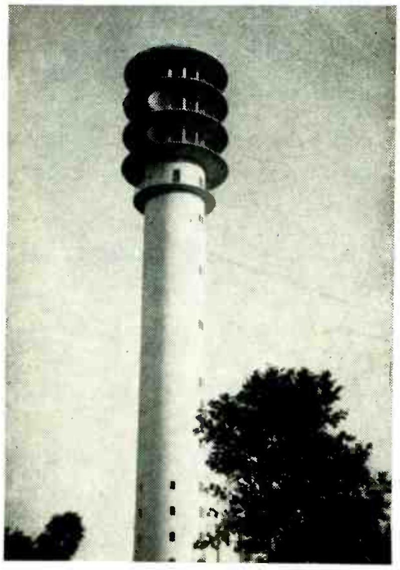
model **410-A**

SPECIFICATIONS: **FREQUENCY RANGE:** 0.02 to 20,000 cps., continuously variable in six decade bands.
FREQUENCY ACCURACY: Calibration ±2%, drift is less than 1% including initial warm-up and less than .01% for ±10% change in line voltage.
SINE WAVE OUTPUT:
VOLTAGE: 15 volts maximum adjustable continuously by a "T" pad, and by a step switch providing 100:1, 10:1, 2:1, and 1:1 attenuation.
AMPLITUDE: Varies less than 0.25 db over entire frequency range from .02 to 20,000 cps.
POWER: 10 mw maximum across 500 ohms.
DISTORTION: Less than 0.1% over entire frequency range from .02 to 20,000 cps.
HUM: Less than .1% at any output level.
SQUARE WAVE OUTPUT: 10 volts peak to peak maximum.

KROHN-HITE INSTRUMENT COMPANY
580 MASSACHUSETTS AVENUE
DEPT. E, CAMBRIDGE 39, MASS.

All Krohn-Hite Instruments fully guaranteed for one year against defective materials and workmanship. Prices net — f.o.b. Cambridge. *Write for free catalog.*

Want more information? Use post card on last page.



Microwave relay links new German tv stations. Tower houses repeater station

broadcast from transmitters in both East and West Berlin. The West Berlin transmitter is linked by vhf relay across the Soviet Zone with the Northwest German Radio (NWDR) network; the East Berlin station may soon be joined by other stations in the Hartz Mountains near the West German border and in Thuringia.

The Voice of America reports that it has no plans to acquire television equipment, although it will make filmed programs available to West German broadcasters. Radio Free Europe, a private organization broadcasting to Russia and her satellites, likewise disclaims interest in television broadcasting. Such programs "would reach only a small portion of Europe's captive population due to propagation difficulties and would be overly vulnerable to interference and jamming."

▶ **Limited Audience**—Only 1,200 television sets are in use in West Berlin; about 200 are in bars. Chief reason for the small tv audience is economic; the cheapest German television sets cost $300, almost six months income for the average German. Television receivers in East Berlin are Russian 7-inch sets. Most of these have been installed in public places, presumably to discourage channel jumping. Both East and West German television stations broadcast a 625-line, 25-frame picture using a 7-mc bandwidth with f-m sound.

NWDR operates stations in Hamburg, Hanover, Langenberg (in the Ruhr basin) and Cologne. The stations are linked by microwave radio relay stations, like the one in the photograph, sited at 40-mile intervals. Stations are planned for Frankfurt, Stuttgart and Munich.

The 200-mc vhf relay that ties West Berlin into the network terminates atop a 500-ft tower built on a 200-ft hill at Hoebeck in the British zone. Signals received from West Berlin 80 miles away are relayed to the other network stations through Hamburg.

Lawrence Tri-Color Tube In Production

NOW CALLED 'CHROMATRON', the tricolor tube (p 81 and 146, Nov. 1951) developed by E. O. Lawrence of the University of California is being produced in pilot-plant quantities by Chromatic Television (Paramount Pictures) of Oakland, Calif. At a closed-circuit demonstration for the press in New York City, Richard Hodgson, president of Chromatic, said 200 have already been made. The tube is 22 inches in diameter but, due to the wire grid arrangement integral to construction, it produced an 18-in. picture.

▶ **Claims**—Demonstrated with a flying-spot scanner and Kodachrome slides, the picture was very bright. Hodgson said less scanning power is now needed for the color sync pulses, as a result of increasing the number of vertical grid wires and other improvements. A major advantage claimed for the new tube is its adaptability to mass assembly methods. Mass-produced color grids and mass-produced phosphor-striped screens may be mass-assembled without much hand tailoring, giving a color tube for about twice the cost of conventional monochrome types.

The tube was demonstrated on the CBS color system but is adaptable to NTSC signals. It can be made as short as monochrome tubes usually are.

Militronic Equipment: Too Complex?

"Perhaps," say top brass as drive gains to reduce both cost and upkeep

LEVELED jointly at military men and equipment designers is the charge that excess gimmicks and gadgets in modern weapons are killing our boys with kindness. Critics also contend that weapons cost more than they are worth, that they should be far simpler in design and construction. The charge is popular with economy-minded congressmen and a widespread conclusion has been drawn that we are designing ourselves into bankruptcy.

Much of the complexity arises from wider application of electronic devices. A modern battleship uses 9,000 electron tubes, a B-36 heavy bomber depends upon 2,100 tubes for navigation and control. An F-86 Sabrejet employs 600. In all, 15,000,000 tubes are currently used in military equipment. Costwise, electronic gear aboard a destroyer brings $3,000,000 today as against $40,000 during World War II.

Maintenance costs likewise measure complexity of new weapons. Experience shows that each 100 million dollars worth of military electronic equipment needs one billion dollars worth of maintenance before it wears out.

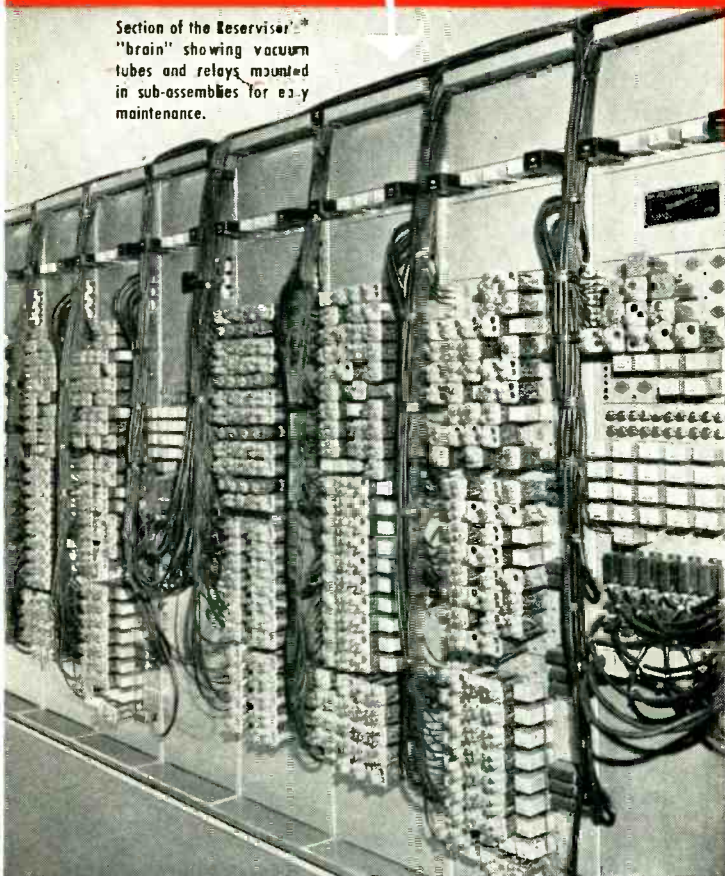
▶ **How to Simplify**—Interest is mounting in simple and reliable equipment. Department of De-

(Continued on page 24)

1400 CLARE RELAYS

in "brain" of first completely automatic reservations system

Section of the Reservisor* "brain" showing vacuum tubes and relays mounted in sub-assemblies for easy maintenance.

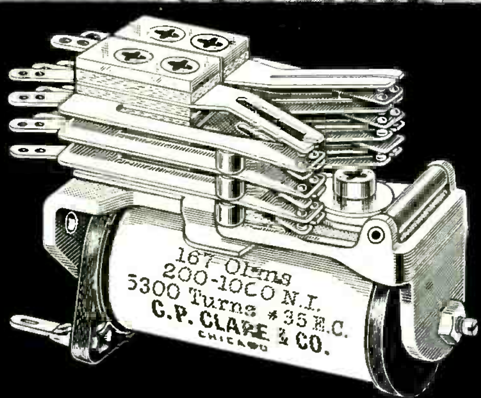


IMMEDIATE INFORMATION on reservations for American Airlines' 1000 flights a day is available to airline personnel through the use of The Teleregister Corporation's Magnetronic Reservisor,* the first completely automatic reservations system.

With its 1500 tubes and 1400 CLARE relays, the Reservisor* is also a high-speed computer, a storage and filing system, data transmission system, display device, and a logging or recording unit.

In their vast experience with electrical controls, Teleregister's engineers have acquired a knowledge of relays that is wide and deep. The importance which they attached to selecting the best possible relays for the Magnetronic Reservisor* stands out in these their own words, "Choice of components, equipment layout, and circuitry were aimed at reliability. First of all, the incidence of trouble should be held to the minimum. This has been accomplished by using only the finest components and by using a sturdy relay instead of a vacuum tube wherever possible." Their deliberate choice of CLARE relays is therefore charged with meaning for industrial designers.

CLARE sales engineers are located in principal cities to cooperate in the development or "custom-building" of relays to meet your most difficult design applications. Call them or write: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable address: CLARELAY.



Clare Type J Relay of which 1400 are used in Magnetronic Reservisor* is an extremely compact and lightweight relay.

*Trade Mark of The Teleregister Corp.

CLARE RELAYS

First in the Industrial Field

fense procurement officials are offering incentive contracts rewarding manufacturers who design and perfect weapons that do their job and are simpler than predecessors. Britain's RAF recently ordered 25 'poor-man's' radar sets. Hand-operated, the sets cost $11,200 and use only 50 tubes. Shying from 'cheap-and-dirty' equipment, U. S. military men too have nevertheless embarked on a program of simplifying equipment and reducing upkeep through unitization and automatic fault location.

▶ **Plug-In Radar** — Unitization means building up equipment with independent black boxes that can be plugged in when needed. A unitized radar set aboard a battleship would be replete with all extras while the same set, stripped to its essentials, would serve adequately aboard an LST.

Fault-locating devices of sufficient sensitivity to predict failure simplify maintenance in an emergency. Repair consists of plugging in a complete spare unit, with overhaul chores deferred to a convenient time and place.

Transistor Weds Magnetic Amplifier

Ceremony yields rugged servo system with high gain, fast response and high power output

USE OF TRANSISTORS in conjunction with magnetic amplifiers was suggested shortly after the transistor was announced. Each was known to be extremely rugged. The absence of standby power inherent in both devices showed promise.

The transistor is an efficient amplifier at low power levels and the magnetic amplifier excels at high power levels.

The marriage is in a servo amplifier by the Industrial Control Co. of Wyandanch, New York. The transistor acts, in effect, as a preamplifier for the magnetic amplifier power stage.

▶ **Simple Circuit**—The circuit used is quite simple, and yet it offers power gains of several thousand with a speed of response limited only by the operating frequency.

Input and output may be either d-c or a-c, and negligible power is consumed by the amplifier when no power is being delivered to the load.

Work is still going on to develop new designs, although the existing circuit is directly applicable to a wide variety of control applications in its present form.

A number of improvements are expected to result from use of better transistors, when they become available in sufficient quantity to make their use in commercial equipment feasible. Higher gains may be obtained by using cascaded transistors.

The new development makes available to industry a highly efficient and versatile packaged servo amplifier that is virtually indestructible and may be expected to have a long life. With present models power levels of a fraction of a watt to 500 watts may be controlled by such low-power devices as thermocouples, synchros, small potentiometers and photocells. The transistor-magnetic amplifier may also be used in other applications where low-frequency amplification is desired.

TV Servicing Business Patterns

Survey of dealers reveals large variations in efficiency of operation and charges for work

THE pattern of radio and television service business operation shows up as hectic and varied in a recent GE survey of 2,175 full-time dealers.

Average dollar volume for all dealers in 1951 ranged from $6,150 per technician in the small shop to $8,200 per technician in shops having over 10 technicians. Corresponding figures for shops specializing in tv work are $7,330 to $8,500.

▶ **Jobs Per Technician**—An average of 35 jobs is completed per week by each technician, but the average is by no means representative. Some of the six to nine man shops fixed over 60 sets per week per technician, while others got less than 14 jobs per week out of each technician.

Billing per service call also showed an extreme variation from the $8 average figure for tv and $5.50 for radio. Combining all dealers, the extremes show 9 percent of the firms averaging $3 per call as a low and $14 per call as a high. On the other hand, over 75 percent had average billings in the range of $5 to $10.

▶ **Contracts**—In firms having under 5 technicians, less than 10 percent of the tv calls were under service contract. With large firms specializing in tv service, a surprisingly high figure was reported for 1951; 75 percent of the calls were under service contract.

Percent of service jobs completed in the home on tv sets ranged from 78 percent for the small dealer to 86 percent for those having over 40 technicians.

Triple-Use Waveguide For TV, Phones, Power?

"Barlow's Tube" in London has U. S. counterpart at Bell Labs and Signal Corps

FOR many years, power companies have also been using their high-tension lines stretching across the country as carriers for wired-wireless radiotelephone communication. More recently, the Signal Corps has been experimenting with

(Continued on page 26)

the G-string, a single wire coated with enamel or plastic along which very high-frequency currents travel. Radar has made familiar the use of the waveguide, a hollow tube through which microwaves pass.

▶ **Marriage of Convenience**—H. M. Barlow, a professor at the University of London, proposes the use of a pair of hollow copper tubes that will carry multiple telephone conversations within, television signals on the outside surface and power within the copper. So far, he has confined his research primarily to the radio phase of the problem.

Bell Telephone Laboratories engineers, whose main concern likewise is communications, admit to "strenuous activity" in the development of long-distance techniques using circular waveguides at 50,000 megacycles—only slightly different from those employed by Barlow.

The new Bell type L-3 coaxial cable system handles 1,800 circuits. The number might be more than doubled with the waveguide technique.

MEETINGS

FEB. 4-6: Western Computer Conference, Hotel Statler, Los Angeles, Calif.

FEB. 5-7: IRE Southwestern Conference and Electronics Show, Plaza Hotel, San Antonio, Texas.

FEB. 5-7: Audio Fair, Alexandria Hotel, Los Angeles, Calif.

MARCH 9-12: NEMA, Edgewater Beach Hotel, Chicago, Ill.

MARCH 19-20: National Collegiate Industry-Government Conference on Instrumentation, Michigan State College, East Lansing, Mich.

MARCH 23-25: Sixth Annual Conference for Protective Relay Engineers, A & M College of Texas, College Station, Texas.

MARCH 23-26: IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.

MARCH 23-27: Western Metal Exposition, Pan-Pacific Auditorium and Western Metal Congress, Statler Hotel, Los Angeles, Calif.

APRIL 18: Seventh Annual Spring Technical Conference, Cincinnati IRE, Cincinnati, Ohio.

APRIL 27-30: Spring Meeting of USA National Committee of URSI-IRE Professional Group on Antennas and Propagation, National Bureau Of Standards, Washington, D. C.

APRIL 27-MAY 8: British Industries Fair, Birmingham & London, England.

APRIL 28-May 1: Seventh Annual NARTB Broadcast Engineering Conference, Burdette Hall, Philharmonic Auditorium, Los Angeles, California.

APRIL 29-MAY 1: 1953 IRE-AIEE Electronic Components Symposium, Shakespeare Club, Pasadena, Calif.

MAY 1: American Association of Spectrographers Symposium, Chicago, Ill.

MAY 11-13: IRE National Conference on Airborne Electronics, Dayton, Ohio.

MAY 18-21: 1953 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

MAY 18-23: Third International Congress On Electroheat, Paris, France.

MAY 24-28: NAED, 45th Annual Convention, Conrad Hilton Hotel, Chicago, Ill.

MAY 24-28: Scientific Apparatus Makers Association Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va.

JUNE 15-19: Exposition of Basic Materials for Industry, Grand Central Palace, New York N. Y.

JUNE 16-24: International Electro-acoustics Congress, The Netherlands.

JUNE 20-OCT. 11: German Communication and Transport Exhibition, Munich, Germany.

AUG. 19-21: IRE Western Electronic Show & Convention, Municipal Auditorium, San Francisco, Calif.

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. 21-25: Eighth National Instrument Exhibit, Sherman Hotel, Chicago, Ill.

Business Briefs

▶ **Cheaper**, better transistors may not be far away, if a new "substance" recently announced by Brown-Allen Chemicals, Inc. of New York City lives up to claims made for it.

▶ **Super-sniffer** that smells gas leaks by electronics and sounds an alarm if all is not well is now being used to detect leaks in hermetically sealed aircraft equipment.

▶ **Swiss** financial group representing the Union des Banques Suisses may invest in tv set manufacturing in Italy. It has been estimated that 100,000 sets could be absorbed by the Italian market in 1953.

▶ **If the** Bureau of Internal Revenue takes over Grand Central Palace for office space later this year, as has been reported, the 1954 IRE National Convention will be held in the Kingsbridge Armory, Bronx, N. Y., according to an announcement by J. W. McRae, president, and G. W. Bailey, executive secretary of the Institute.

▶ **Australia** will spend a total of $20 million on military electronic equipment with local manufacturers. New types of radar equipment will not, however, be developed in Australia as previously planned because of insufficient time. U. S. and British designed radar will be used. It will be made by local firms having overseas affiliations.

▶ **Satellite** tv station for Hawaii may be put into operation this year by KGMB-TV in Honolulu as part of a plan to extend tv service to six major islands extending over a chain 300 miles long.

▶ **Power** consumption of tv home receivers adds an estimated $200 million a year to the utility industry's revenues, according to C. B. Jolliffe of RCA. Tv studios and transmitters increase income another $2.5 million. In New York alone, an income of $12 million during the year ending June 30, 1952 is attributed to home tv usage.

Filtered by Filtron

LOCKHEED F-94

GUARANTEES CONFORMANCE TO RADIO INTERFERENCE SPECIFICATION

MIL-I-6181

(0.15 TO 1000 MEGACYCLES)

BOEING B-47

Filters by Filtron

FILTRON'S Engineering division, with its completely equipped screen room facilities, is always available to measure and recommend RF Interference Filters for your equipment, to meet and exceed the Radio Interference requirements of MIL-I-6181.

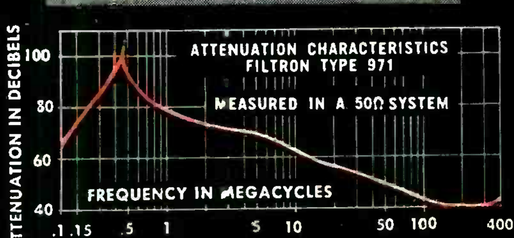
FILTRON'S production facilities are suppying more RF Interference Filters for use in military electronic equipment than ever before, to meet the nation's requirements.

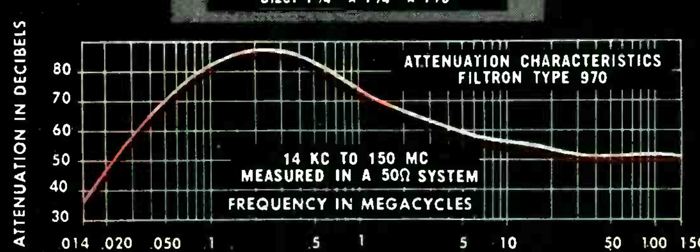
FILTRON . . . the LEADER IN RF INTERFERENCE FILTERS . . . has pioneered:

- Sub-miniature Filters
- High-temperature Filters
- RF Filters to withstand Shock and Vibration
- Wide band Multi-section Units
- RF Filters "Custom Designed" to meet YOUR requirements

FILTER FA 971
1.5 AMP, 130V AC, 400 CY.
Size: 1¹³⁄₁₆" x 1" x 1"

FILTER FA 970
155 MA, 130V AC-DC, 50-1000 CY.
Size: 1¾" x 1¼" x 1⅛"





An inquiry on your Company letterhead will receive prompt attention

THE **FILTRON** COMPANY INC., FLUSHING, LONG ISLAND, NEW YORK

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS

What does this 126

year old Patent mean to you?

One hundred twenty-six years of experience, know-how, inventiveness—call it what you will—is something we alone can give you in our particular field.

For Chester Stone, the inventor of the washing machine of this patent, was the father of our founder, and the great uncle of our president.

One hundred twenty-six years later to the month, we continue to be very much interested in washing machines, but in a different way. Today we manufacture insulating bushings for the electric motors, fibre bobbins for the time controls, and laminated paper base phenolic sleeves for mounting insulation.

The United States has become a nation of specialists in the years since John Quincy Adams, the President; Henry Clay, the Secretary of State; and William Wirt, the Attorney General, signed this patent in 1827.

We have become specialists in the manufacture of spiral wound insulating tubing, sleeves, and bobbins. They can be furnished in diameters as small as 3/64" ID, various wall thicknesses and lengths, and of many materials including hi-dielectric kraft, fish paper, and plastic films. We can produce these custom-made quality products to close tolerances. They are low in cost and our service is unsurpassed.

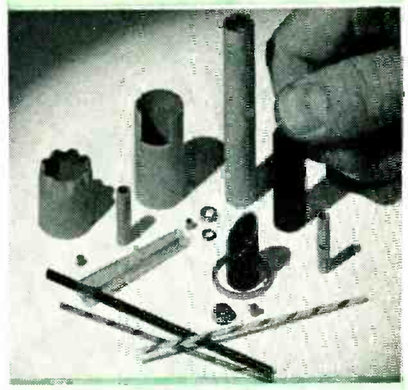
The use of our products by many hundreds of America's leading manufacturers is ample testimony that this heritage of one hundred twenty-six years has well equipped us to satisfactorily fulfill a large number of their specific requirements.

Sales representatives are located in principal cities. We would welcome an opportunity to serve you.

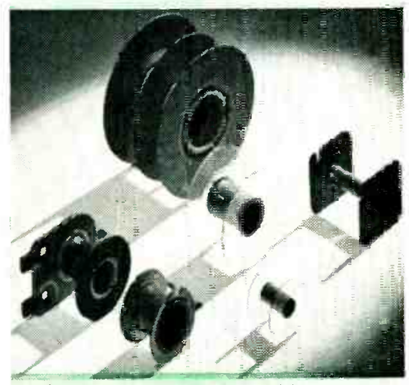
STONE PAPER TUBE COMPANY

INCORPORATED

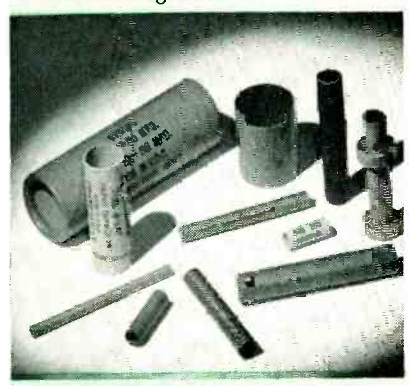
900-922 Franklin Street, N. E. Washington 17, D. C.



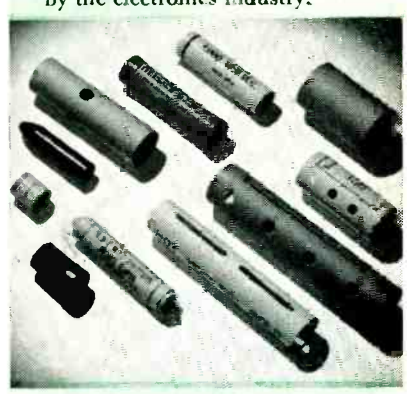
For more than a quarter century Stone has aided the expanding automotive and electrical industries by the development of low cost spiral insulating tubes.



Low cost quality bobbins and spools by Stone are meeting the exacting specifications of leading coil winding firms.



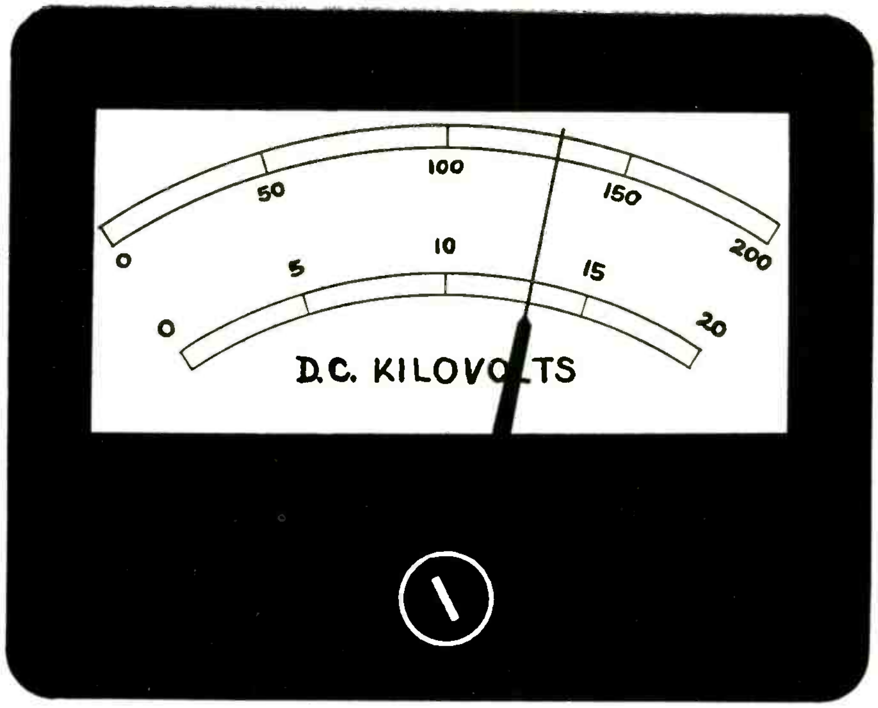
Stonized spiral wound phenolic coil forms, collars, and assemblies are finding increasing acceptance by the electronics industry.



Stone's plain or printed containers and specialties are widely used in the pharmaceutical and industrial fields.

Want more information? Use post card on last page.

DO YOU USE



High-Voltage CAPACITORS?

Plastic Capacitors, Inc., achieve capacitor designs in smaller sizes and higher working temperatures with increased life expectancy.

This is accomplished by *uniquely* processing plastic films for use as the solid dielectric in their capacitors.

Our catalog describes these features including capacitors with voltage range up to 60 Kv. but AC capacitors and higher voltage DC capacitors are available on special order.

Write today on your company letterhead for your copy of this comprehensive catalog.

Your inquiries are invited.

Plastic Capacitors, Inc.

PLASTIC FILM CAPACITORS • HIGH VOLTAGE POWER PACKS • PULSE FORMING NETWORKS

2511 WEST MOFFAT STREET • CHICAGO 47, ILLINOIS

KEEP YOUR PRODUCTION ROLLING!

Thin wall 3-core construction assures flux continuity...prevents "dry" joints.

Contains only Virgin tin & lead. Tin — 99.75% pure. Lead — 97.97% pure.

Only Multicore has Ersin Flux — high grade water-white rosin, homogeneously activated.

Non-corrosive even after long exposure to humidity.

Wets metal rapidly due to reduced surface tension.

Vigorous fluxing action.

Leaves only pure rosin after soldering.

Perfect joints on difficult metals & alloys even if oxidized.

Total % flux to solder less than many single cored solders.

Rigid quality control insures same standards in every Multicore reel.

Conforms with QQ-S- 571-b and all other pertinent Federal Specifications.

On the Assembly line...time *is* money!

Save the time lost in producing "rejects"; the time lost with ordinary "slow" solders on difficult metals; the time lost in finding "dry" joints.

Save the time...save the money...the efficiency of your plant...the good name of your product!

In every part of the World, leaders in Electronics are insuring their production efficiency with Multicore.

Nothing less will do . . .
MULTICORE IS THE WORLD'S FINEST SOLDER!

New Edition FREE—
Valuable booklet "Modern Solders" and testing samples available on request.

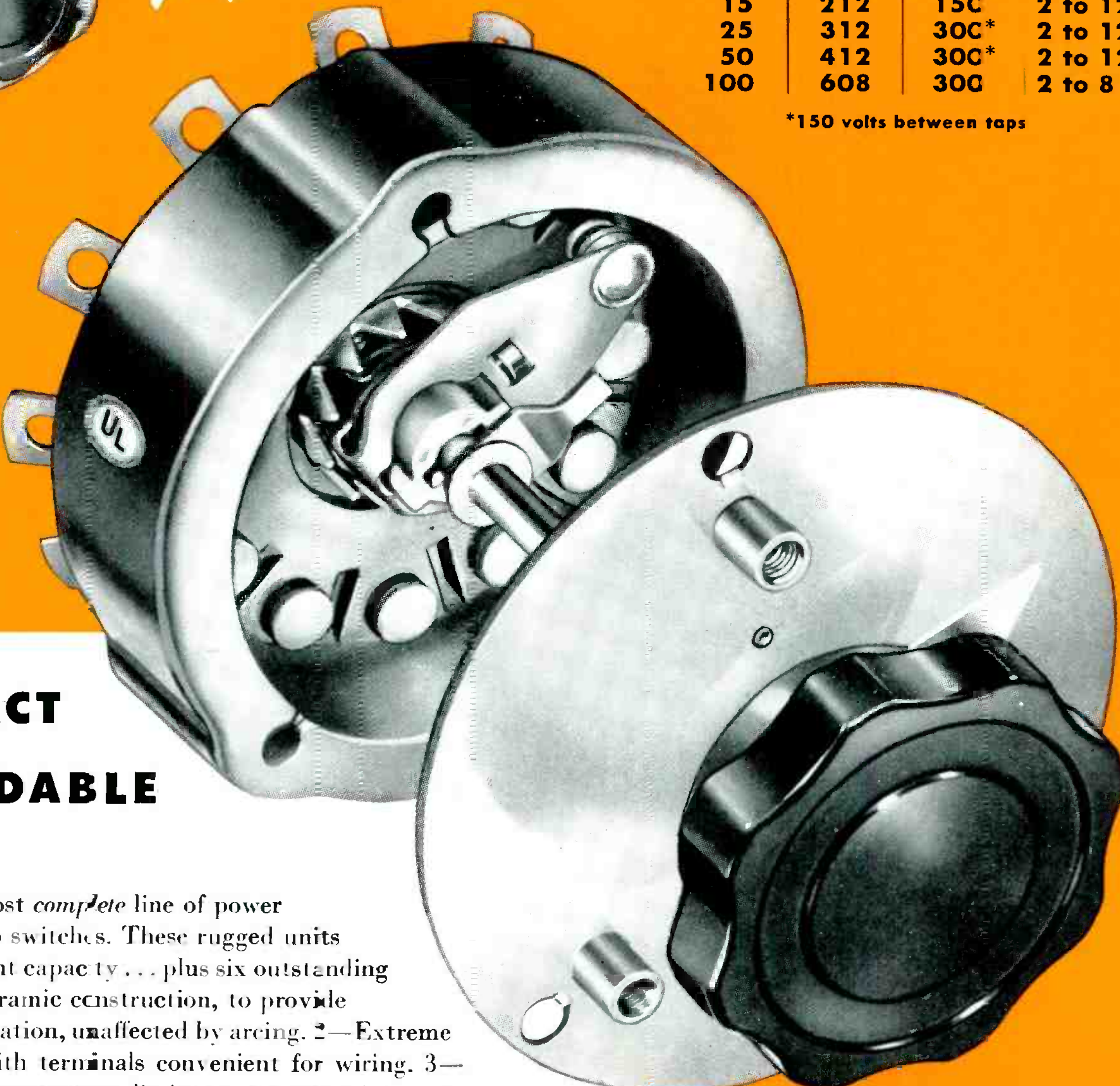
Address U.S.A. and Canadian inquiries to
MULTICORE SALES CORP.
164 Duane Street • New York 13, N. Y.

Inquiries regarding other territories to
MULTICORE SOLDERS LTD.
Maylands Ave. • Hemel Hempstead, Herts., England

OHMITE®

ALL-CERAMIC • POWER TYPE

Tap Switches



FIVE SIZES

AMPS.	MODEL No.	MAX. V. (A-C)	No. TAPS
10	111	150	2 to 11
15	212	150	2 to 12
25	312	300*	2 to 12
50	412	300*	2 to 12
100	608	300	2 to 8

*150 volts between taps

COMPACT

DEPENDABLE

Here's the most *complete* line of power type, rotary tap switches. These rugged units have high current capacity . . . plus six outstanding features! 1—Ceramic construction, to provide permanent insulation, unaffected by arcing. 2—Extreme compactness, with terminals convenient for wiring. 3—Silver-to-silver contacts to eliminate contact maintenance. 4—Self-cleaning rotor contact. 5—"Slow-break" mechanism, with positive cam-and-roller for "slow-break, quick-make" action for A-C. 6—"Dead" switch shaft, insulated by strong ceramic hub.

OHMITE MANUFACTURING COMPANY
4816 Flournoy Street
Chicago 44, Illinois

Write on company letterhead for this comprehensive OHMITE catalog

Be Right with **OHMITE** RHEOSTATS • RESISTORS • TAP SWITCHES

...has everything you need for PRINTED CIRCUITS

First to provide Tubes and Transistors that are correctly designed for quick, efficient printed circuit assembly. For the ultimate in portable performance, combine Raytheon's high-efficiency, filamentary Subminiature Tubes with Raytheon's Junction Transistors.

Subminiatures		Filament Volts	Filament Ma.	Plate Volts	Screen Volts	Grid Volts	Plate Ma.	Screen Ma.	Mutual Cond. Umhos.	Voltage Gain	Plate Resis. Meg.
1AG4	Output Pentode	1.25	40	41.4	41.4	-3.6	2.4	0.6	1000	35†	0.18
1AH4	RF Pentode	1.25	40	45.	45.	0	0.75	0.2	750		1.5
1AJ5	Diode-Pentode	1.25	40	45.	45.	0	1.0	0.3	425	50	0.3
1V6*	Mixer-Pentode	1.25	40	45.	45.	0	0.4	0.15	200**		1.0
	Osc.-Triode			45.	—	Rg = 1 meg.	0.4	—	550		
1AK4	RF Pentode	1.25	20	45.	45.	0	0.75	0.2	750		1.5
1AK5	Diode-Pentode	1.25	20	45.	45.	5 meg.	0.5	0.2	280	40	0.4

†Power Output — milliwatts **Conversion Conductance

***Type 1V6 is a high performance, low battery drain converter. Note the comparison with 1R5 using 45 volt supply.**

	1V6	1R5
Total Cathode Current (ua)	960	2750
Conversion Conductance (umhos)	200	235
Plate Resistance (megohms)	1.0	0.6
Conversion Gain (load = 175K)	30	32
Equiv. Noise Resistance (ohms)	70K	180K

PNP JUNCTION TRANSISTORS
(Average Characteristics at 30° C)

	CK721	CK722
Collector Voltage (volts)	-1.5	-1.5
Collector Current (ma.)	-0.5	-0.5
Base Current* (ua.)	-6	-20
Current Amplification Factor*	40	12
Power Gain* (db)	38	30
Noise Factor* (1,000 cycles) (db)	22	22

*Grounded Emitter connection

RAYTHEON®
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

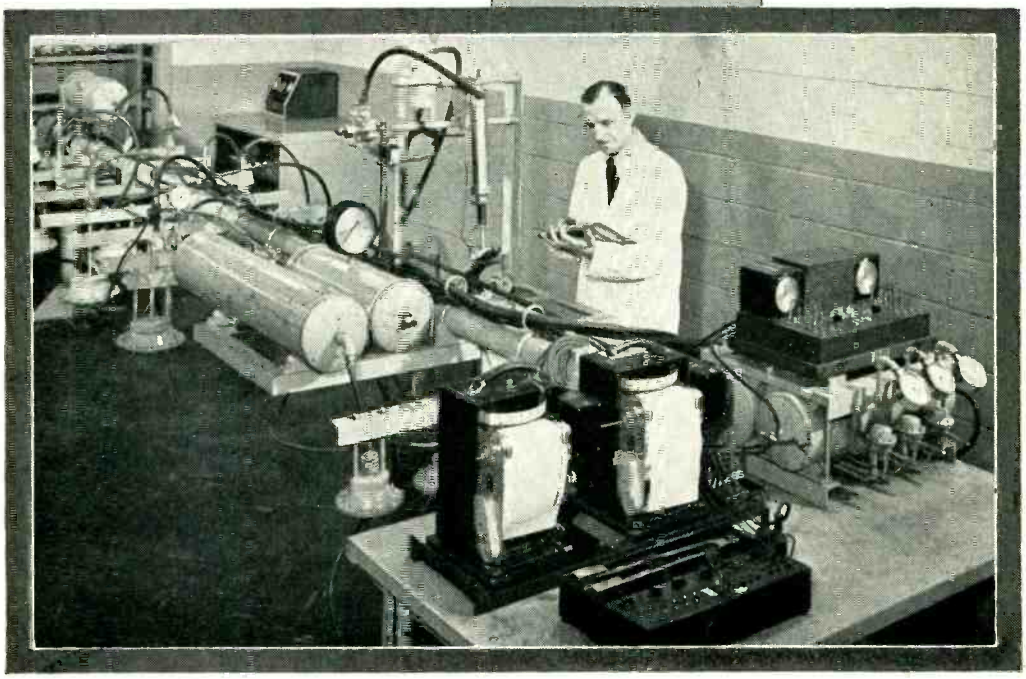
Newton, Mass. Bigelow 4-7500 ● Chicago, Ill. NAtional 2-2770 ● New York, N. Y. WHitehall 3-4980 ● Los Angeles, Calif. Richmond 7-5524

RAYTHEON MAKES ALL THESE:

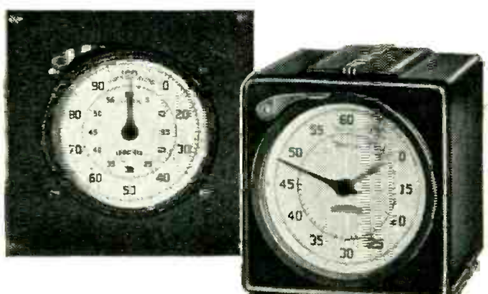
RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

Want more information? Use post card on last page.

TIME TO STOP... IN TIME!



SPLITTING THE SPLIT SECOND at the Bendix-Westinghouse Engineering Research Department laboratories is absolutely essential in exploring every possible braking requirement for transportation tomorrow.



STANDARD ELECTRIC TIME has been serving industry, government and educational institutions for almost seventy years with fine precision instruments and equipment for the accurate measurement of time.

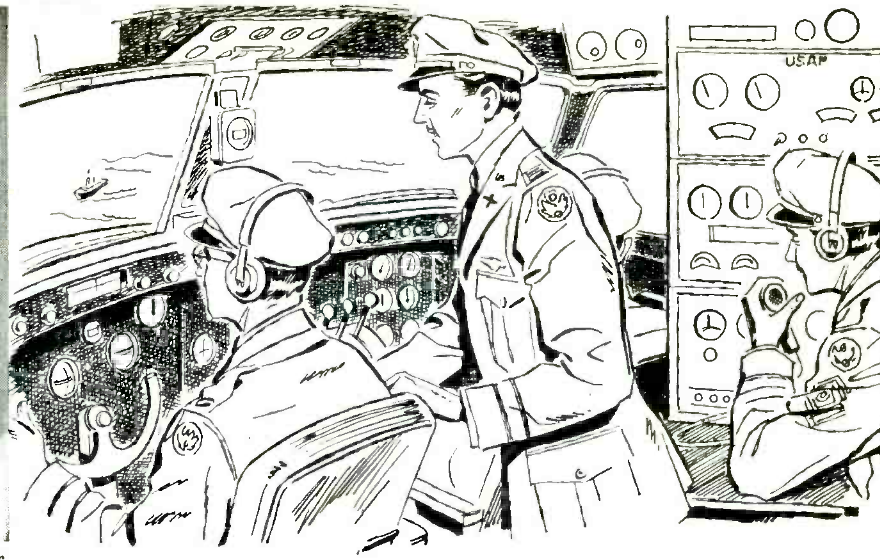
STANDARD ELECTRIC MODEL S-1 Clocks are a part of the modern laboratory controls testing equipment and timing devices shown in this photograph . . . they accurately measure air brake application and release trasmission time to one-hundredth of a second . . . The timers are started instantaneous to brake pedal movement transmitted through an electronic circuit and are stopped by means of a highly sensitive electro pneumatic switch located at pre-determined stations in the air brake system.

STANDARD
SINCE 1884

THE STANDARD ELECTRIC TIME COMPANY
97 LOGAN STREET • SPRINGFIELD 2, MASSACHUSETTS

Want more information? Use post card on last page.

Courtesy Lear, Inc.



in instruments where reliability is imperative

SILASTIC* works

where other materials fail

To assure maximum service life and accuracy, engineers at Lear, Incorporated, planned to protect their new vertical gyro-mechanism from corrosion by housing it in a completely inert and dehydrated atmosphere.

Sealing the housing, however, proved to be more easily said than done. Despite the most elaborate precautions, solder and flux fumes often penetrated the joint and contaminated the delicate mechanism. Once sealed, it was impossible to reopen the case without loss of the expensive cover and harness.

To both of these problems a simple and ingenious solution was found. A thin O-ring of Silastic molded to fit snugly under the cover flange is used to exclude the corrosive fumes generated in soldering a metal strip over the entire joint. The Dow Corning silicone rubber O-ring is not damaged by soldering temperatures. And, the gyro-mechanism is just as accessible for repairs as the contents of a hermetically sealed can of coffee.

Lear also uses a large ring washer of Silastic at each end of the housing to serve as resilient, shock-absorbing cushions for the apparatus at stratospheric temperatures.

And that's just one of hundreds of examples of how Silastic is used to improve the performance of products ranging from cable to traction motors, from domestic steam irons to aircraft.

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

For more information about the properties or fabricators of Silastic, mail this coupon today or phone our nearest branch office.

Dow Corning Corporation, Dept. BE-2, Midland, Mich.

Please send me:

- ☐ Silastic Facts 10a with new data on properties and applications of all Silastic stocks and pastes.
- ☐ "What's A Silicone?", your new 32-page booklet on silicone products and applications.

Name ______ Title ______

Company ______

Address ______

City ______ Zone ______ State ______

FIRST IN SILICONES

DOW CORNING SILICONES

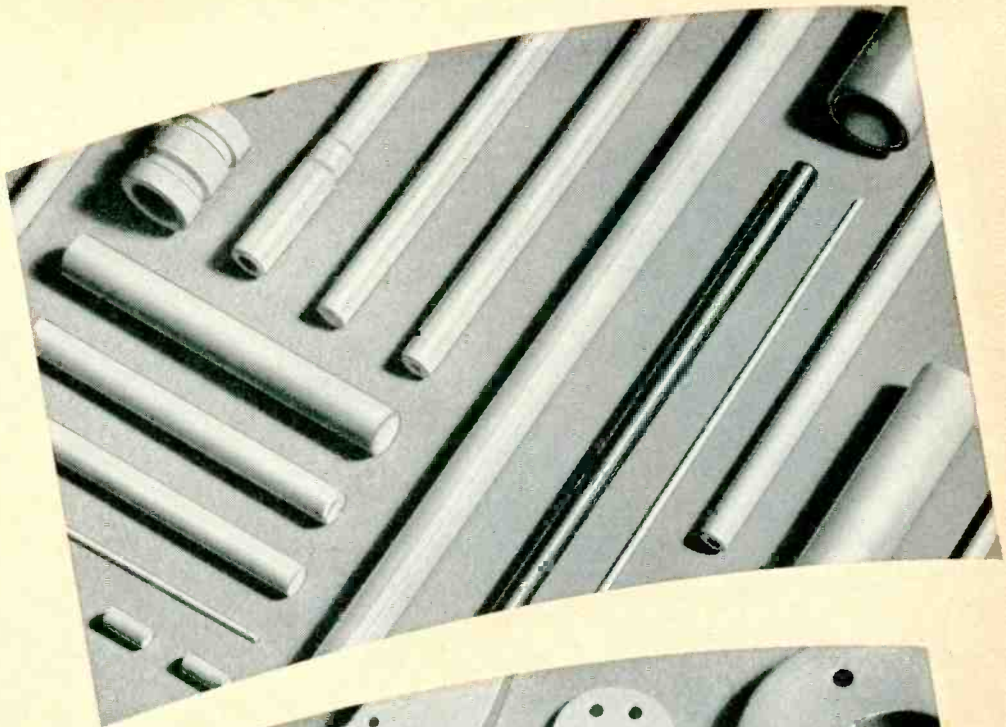
MIDLAND, MICHIGAN

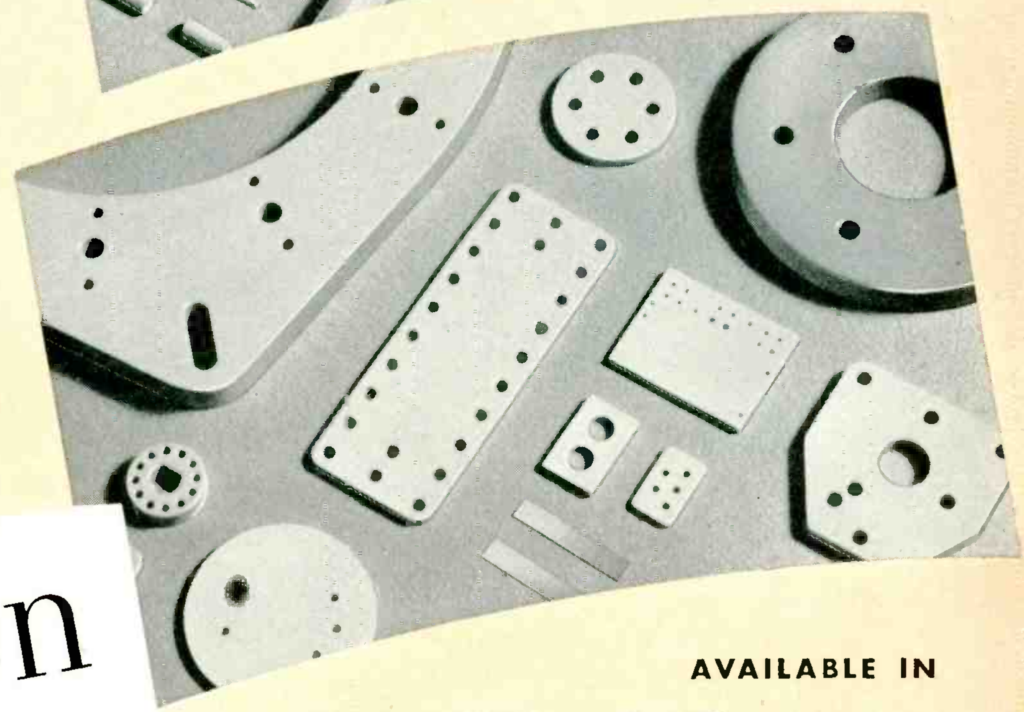
Atlanta • Chicago • Cleveland • Dallas • New York • Los Angeles • Washington, D. C. • In Canada: Fiberglas Canada Ltd., Toronto • In England: Midland Silicones Ltd., London

Want more information? Use post card on last page.

- Outside diameter of tubes and rods as small as .062" diameter centerless ground to tolerance of ±.0001".
- Rods free of camber for precision shafts.
- Rods and tubes centerless polished to 5 micro inch RMS finish $\overset{5}{\surd}$.
- Cylindrical parts ground both inside and outside to diameter tolerance of ±.0005" with concentricity of .001" TIR. Sizes up to 8½" O.D. by 24" long are available.
- Holes as small as .187" diameter can be economically lapped to tolerance of ±.001".
- Plates and discs up to 50 square inches can be precision ground. Flat parts up to 4 square inch area are ground flat and parallel simultaneously on two sides; flat within .0002", parallel within .0005", and thickness tolerance .001" is practical.
- Parts lapped flat within a few light bands. Special parts have been lapped to .008" thickness.

As a rule of thumb: On critical dimensions which lend themselves to grinding, AlSiMag ceramics can be furnished with the accuracy of comparable precision metal parts. AlSiMag ceramics are more wear resistant than steel and, in many designs, can be manufactured to close tolerances at lower cost.





Precision TOLERANCES

AVAILABLE IN

ALSIMAG®

CUSTOM MADE TECHNICAL CERAMICS

Each year we have added more equipment and gained more skill and experience in grinding AlSiMag ceramics. We like difficult and complicated problems. If you have a tough one, send it to us. We'll tackle it.

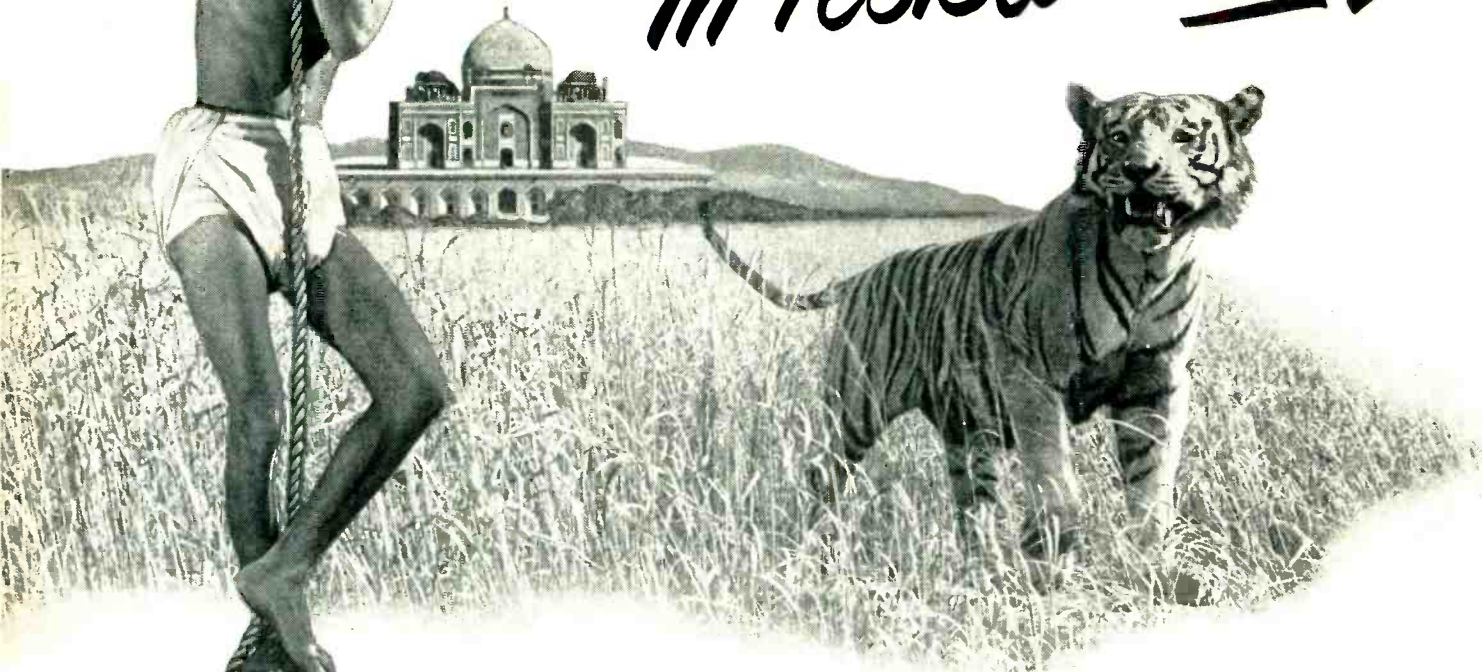
51ST YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

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

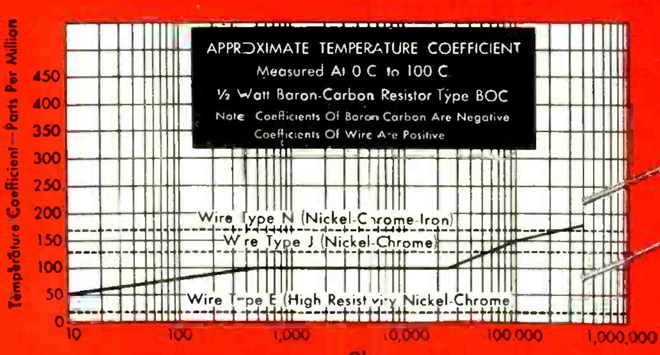
Ingenuity is *in resistors too!*



New Materials—New Techniques—New Advantages
Features in 4 New IRC Resistors

1 IRC Type BOC Boron-Carbon ½-Watt PRECISTOR Meets All Requirements of MIL-R-10509 Specification

No other non-wire-wound resistor combines the advantages of this all-new Boron-Carbon unit. Type BOC reduces the temperature coefficient of conventional deposited carbon resistors—provides high accuracy *and* long-time stability—replaces high value wire wound precisions at savings in space and cost. You'll find it adaptable to a host of critical circuitry needs—in electronics and avionics, communications, telemetering, computing and service instruments. Send for full details in Catalog Data Bulletin B-6.



Type BOC conforms to *all* requirements of MIL-R-10509. Exposed to a temperature of 65°C. for one hour, the new BOC shows a resistance change of less than .2%. High temperature operation with reliability is now possible. Voltage coefficient is less than 20 parts per million per volt. Load life is outstanding; on a 500-hour test at ambient temperature of 40°C., resistance change will not exceed 2%.

VOLTAGE REGULATED POWER SUPPLY

MODEL 700

The Kepco Model 700 features one regulated voltage supply with excellent regulation, low ripple content and low output impedance.

SPECIFICATIONS

OUTPUT VOLTAGE DC: 0-350 volts continuously variable.

OUTPUT CURRENT DC: 0-750 milliamperes continuous duty.

REGULATION: In the range 30-350 volts the output voltage variation is less than ½% for both line fluctuations from 105-125 volts and load variation from minimum to maximum current.

RIPPLE VOLTAGE: Less than 10 millivolts.

FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to protect rectifier tubes.

POWER REQUIREMENTS: 105-125 volts, 50-60 cycles.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post mounted on the front of the panel is available for connecting to the chassis. All terminals are also brought out at the back of the chassis.

METERS:
Ammeter: 0-1 ampere, 4" rectangular.
Voltmeter: 0-500 volts, 4" rectangular.

PHYSICAL SPECIFICATIONS: Cabinet height 22¾", width 21¾", depth 15¼". Rack panel height 21", width 19", color gray, panel engraved.

CONTROLS: Power on-off switch, H.V. on-off switch, H.V. control.

ADDITIONAL MODELS AVAILABLE IN THE 700 SERIES VOLTAGE REGULATED POWER SUPPLIES

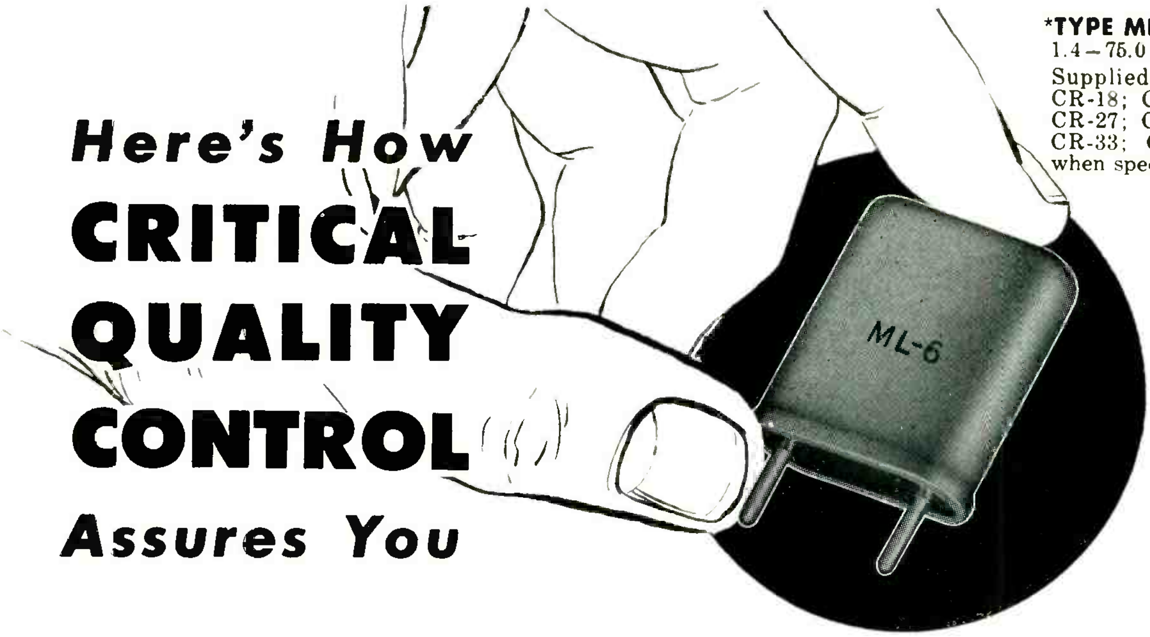
Volts	Current	Model
0-350	0-0.75 Amp.	700
0-350	0-1.50 Amp.	710
0-350	0-2.25 Amp.	720
0-350	0-3.00 Amp.	730
0-600	0-0.75 Amp.	750
0-600	0-1.50 Amp.	760
0-600	0-2.25 Amp.	770
0-600	0-3.00 Amp.	780

FOR NEW POWER SUPPLY CATALOG — WRITE DEPT. #1

KEPCO LABORATORIES, Inc.

131-38 SANFORD AVENUE FLUSHING 55, NEW YORK

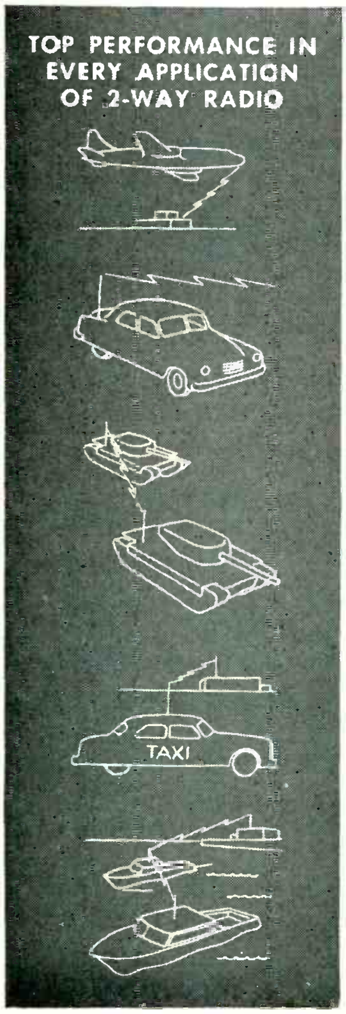
Want more information? Use post card on last page



***TYPE ML-6 – RANGE:**
1.4 – 75.0 mc
Supplied per Mil type CR-18; CR-19; CR-23; CR-27; CR-28; CR-32; CR-33; CR-35; CR-36 when specified.

Here's How CRITICAL QUALITY CONTROL Assures You

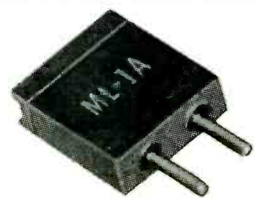
LASTING STABILITY in Midland CRYSTALS



Midland Quality Control is Midland's own system of making sure you get a crystal that takes the beating of extreme heat without excessive drift. Quality control starts with exacting selection of quartz and extends through every step of processing.

For example, slicing of the crystal is guided by X-ray checks to maintain highest accuracy. Correct angular relationships are strictly maintained. After lapping, X-ray is again used to detect any deviation from precision standards. And finally, after sealing, tests are made again – tests far more punishing than conditions found in actual use.

That's why STABILITY is something you can count on in your Midland crystal – and why Midland quality will give you years of dependable service in every respect.



***TYPE ML-1A–RANGE:**
2.0 – 15.0 mc
Supplied per Mil type CR-1A when specified.

***TYPE ML-4 – RANGE:**
1.0 – 10.0 mc
Supplied per Mil type CR-5; CR-6; CR-8; CR-10 when specified.

Whatever your crystal need, conventional or highly specialized . . .

When It Has to Be EXACTLY RIGHT . . . Contact

Midland

MANUFACTURING CO., INC.
3155 Fiberglas Road **Kansas City, Kansas**

Manufacturer of Quartz Crystals for Electronic Frequency Control

TINNERMAN Speed Nut SAVINGS STORIES

How SPEED NUT Coil Form Fasteners *Transmit 3-way advantage* to Weather-Reporting RADIOSONDE

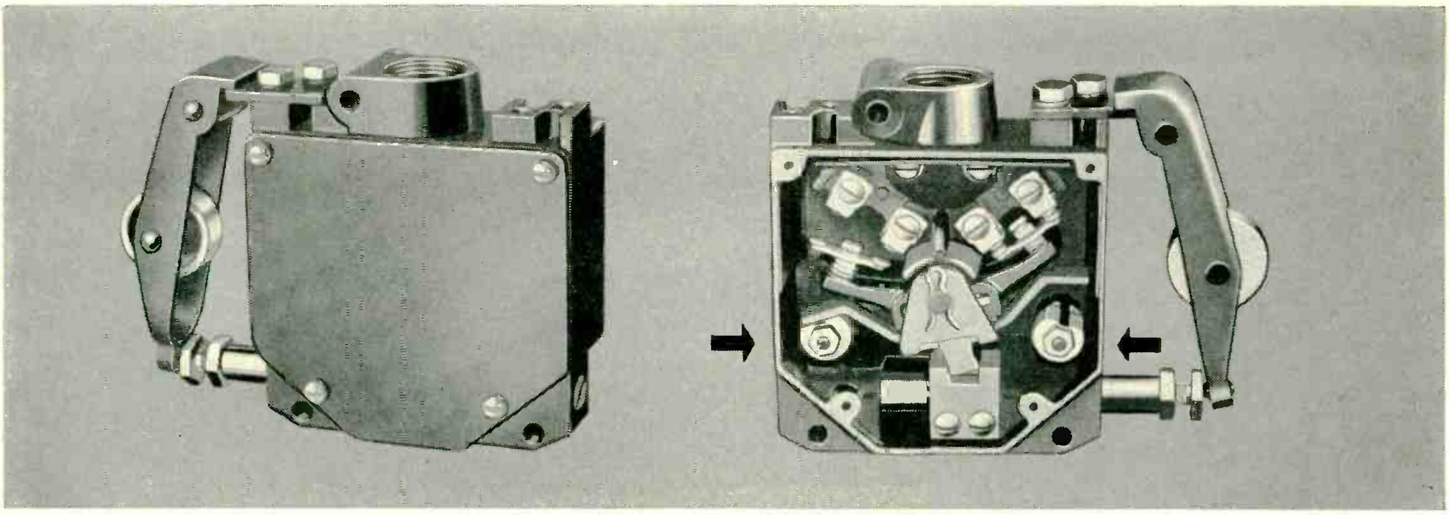
...as told by **FRIEZ INSTRUMENT DIVISION of Bendix Aviation Corp., Baltimore, Md.**

FRIEZ engineers faced three basic requirements in specifying fasteners for the AN/AMT-4A Radiosonde. First, fasteners had to be *light-weight*, since the device is set free and carried to upper altitudes by balloon. Second, this equipment is expendable, making *economy* a prime factor. And third, because the Radiosonde transmits vital weather data back to the ground, its precise nature demands rigid, *vibration-resistant* fasteners for proper operation. Tinnerman SPEED NUT Coil Form fasteners were selected by Friez after checking many various attaching methods. They more than met the 3-count performance requirement, giving added savings in materials and handling over elaborate machined types.

No matter what your fastening problem, you can rely on a Tinnerman Fastening Analysis to lead the way to production savings. See your Tinnerman representative for details on this free service for your products. And, write today for your copy of SPEED NUT Savings Stories, a booklet of amazing savings to industry: TINNERMAN PRODUCTS, INC., Department 12, Box 6688, Cleveland 1, Ohio.

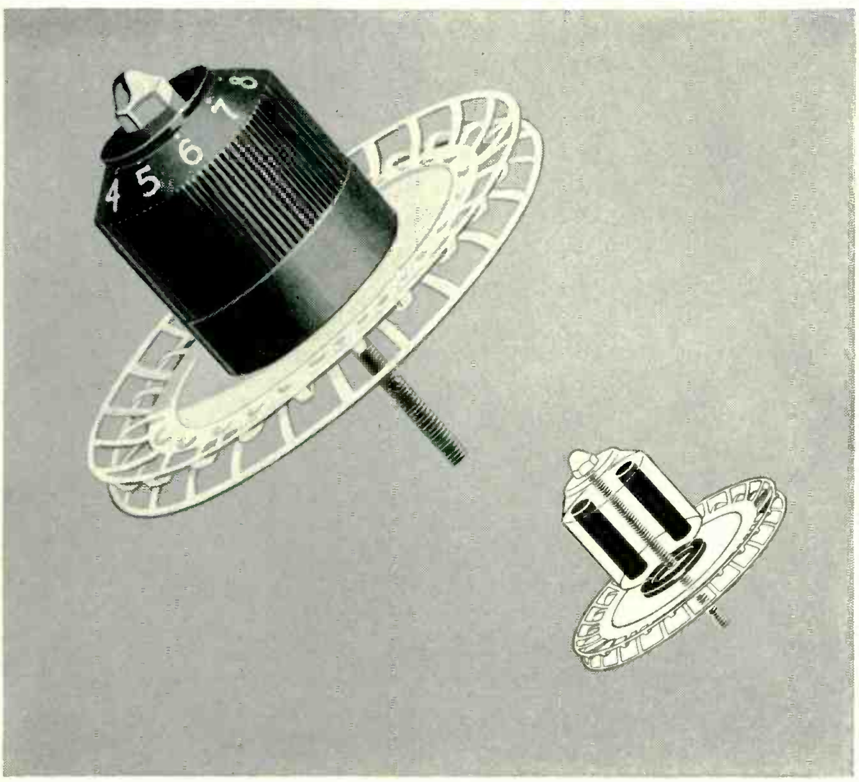
In Canada: Dominion Fasteners Ltd., Hamilton, Ontario. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *In France:* Aerocessoires Simmonds, S. A.—7 rue Henri Barbusse, Levallois (Seine).

Want more information? Use post card on last page



LIMIT SWITCHES — Even under severe service, this double-break switch will stand up well. Its 2 independent circuits are alternately held open and closed solely by small Carboloy permanent magnets. The magnets assure positive contacts, cleaner breaks without strain or appreciable wear on operating parts, plus a higher degree of accuracy within limits. Also cut down costs of materials, assembly. A typical case of product improvement with Carboloy magnets.

How you can improve controls size, weight, cost with

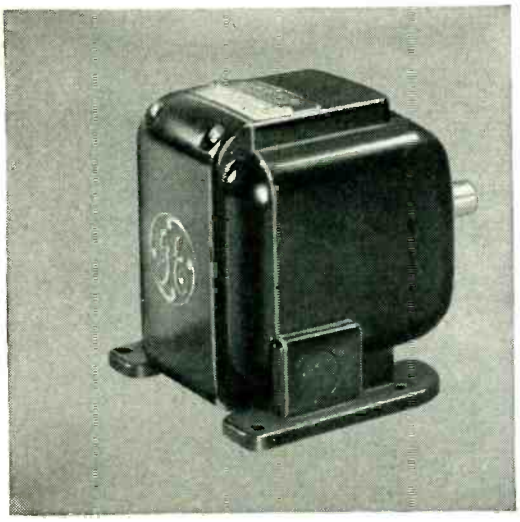


TENSION BRAKES — Three tiny Carboloy permanent magnets are used in this new magnetic brake that controls the winding of yarn and fine fibres. The magnets (shown in cutaway) provide even tension through magnetic drag, cut down on abrasion, slippage, static electricity — give wider tension and speed ranges. Carboloy permanent magnets never need maintenance, never fail.

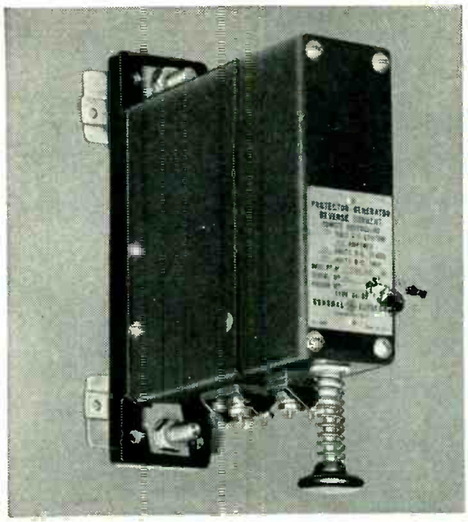
OUTSTANDING ADVANTAGES OF CARBOLOY PERMANENT MAGNETS

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

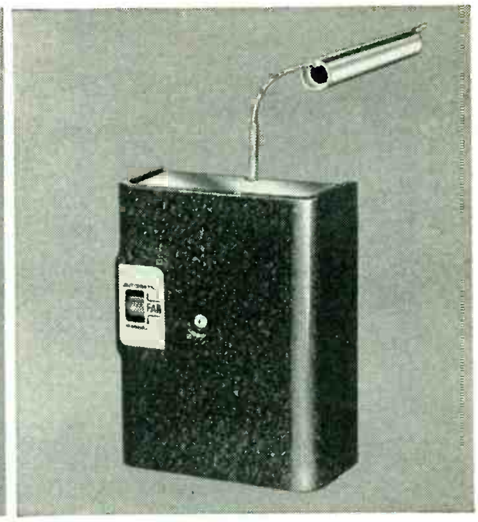
Want more information? Use post card on last page.



PLUGGING CONTROLS — New device for brakeless stopping of motors features Carboloy magnets. Eddy-current disk rotates in magnetic assembly, creates torque. As motor's speed nears zero with power reversed, torque interrupts circuit, cuts stopping time from 20 seconds to 1 second.



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, eliminates nuisance trips in circuits.



SNAP SWITCHES — Three reasons Minneapolis-Honeywell uses a Carboloy permanent magnet in this fan control and high-limit switch: 1) It occupies a small space and gives a higher degree of magnetic energy per unit per space. 2) It offers higher stability. 3) The cost is low.

. . . trim down their Carboloy Permanent Magnets

Here are 5 compact controls that now work better, weigh less and cost less to build, thanks to engineering foresight and Carboloy permanent magnets.

Do you manufacture controls or similar devices? If so, chances are excellent that you can profit from Carboloy permanent magnets, too.

For these magnets are simple, self-containing sources of energy that never fail. Powerful in small sizes, they need no external power supply, never require maintenance. They reduce fabrication costs by eliminating wires, coils and operating parts. They let you simplify designs . . . build lighter, smaller, finer-performing products at substantial savings.

Check the controls on these pages. Then check Carboloy magnet engineers. These experts can likely tell you in a hurry just where and how a magnetic assembly can help you. And, of course, they're at your service whenever you want a hand in magnet design and application.

Look to Carboloy production lines, too, for *uniform, high-quality, low-cost* magnets for control equipment—all sizes, all shapes; cast or sintered to your specifications. Mail coupon for free Magnet Design Manual and Standard Stock Catalog.

CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

11139 E. 8 Mile Ave., Detroit 32, Michigan

Plants at Detroit, Michigan; Edmore, Michigan and Schenectady, New York

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

MAIL COUPON TODAY

CARBOLOY Department of General Electric Company
11139 E. 8 Mile Ave., 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 ____________

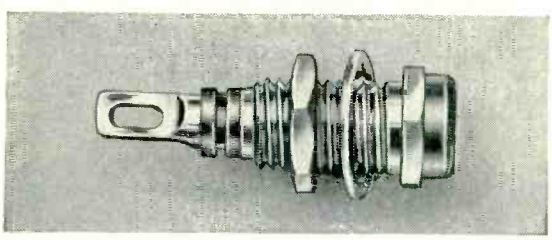
ADDRESS ____________

CITY ____________ ZONE ______ STATE ______

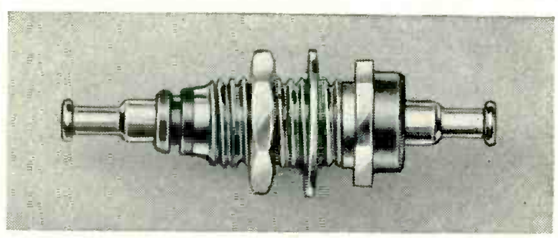
Want more information? Use post card on last page.

General features of 118930 test jack: Silver-plated, heat-treated beryllium copper contact is made in one piece with large terminal end for easy soldering. Terminal end is tin-dipped. Brass, nickel-plated shell and nut. Metal shell insures firm, dependable mounting. Phosphor bronze lock washer is nickel-plated. Nylon insulator available in different colors: White, black, red, green, brown, orange, blue.

ALSO AVAILABLE



119052. *Same as 118930 but with special milled end with elongated hole for wiring.*



118984. *Feed through type, similar to 118930 but with one-piece brass terminal stud, tin-plated.*

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

STOP
WASTING TECHNICAL TALENT

Turn over your special fastening problems to *specialists* . . . trained fastener engineers who have been through the trial-and-error stage in this highly specialized field and can free your own engineering staff for finished-product engineering.

It pays. We've proved it . . . for leading manufacturers in the electronics industry . . . and in the automotive, aviation, appliance and furniture industries, too.

United-Carr and its subsidiaries have had years of experience in the design and production of *tailor-made* fasteners and allied devices. Each division of the company provides a reservoir of special knowledge for the others. The result: an integrated organization that makes use of every improvement in materials and methods to produce fasteners that *speed assembly, cut costs* and, in many cases, actually *improve product performance.*

With complete facilities in our own plants for the volume production of special metal stampings and for the assembly of metal to plastic and ceramic components, we are in a position to supply practically any fastening need.

Before bidding on government contracts requiring fasteners or special fastening devices, consult your nearest United-Carr field representative.

UNITED-CARR

MAKERS OF DOT FASTENERS

UNITED-CARR FASTENER CORPORATION, CAMBRIDGE 42, MASSACHUSETTS

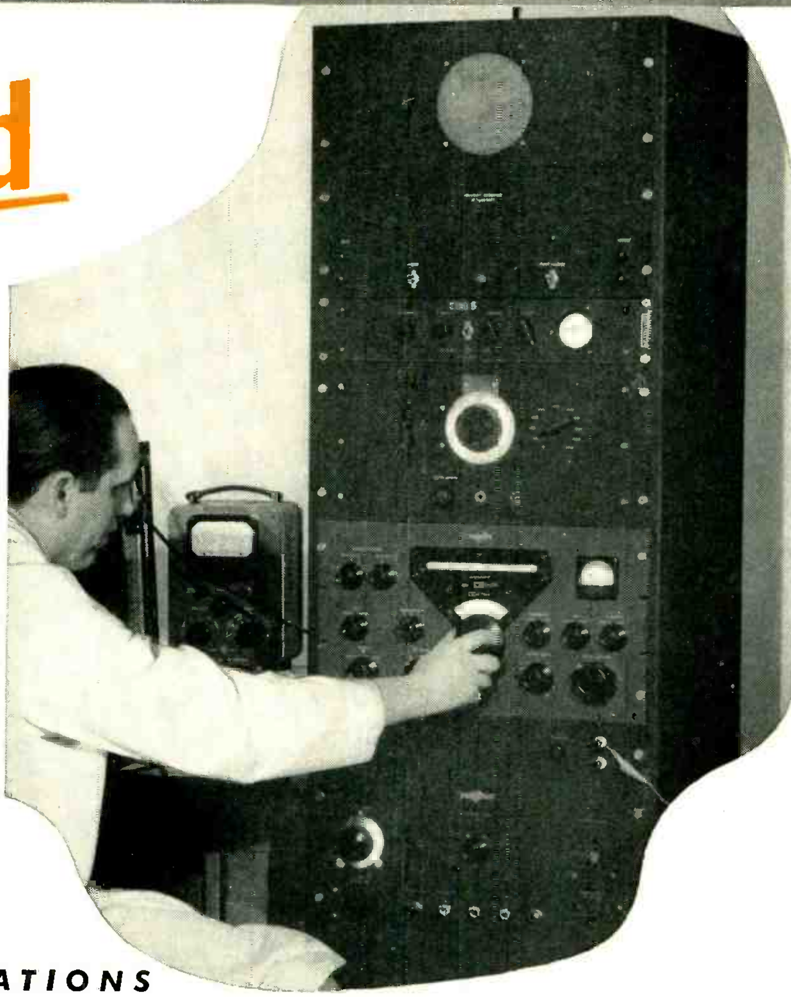
Want more information? Use post card on last page.

Unexcelled

in

★ **Accuracy**
★ **Dependability**

The COLLINS 51J Communications Receiver



The Collins 51J Communications Receiver in addition to its outstanding performance in the communications field, is being widely used in industrial laboratories as a sensitive and accurate measuring instrument and as a spectrum analyzer. Write for complete specifications and details today.

CONDENSED SPECIFICATIONS

FREQUENCY RANGE:
.54 to 30.5 megacycles.

TYPE OF CIRCUIT:
Double Conversion Superheterodyne.

CALIBRATION:
Direct reading in megacycles and kilocycles. One turn of main tuning dial covers 100 kilocycles on all bands.

TUNING:
Linear, divided into 30—one mc bands.

FREQUENCY STABILITY:
Overall stability within 1 kc under normal operating conditions.

SELECTIVITY:
5.5 to 6.5 kilocycles wide at 6 db down. 17 to 20 kilocycles wide at 60 db down.

AUDIO OUTPUT:
4 and 600 ohms impedance. 1 1/2 watts at 1000 cps with less than 15% distortion overall. "S" meter may be switched to read audio output.

RF INPUT:
High impedance single-ended. Break-in relay mounted internally. Antenna trimmer will resonate input circuit when used with any normal antenna.

POWER REQUIREMENTS:
85 watts 45/70 cps, 115 volts or 230 volts by reconnection on power transformer.

DIMENSIONS:
Panel — 10 1/2 inches high, 19 inches wide, notched for rack mounting. Optional metal cabinet — 21 1/8 inches wide, 12 1/4 inches high and 13 1/8 inches deep. Speaker available in metal cabinet 15 inches wide, 10 5/8 inches high and 9 1/8 inches deep.

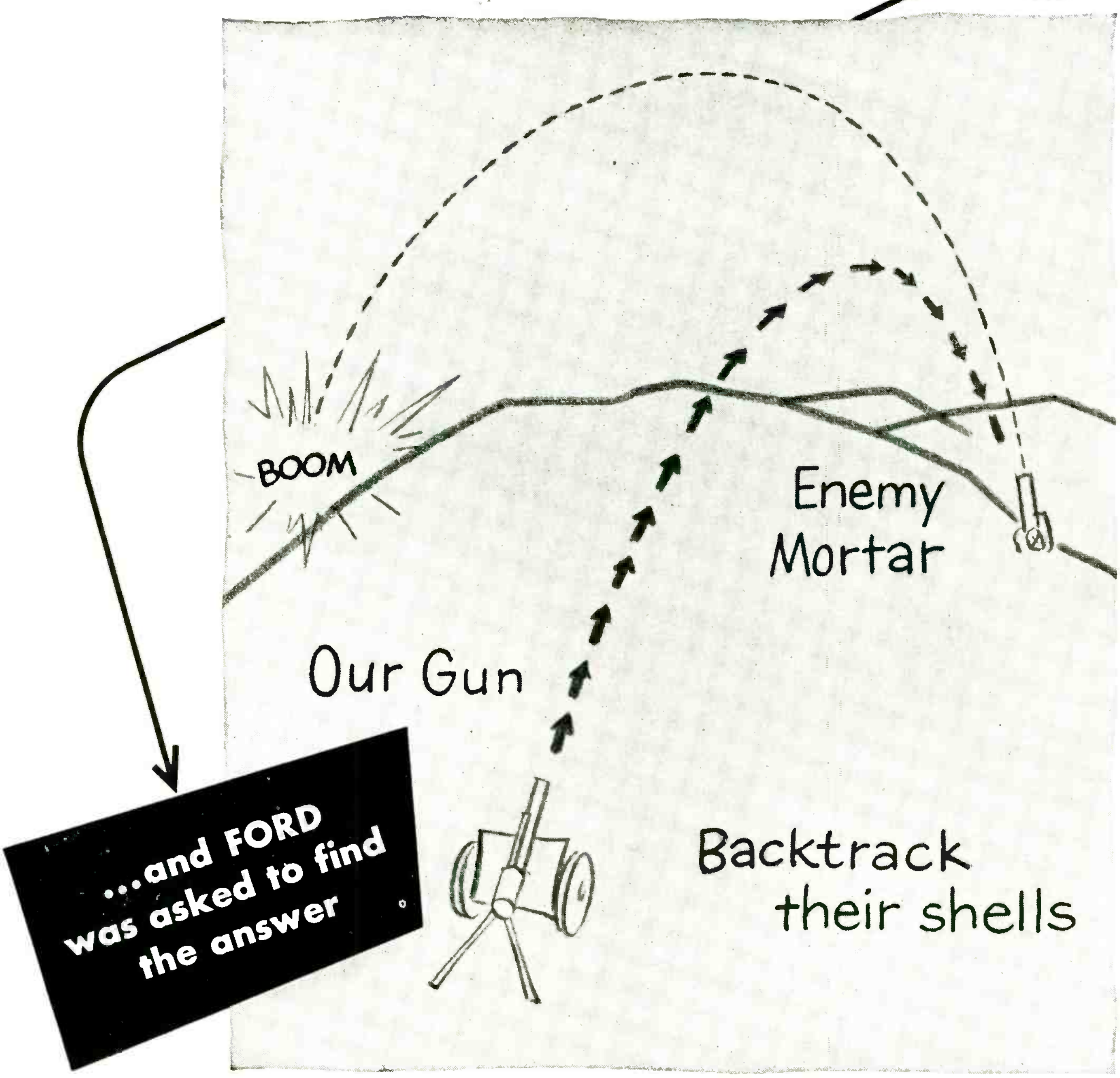
For excellence in radio communications equipment, it's . . . COLLINS

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.

TO BACKTRACK SHELL TO GUN
and destroy same



Can projectiles be "seen" approaching and their flight backtracked to locate the mortar or gun that fires them? This problem was simply reconciled with special computing equipment designed to be built right into the gun. The engineering of such a computer, the handling of such ballistic data, all falls into the pattern of previous Ford achievements.

This is typical of the problems that Ford has solved 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 "tomorrow" today. Control problems of both Industry and the Military are Ford specialties.

6

You can see why a job with Ford Instrument Company offers a challenge to young engineers. If you qualify, there may be a spot for you in automatic control development at Ford. Write for illustrated brochure.

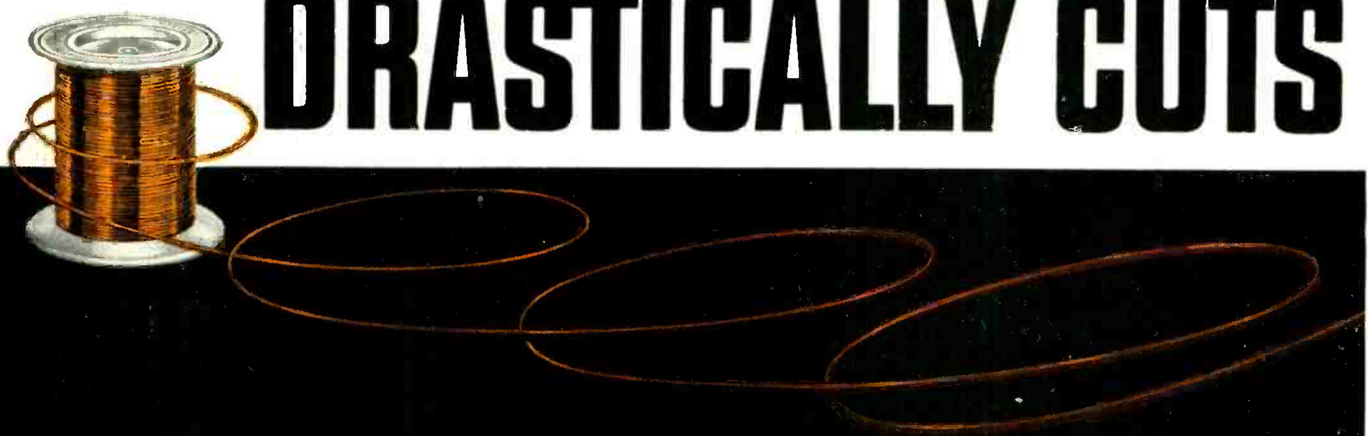
FORD

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

Unique PHELPS DODGE *development*

DRASTICALLY CUTS



- ✓ FAST WIRE-TO-WIRE BONDING INTO RIGID COIL.
- ✓ REDUCES FORMING AND ASSEMBLY OPERATIONS.
- ✓ FAR FEWER STEPS IN WINDING TYPICAL TV YOKE COIL.
- ✓ MAKES POSSIBLE UNUSUAL SHAPE COILS.

"Bobbin-less" coil

Fly-back coil

TV yoke coil

Hoop-shaped coil

"It takes the best

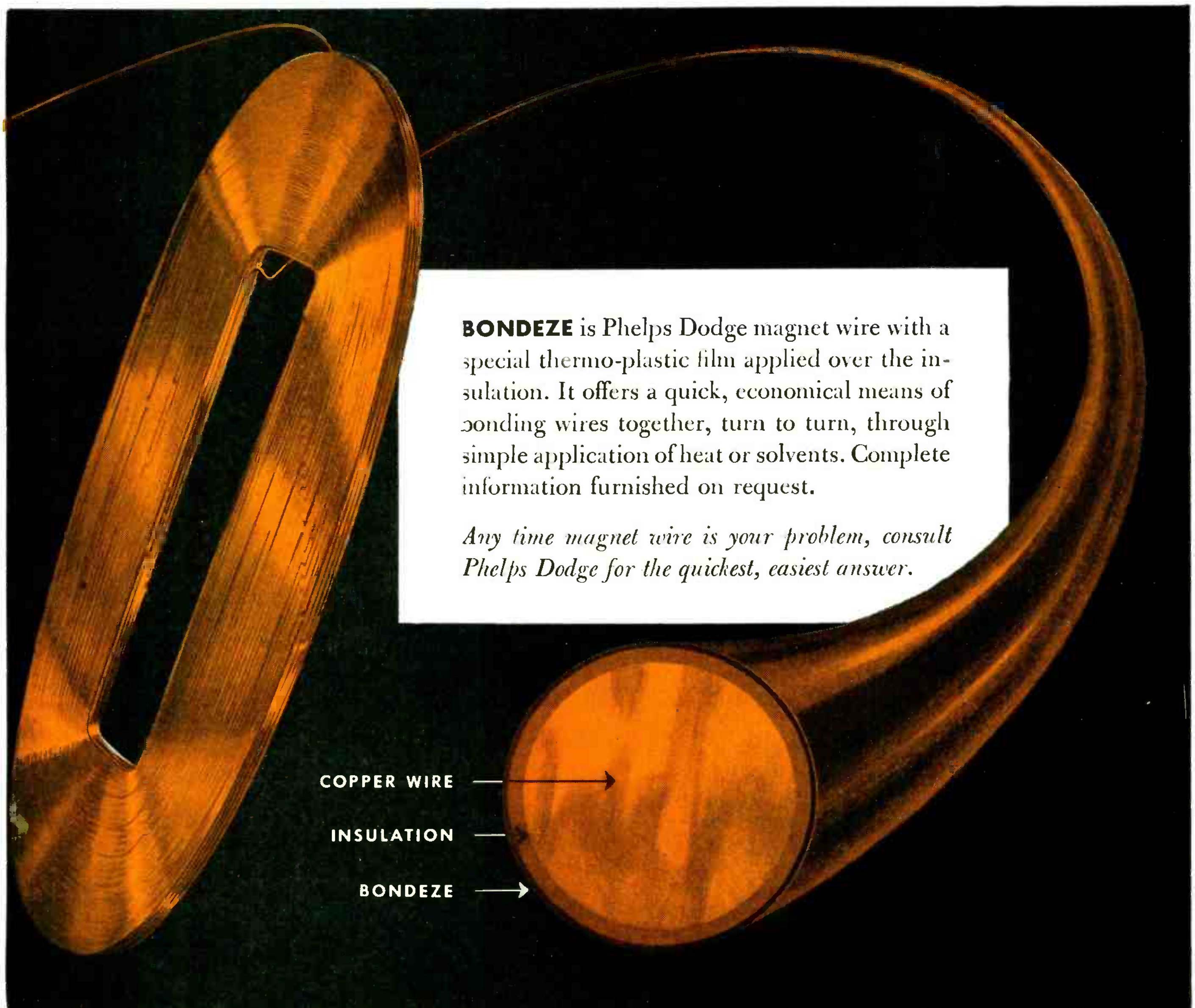
PHELPS DODGE COPPER PRODUCTS

CORPORATION

Want more information? Use post card on last page.

in Magnet Wire--BONDEZE*...

COIL WINDING COSTS!



BONDEZE is Phelps Dodge magnet wire with a special thermo-plastic film applied over the insulation. It offers a quick, economical means of bonding wires together, turn to turn, through simple application of heat or solvents. Complete information furnished on request.

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

*Bondeze is a Phelps Dodge Trade Mark

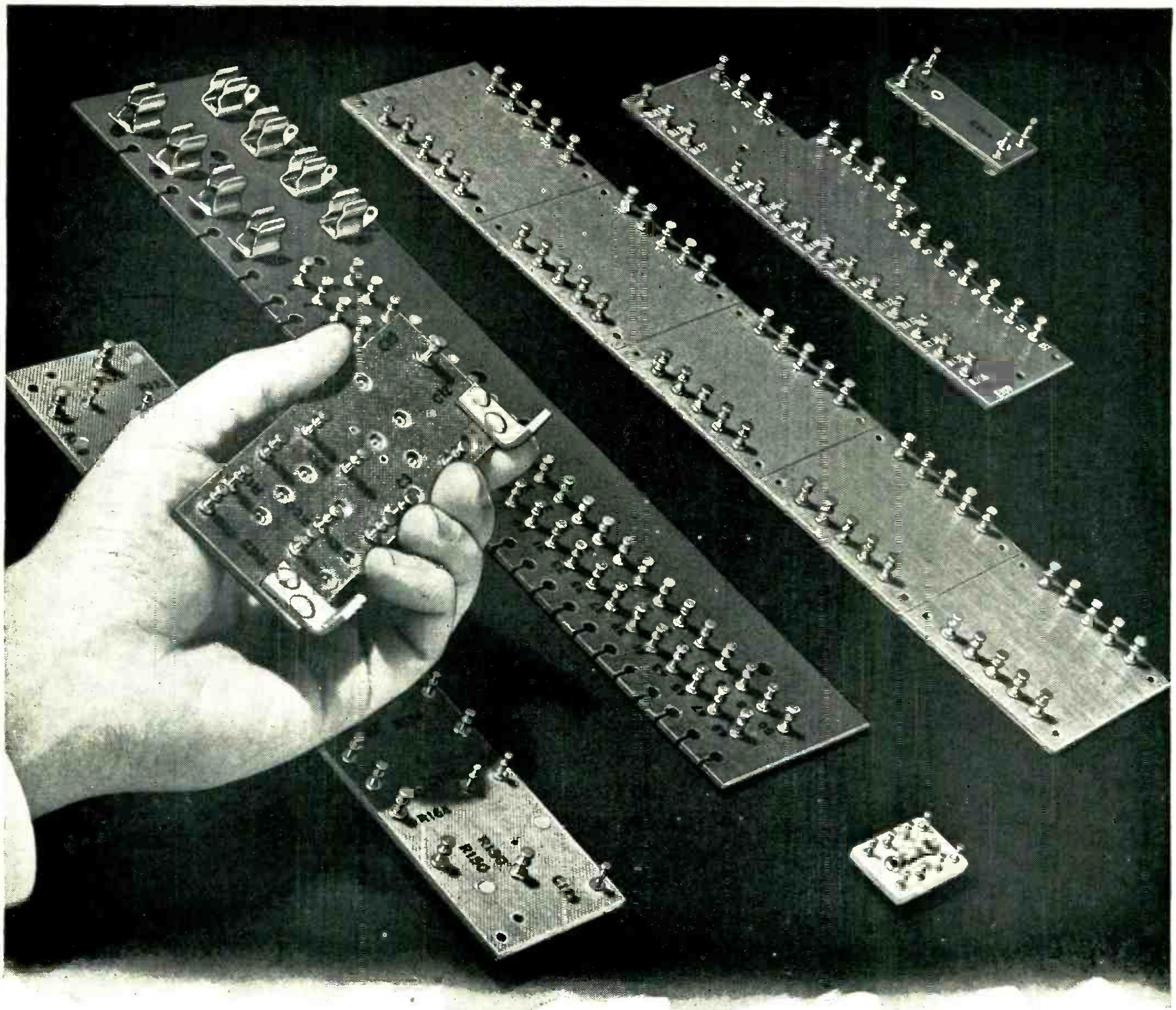
to make the best!"

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.



Name your needs in terminal boards
...we'll meet them *accurately*

The rigid specifications of government agencies and the armed forces need pose no problem to you. C.T.C. is in an excellent position to handle government sub-contracts for electronic parts and assemblies.

Our Custom Engineering Service is constantly supplying special terminal boards to the top names in electronics. These boards are built to severe government specifications, are fabricated of certified materials to fit the job. Among the specifications involved are: MIL-P-3115A, MIL-P-15037, MIL-P-15035A, MIL-P-15047, MIL-P-997A.

Boards can be made of cloth, paper, nylon or glass laminates (phenolic, melamine or silicone resin), and can be lacquered or varnished to specifications: JAN-C-173 and JAN-T-152. Lettering and numbering is done by rubber stamping, silk screening, hot stamping, engraving. Inks used in rubber stamping contain anti-fungus and fluorescent additives.

Terminals, feed-throughs, mounting hardware and all other terminal board fixtures meet all applicable government specifications.

Standard "All Set" Boards, scribed for easy separation, for the assembly line and laboratory are available in cotton fabric phenolic per specification MIL-P-15035A and in nylon phenolic per MIL-P-15047A.

For complete information write: Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast manufacturers, contact: E. V. Roberts, 5068 W. Washington Blvd., Los Angeles 16, or 988 Market St., San Francisco, Cal.

custom or standard... the guaranteed components CTC

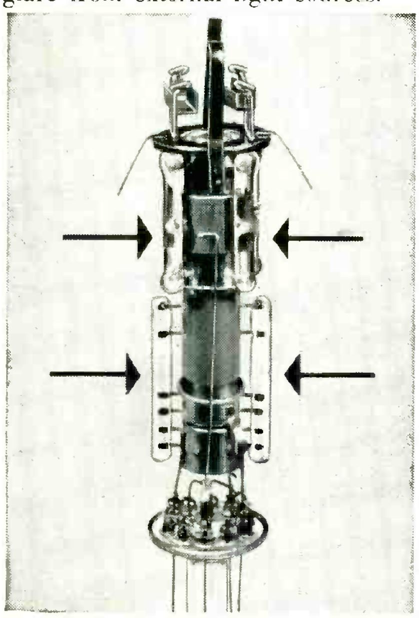
See us at Booth 287, IRE Show

453 439 456

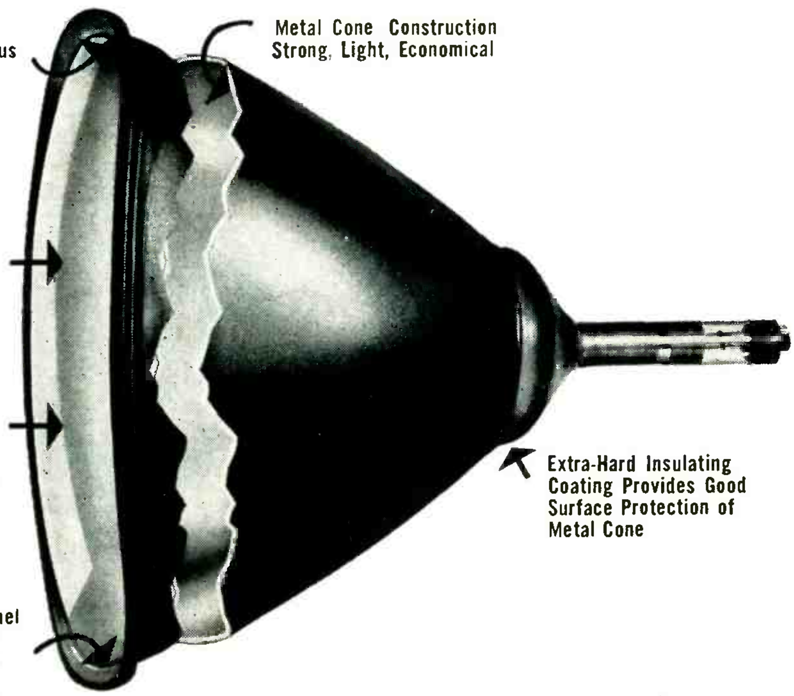
Two 21-inch Metal Cone Picture Tubes Announced by Westinghouse

21AP4 and 21MP4 now available for immediate delivery

Manufacturers faced with problems of handling, cost and uniformity in large picture tubes now may order Westinghouse 21-Inch RELIATRON™ Metal Cone Picture Tubes for immediate delivery. The new tubes—almost 33⅓% lighter in weight—are manufactured under the most rigid quality control system in the country. Superior face plate quality assures greater freedom from blemishes and glass imperfections. Uniform face plate thickness greatly reduces optical distortion over the viewing area. The etched glass of the face plate eliminates glare from external light sources.



Improved Gun Employs Glass Beads. Westinghouse makes the new metal cone electrostatic focus tube with glass-beaded assembly. This assures accurate element spacing within close tolerances to improve spot size and picture uniformity.



The 21-Inch RELIATRON Picture Tubes feature still another important improvement. The face plate is sealed to the metal cone using an intermediate glass-enamel frit.

PRODUCTION SAVINGS

The 21-Inch RELIATRON Picture Tubes introduce new economies throughout TV set production. Their lighter weight cuts shipping costs. The 21MP4 tube is electrostatically focused, requiring no focusing coil or focusing magnet. The 21AP4 is designed for magnetically focused operation.

Metal cone tubes give increased mechanical strength, and because of their light weight are easier to handle and assemble in TV receivers.

BETTER PICTURES

Metal cone picture tubes permit the use of spherical face plates of uniform thickness that allow receiver manufacturers to use standard available deflection components that produce pictures of consistently high quality.

Employment of the Westinghouse 21-Inch RELIATRON Metal Cone Picture Tubes enables you to meet the growing demand for larger screen TV receivers, to deliver a better picture, and at the same time, to realize important savings in your production operations.

The new RELIATRON metal cone tubes now are available in quantities which permit immediate delivery of production-size orders. For complete details, write Dept. A-202.

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

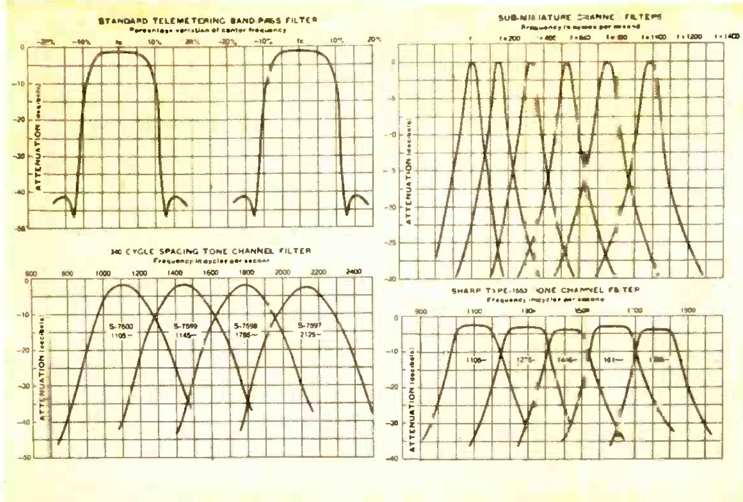
RELIATRON™ TUBES

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

Want more information? Use post card on last page.

EXPANDING PRODUCTION

in Toroids & Coils

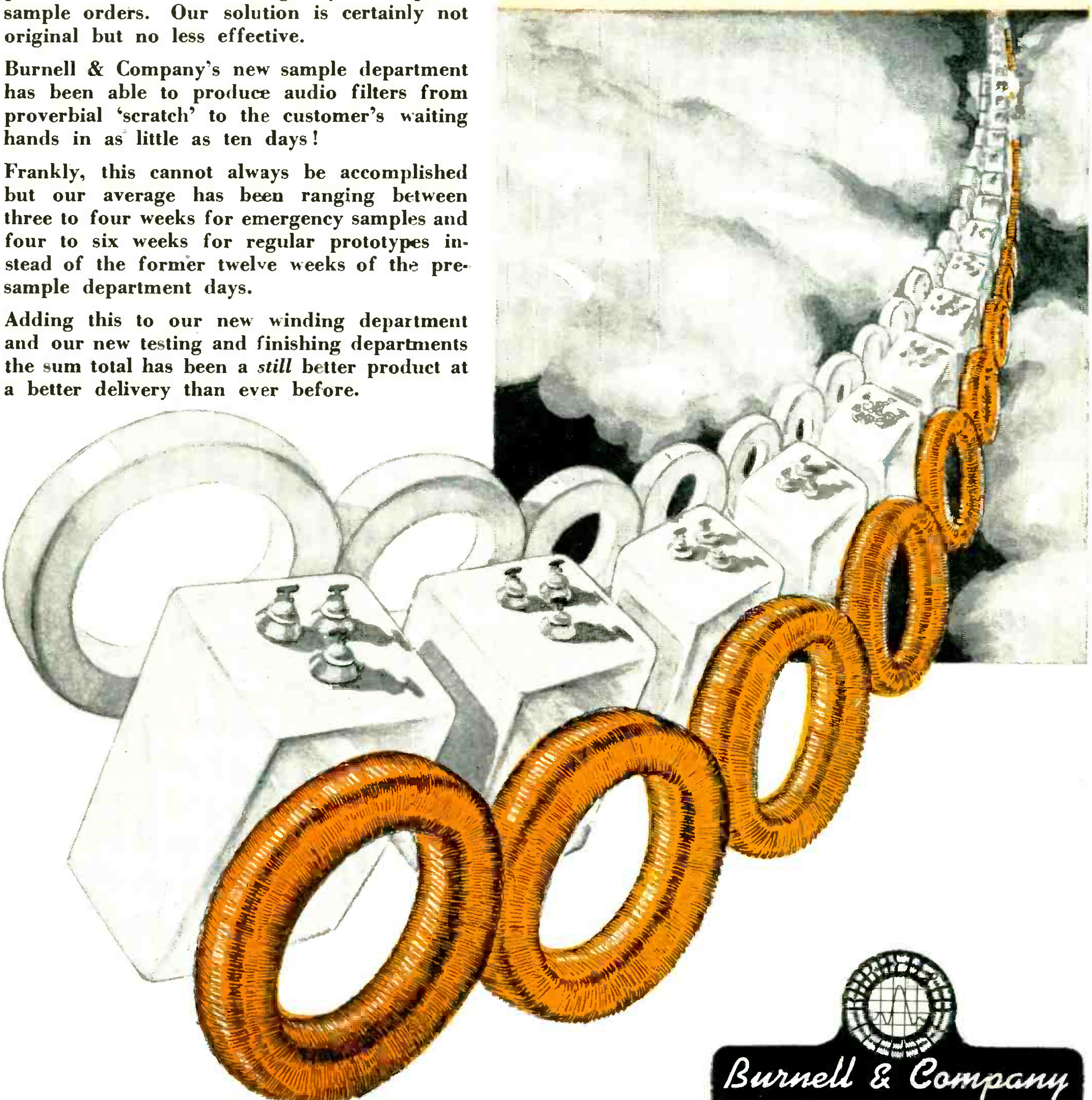


At every management meeting in Burnell & Company there is an unseen but highly respected visitor. He is the spectre of all our customers and his opinions carry weight. Recently he suggested that in addition to our other expansion measures that we must find a way to improve deliveries for emergency and special sample orders. Our solution is certainly not original but no less effective.

Burnell & Company's new sample department has been able to produce audio filters from proverbial 'scratch' to the customer's waiting hands in as little as ten days!

Frankly, this cannot always be accomplished but our average has been ranging between three to four weeks for emergency samples and four to six weeks for regular prototypes instead of the former twelve weeks of the pre-sample department days.

Adding this to our new winding department and our new testing and finishing departments the sum total has been a *still* better product at a better delivery than ever before.



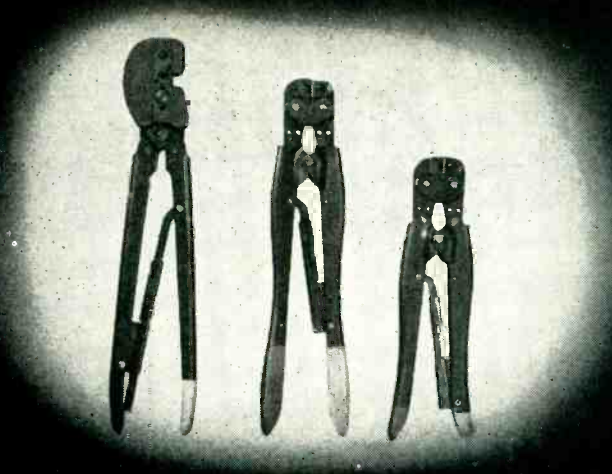
EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

Burnell & Company

YONKERS 2, NEW YORK

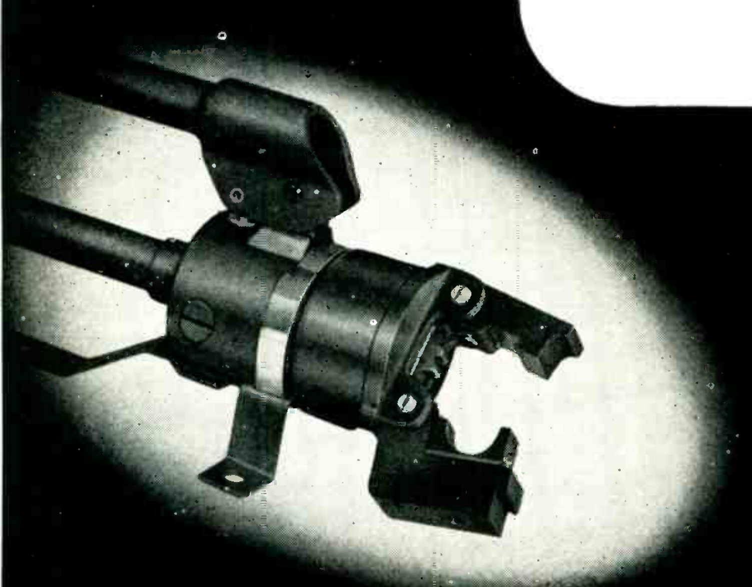
CABLE ADDRESS "BURNELL"

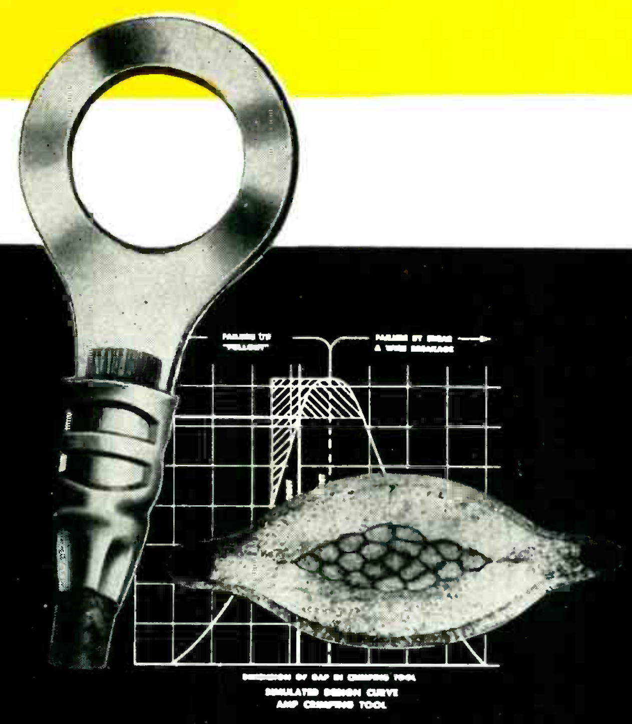
Want more information? Use post card on last page.



it's the Extra Factor of Assurance that counts . . .

A-MP CONTROLLED WIRE TERMINATION

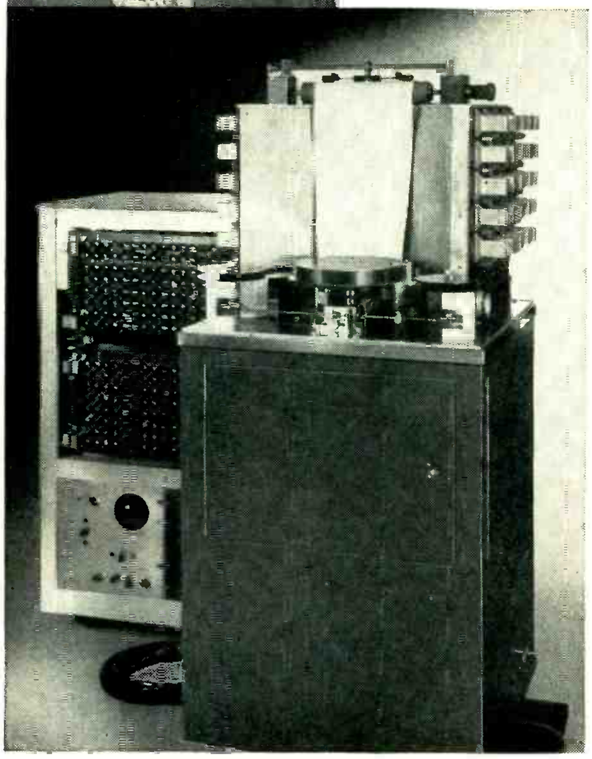


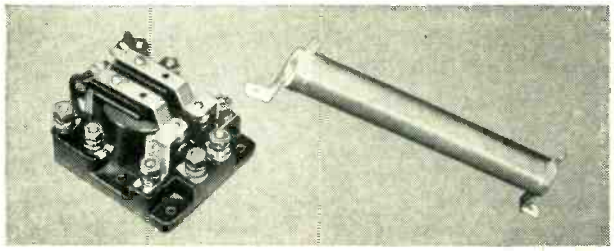


Potter Instrument Company, Inc.

"The 'Flying Typewriter' and all electronic counters require electric components that are rugged and reliable"

says Jack Leight, Sales Engineer,
Ward Leonard Electric Company, Mount Vernon, New York





The "Flying Typewriter" is a revolutionary new high-speed electronic printer for data handling, communications, and computing. Developed by the Potter Instrument Company, Inc., Great Neck, New York, it is capable of printing 24,000 characters a minute "on the fly" from a continuously revolving type wheel.

Coupled to an electronic storage or memory unit, the machine first interprets, then prints in familiar typed lines, information taken in coded form from magnetic tape and punched cards or transmitted over narrow channel radio link, telephone and telegraph lines. The entire alphabet, numerals, punctuation and other special symbols are used in printing 300 lines per minute.

Such speed and accuracy in a machine require reliable, rugged electric components. That is why the Potter Instrument Company uses Ward Leonard VITROHM resistors and relays in the electronic counters for the "Flying Typewriter" as well as in many other types of high-speed electronic counters.

The trouble-free operation of Ward Leonard controls also eliminates many costly and time-consuming repairs.

Ward Leonard is always ready to put its staff of application engineers to work with you.

WARD LEONARD

WARD LEONARD ELECTRIC COMPANY

MOUNT VERNON, NEW YORK

Result-Engineered Controls Since 1892

Special alloy resistance wire is being wound on Vitrohm cores by Caroline Jervisa, for 17 years an employee of the company.

Skilled operators spot weld terminals to Vitrohm resistor ceramic cores. Welding assures permanent anchorage to the cores.

Long service life of VITROHM resistors results from unified manufacture, uniform quality, matched thermal characteristics

VITROHM resistors stay on the job under the most adverse operating conditions such as those to which they are subjected in electronic counters where less carefully made resistors would break down.

Thermal shock, vibration, corrosive atmosphere, overloads, even prolonged exposure to humidity and electrolysis will not affect their performance. All parts are uniform in quality, balanced in respect to thermal coefficient of expansion.

All Ward Leonard controls are made to exacting specifications, are guaranteed to give dependable service.

Consult Ward Leonard on their complete line of resistors, relays, rheostats, and other electric controls to meet your special needs.

O.D. and concentricity of finished ceramic cores is checked by Minna M. Henderson, who has had 12 years experience with Ward Leonard.

Prior to firing, tubular ceramic cores are being cut to exact size by Ann Trotta. A continuous check is made to maintain close dimensional tolerances.

DISTRICT OFFICES AND REPRESENTATIVES

Atlanta 5, Georgia	C. B. Rogers and Associates
Baltimore 18, Md.	Durling Electric Co.
Charlotte 1, N. C.	James L. Highsmith & Co.
Chicago 4, Illinois	Ward Leonard Electric Co.
Cincinnati 2, Ohio	Sheldon Storer and Assoc.
Cleveland 14, Ohio	The Ambos-Jones Co.
Corpus Christi, Texas	Brance-Krachy Co., Inc.
Denver 2, Colorado	Mark G. Mueller
Detroit 21, Michigan	Jesse W. Eakins Co.
Hartford 6, Conn.	Ward Leonard Electric Co.
Houston 1, Texas	Brance-Krachy Co., Inc.
Kansas City 2, Mo.	Maury E. Bettis Co.
Knoxville, Tennessee	John G. Pettyjohn
Los Angeles 13, Calif.	Ward Leonard Electric Co.
Memphis 3, Tenn.	E. E. Torkell
Minneapolis 5, Minn.	Marvin H. Kirkeby
Newark 2, N. J.	Ward Leonard Electric Co.
New Orleans 13, La.	Electron Engineering Co.
Philadelphia 2, Pa.	Ward Leonard Electric Co.
Pittsburgh 16, Pa.	W. A. Bittner
Roanoke, Virginia	Lynn H. Morris
Rochester 7, N. Y.	Ward Leonard Electric Co.
St. Louis 10, Mo.	Ward Leonard Electric Co.
Salt Lake City 1, Utah	Leonard M. Slusser
San Antonio, Texas	Brance-Krachy Co., Inc.
San Francisco 3, Calif.	L. F. Church Co.
Seattle 4, Wash.	Northwestern Agencies, Inc.
Tucson, Arizona	Central Station Equipment Co.

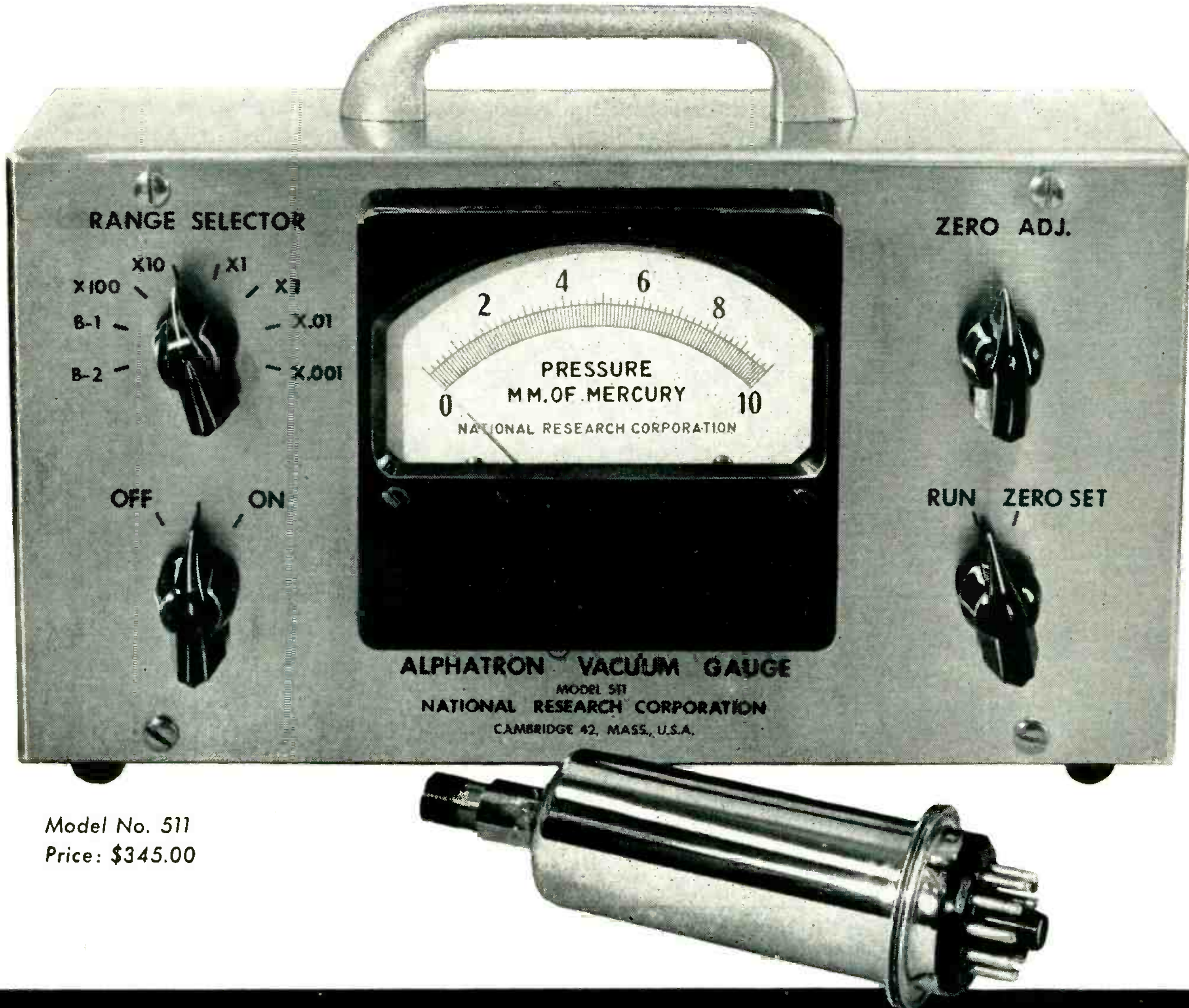
CANADA

Edmonton, Alta.	D. M. Fraser, Ltd.
Halifax, N. S.	D. M. Fraser, Ltd.
Montreal 25, P. Q.	D. M. Fraser, Ltd.
Toronto 1, Ont.	D. M. Fraser, Ltd.
Vancouver, B. C.	D. M. Fraser, Ltd.
Winnipeg, Man.	D. M. Fraser, Ltd.

EXPORT

New York 4, N. Y.	Ad. Auriema, Inc.

Want more information? Use post card on last page.



Model No. 511
*Price: **$345.00***

Versatile New Alphatron* VACUUM GAUGE...

NEW LOW COST—WIDER RANGE

BATTERY OPERATION eliminates expensive power supply, improves accuracy and stability by removing variables of line voltage and power supply.

1000 TO 0.00001 mm HG READINGS. Wider range than previous models. Full scale deflections at 1000, 100, 10, 1, 0.1 and .01 mm HG absolute. All scales linear.

QUICK START. Only a few seconds warm-up time required. Convenient "on-off" operation saves batteries. Special switch permits instant check of battery condition on meter.

PERMANENT ACCURACY of $\pm$ 2% full scale. Long half-life ionization source insures permanent maintenance of original factory calibration.

INSTANT RESPONSE. Tracks pressure fluctuations with negligible time lag.

SMALL VOLUME. Net addition to your vacuum system about 50 cc.

SMALL, LIGHT, PORTABLE. As convenient to use as it is accurate and dependable. Write for more information.

*Reg. U. S. Pat. Off.

INDUSTRIAL RESEARCH • PROCESS DEVELOPMENT • HIGH VACUUM ENGINEERING AND EQUIPMENT

METALLURGY • DEHYDRATION DISTILLATION COATING • APPLIED PHYSICS

National Research Corporation
EQUIPMENT DIVISION
Seventy Memorial Drive, Cambridge, Massachusetts

Want more information? Use post card on last page.

Special alloy resistance wire is being wound on Vitrohm cores by Caroline Jervisa, for 17 years an employee of the company.

Skilled operators spot weld terminals to Vitrohm resistor ceramic cores. Welding assures permanent anchorage to the cores.

Long service life of VITROHM resistors results from unified manufacture, uniform quality, matched thermal characteristics

VITROHM resistors stay on the job under the most adverse operating conditions such as those to which they are subjected in electronic counters where less carefully made resistors would break down.

Thermal shock, vibration, corrosive atmosphere, overloads, even prolonged exposure to humidity and electrolysis will not affect their performance. All parts are uniform in quality, balanced in respect to thermal coefficient of expansion.

All Ward Leonard controls are made to exacting specifications, are guaranteed to give dependable service.

Consult Ward Leonard on their complete line of resistors, relays, rheostats, and other electric controls to meet your special needs.

O.D. and concentricity of finished ceramic cores is checked by Minna M. Henderson, who has had 12 years experience with Ward Leonard.

Prior to firing, tubular ceramic cores are being cut to exact size by Ann Trotta. A continuous check is made to maintain close dimensional tolerances.

DISTRICT OFFICES AND REPRESENTATIVES

Atlanta 5, Georgia	C. B. Rogers and Associates
Baltimore 18, Md.	Durling Electric Co.
Charlotte 1, N. C.	James L. Highsmith & Co.
Chicago 4, Illinois	Ward Leonard Electric Co.
Cincinnati 2, Ohio	Sheldon Storer and Assoc.
Cleveland 14, Ohio	The Ambos-Jones Co.
Corpus Christi, Texas	Brance-Krachy Co., Inc.
Denver 2, Colorado	Mark G. Mueller
Detroit 21, Michigan	Jesse W. Eakins Co.
Hartford 6, Conn.	Ward Leonard Electric Co.
Houston 1, Texas	Brance-Krachy Co., Inc.
Kansas City 2, Mo.	Maury E. Bettis Co.
Knoxville, Tennessee	John G. Pettyjohn
Los Angeles 13, Calif.	Ward Leonard Electric Co.
Memphis 3, Tenn.	E. E. Torkell
Minneapolis 5, Minn.	Marvin H. Kirkeby
Newark 2, N. J.	Ward Leonard Electric Co.
New Orleans 13, La.	Electron Engineering Co.
Philadelphia 2, Pa.	Ward Leonard Electric Co.
Pittsburgh 16, Pa.	W. A. Bittner
Roanoke, Virginia	Lynn H. Morris
Rochester 7, N. Y.	Ward Leonard Electric Co.
St. Louis 10, Mo.	Ward Leonard Electric Co.
Salt Lake City 1, Utah	Leonard M. Slusser
San Antonio, Texas	Brance-Krachy Co., Inc.
San Francisco 3, Calif.	L. F. Church Co.
Seattle 4, Wash.	Northwestern Agencies, Inc.
Tucson, Arizona	Central Station Equipment Co.

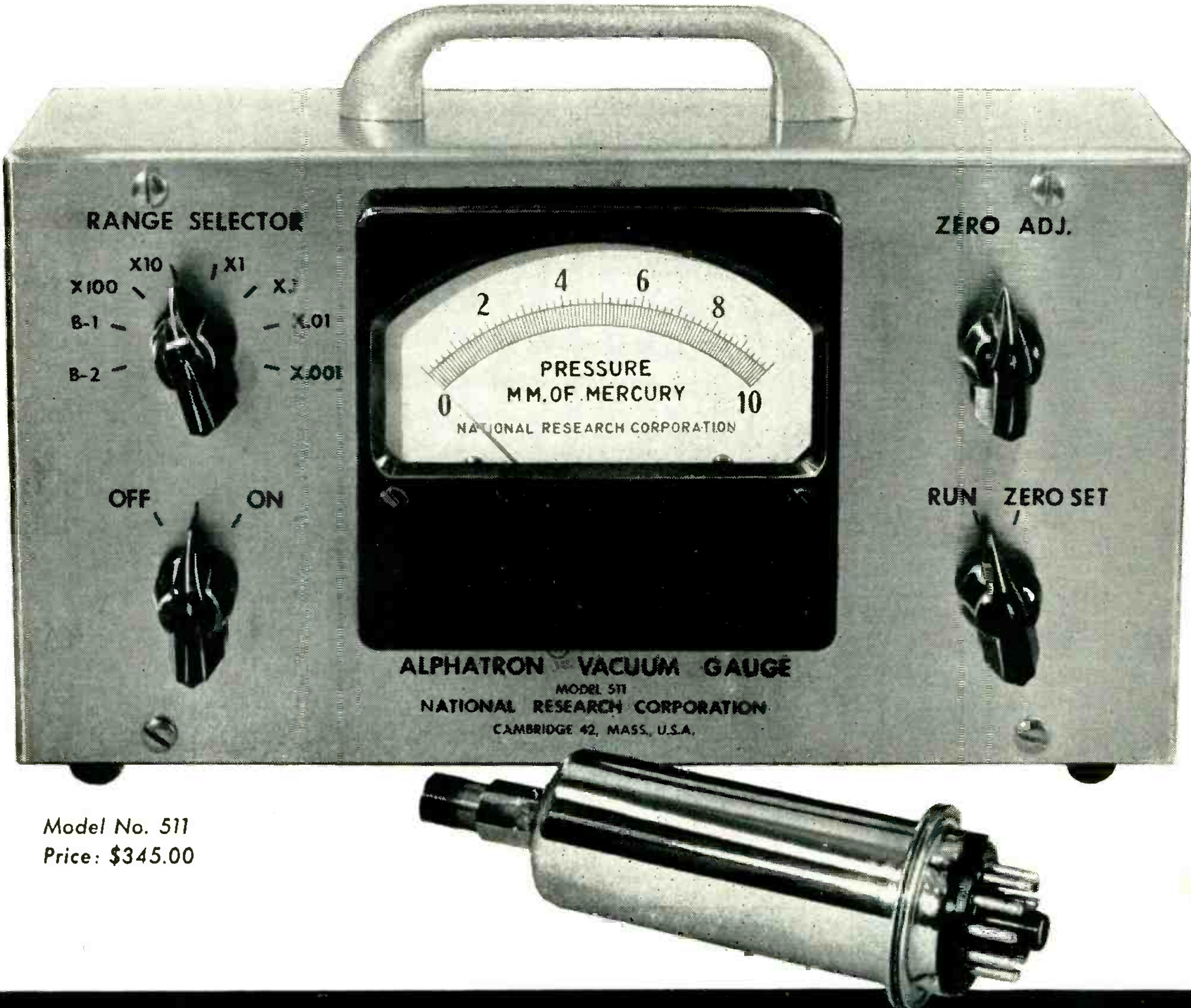
CANADA

Edmonton, Alta.	D. M. Fraser, Ltd.
Halifax, N. S.	D. M. Fraser, Ltd.
Montreal 25, P. Q.	D. M. Fraser, Ltd.
Toronto 1, Ont.	D. M. Fraser, Ltd.
Vancouver, B. C.	D. M. Fraser, Ltd.
Winnipeg, Man.	D. M. Fraser, Ltd.

EXPORT

New York 4, N. Y.	Ad. Auriema, Inc.

Want more information? Use post card on last page.



Model No. 511
Price: $345.00

Versatile New Alphatron* VACUUM GAUGE...

NEW LOW COST—WIDER RANGE

BATTERY OPERATION eliminates expensive power supply, improves accuracy and stability by removing variables of line voltage and power supply.

1000 TO 0.0001 mm HG READINGS. Wider range than previous models. Full scale deflections at 1000, 100, 10, 1, 0.1 and .01 mm HG absolute. All scales linear.

QUICK START. Only a few seconds warm-up time required. Convenient "on-off" operation saves batteries. Special switch permits instant check of battery condition on meter.

PERMANENT ACCURACY of ± 2% full scale. Long half-life ionization source insures permanent maintenance of original factory calibration.

INSTANT RESPONSE. Tracks pressure fluctuations with negligible time lag.

SMALL VOLUME. Net addition to your vacuum system about 50 cc.

SMALL, LIGHT, PORTABLE. As convenient to use as it is accurate and dependable. Write for more information.

*Reg. U. S. Pat. Off.

INDUSTRIAL RESEARCH · PROCESS DEVELOPMENT · HIGH VACUUM ENGINEERING AND EQUIPMENT

METALLURGY · DEHYDRATION DISTILLATION COATING · APPLIED PHYSICS

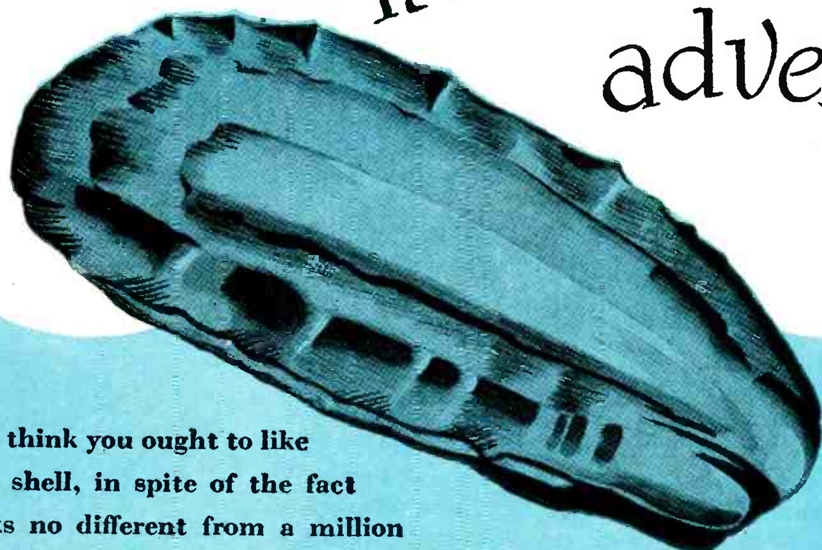
National Research Corporation

EQUIPMENT DIVISION

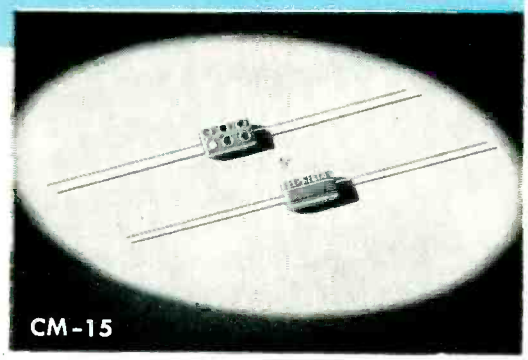
Seventy Memorial Drive, Cambridge, Massachusetts

Want more information? Use post card on last page.

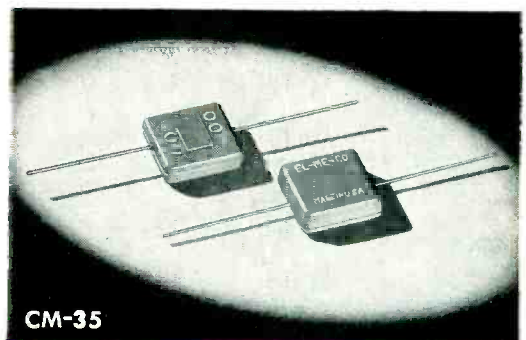
an oyster never advertises



He seems to think you ought to like him for his shell, in spite of the fact that it looks no different from a million other oyster shells. If he's got a pearl inside, why doesn't he say so.



CAPACITORS LOOK PRETTY MUCH ALIKE FROM THE OUTSIDE, BUT EL-MENCO'S HAVE SOMETHING IN THEM *and we want the world to know it.*



Into every El-Menco Capacitor goes superb design, precise workmanship and the finest of materials. The finished unit is then factory-tested at *double* its working voltage to *insure* satisfactory performance on whatever job it is given.

No wonder we are *proud* to put our name on these capacitors—no wonder they have won the highest praise for their absolute reliability.

The range runs from the smallest (CM-15-2-525 mmf. cap.) to the largest (CM-35-3300-10000 mmf. cap.)

Jobbers and Distributors: For information write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U.S. and Canada.

Write on business letterhead for catalog and samples.

MOLDED MICA **El-Menco** **MICA TRIMMER**

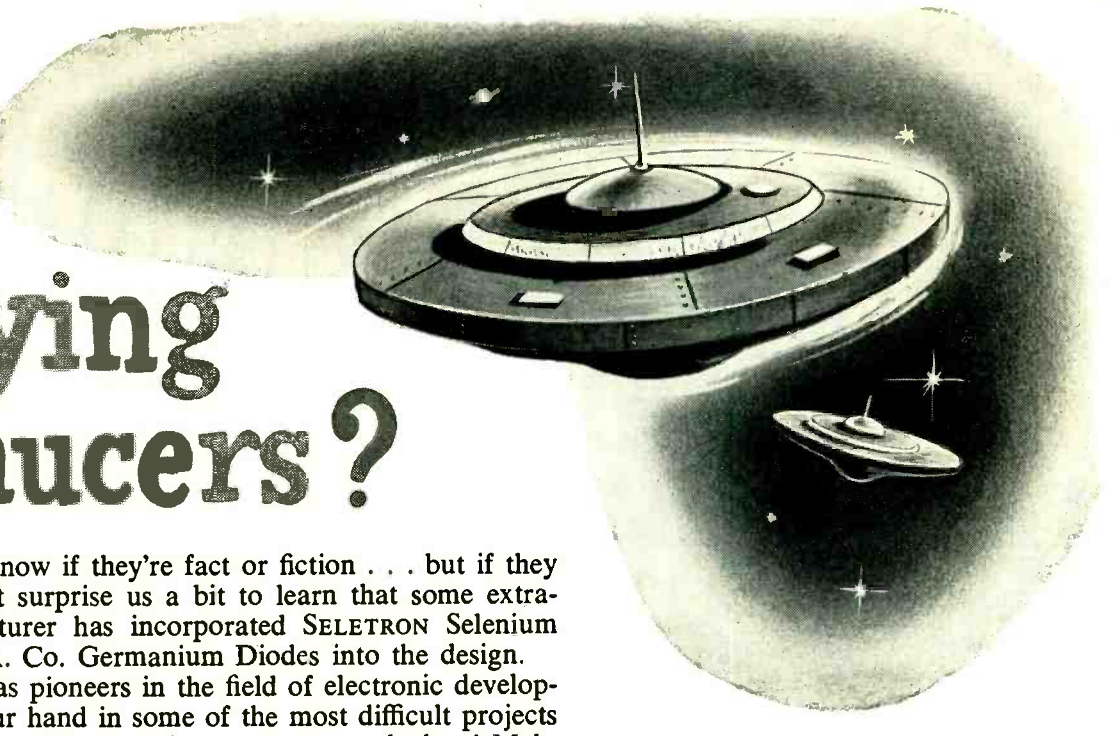
CAPACITORS

Radio and Television Manufacturers, Domestic and Foreign, Communicate Direct With Factory—

THE ELECTRO MOTIVE MFG. CO., INC. **WILLIMANTIC, CONNECTICUT**

Want more information? Use post card on last page.

Flying Saucers?



Frankly we don't know if they're fact or fiction . . . but if they *are* fact it wouldn't surprise us a bit to learn that some extra-terrestrial manufacturer has incorporated SELETRON Selenium Rectifiers and R. R. Co. Germanium Diodes into the design.

That's because—as pioneers in the field of electronic development—we've had our hand in some of the most difficult projects and met some of the stiffest requirements ever cooked up! Making drawing board dreams come true are daily chores at Radio Receptor Co.!

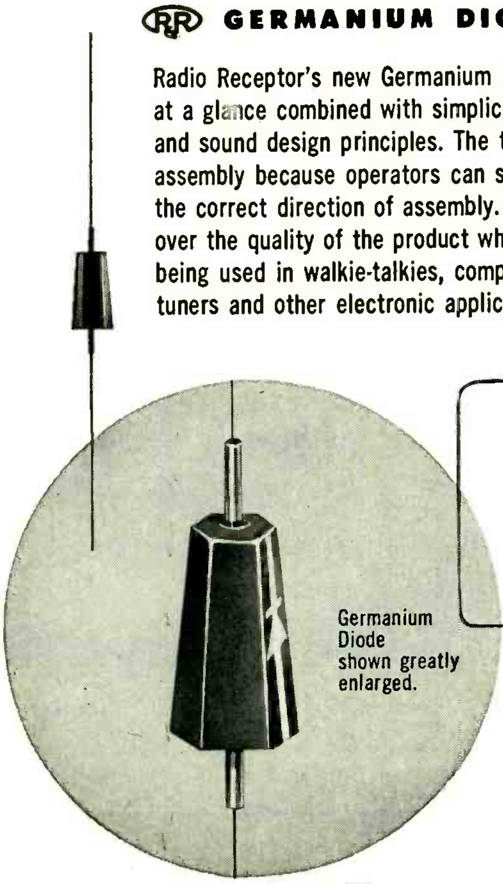
Seletron

RR GERMANIUM DIODES

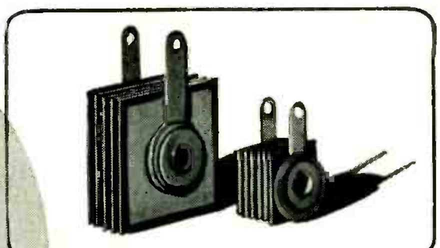
Radio Receptor's new Germanium Diodes feature polarity at a glance combined with simplicity of construction and sound design principles. The tapered shape speeds assembly because operators can see at a glance the correct direction of assembly. Users are enthusiastic over the quality of the product which is currently being used in walkie-talkies, computers, TV sets, tuners and other electronic applications.

SELENIUM RECTIFIERS

Seletron Selenium Rectifiers, in both miniature and industrial types, are in constant demand by an increasingly large number of engineers throughout the world because they are completely dependable under the most grueling conditions. Years of experience have given Radio Receptor Co. a deep insight into the idiosyncrasies of rectification.



Germanium Diode shown greatly enlarged.



Our Germanium Diodes and Seletron Selenium Rectifiers may hold the answer to many of your problems. Radio Receptor Engineers will be glad to study your requirements and submit their recommendations on both of these products.

Germanium Transistors available in limited quantities.

Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

RR *Since 1922 in Radio and Electronics* RR

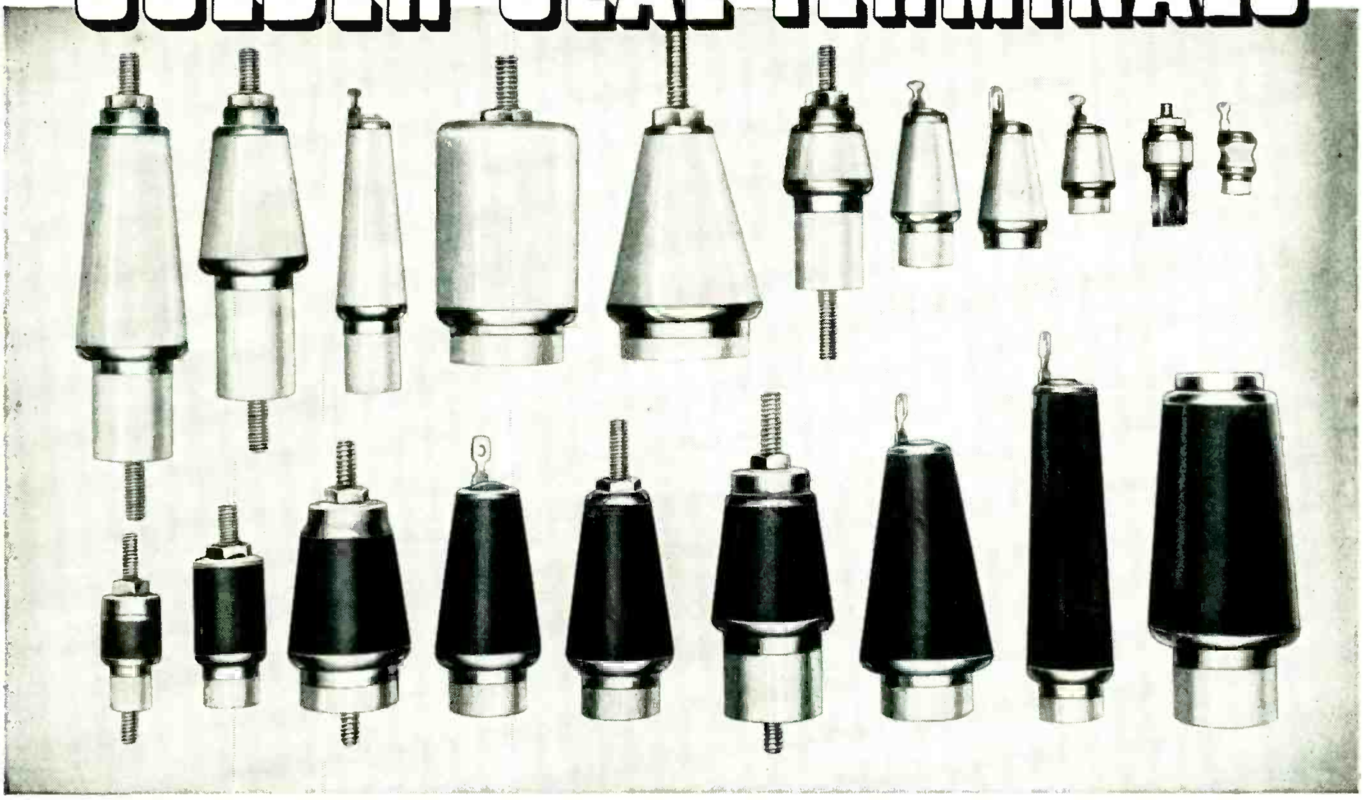
SALES DEPT: 251 West 19th Street, New York 11, N. Y. • FACTORY: 84 North 9th Street, Brooklyn 11, N. Y.

Solve your hermetic seal problems with this expanded line of rugged

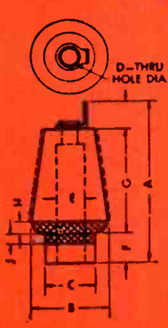
GENERAL CERAMICS

- EASE OF ASSEMBLY
- SUPERIOR STRENGTH
- NON-DETERIORATION
- PERMANENT SEALING
- RESISTANCE TO HEAT
- EXTREMELY LOW-LOSS

SOLDER-SEAL TERMINALS



General Ceramics Solder-Seal Terminals are available in a range of sizes and shapes capable of meeting practically any requirement. Solder-Seal Terminals are easily soft-soldered to closures and effect a permanent, positive hermetic seal that is virtually immune to mechanical or thermal shock. There are no rubber or plastic gaskets to age or deteriorate. For complete information call, wire or write today.

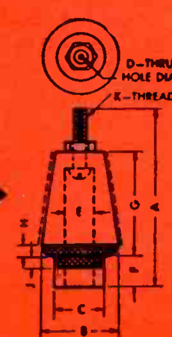


STANDARD SOLDER LUG TYPES

PART NO.	A	B	C	D	E	F	G	H	J
D-3342	1 1/32	.490	3/8	.095	3/16	3/16	1/2	1/16	3/32
D-3346	1 19/32	5/8	.490	.095	1/4	3/8	7/8	3/32	1/8
D-3350	2 9/32	15/16	11/16	.130	3/8	3/8	1 15/32	1/8	1/8
D-3349	3 3/16	3/4	9/16	.130	1/4	5/16	2 7/16	1/8	1/8

STANDARD THREADED STUD TYPES

PART NO.	A	B	C	D	E	F	G	H	J	K
D-3856	1 7/32	.490	3/8	1/16	1/4	3/16	1/2	1/16	3/32	6/32
D-3857	1 51/64	5/8	.490	1/16	1/4	3/8	7/8	3/32	1/8	6/32
D-3962	2 15/32	15/16	11/16	.055	3/8	3/8	1 15/32	1/8	1/8	8/32
D-3638	2 15/32	15/16	11/16	1/16	3/8	3/8	1 15/32	1/8	1/8	10/32



GENERAL CERAMICS AND STEATITE CORPORATION — STEATITE INSULATORS

General CERAMICS and STEATITE CORP.

Telephone: Perth Amboy 4-5100

GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

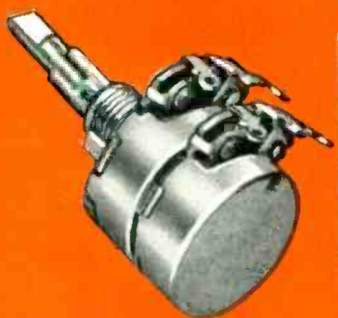
MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, FERRAMICS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE

COMPLETE CIVILIAN LINE

***Exceptionally* good delivery cycle on civilian orders due to tremendous mass production facilities.**

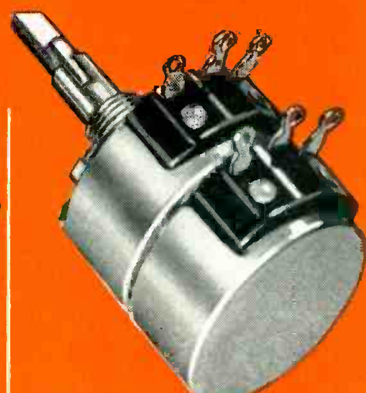
TYPE C45-70

NEW HIGH QUALITY MINIATURIZED "DIME-SIZE" CIVILIAN CONTROL— *Performance Fully Equals Larger Types.*
TYPE 70, 3/4" diameter variable composition resistor. Wattage rating: .3 watt for resistances through 10,000 ohms, .2 watt with 350 volts maximum across end terminals for resistances over 10,000 ohms. Also available in concentric shaft tandem construction C45-70 as shown above.

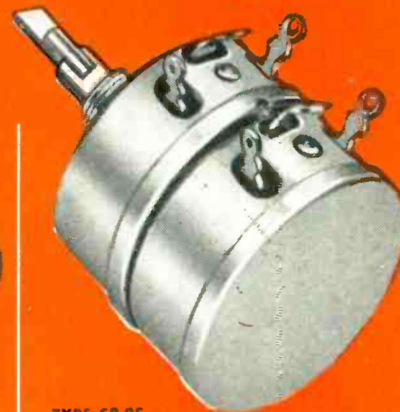


TYPE C2-45

TYPE C2-35



TYPE C2-252

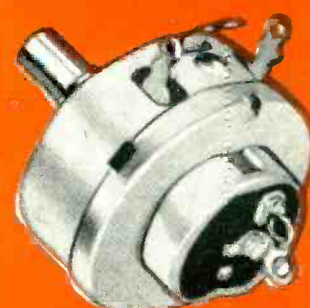


TYPE C2-25

TYPE GC-45, 15/16" diameter variable composition resistor. Wattage rating: 1/2 watt for resistances through 10,000 ohms, 1/3 watt for resistances over 10,000 ohms through 100,000 ohms, 1/4 watt with 500 volts maximum across end terminals for resistances over 100,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-45 as shown above.

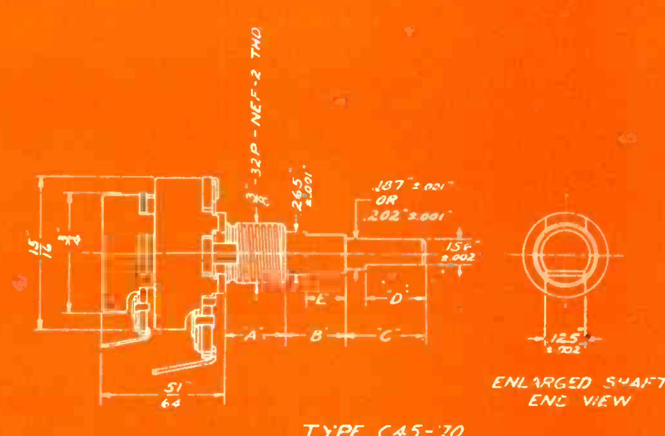
TYPE GC-35, 1 1/8" diameter variable composition resistor. Wattage rating: 3/4 watt for resistances through 10,000 ohms, 2/3 watt for resistances over 10,000 ohms through 25,000 ohms, 1/2 watt with 500 volts maximum across end terminals for resistances over 25,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-35 as shown above.

TYPE GC-252, 2 watt, 1 17/64" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-252 as shown above.



TYPE GC-25, 4 watt, 1 17/32" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-25 as shown above.

Typical concentric shaft tandem with panel and rear sections operating separately from concentric shafts (TYPE C45-70 ILLUSTRATED). Similar construction available for all military resistors.



REPRESENTATIVES
Henry E. Sanders
McClatchy Bldg.
69th & Market St.
Upper Darby, Penna.
Phone: Flanders 2-4420

W. S. Harmon Company
1638 So. La Cienega Blvd.
Los Angeles 35, California
Phone: Bradshaw 2-3321

John A. Green Company
6815 Oriole Drive
Dallas 9, Texas

IN CANADA
C. C. Meredith & Co.
Streetsville, Ontario

SOUTH AMERICA
Jose Luis Pontet
Buenos Aires, Argentina
Montevideo, Uruguay
Rio de Janeiro, Brazil
Sao Paulo, Brazil

OTHER EXPORT
Sylvan Ginsbury
8 West 40th Street
New York 18, N. Y.

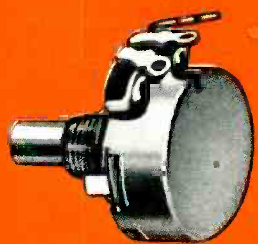
Specialists in

COMPLETE MILITARY LINE

***Immediate delivery* from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.**

NEW 38-PAGE ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. *Write today for your copy.*

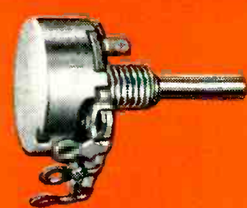
TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



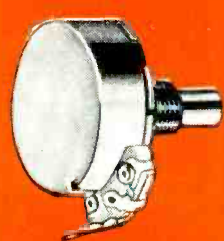
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

TYPE 252, (JAN-R-19, Type RA20)
2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.

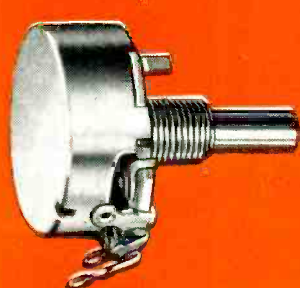
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

See the complete CTS military and civilian lines of variable resistors at the

IRE SHOW

Grand Central Palace, New York City

MARCH 23-26, 1953

BOOTH 4-608

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Specially designed for military communications equipment subject to extreme temperature and humidity ranges. −55°C to +150°C...aridity to saturation.

Burton Browne Advertising

CTS

CHICAGO TELEPHONE SUPPLY *Corporation*

ELKHART • INDIANA

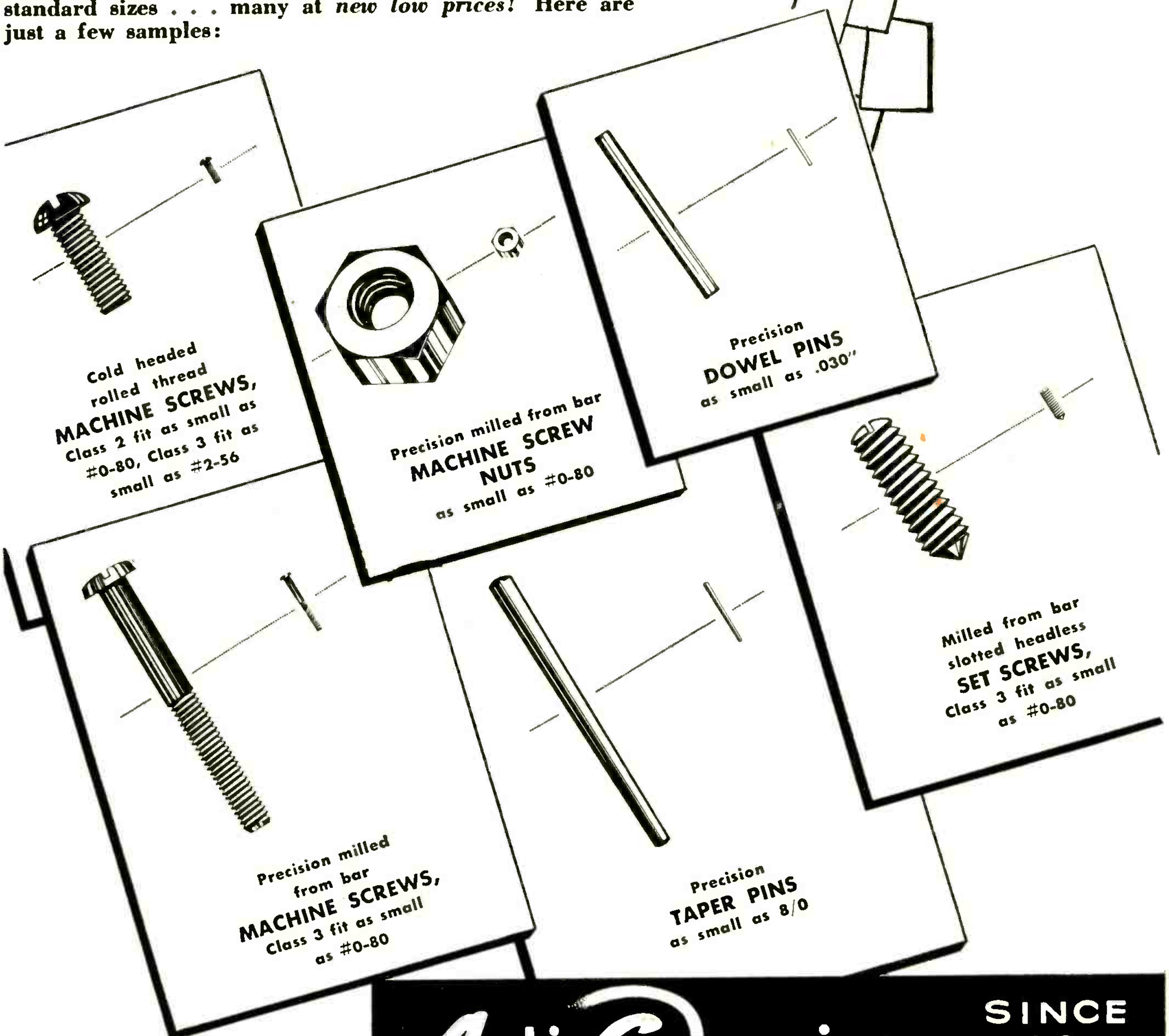
Precision Mass Production of Variable Resistors

in a HURRY . . . for precision

STAINLESS STEEL FASTENINGS

in large or small quantities?

Greatly expanded production capacity PLUS a tremendous inventory of IN STOCK items gives you quick-to-IMMEDIATE DELIVERY in chrome-nickel stainless steel fastenings of all standard sizes . . . many at *new low prices!* Here are just a few samples:



Thousands of other items and sizes **IN STOCK** . . . write, call or wire TODAY for full information . . . ask for Catalog 52Z.

Anti-Corrosive Metal Products Co., Inc.

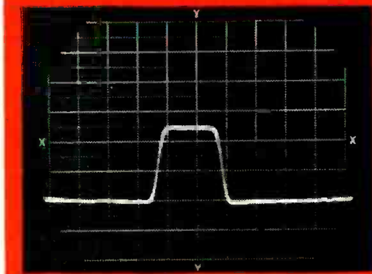
SINCE 1927

Manufacturers of STAINLESS STEEL FASTENINGS

CASTLETON-ON-HUDSON, NEW YORK

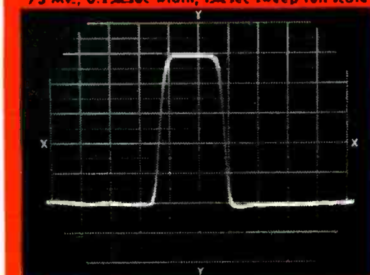
ONLY THE LFE 401 OSCILLOSCOPE

Offers all these Important Features

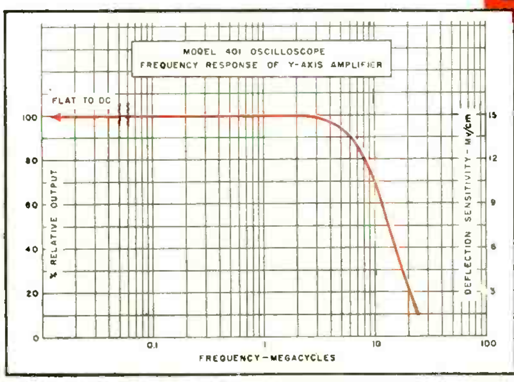


37.5 Mv., 0.2 μ sec width, 1 μ sec sweep full scale

75 Mv., 0.2 μ sec width, 1 μ sec sweep full scale



LINEARITY OF VERTICAL DEFLECTION The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection without serious compression; at 3 inches, the compression is approximately 15%. The accompanying photographs illustrate transient response and linearity of deflection.



HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER The vertical amplifier of the 401 has been designed to provide uniform response and high sensitivity *from D-C.* The accompanying amplifier response curve shows the output down 3 db. at 10 Mc. and 12 db. at 20 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time. Coupled with this wide band characteristic is a high deflection sensitivity of 15 Mv./cm. peak to peak, D-C and A-C.

SWEEP DELAY The accurately calibrated delay of the 401 provides means for measuring pulse widths, time intervals between pulses, accurately calibrating sweeps and other useful applications wherein accurate time measurements are required.

The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

SPECIFICATIONS

Y-Axis

Deflection Sens.—15 Mv./cm, peak-to-peak.

Frequency Response—DC to 10 Mc

Signal Delay—0.25 μ sec

Input line terminations—52, 72 or 93 ohms, or no termination

Input Imp.—Direct—1 megohm, 30 $\mu\mu$f
Probe—10 megohms, 10 $\mu\mu$f

X-Axis

Sweep Range—0.01 sec/cm to 0.1 μ sec/cm

Delay Sweep Range—5-5000 μ sec in three adjustable ranges.

Triggers—Internal or External, + and −, trigger generator, or 60 cycles, or undelayed or delayed triggers may be used.

Built-in trigger generator with repetition rate from 500-5000 cps.

General

Low Capacity probe

Functionally colored control knobs

Folding stand for better viewing

Adjustable scale lighting

Facilities for mounting cameras

PRICE: $895.00

Additional Features:

TRIGGER GENERATOR with variable repetition rate from 500 to 5000 cps.

POSITIVE & NEGATIVE UNDELAYED TRIGGERS and a **POSITIVE DELAYED TRIGGER** are externally available.

An **INPUT TERMINATION SWITCH** for terminating transmission lines at the oscilloscope.

A **FOLDING STAND** for convenient viewing.

FUNCTIONALLY COLORED KNOBS for easier location of controls.

Designed and built *for* electronic engineers, the 401, with its high gain and wide band characteristics, and its versatility, satisfies the ever-increasing requirements of the rapidly growing electronics industry for the ideal medium priced oscilloscope.

Write for Complete Information

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

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • MICROWAVE OSCILLATORS • MERCURY DELAY LINES

Our most eloquent salesman can't talk

BUT HE CAN SELL. In fact, every prospect who meets him becomes a customer. Every one.

For "he" is the Karp plant itself. And if you saw him, you'd know why he's a successful salesman.

It begins with our engineering department where your designs are detailed for sheet metal production. It continues through tooling where our vast assortment of available dies often eliminates the need for new tooling . . . where our toolmakers create special tooling when needed.

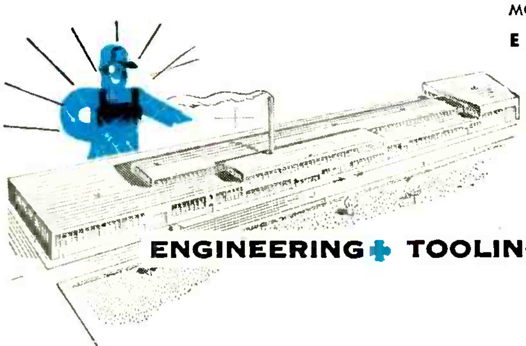
Then to actual fabrication, where skilled craftsmen process every job, whether large or small, with equal care — and use the finest of metal-working equipment to do it.

You'd see all of these things and much, much more as you travel through our plant ranging three city blocks.

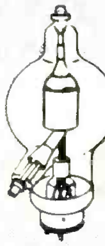
At the risk of becoming dissatisfied with your present sheet metal fabrications, you're invited to tour the Karp plant — any time. Meanwhile, write for a copy of our data book.

KARP METAL PRODUCTS CO., INC. • 215 63RD ST., BROOKLYN 20, N. Y.

MOST COMPLETE FACILITIES FOR LARGE AND SMALL RUNS OF
ENGINEERED SHEET METAL FABRICATION

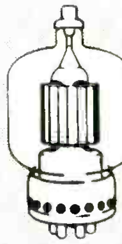


ENGINEERING + TOOLING + PRODUCTION + FINISHING = KARP



TRIODES

2C39A
3W5000A3
3W5000F3
3W10000A3
3X2500A3
3X2500F3
3X3000A1
3X3000F1
6C21
25T
35T
35TG
75TH
75TL
100TH
100TL
152TH
152TL
250TH
250TL
304TH
304TL
450TH
450TL
592/3-200A3
750TL
1000T
1500T
2000T

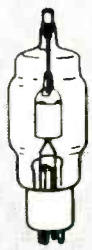


TETRODES

4-65A
4-125A
4-250A
4-400A
4-1000A
4PR60A
4W20000A
4X150A
4X150D
4X150G
4X500A
4X500F

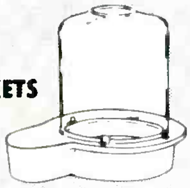
PENTODE

4E27A/5-125B



RECTIFIERS

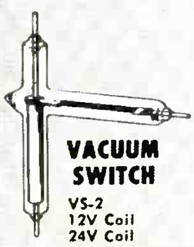
2-01C
2-25A
2-50A
2-150D
2-240A
2-2000A
KY21A
RX21A
250R
253
866A
872A
8020 (100R)



AIR SYSTEM SOCKETS

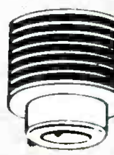
4-400A/4000
4-400A/4006*
4-1000A/4000
4-1000A/4006*
4X150A/4000
4X150A/4006*

*Replacement Chimneys



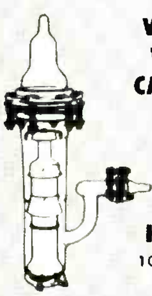
VACUUM SWITCH

VS-2
12V Coil
24V Coil



ACCESSORIES

HR Heat dissipating connectors
Preformed Contact Finger Stock



VACUUM PUMP

HV-1
OIL
DIFFUSION
PUMP

Type A
Pump Oil
HV-1
Pump Parts

VARIABLE VACUUM CAPACITORS

VVC60-20
VVC2-60-20
VVC4-60-20

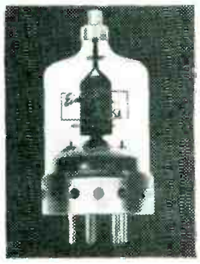
ION GAUGE

100 IG ion gauge

VACUUM CAPACITORS

VC6-20
VC6-32
VC12-20
VC12-32
VC25-20
VC25-32
VC50-20
VC50-32

follow the leaders to EIMAC TUBES!

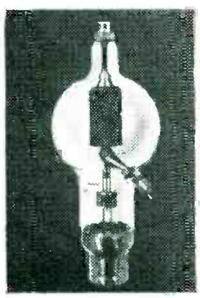


4-125A

The radial-beam power tetrode that made transmitting screen-grid tubes popular. This tube will take a plate input of 500 watts for CW or 380 watts for fone. Driving power is less than two watts. A pair of these tetrodes make an ideal high power fone or CW final for the amateur.

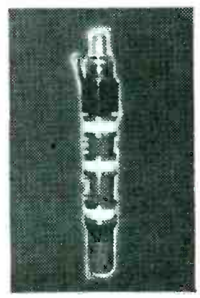
4X150A

This small external anode radial-beam power tetrode operates efficiently at all frequencies into the UHF range with a driving power of only a few watts. Its small size and ruggedness make it ideal for compact equipment such as mobile.



450T

Often referred to as the workhorse of modern communication systems, this dependable triode has a plate dissipation rating of 450 watts. It is widely used as an amplifier, oscillator or modulator.



3K20000L (A-F-K)

These Klystrons, the latest development in UHF television transmitting, have a power output of 5000 watts. The three versions of the Klystron will cover the entire UHF range —470-890 mc. These water and air cooled Klystrons have a power gain of 20 db.

VVC60-20

This is but one type in the Eimac line of variable and fixed vacuum capacitors for plate tank circuits. It is variable over a range of 10 mmfd to 60 mmfd. Maximum rf voltage is 20 kv. at 40 amperes.

2C39A

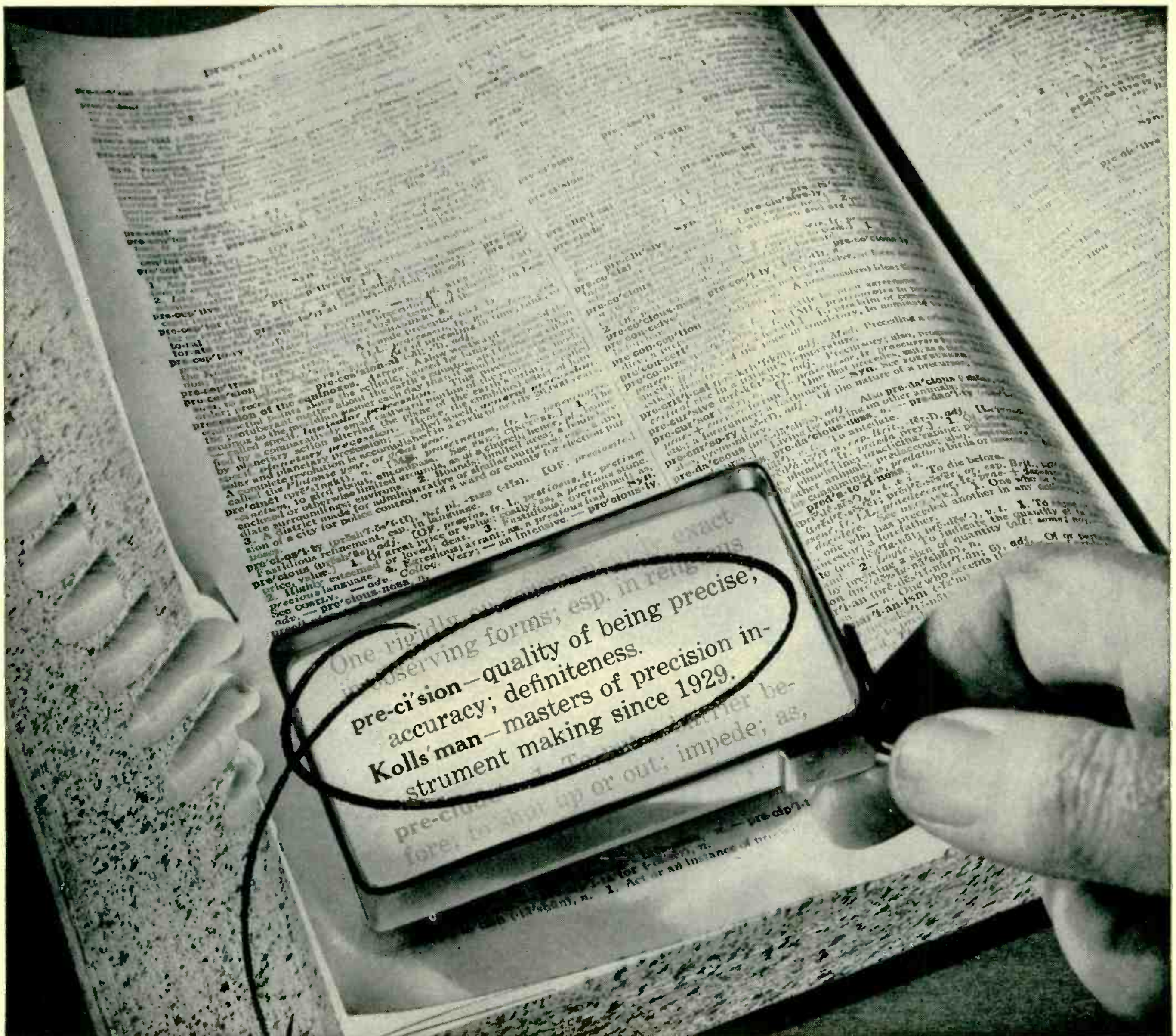
This small, rugged triode is designed for use as a power amplifier, oscillator or frequency multiplier to frequencies above 2500 mc. It is particularly suitable for compact fixed or mobile equipment.

Eimac TUBES

● Complete technical data available on request.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

EXPORT AGENTS: FRAZAR & HANSEN • 301 CLAY STREET • SAN FRANCISCO 11, CALIFORNIA



Synonyms

THE KOLLSMAN INSTRUMENT CORPORATION—designers, developers and manufacturers of precise, dependable instruments in the fields of:

Aircraft Instruments and Controls • • Miniature AC Motors for Indicating and Remote Control Applications • • Optical Parts and Optical Devices • • Radio Communications and Navigation Equipment

While current facilities of our laboratories and plants are geared to production for National Defense, the planning divisions of Kollsman are ever active. And versatile Kollsman research engineers stand ready to assist America's scientists in the solution of instrumentation and control problems.

KOLLSMAN INSTRUMENTS

KOLLSMAN INSTRUMENT CORPORATION

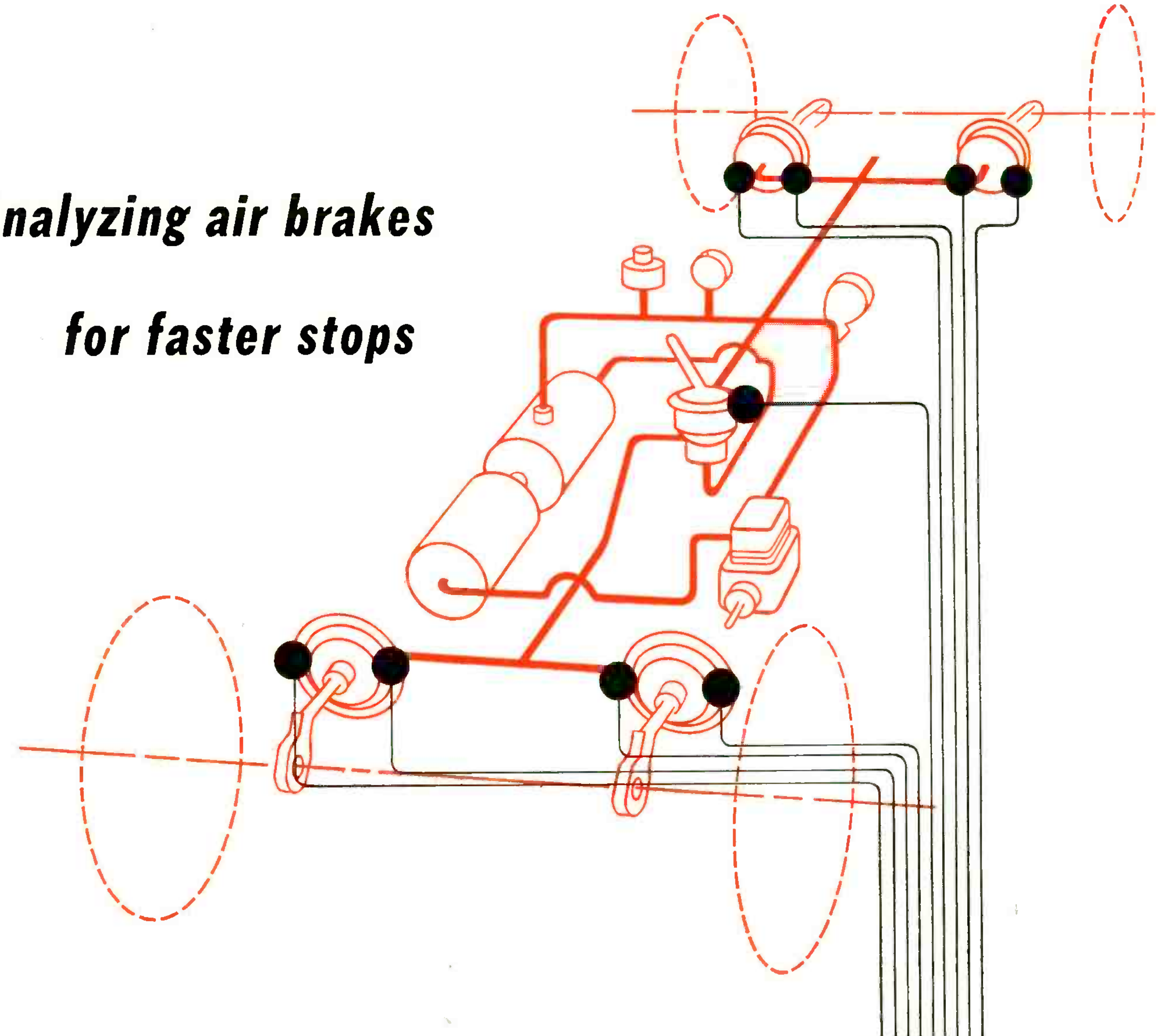
ELMHURST, NEW YORK GLENDALE, CALIFORNIA

SUBSIDIARY OF

Standard COIL PRODUCTS CO. INC.

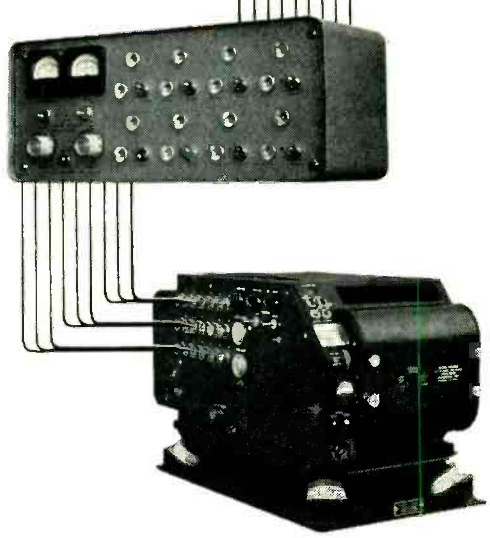
Want more information? Use post card on last page.

Analyzing air brakes for faster stops



How LONG does it take pressure to build up to required levels at the brake chambers after the driver applies the brake pedal? To answer this all-important question of "air-transmission" time, Bendix-Westinghouse Automotive Air Brake Company assembles on a test stand a complete counterpart of the brake system which is to be installed in a truck, truck-tractor, or bus. All components and air lines are the same as those to be used on the vehicle.

Pressure pickups are used at various critical points in the system, and a mechanical foot is used to depress the brake pedal. A Consolidated Recording Oscillograph records the time that the pedal starts downward and the rate at which pressure builds up at the brake chambers. At maximum pressure, the brake pedal is released and the rate of pressure drop recorded. A full report on the air-transmission time of the system based on this accurate analysis is furnished the vehicle manufacturer.



Consolidated Engineering
CORPORATION
300 North Sierra Madre Villa, Pasadena 8, 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

Dynamic Recording Systems

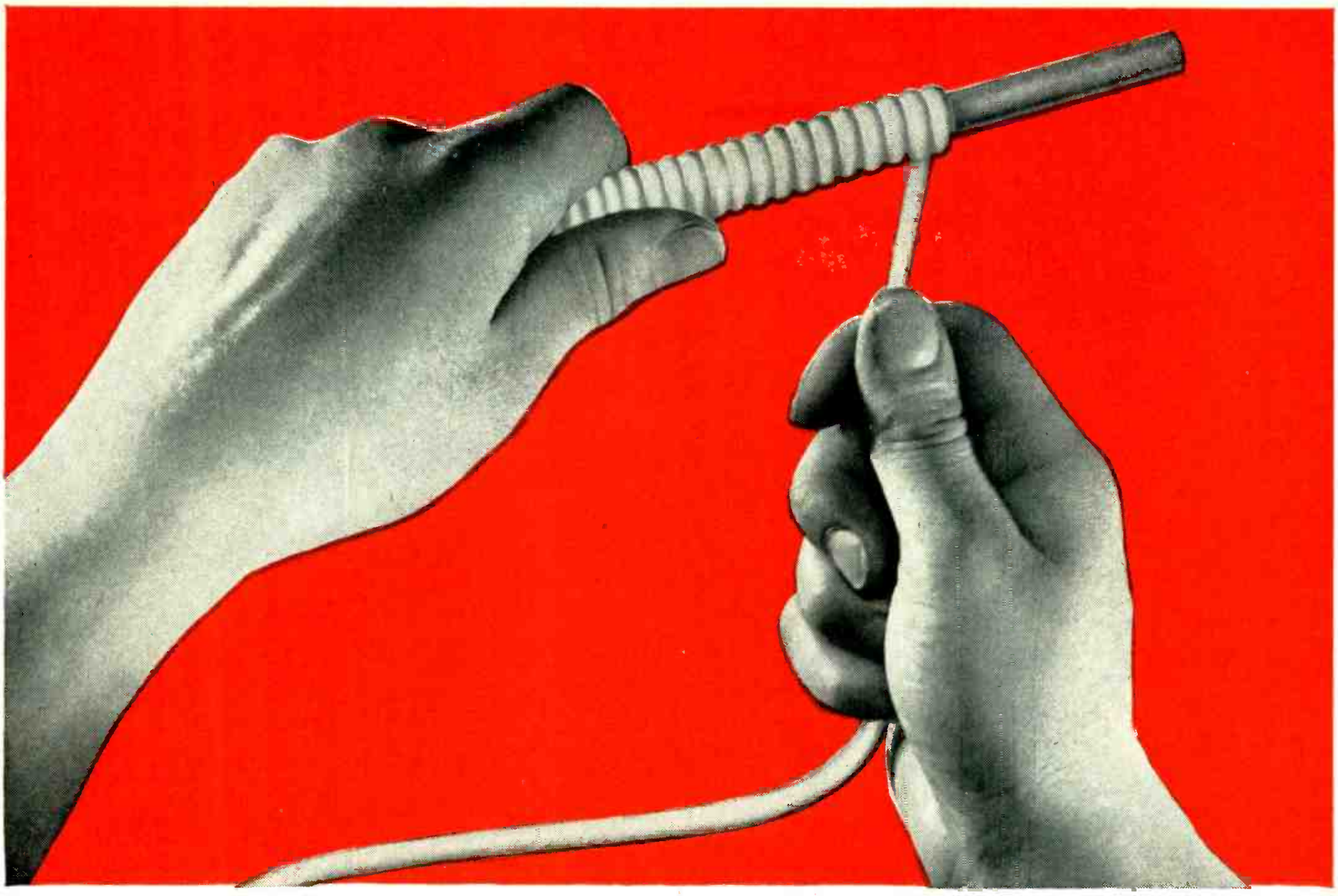
. . . like the one shown here are designed and manufactured by Consolidated. Variations in the arrangement of the equipment are infinite. Applications are widely varied throughout industry and the sciences. A typical recording system includes pickups, amplifiers or bridge balances, and a recording oscillograph. Write for Bulletin CEC 1500B.

THE STORY OF THE BIG I.R.E. SHOW

and THE BIG ISSUE OF ELECTRONICS

The March I.R.E. Show has become the accepted focal point of interest for everyone concerned with any aspect of electronics — engineering or sales. It is the highlight of the year that brings out in the open the equipment, components and materials of tomorrow and, as such, has always attracted one of the largest audiences of any technical show. The March issue of ELECTRONICS has, through the years, been the preferred medium through which manufacturers have apprised individual customers and prospects of their participation in this show or as a "Show in Print" if they are not exhibiting. Proof of that is shown on the next page.

Want more information? Use post card on last page.



Now . . . an extremely flexible high-temperature tubing . . .
IRVINGTON Silicone Rubber-Coated Fiberglas*

If you need a *flexible* insulating tubing that meets Class "H" specifications—and particularly if you need it *now*—look into this new Irvington product!

With the introduction of Silicone *Rubber*-Coated Fiberglas Tubing, Irvington offers to the electrical industry a product that, like the resin-coated type, meets all NEMA Class "H" requirements. In addition, this new tubing has the advantage of extreme flexibility. Its white color is a plus wherever appearance is a factor.

AND . . . Irvington Silicone Rubber-Coated Fiberglas Tubing is available for immediate delivery!

Get the full story—just mail the coupon for technical data sheet.

Look to
IRVINGTON
for Insulation Leadership
INSULATING VARNISHES
VARNISHED CAMBRIC
VARNISHED PAPER
VARNISHED FIBERGLAS
INSULATING TUBING
CLASS "H" INSULATION

*T.M. Reg. U. S. Pat. Off. by Owens-Corning Fiberglas Corp.

Send this convenient coupon now

Irvington
VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey

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

Irvington Varnish & Insulator Co. EL-2-53
11 Argyle Terrace, Irvington 11, N. J.

Gentlemen:
Please send me technical data sheet on Irvington Silicone Rubber-Coated Fiberglas Insulating Tubing.

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

Want more information? Use post card on last page

ELECTRONIC TEST

New *Multi-purpose*

New!

-hp- 612A — VERSATILE, DIRECT READING. FOR UHF-TV, OTHER WORK 450 TO 1,200 mc

This master oscillator-power amplifier generator is especially designed for UHF-TV measurements including receiver and amplifier gain, selectivity, sensitivity and image rejection. It is also a convenient, direct-reading laboratory power source for driving bridges, slotted lines, antennas and filter networks. Both frequency and output are directly set on large, precisely calibrated dials. No charts or interpolation are required.

Model 612A has a maximum output of 0.5 volts into 50 ohms over its entire frequency range. The instrument also has low incidental fm and broad band modulation up to 5 mc. It may be modulated internally or externally, amplitude modulated, or pulse modulated (good rf pulses 0.2 μsec or longer). Pulse modulation may be applied to the amplifier; or direct to the oscillator when high on-off signal ratios are required.

BRIEF SPECIFICATIONS

Frequency Range: 450 to 1,200 mc, 1 band.

Accuracy: Calibration $\pm$1%. Resettability better than 5 mc at high frequencies.

Output: 0.1 μv to 0.5 v continuously variable. Calibrated in volts and dbm. Impedance 50 ohms. Max. VSWR 1.2. Accuracy $\pm$1 db entire range.

Modulation: Amplitude: From 0 to 90% indicated by panel meter.

Envelope Distortion: 2% at 30% modulation.

Internal: Fixed modulation frequencies, 400 and 1,000 cps.

External: Any frequency 20 cps to 5 mc.

Pulse Requirements, External Modulation:

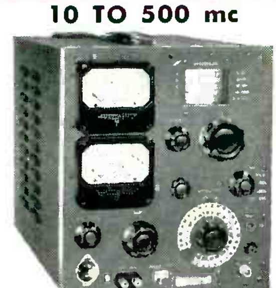
Pulse to Amplifier: Good pulse shape at 0.2 μsec length.

Pulse to Oscillator: 1.0 μsec minimum.

Size: Cabinet 12" x 14" x 18" deep.

Price: $1,200.00

10 TO 500 mc



-hp- 608A VHF Signal Generator provides output ranging from 0.1 μv to 1.0 v into 50 ohms. Accuracy is $\pm$1 db. Direct reading frequency and output calibration; no charts or interpolation required. Pulsed, cw or amplitude modulated output (50 cps to 1 mc). Resettability better than 1 mc. Has master oscillator-power amplifier for widest modulation capabilities. Constant internal impedance. Maximum VSWR 1.2. $850.00

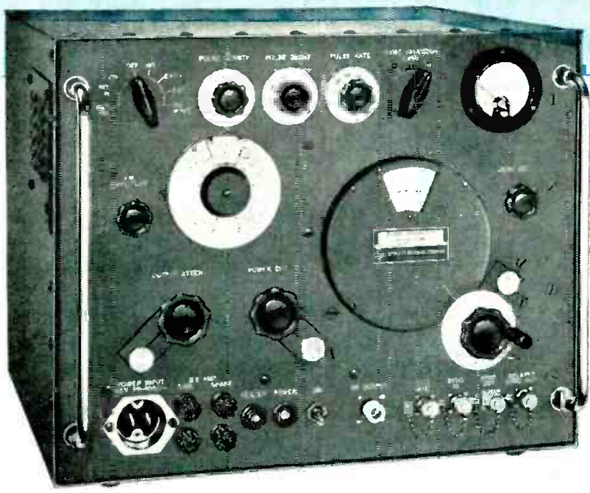
800 TO 2,100 mc

-hp- 614A UHF Signal Generator provides output ranging from 0.1 μv to 0.223 v (1 mw) into 50 ohms. Accuracy $\pm$1 db. Has single dial, direct reading frequency and output, no charts or interpolation. Offers cw, fm or pulsed output. Widely variable pulsing, synchronizing, delay and triggering features. Extremely fast rise/decay time of 0.1 μsec. Constant internal impedance. Maximum VSWR 1.6. $1,950.00

Complete Coverage HEWLETT-PACKARD

INSTRUMENTS

SIGNAL GENERATORS



New!

-hp- 618B — VARIED PULSING CAPABILITIES, DIRECT READING. RANGE 3,800 TO 7,600 mc

Model 618B offers faster, more accurate measurement of component performance in radar, radio relay and TV carrier systems and similar field and laboratory applications. Frequency is generated in a reflex klystron oscillator; accuracy and stability are high throughout the instrument's wide frequency range. Frequency and voltage are directly set and read. Dial tuning is tracked automatically, and no voltage adjustment is required during operation.

Extremely wide pulsing capabilities have been built into *-hp-* 618B. The instrument may be internally or externally pulse modulated, internally square wave modulated and frequency modulated. The repetition rate is continuously variable between 40 and 4,000 pps. Pulse width is variable 0.5 to 10 μsec. Sync-out signals are simultaneous with the rf pulse or in advance by any time-span from 3 to 300 μsec. The instrument also may be synchronized with an external sine wave, or with positive or negative pulse signals.

BRIEF SPECIFICATIONS

Frequency Range: 3,800 to 7,600 mc. 1 band.

Calibration: Direct. Accuracy better than 1%.

Stability: Frequency: less than 0.006% per °C change.
Line Variation: $\pm$10 v causes less than 0.01% frequency change.

Output: 1 mw/0.223 v to 0.1 μv into 52 ohms. (0 to −127 dbm).

Modulation: Internal or external pulse, fm, or internal square wave.

External Sync: (1) Sine wave 40 to 4,000 cps, 5 to 50 v rms.
(2) Pulse signals 40 to 4,000 pps, 5 to 50 v (pos. and neg.) Pulse width 0.5 to 5 μsec. Rise time 0.1 to 1.0 μsec.

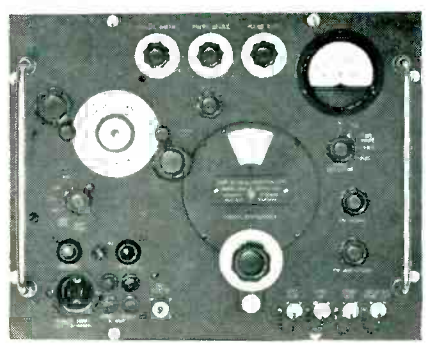
Size: Cabinet 16¾" x 13½" x 16" deep.

Price: $2,250.00

Data subject to change without notice. Prices f.o.b. factory.

1,800 TO 4,000 mc

-hp- 616A UHF Signal Generator offers the same simple operation, wide pulsing capabilities, high stability and accuracy as *-hp-* 618B, but is designed for UHF frequencies. Output ranges from 0.1 μv to 0.223 v (1 mw) into a 50-ohm load. Accuracy is $\pm$1 db. Output may be cw, fm or pulsed. Modulation and synchronizing features are similar with *-hp-* 618B. Oscillator section is a reflex klystron. Frequency changes are automatically tracked and no voltage adjustment is needed during operation. Frequency and output are directly set and read on large, carefully calibrated dials. No charts or interpolation are needed. $1,950.00

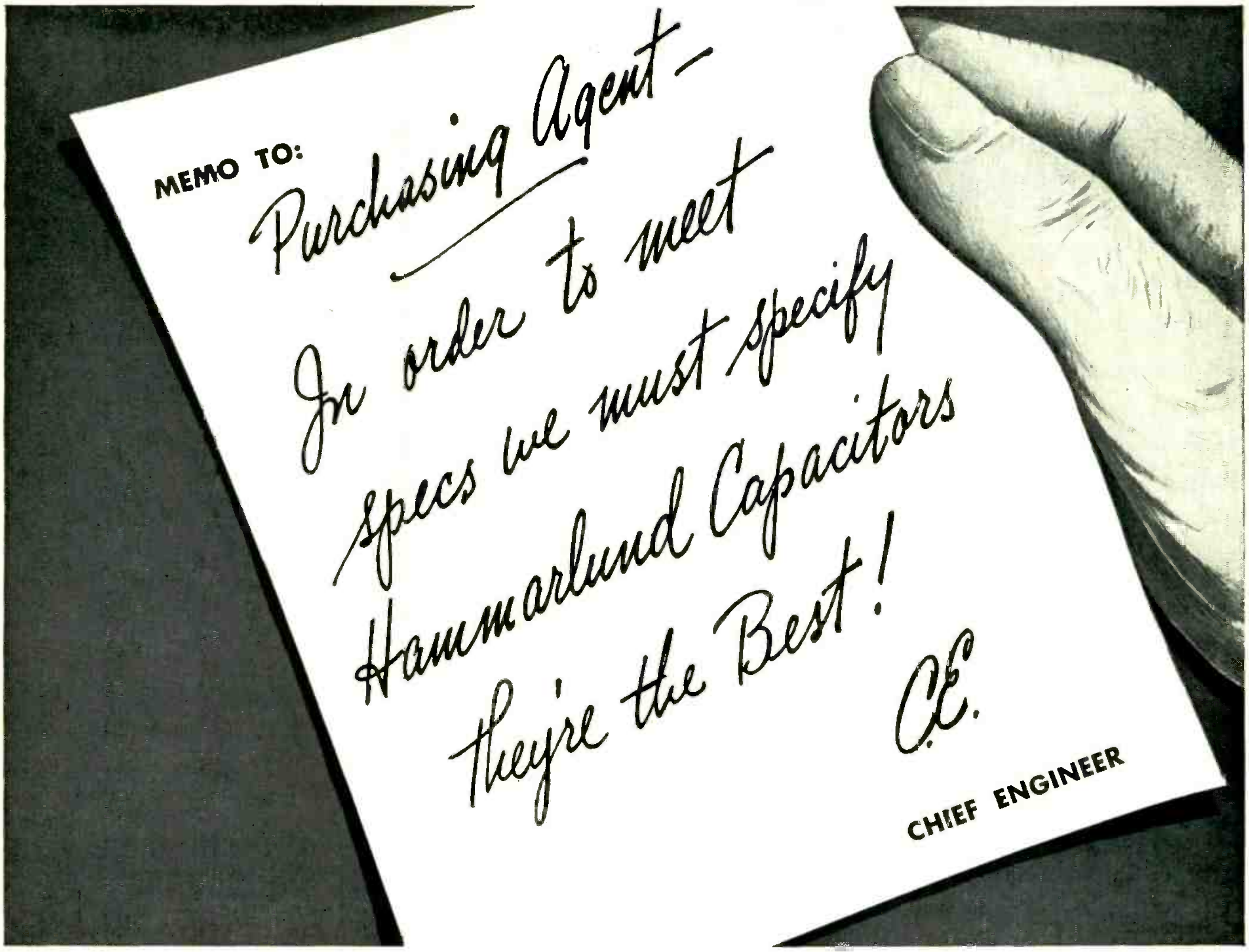


For complete details, see your -hp- field representative or write direct

HEWLETT-PACKARD COMPANY
2524A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U. S. A.
Export: FRAZAR & HANSEN, LTD., San Francisco • Los Angeles • New York

INSTRUMENTS ***Complete Coverage***

Want more information? Use post card on last page.

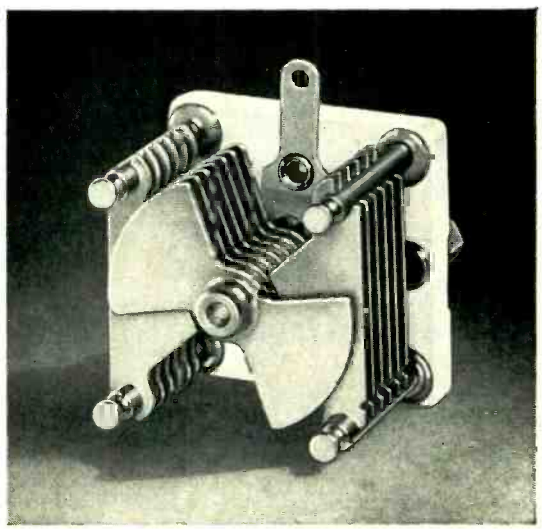


They've always been the best!

VARIABLE CAPACITORS

Hammarlund Capacitors, backed by 42 years of design, engineering and production experience, are today recognized by the military services, electronic manufacturers and research engineers, as the finest quality capacitors available. Millions of them are in use by almost every important manufacturer of electronic equipment.

See for yourself. Write today for the 1952 CAPACITOR CATALOG. It has the complete story.



HAMMARLUND

MORE THAN 40 YEARS EXPERIENCE COUNTS!

THE HAMMARLUND MANUFACTURING CO., INC.
460 WEST 34th STREET • NEW YORK 1, N. Y.

KOVAR* Glass Sealing Alloy

Western Electric
15 YEARS

SPERRY
12 YEARS

17 YEARS

RCA
17 YEARS

VARIAN associates
4 YEARS

The Most DEPENDABLE Proved by Experience

RAYTHEON
17 YEARS

Eimac TUBES
12 YEARS

Bomac
5 YEARS

MACHLETT
14 YEARS

WESTINGHOUSE
17 YEARS

6 YEARS

GE
17 YEARS

FEDERAL TELEPHONE & RADIO FTR
10 YEARS

Supplied by Stupakoff

in the form of: SHEET, ROD, WIRE, FOIL, TUBING, EYELETS, LEADS and FABRICATED SHAPES

The ideal alloy for glass sealing, Kovar matches the expansivity of certain hard glasses over the entire working temperature range. It resists mercury attack, has ample mechanical strength and seals readily with simple oxidation procedure. It is available as sheet, strip, foil, rod, tube, wire—or fabricated into cups, eyelets, leads and other shapes. The prominent users of KOVAR and the length of time they have employed this metal are convincing proof of satisfaction.

*Westinghouse Trade Mark No. 337,962

STUPAKOFF *Products for Electrical and Electronic Applications*

ASSEMBLIES—Metallized ceramic induction coils and shafts; metallized plates for fixed rigid assemblies; ceramic trimmer condensers.

CERAMICS—Precision-made ceramic products for electrical and electronic applications, all voltages, frequencies and temperatures.

RESISTOR CERAMICS—Used for temperature indicating or measuring equipment, for infra-red light source and for heating elements. Complete with terminals, in the form of rods, tubes, discs, bars, rings, etc.

CERAMIC DIELECTRICS—For by-pass, lead-through, blocking, stand-off and trimmer applications. Temperature compensating Ceramic Dielectrics and high K materials. Tubes, discs and special shapes, plain or silvered.

PRINTED CIRCUITS—Amplifiers, couplings, filters, integrators.

STUPALITH—Will withstand extreme thermal shock. May be made to have zero, low-positive or negative expansivities. Safely used at temperatures up to 2400° F.

SEALS, KOVAR-GLASS—Terminals, Lead-ins; Stand-offs—for hermetically sealing and mechanical construction in radio, television, electronic and electrical apparatus. Single or multiple terminal units, in a wide variety of sizes and ratings.

KOVAR METAL—The ideal alloy for sealing to hard glass. Used for making hermetic attachments. Available as rod, wire, sheet, foil—or as cups, eyelets and other shapes.

STUPAKOFF CERAMIC & MFG. CO., Latrobe, Pennsylvania

Want more information? Use post card on last page.

Precision-Built . . . *for dependable performance*

Whatever your requirements for top quality wire-wound components, you can count on I-T-E products. Power resistors, precision resistors, deflection yokes—all are specially designed and precision-built to meet the exacting standards demanded for critical electronic applications. Close quality control and modern production methods give you assurance of *quality* components in any quantity you need.

I-T-E POWER RESISTORS

Non-hygroscopic ceramic foundations are in accordance with JAN specifications.

Purest resistance wires are uniformly wound to prevent shorted turns and excessive hot spots. All connections silver-soldered.

Vitreous enamel coating (organic if required) provides a glazed moisture-repellent surface with fast heat-dissipation qualities.

Advanced production methods assure high stability, long life.

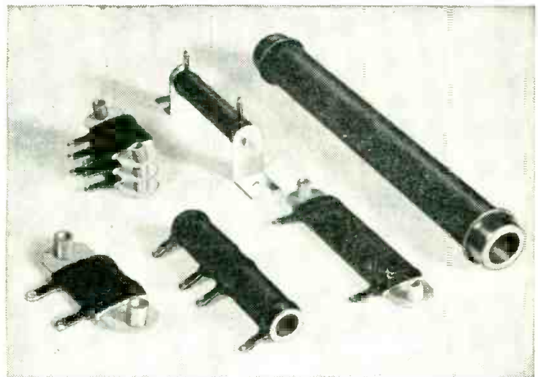
Standard fixed resistors:
5-200 watts

Adjustable resistors:
10-200 watts

Oval resistors:
30-75 watts

Ferrule resistors:
12-200 watts

Special resistors:
built to specifications



Standard Tolerance: ±10%. ±5% *and less* made to order.

I-T-E PRECISION RESISTORS

High-quality wire alloys are used—free from internal stresses and strains.

Automatic precision winding assures even tension—eliminates hot spots.

Hermetic or vacuum-impregnated sealing protects against destructive effects of salts, moisture, and atmospheric conditions.

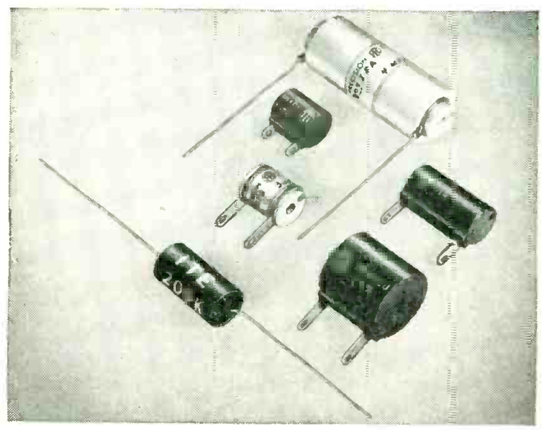
Accelerated aging process prior to calibration assures accuracy.

Critical quality control eliminates all resistors which do not come up to high I-T-E standards.

TYPE A:
lightweight, hermetically sealed—for precision operation up to 125° C. Surpass JAN R-93 A, *Characteristic A,* and MIL R-93 A specifications.

TYPE B:
vacuum-impregnated, moisture-resistant. For JAN R-93, *Characteristic B,* specifications.

Ratings from 0.01 ohm-10 megohms, 0.125-5 watts.



Standard Tolerance:
±1%. Available in specified tolerances down to ±0.05%.

I-T-E DEFLECTION YOKES

Wire size and quality constantly checked. Coils impregnated in special moisture-resistant thermoplastic—properly cured to assure firm coil with minimum losses. Yokes can be obtained complete with wire leads, resistors, and capacitors to your specifications.

WRITE FOR DETAILS

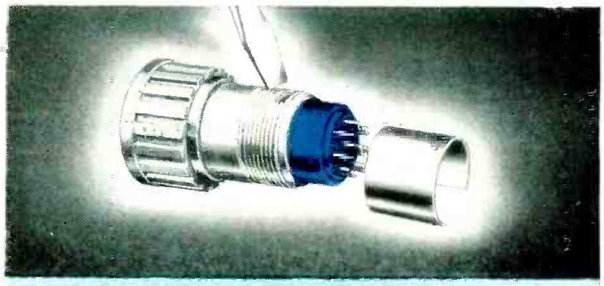
WIRE-WOUND PRODUCTS

I-T-E RESISTOR DIVISION

1924 Hamilton St., Phila. 30, Pa. • A division of the I-T-E Circuit Breaker Co.

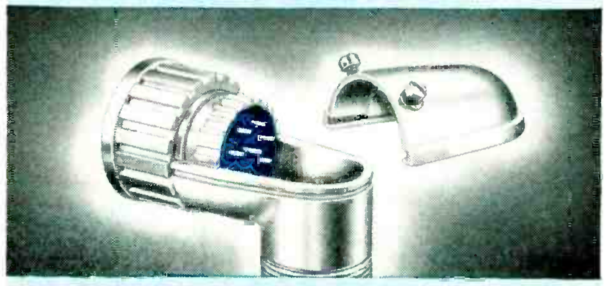
Prove to yourself...

These are better AN connectors--and at competitive prices



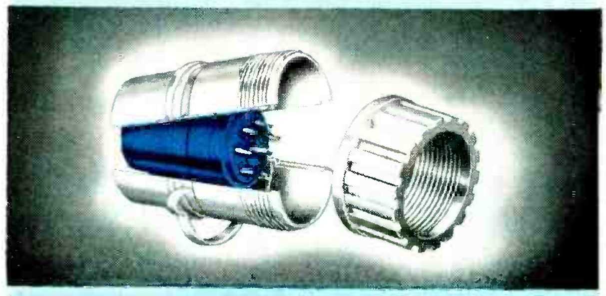
AN Solid Shell Connector

BETTER . . . because its snap-in retaining sleeve connot work loose, yet can be released quickly with a screw driver and the insert removed for inspection or soldering.



AN Split-Shell 90° Angle Plug

BETTER . . . because top can be removed to inspect wiring without unmoting or disassembling plug from conduit or cable. Conduit thread is not split. Split-shell ease of wiring is combined with advantages of solid shell construction.



AN Split-Shell Straight Plug

BETTER . . . because Monowatt engineers have succeeded in reducing number of metal parts and weight, while improving connector performance. This type is preferred where assembly must be made in tight places.

BETTER . . .

. . . Because Monowatt *AN* Connectors have *all* these features:

- ***Moisture-proof seal.*** Two-piece inserts are joined with a silicone sealing compound. Moisture and condensation effectively excluded . . . parts held together while inserts are soldered to cable assemblies.
- ***Diallyl Phthalate insert material*** (blue) used in all connectors. Negligible post-mold shrinkage . . . superior dielectric properties.
- ***Fewer parts and simpler design*** make installation and inspection easy.
- ***Cadmium-plated housings*** resist corrosion.
- ***Tellurium copper pins,*** heavily silver-plated, insure greater conductivity . . . 99% that of copper.
- ***Available in complete wiring harness or cable assemblies.*** Made by Monowatt to your specifications.

PRICED RIGHT . . .

. . . Because the Monowatt Department of General Electric has complete modern facilities for mass-production, these features are offered at competitive prices.

THE PROOF STARTS WITH THE QUOTATION

. . . *Prove to yourself* that Monowatt *AN* Connectors at competitive prices bring you extras—extras which save assembly time and insure a superior connecting job.

Send your specifications with this coupon. In return you'll receive a catalog describing the unique cost-saving features of Monowatt electrical connectors and wiring assemblies for aircraft, ordnance and electronic equipment — plus — quotations on your specific requirements. If you wish, a representative will call with sample connectors . . . all without cost or obligation.

MAIL COUPON AND YOUR SPECIFICATIONS TODAY.

Monowatt Department G11, General Electric Company
95 Hathaway St., Providence 7, R. I.

☐ Please quote on the attached specifications and send catalog.
☐ Please quote on the attached specifications and have your representative call with sample connectors.
☐ Please send catalog only.

I understand neither the quotation, catalog nor call obligates me in any way.

Name ....
Title ....
Firm ....
Street ....
City .... **Zone** .... **State** ....

MONOWATT

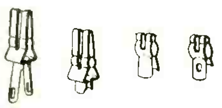
A DEPARTMENT OF GENERAL ELECTRIC COMPANY, PROVIDENCE 7, R. I.

Want more information? Use post card on last page.

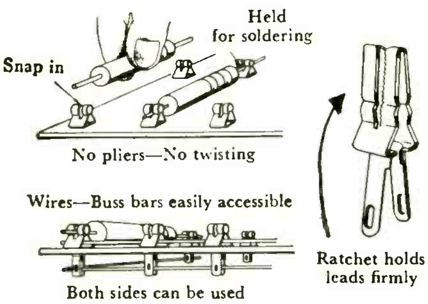
Here is Plug-in Unit Construction

Everything you need to mount, house, fasten, connect, monitor your equipment.

ALDEN MINIATURE TERMINALS

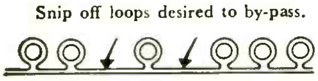


Here's a beautiful new little Terminal that really puts soldering on a production basis; taking a minimum of space and material. Ratchet holds leads firmly for soldering, no wrap-around or pliering necessary. Unique punch press configuration gives rapid heat transfer, taking less time and solder. Designed for Govt. Miniaturization contracts. Staked in Alden Prepunched Terminal Cards, allow patterns for any circuit.



Snip off loops desired to by-pass.

JUMPER STRIP

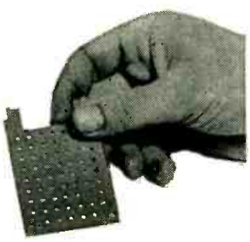


Stake under Terminals for common circuits. Loops match prepunched holes in Terminal Cards. Snip off loops desired to by-pass.

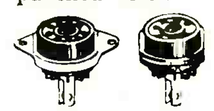
FOR YOUR SMALLER UNITS .

1st Take Pre-punched Terminal Mounting Card ready-cut to size you require. Stake in Alden Miniature Terminals to mount your circuitry.

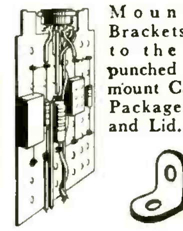
Prepunched Terminal Mounting Cards come in all sizes needed for Packages: miniature 7-pin and 9-pin units, or 11-pin and 20-pin plug-in units. Card is natural phenolic 1/16" thick prepunched on 1/4" centers with .101" holes for taking the Miniature Terminals.



2nd Attach Alden Card-mounting Tube Sockets and Mounting Brackets, which mount in the prepunched holes.



Alden Card-mounting Tube Sockets for miniature 7, miniature 9 and octal tubes, are complete with studs and eyelets for easy mounting on Prepunched Cards.



Mounting Brackets stake to the Prepunched Card, mount Card to Package Base and Lid.

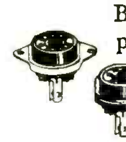
FOR YOUR LARGER UNITS .

1st Lay out circuitry with Prepunched Terminal Mounting Card in lengths up to 3'.

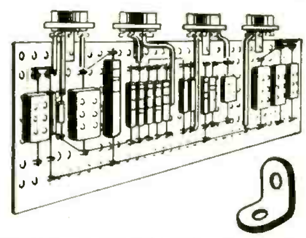
READY MADE to fit various ready made Chassis sizes.

Organize circuitry in compact vertical planes. Use both sides of Prepunched Card to stake in Alden Miniature Terminals to your circuitry layout. Vertical position gives ready accessibility; there is no "underneath" in Alden design.

2nd Attach Alden Card-mounting Tube Sockets and Mounting Brackets, which fit any of the prepunched holes.



Alden Card-mounting Tube Sockets, ready-made in variety of sizes, complete with studs and eyelets for easy mounting on Prepunched Cards.



TO OBTAIN COMPLETE DETAILS .

Tiny Sensing Elements specifically designed to spot trouble instantly in any unit.

Here are tiny components to isolate trouble instantly by providing visual tell-tales for each unit.

"PAN-i-LITE" MIN. INDICATOR LIGHT

So compact you can use it in places never before possible. Glows like a red-hot poker. Push-mounts in .348" drill hole. Bulbs replace from front. Tiny spares are unbreakable, easily kept available, taped in recess of equipment. Alden #86L, ruby, sapphire, pearl, emerald.

MINIATURE TEST POINT JACK

Here are tiny insulated Test Point Jacks that make possible checking critical plate or circuit voltages from the front of your equipment panel—without pulling out equipment or digging into the chassis. Takes a minimum of space, has low capacitance to ground, long life beryllium copper contacts. Available in black, red, blue, green, tan and brown phenolic conforming to MIL-P 14B- CGF; also nylon in black, red, orange, blue, yellow, white, green. Alden #110BCS.

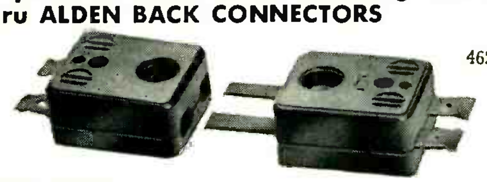
ALDEN "FUSE-LITE"

Fuse Blows — Lite Glows.

Signals immediately blown fuse. Lite visible from any angle. To replace fuse simply unscrew the 1-pc. Lite-lens unit. Mounts easily by standard production techniques, in absolute minimum of space. 110V Alden #440-4FH. 28V #440-6FH.

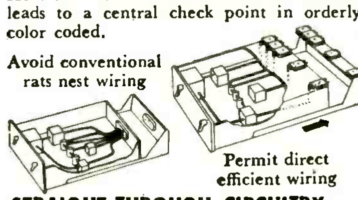
Free Samples Sent Upon Request

Get one point of check of all incoming and outgoing leads thru ALDEN BACK CONNECTORS



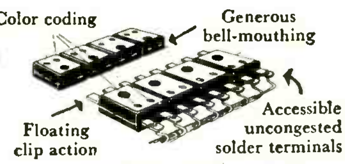
SINGLE CHECK POINT

Here for the first time is a slide-in connector that brings all incoming and outgoing leads to a central check point in orderly rows, every lead equally accessible and color coded.



STRAIGHT-THROUGH CIRCUITRY

Wiring is kept in orderly planes, avoiding rat's nest of conventional back plate wiring. Connections between Terminal Mounting Cards are through Back Connectors so that all circuitry is controlled at this central point. Incompatible voltages safely isolated and separated.



EASY INSERTION AND REMOVAL

Mating tolerances permit easy insertion and removal without demanding critical alignment tolerances. Assure proper contact, with safety shielding of dangerous voltages. Leads can be attached above, below or out of the back for most direct and efficient interconnects.

Ready-made Alden Back Connectors meet all conceivable needs, for slide-in chassis replaceable in 30 seconds with spare.

VISIT OUR COMPLETE DISPLAY AT THE I.R.E. SHOW

NA-ALD **ALDEN PRODUCTS COMPANY**

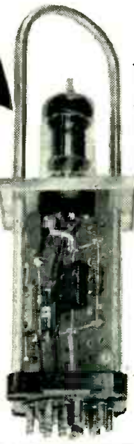
READY-MADE for your Electronic Equipment

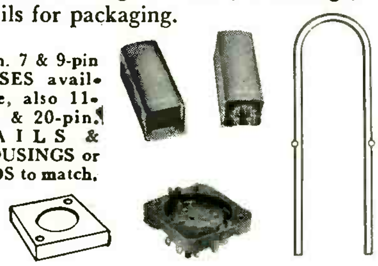
All designed — all tooled — production immediately available — no procurement problems. *Apply ALDEN Standards wholly or in part.*

ALDEN PLUG-IN PACKAGES

3rd After mounting your circuits on Terminal Cards, use Alden Standard Plug-in Bases, Housings, Bails for packaging.

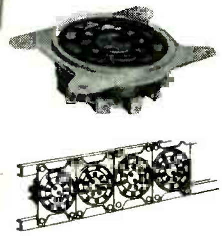
Min. 7 & 9-pin BASES available, also 11-pin & 20-pin. BAILS & HOUSINGS or LIDS to match.





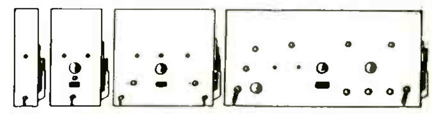
ALDEN PLUG-IN PACKAGES

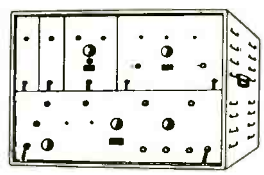
Using standard Alden Plug-in Packaging Components you can mount a tremendous variety of circuits on chassis or in racks.



Alden "20" Rack Mounting Socket with extended ears that mount side by side and in multiple rows on U-Channels that accommodate 50 Alden "20" Plug-in Units illustrated, in 10½ x 19" rack mounting panel.

HOUSE PLUG-IN UNITS IN ALDEN BASIC UNI-RACKS

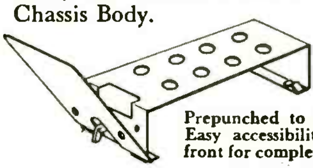




FOUR SIZES OF CHASSIS MOUNT IN ANY COMBINATION IN ALDEN UNI-RACKS

ALDEN BASIC CHASSIS

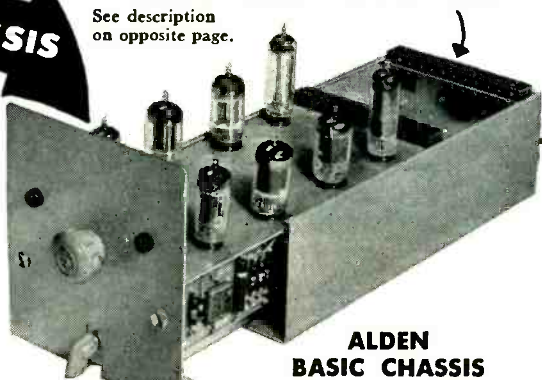
3rd Fit Prepunched Cards carrying completed circuitry into Standard Alden Basic Chassis Body.



Prepunched to your specs. Easy accessibility at sides, front for completing wiring.

SERV-A-UNIT LOCK
pulls in or ejects chassis.

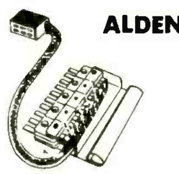
SLIDE-IN BACK CONNECTORS
See description on opposite page.



ALDEN BASIC CHASSIS
with spares provides 30-second servicing for your unitized circuitry.

STACKED
Mounting all equipment in Alden Uni-Racks provides a uniform system easy to handle and ship. Can be installed and interconnected as fast as unloaded.

ALDEN UNIT CABLE



interconnects between Uni-racks or other major circuitry divisions. Quick, sure, coded means of isolating and restoring (with spare) inter-division circuits.

SEND FOR FREE "ALDEN HANDBOOK"

Your design and production men have always wanted these advantages:

1. Experimental circuitry can be set up with production components, cutting down debugging time.
2. Allows technicians, rather than engineer, to debug, by taking out unit.
3. Given the circuitry, nothing further to design—make up from standard Alden components.
4. Optimum circuit layout using standard terminal card.
5. Absolute minimum requirements of labor, materials, space.
6. The various sub-assemblies can be built concurrently on separate assembly lines.
7. No tooling costs—no delays—no procurement headaches.
8. Fewer prints—smaller parts inventory.
9. Can subcontract assemblies.

Your customers and sales force will welcome these advantages:

The big objection to electronic equipment—from the user's point of view—is that if it goes out of order he feels helpless. But you have a perfect answer when your equipment is made to Alden Standards of Plug-in Unit Construction because they assure DEPENDABLE OPERATION, as follows—

30-SECOND REPLACEMENT OF INOPERATIVE UNITS by plugging in available coded spares.

TROUBLE INSTANTLY INDICATED AND LOCATED by monitoring elements assigned to each functional unit.

TECHNICAL PERSONNEL NOT REQUIRED to maintain in operation, due to obvious color coding and fool-proof non-interchangeability of mating components.

TOOLESS MAINTENANCE made possible by patented Alden fasteners and plug-in locking and ejecting devices.

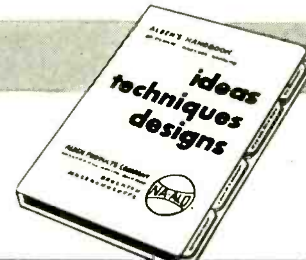
AIRMAIL SERVICE—
Compact functional units practical to send airmail to factory for needed overhaul.

UNI-RACK FIELD HANDLING UNIT—groups functional units into stacking cabinets not exceeding one- or two-man handling capacity—go easily through windows, doors.

CONNECT AS FAST AS UNLOADED, by coded non-interchangeable unit cables plugged in between Uni-racks.

SEND FOR FREE 226-PAGE HANDBOOK

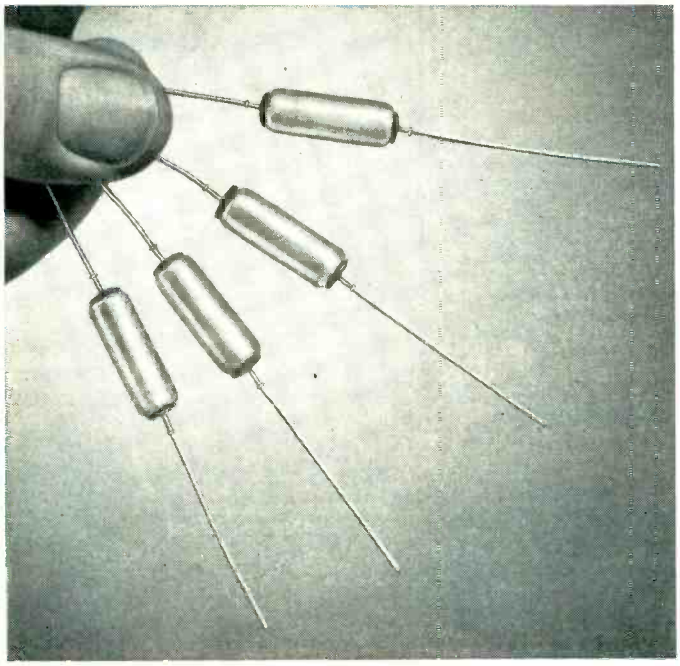
This 226-page Handbook describes fully the Alden System of Plug-in Unit Construction and the hundreds of components ready-made and completely tooled to meet your every requirement. It's a gold-mine for those designing electronic control equipment that is practical in manufacture; dependable in operation.



REQUEST YOUR COPY TODAY — SENT FREE!

127 North Main Street • Brockton 64 • Massachusetts NA-ALD

DESIGNER'S



Miniaturize your product with Tantalytic* capacitors

On low-voltage d-c applications, where your equipment miniaturization calls for both small size and superior performance, General Electric Tantalytic capacitors offer a host of advantages. These foil-type, tantalum-electrode, electrolytic capacitors have greater capacitance per unit volume and far longer shelf life than aluminum-electrolytic types. Long operating life, too, is provided by their inherently inert characteristics, and the use of non-corrosive, chemically neutral electrolyte. And leakage current is low—less than 10 microamps per microfarad.

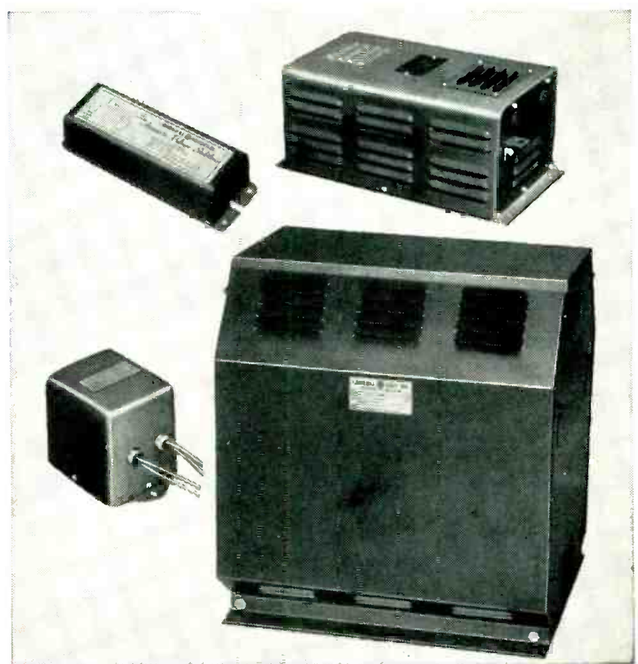
Built to withstand severe shock, these lightweight units operate over a wide temperature range (−55 C to +85 C and higher). Hermetic sealing protects them against leakage and contamination. Available in polar and non-polar construction, in ratings from 175 muf at 5 volts d-c to 12 muf at 150 volts d-c. For complete description of the line, plus application information, check Bulletins GEC-808 and GER-451 in the coupon on the next page.

*Trade-mark of General Electric Company.

Now—greater flexibility in voltage stabilizers

Fluctuating voltage is serious on sensitive electronic equipment designed for best performance at a specified voltage. Now, to help you get rid of voltage ups and downs, G.E. offers a new 15- to 5000-va line of automatic voltage stabilizers that gives you greater design flexibility at no increase in price, plus weight reduction in larger sizes. New output ratings of 1000, 2000, 3000, and 5000 volt-amperes—with 115 and 230 volts on both input and output—permit operation in any combination of these input and output voltages.

Fluctuations between 95 and 130 volts, or 190 and 260 volts, are corrected to a stable 115 or 230 volts within ±1 percent—and in less than two cycles. Single-core construction permits input circuit to be completely isolated from output circuit. Installation is easy: connect one set of terminals for supply and another set for the load. With no moving parts, maintenance is virtually eliminated. See Bulletin GEA-5754 for complete description.



GENERAL ELECTRIC

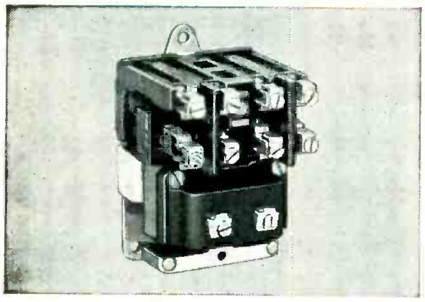
DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS

Prices reduced as much as 35% on light, flexible delay line

Increased use of delay line in special circuits for electronic equipment now enables General Electric to mass-produce it, at savings to you of up to 35 percent. Originally developed to provide delay with minimum distortion in radar equipment, G-E delay line now has many commercial uses such as color television and electronic calculators.

Bulk line is available in lengths of 100 feet or less to be cut as desired. Time delay is approximately $\frac{1}{2}$ microsecond per foot for 1100-ohm line, $\frac{1}{4}$ microsecond per foot for 400-ohm line. Line is light in weight, $\frac{1}{4}$-inch in diameter, and easily bent into a 4-inch diameter coil. Operates between −50 C and 100 C. Bulletin GEC-459.



Size 00 relays cut inventories

Many of your control-circuit needs can be met with compact G-E size 00 contactors and relays—available in any combination of normally open and normally closed contacts from 2 to 8 poles. Since contact tips are easily changed from NO to NC without extra parts, your "specials" inventory is cut. Easily accessible terminals take up to 3 wires, speed connections. For complete details, see your General Electric apparatus sales representative.

Reliable d-c to a-c amplification

Designed mainly for 400-cycle excitation, the General Electric second-harmonic converter is a magnetic-amplifier type unit that converts low-level d-c error signals (such as thermocouple output) to 800-cycle a-c output. Static operation and hermetic sealing make it reliable under extreme conditions of acceleration, temperature, and pressure—important in aircraft applications. Length is $3\frac{1}{16}$ in., tube diameter $1\frac{1}{4}$ in., weight, 0.2 lb. See Bulletin GEC-832.

Now—sealed-relay line expanded

G-E hermetically sealed relays for 28-volt circuits are now available in these forms: DPDT, 3PDT, 4PDT, 6PNO—with coil ratings up to 10,000 ohms. Certain other configurations available on request. All have extra-high tip pressures, yet don't exceed Air Force-Navy size and weight specs. They withstand all outside atmospheric conditions, 50g operational shocks, and instantaneous voltage surges up to 1500 volts. Bulletin GEA-5729.

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 recorders
- Demagnetizers

*Reg. Trade-mark of General Electric Co.

General Electric Company, Section 667-24
Schenectady 5, New York

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

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

- ☐ GEA-5729 Sealed Relays
- ☐ GEA-5754 Voltage Stabilizers
- ☐ GEC-459 Delay Line
- ☐ GEC-808 & GER-451 Tantalytic Capacitors
- ☐ GEC-832 2nd-Harmonic Converter

Name ____________

Company ____________

City ____________ State ________

Want more information? Use post card on last page.


LUXOLENE
PAT PEND.
LUXOLENE
PAT. PEND.
LUXOLENE
PAT. PEND.

SCINFLEX ASSURES LOW MAINTENANCE BECAUSE IT PERMITS SIMPLICITY

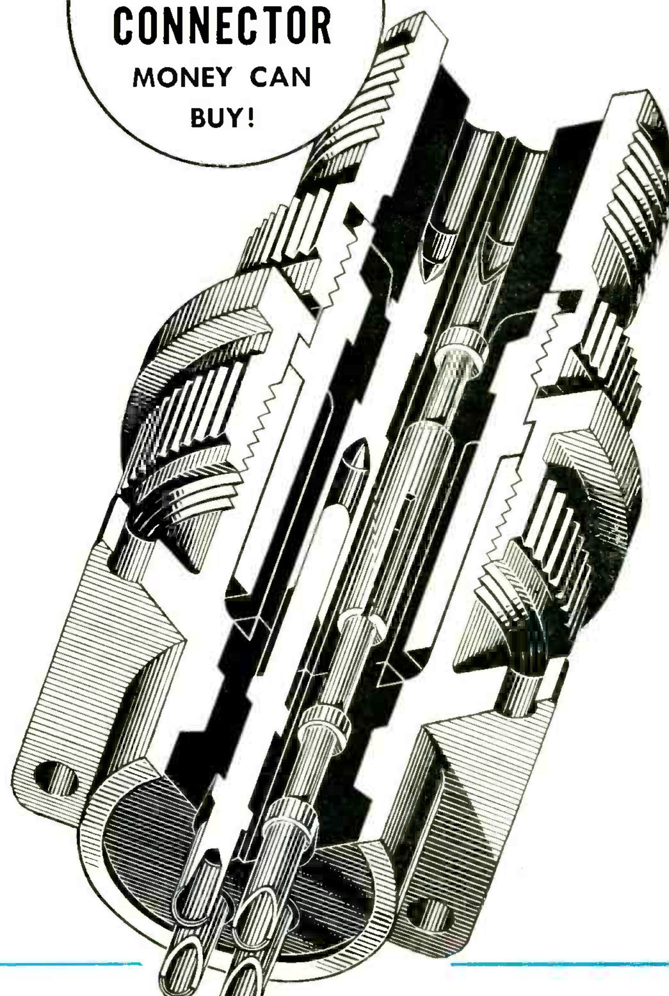
When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength 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

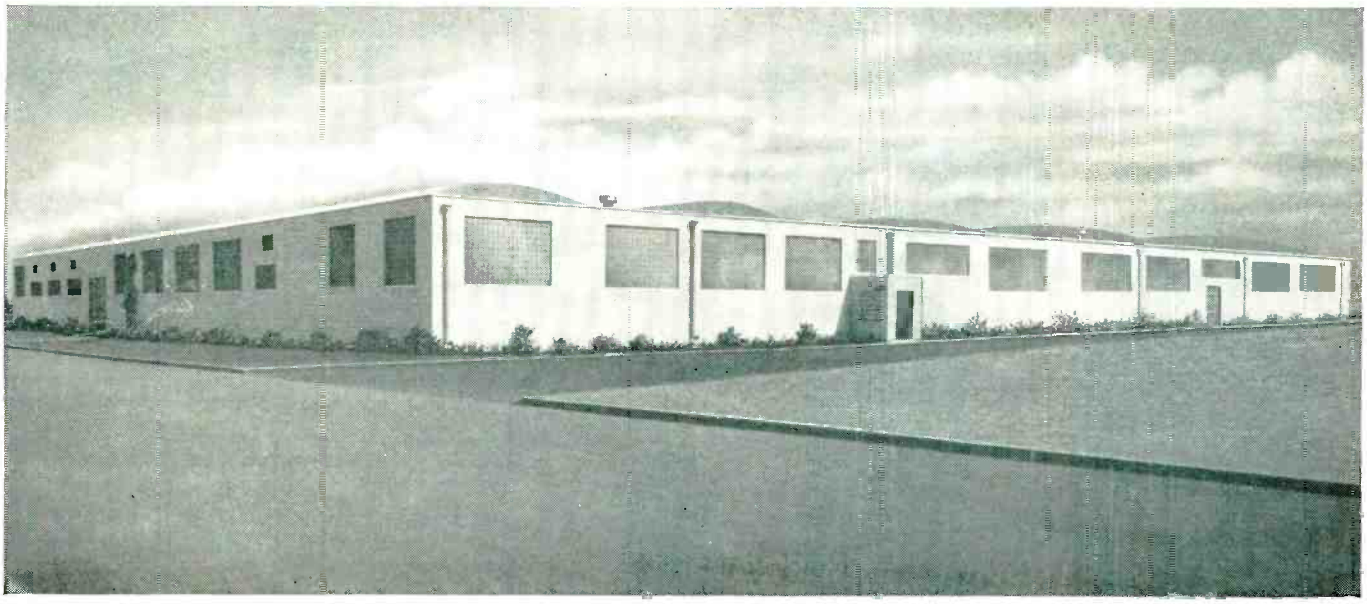
SCINTILLA MAGNETO DIVISION of Bendix AVIATION CORPORATION

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

LITTON INDUSTRIES NEWS

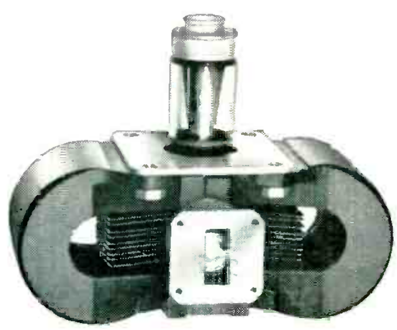


ANOTHER ADDITION TO LITTON PLANT TO HELP MEET YOUR TUBE DEVELOPMENT AND PRODUCTION NEEDS

Litton is now building a new addition to its vacuum tube plant at San Carlos, California. This expansion will approximately double tube development and manufacturing facilities and will allow expansion of our affiliate, Litton Engineering Laboratories, which has taken over the manufacture of glassworking lathes and other machine products. Like the plant completed last year, the new building has been designed specifically for vacuum tube manufacture; it has similar reinforced concrete block walls with large glass-block panels for diffused daytime illumination.

Included is complete environmental control of temperature, sound, light and air for optimum manufacturing conditions.

Increasing demand for Litton products has brought about this expansion, and we expect that the added capacity will provide greater volume and service to our friends in industry.



LITTON MAGNETRONS

Concurrent with plant expansion is a marked increase in the variety of pulse and CW magnetrons for radar, beacon and countermeasure equipment. It is quite possible that Litton Industries now has in production or development the specific tube to meet your needs.

Application of Litton design and processing criteria to all our tube types permits manufacture of tubes that require no aging racks in the plant or in the field and have long shelf life with snap-on operation to full rated power output immediately after completion of the cathode warm-up period.

2674

LITTON INDUSTRIES

1025 BRITTAN AVENUE • SAN CARLOS, CALIFORNIA • U. S. A.

Manufacturers of Vacuum Tubes and Accessory Equipment

Want more information? Use post card on last page.

ELECTRONICS AND EQUIPMENT

Electronic Tubes

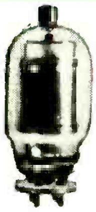
Ruggedized Type Tubes

The following tubes fully conform to JAN specifications and can be supplied promptly, usually direct from stock:

5R4WGY	2D21W
6AL5W	OC3W
6H6WGT	OD3W
25Z6WGT	2050W

TYPE 395-A COLD CATHODE GAS TRIODE

Requires no filament supply and is used in many grid controlled rectifier and relay applications. Maximum D.C. anode current— 10 ma. Maximum D.C. anode voltage—150 volts



TYPE 719-A HIGH VACUUM CLIPPER DIODE

This tube is used primarily for clipper diode service in hard tube modulator circuits. Filament 7 volts, 7 amps . . . Inverse peak anode voltage 25 kv, Max., peak anode current 10 amps, Max., anode dissipation 75 watts.

TYPE 4B32 RECTIFIER

A rugged half-wave Xenon filled rectifier. Operates in any position throughout an ambient temperature range of −75°C to +90°C. Filament 5 volts, 7.5 amp . . . Inverse peak anode voltage 10,000 average anode current 1.25 amps.

TYPE 1Z2 RECTIFIER

A small bulb high voltage vacuum rectifier. Low cathode heating power and low dielectric losses make tube suitable for radio frequency supply circuits. Filament 1.5 volts, .290 amps . . . Inverse peak anode voltage 20,000, average plate current 2 ma. . . . peak plate current 10 ma.

TYPE 394-A THYRATRON

A Mercury vapor and Argon filled thyratron for grid controlled rectifier service. Operates over wide ambient temperature range. Heater 2.5 volts, 3.2 amps . . . Inverse peak anode voltage 1250, average anode current 640 ma.

TYPE 1B46 REGULATOR

A cold cathode glow discharge tube designed for voltage stability. DC operating voltage 82 volts, operating current range 1 ma minimum, 2 ma maximum. Regulation 3 volts.

TYPE 3B28 RECTIFIER

This rugged half-wave Xenon filled rectifier will operate in any position and throughout an ambient temperature range of −75°C to +90°C. Filament 2.5 volts, 5.0 amps . . . Inverse peak plate voltage 10,000, average anode current .25 amp.

Chatham Vacuum Switches

TYPE 1S22 (illustrated) is a mechanically actuated, single-pole, double-throw, glass vacuum switch. This and other types can be supplied.

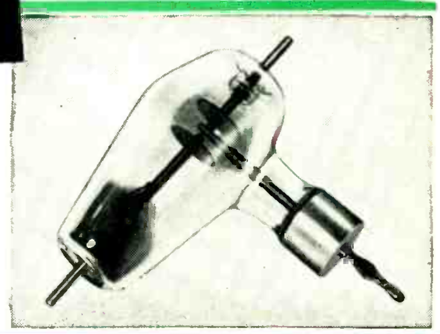
SPECIFICATIONS

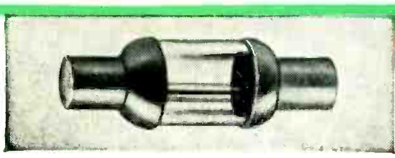
HOLD OFF VOLTAGE: Internal—10,000 volts rms; External* (at 27,000 feet altitude)—10,000 volts rms; External* (at 40,000 feet altitude)—7,500 volts rms.

INTERRUPTING RATING, RESISTIVE LOAD: 1,000 operations life at 10,000 v, ac, rms—10 amp, ac, rms; 1,000,000 operations life at 10,000 v, ac, rms — 2 amp, ac, rms; 500,000,000 operations life at 10,000 v, ac, rms—0.1 amp, ac, rms.

NET WEIGHT (approx.) .... 2 ozs.
MAXIMUM LENGTH (overall) .... $3\frac{5}{8}$ ins.
MAXIMUM WIDTH (overall) .... $4\frac{1}{16}$ ins.
MAXIMUM THICK. (overall) .... $1\frac{9}{16}$ ins.

*at 50% humidity





HIGH VOLTAGE VACUUM FUSES

Can be supplied by Chatham to exact customers' specifications if ordered in adequate quantity. Call or write for full particulars and quotes.

CHATHAM ELECTRONICS CORP.
475 WASHINGTON STREET • NEWARK 2, NEW JERSEY

Want more information? Use post card on last page.

MALLORY TYPE XT
TANTALUM ELECTROLYTIC CAPACITORS

MFD	SIZE D	SIZE H	SIZE C	OHMS	200°C MAX. Type No.	DCV	µA	150°C MAX. Type No.	DCV	µA	125°C MAX. Type No.	DCV	µA	85°C MAX. Type No.	DCV	µA
120 240	7/8 1 1/8	1/2 9/16	1 1	2.5 2.5	XT120-12 XT240-12	12 12	80 80	XT120-14 XT240-14	14 14	90 90	XT120-15 XT240-15	15 15	100 100	XT120-18 XT240-18	18 18	125 125
75 150	7/8 1 1/8	1/2 9/16	1 1	2.5 2.5	XT 75-20 XT150-20	20 20	80 80	XT 7	23	90 90	XT 75-25 XT150-25	25 25	100 100	XT 75-30 XT150-30	30 30	125 125
40 80	7/8 1 1/8	1/2 9/16	1 1	2.5 2.5	XT 40-38 XT 80-								00	XT 40-60 XT 80-60	60 60	125 125
25 50	7/8 1 1/8	1/2 9/16	1 1	2.5 2.5	XT 2 XT									25-100 -100	100 100	125 125
12 25	7/8 1 1/8	27/32 15/16	2 2	5. 5.										12-180 25-180	180 180	125 125
8 16	7/8 1 1/8	1 3/16 1 5/16	3 3	7.5 7.5	X XT									XT 8-270 XT 16-270	270 270	125 125
6 12	7/8 1 1/8	1 17/32 1 21/32	4 4	10. 10.	XT 6 XT 12-									XT 6-360 XT 12-360	360 360	125 125
5 10	7/8 1 1/8	1 29/32 2 1/32	5 5	12.5 12.5	XT 5-300 XT 10-300	300	80	XT XT 10-37				400 400	100 100	XT 5-450 XT 10-450	450 450	125 125
4 8	7/8 1 1/8	2 1/4 2 3/8	6 6	15. 15.	XT 4-360 XT 8-360	360 360	80 80	XT 4-450 XT 8-450	450 450	90	XT 4-480 XT 8-480	480 480	100 100	XT 4-540 XT 8-540	540 540	125 125
3.5 7.	7/8 1 1/8	2 19/32 2 3/4	7 7	17.5 17.5	XT 3.5-420 XT 7-420	420 420	80 80	XT 3.5-525 XT 7-525	525 525	90 90	XT 3.5-560 XT 7-560	560 560	100 100	XT 3.5-630 XT 7-630	630 630	125 125

Case Sizes from 5/8" x 7/8"

The Mallory Tantalum Capacitor shown is but one of the complete range of sizes and ratings indicated in the table. Note the following advantages:

- Compactness
- Continuous performance over a temperature range of –60° C. to +200° C.
- High resistance to shock and vibration
- Proof against thermal shock from –60° C. to +200° C. without damage
- Double sealing for absolute protection under all operating conditions.

Originally developed for the Armed Forces subminiaturization program, Mallory Tantalum Capacitors are now available in quantity. If you are redesigning your equipment, don't hesitate to call on us for help in any problem involving the application of capacitors, the development of special types or the simplification of related circuits.

For Complete Information...

The above table is part of our new Technical Bulletin 4-3. Write for your copy today. It is complete with sizes, mounting arrangements, surge voltages and performance curves.

***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 Dry Batteries

Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

electronics, W. W. MacDONALD, Editor

CROSS TALK

▶ **VISION** . . . As we enter the age of transistors it is important that engineers open their eyes wide to the potentialities of these new devices that are like tubes and yet are not like tubes. Circuits can be developed by thinking of transistors as substitutes for tubes. But more important circuits will come from the harnessing of characteristics that are peculiar to transistors themselves.

It is, for example, possible to build an audio amplifier that contains junction transistors and nothing much else in the way of component parts. The output of a phonograph pickup is fed into an n-p-n and also into a p-n-p junction. "Complementary symmetry" of the two dissimilar transistors permits this first stage to be direct-coupled to another pair of n-p-n and p-n-p junctions so connected that they drive a loudspeaker without benefit of an output transformer. Phase inversion and impedance matching are inherent in the system, and are accomplished by phenomena that have no counterpart in the terminology of tubes.

In the spring ELECTRONICS begins a carefully planned series of articles dealing with the basic characteristics of semiconductors in general and transistors in particular. This series will appear side by side with detailed descriptions of practical transistor circuits as these are developed. The double-pronged editorial approach to a new horizon will, we think, provide a solid base upon which men with imagination can build.

▶ **MONOPOLY** . . . We are also entering an era in which no one amplifying device will monopolize the expanding field of electronics. Tubes will share it not only with transistors and magnetic amplifiers but also with other devices as yet largely a gleam in some physicist's eye.

Time alone will tell which device is to dominate what equipment. Meanwhile, it does seem that tubes are at their shining best where high power is required at high frequencies and, particularly, where complex broadband modulation components are involved. This, at any rate, is the area in which much current development work is going on, sparked to a considerable extent by the increasing demands of uhf television.

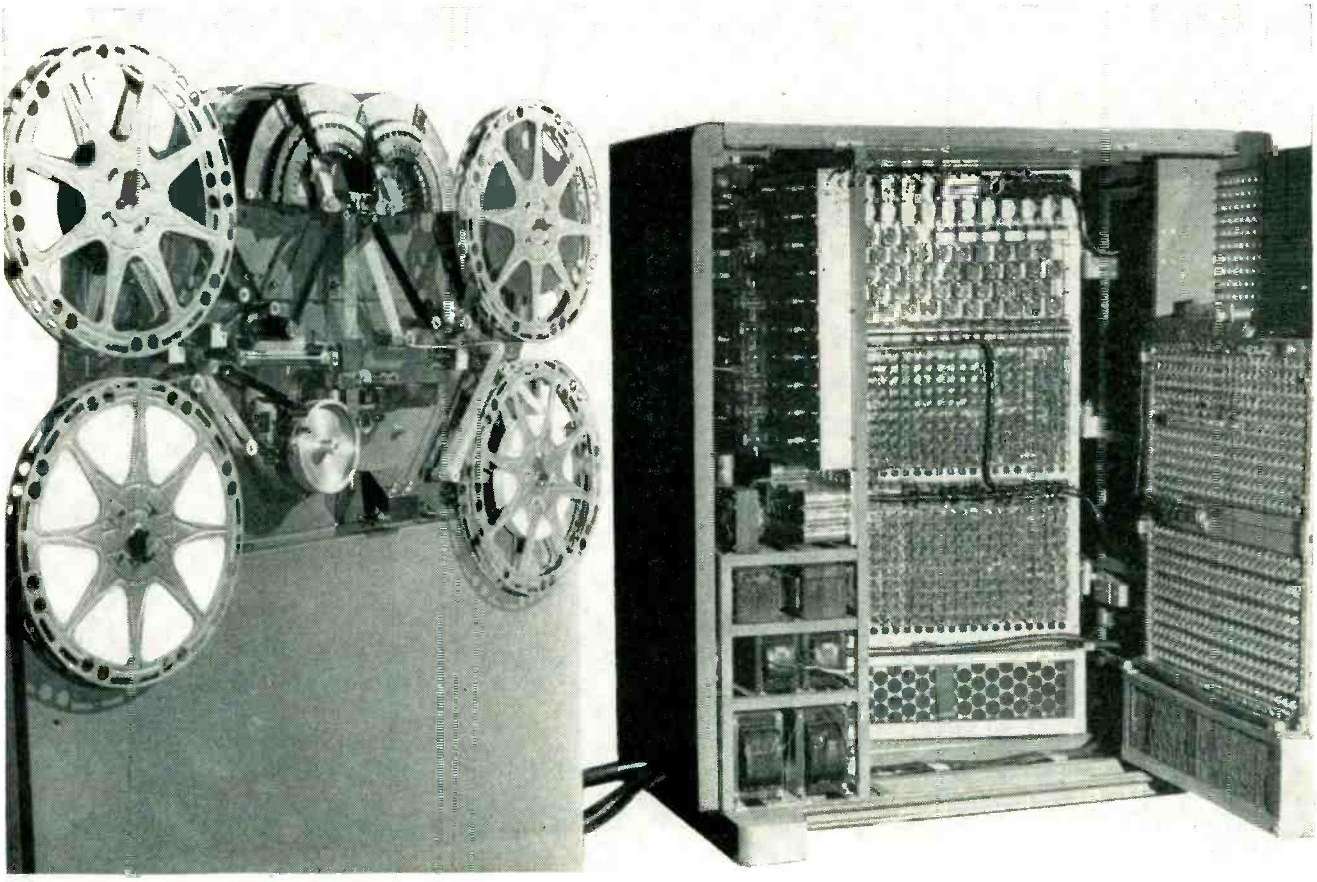
Much is being done to increase the usefulness of klystrons. A new magnetron incorporating a grid exhibits considerable flexibility. Traveling-wave tubes tuneable over a moderate frequency range by mere variation of operating voltages show experimental promise. There is a great deal of constructive thinking going on in the laboratories of highly competitive tube manufacturers.

▶ **MISTAKE** . . . Our whole field is unusually active technically, and the future seems bright. All is not sweetness and light on the sales front, however, and there is one part of the business that has recently acquired a beautiful black eye from which it will take some time to recover.

It seems that an active microwave-relay equipment market attracted some manufacturers who either cut design corners to get into the game quickly or spaced stations too far apart on paper to hold price down and get the order. Now some of the stuff doesn't work too well when transmission conditions are ideal and falls down completely when they are poor. Several installed systems are unused and just gathering dust.

▶ **PICTURE** . . . If you are wondering whether the admittedly flattering photograph at the top of this page is to be a regular eyesore then wonder no more. The answer is, quote: "No."

The subject of the picture has been active in management and sales as well as in technical circles of this industry since 1924, with McGraw-Hill since 1926 and ELECTRONICS since 1941. He was appointed editor January 1, just after the preceding issue mailed. The thought therefore occurred that there may be two or three of the paper's thirty-some-odd-thousand subscribers who wonder what the editor looks like, a condition to be personally rectified in the years ahead as rapidly as flesh and blood, a liberal travel budget and time permit.



Multiple-stylus printer has punch-card feed and photoelectric card reader located behind printing unit (left). Electronic unit converts punch-card data to impulses that drive printing styli

Electronic Addressing

Computers and high-speed printers team up to rush publications to readers. Multiple-stylus machine works directly from punch cards and prints up to 42,000 individual four-line address labels per hour

LIFEBLOOD of a publication is its readership.

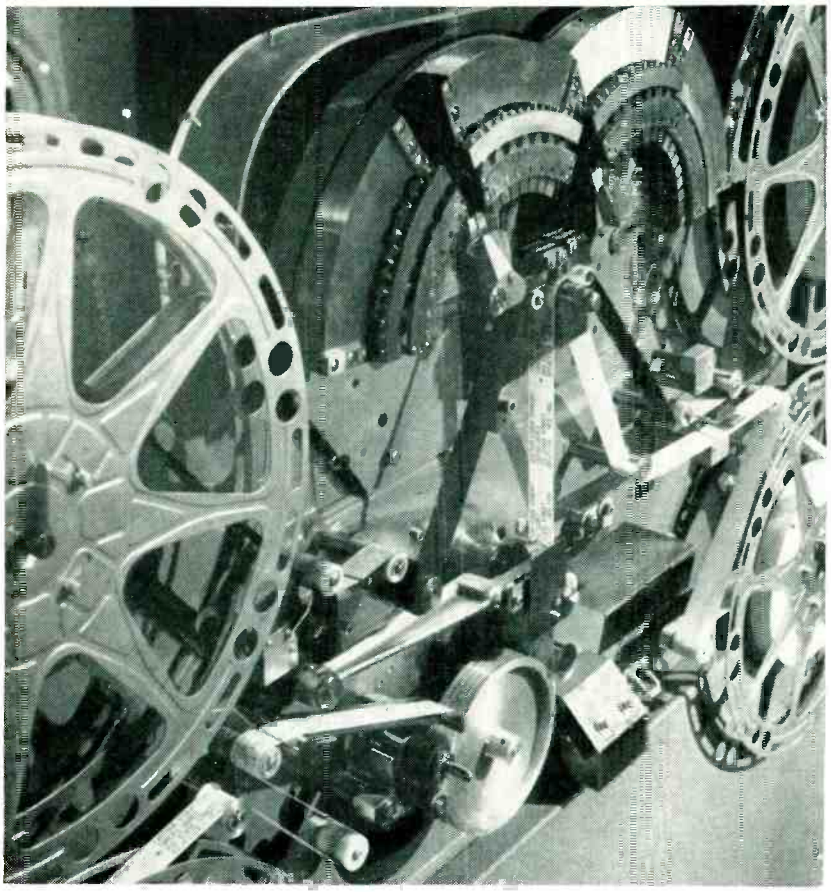
To serve the reader, the subscription-fulfillment department keeps lists current and mails each copy promptly. This involves storing and servicing vast quantities of data as well as printing many thousands of individual address labels for each issue of the publication. Electronic equipment is proving adept at both chores, particularly for publications having large mailing lists.

Currently in use is a facsimile printer[1] made by Addressograph-Multigraph, that works from printed address cards and has a capacity of 6,000 four-line address labels per hour. The address cards are helically scanned by a phototube linked mechanically to the printing bar. Relays are so adjusted that the printing bar strikes when the phototube receives a black signal. Nearly 100 machines are in use.

Multiple-Stylus Printer

A recent addition to the field, the multiple-stylus electronic printer[2], works directly from punch cards and prints up to 42,000 four-line address labels per hour. Developed by Eastman Kodak, the machine is used in that company's advertising and direct-mail department to service extensive mailing lists.

Printing speed depends upon the number of printing heads used and may be increased 24,000 characters per minute with each additional printing head. The present model uses four heads, one for each line of the address. Individual char-



Printing styli strike impact blows on paper through carbon; each of four printing heads prints one line of address

Aids Publishers

By **JOHN M. CARROLL**
Assistant Editor
ELECTRONICS

acters are built-up by printing rectangular dots in a 5 × 7-dot rectangle to form a pattern. Synthesis by this method of the letter *E* is shown in Fig. 1A.

Use of a fixed card carrying city and state names common to many cards increases address-card information capacity and eliminates repetitive card punching.

Each printing head consists of seven styli actuated by multiple vibrators. The styli print rectangular dots by striking impact blows on carbon paper. They are released in the desired pattern by independent relays working in accordance with signals received from an electronic matrix. Carbon impressions are fixed by drying lamps and a flying punch pierces holes between address labels. The close-up shows the printing operation. The four printing heads are arranged in a semi-circle at the top of the picture.

Information to be printed is stored on punch cards like those shown in Fig. 1B. A punch card for a four-line address of 96 characters must have 576 holes arranged in 48 columns of 12 holes each. The card is quartered, each quarter corresponding to one line of the address (24 characters). Characters are expressed in six-unit code and represented by holes punched in the card.

Punch cards are fed to the printer in batches of 700. Reading is done photoelectrically by four independent reading heads that correspond to the four lines of the address. Each head has six lead-sulphide photocells, so that all places of the six-unit code groups are read simultaneously by light shining through the punched holes.

Timing pulses are supplied by a slotted wheel that rotates in synchronism with the card feed and interrupts the light beam falling on another photocell.

Each reading head transmits a group of pulses as a card column passes. These pulse groups are amplified, gated by the timing pulses to insure exact synchronism and fed to the storage matrix.

The matrix has 96 memory sockets, each one corresponding to a possible character in a four-line address. The sockets are arranged in four banks of 24, the same as the code groups on the punch card. A memory plug consisting of seven magnetic memories is inserted in every memory socket from which a printed character is desired.

Pulse groups from the reading heads are channeled into the storage bank corresponding to the proper line of the address. Meanwhile, the timing pulses are applied to step a ring circuit that delivers actuating pulses to successive memory units in exact synchronism with the card reading. Six of each memory unit's magnetic memories are used to store code signals representing characters while the seventh memory forms part of an error-detection system.

Printing

A second slotted wheel rotating in synchronism with the printing unit generates a series of seven pulses for each character to be printed. These pulses drive a seven-tube ring circuit. Every seventh pulse steps a second ring circuit that applies simultaneous read-out pulses successively to the

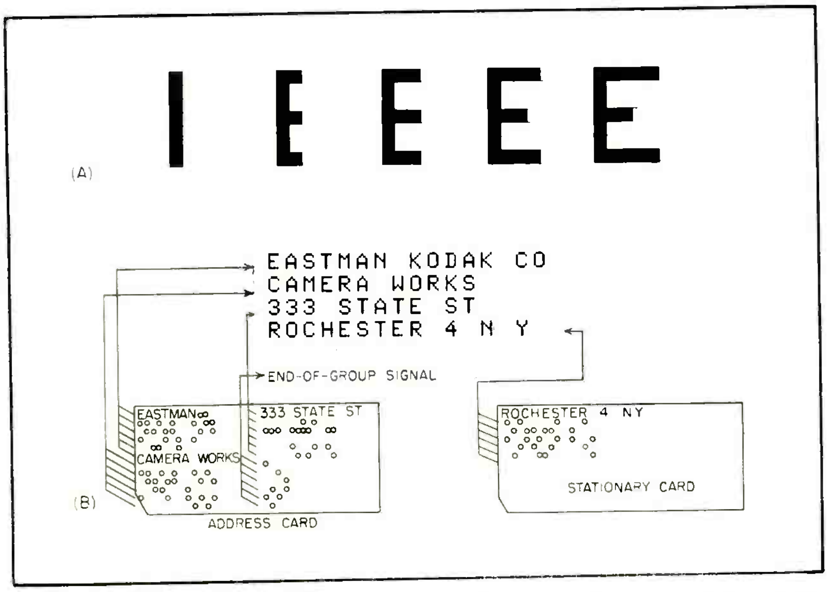


FIG. 1—Letter *E* is built up on 35-dot matrix (A) in five blows by printing styli. Punch cards (B) are quartered to give four-line address of 24 characters per line. Alphabetical and numerical characters are expressed in six-unit code

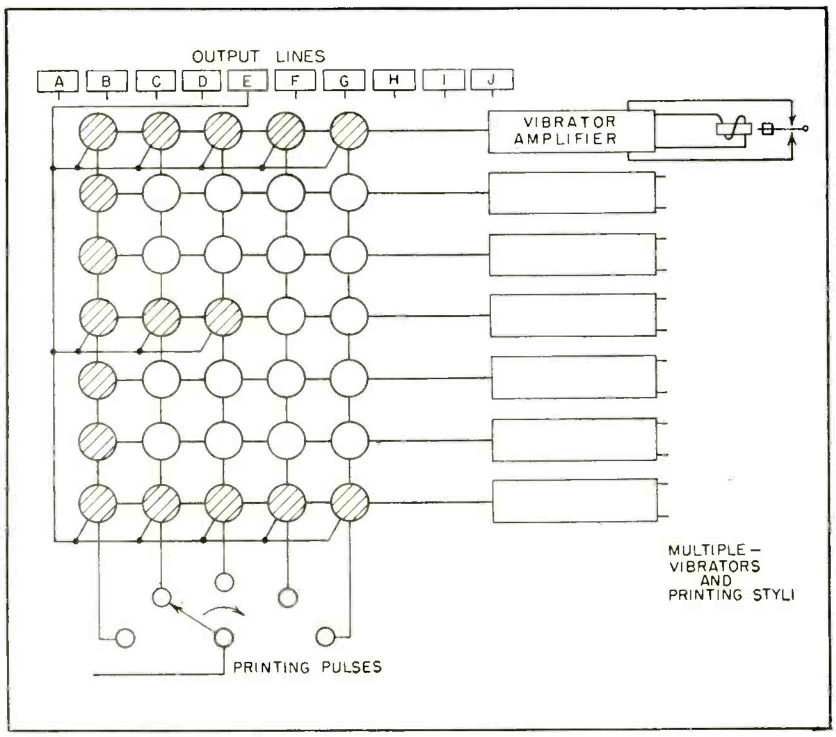


FIG. 2—Output lines from decoding matrix select pattern of switch combinations corresponding to desired character. Switch matrix columns are read out by five of the seven printer timing pulses

memory units in each of the four storage rows.

As each memory unit is read out, its signals go to one of four line-printing units where the signals are first applied to a group of six flip-flops. A trigger signal is set up for each pulse from the memory unit. The trigger signals are connected to a germanium-diode decoding matrix in such a manner that for every different pulse-code group a unique output line is selected that corresponds to the printed character desired.

Each output line connects to a 5 × 7 matrix of 35 switches (Fig. 2). When an output line is energized, certain of the switches close to form the pattern of the character to be printed. Consider the switch matrix to consist of five columns of seven switches each.

A printer timing pulse feeds into each of the five matrix columns in turn. A separate vibrator amplifier is connected to each row of seven switches and as each column is pulsed, a signal is sent to every amplifier whose switch in the column is closed. Each vibrator amplifier is connected to a vibrator that activates one of the seven printing styli. The paper tape advances one dot space as each column is pulsed and the character is built up in five pulses. The fifth pulse resets the trigger tube for the following character.

Over the Horizon

Several other methods of electronic subscription fulfillment are under study. The Potter Instrument Co. is working on a system in which their flying typewriter[3], its tube complement now reduced to 300, teams with a random access memory (RAM) to print 10,800 address labels per hour per printer. The random access memory is the outstanding feature of the system. Over a million subscription records can be stored magnetically and each day's transactions entered without disturbing the unaffected records. Serial tape-handling systems require that the entire tape be rearranged when subsequent transactions are to be filed.

Another proposed method would display information from a storage device on the screen of the Charactron[4,5], a cathode-ray tube with a beam-forming matrix of character-shaped openings through which the electron beam is directed. Addresses, displayed at rates up to 10,000 per sec on the crt face, can be transferred to ordinary paper by a dry-printing process such as Xerography.

REFERENCES

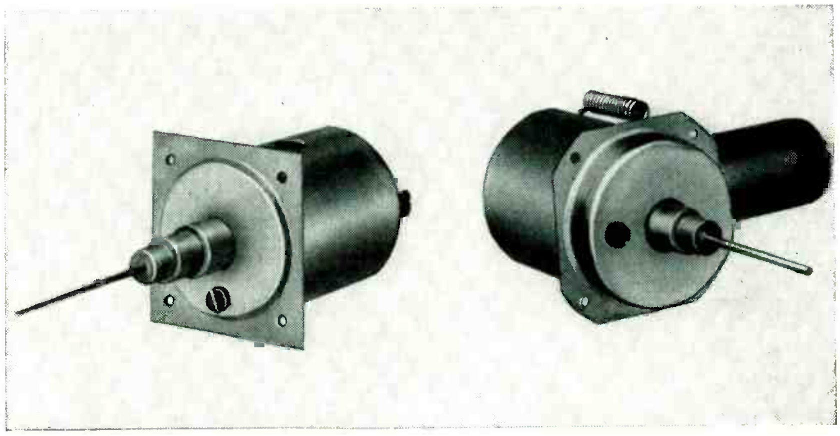
(1) Tumbling Characters, *Arthur D. Little Industrial Bulletin*, Nov. 1952.
(2) R. G. Thompson and C. E. Hunt, Jr., Eastman Kodak Multiple-Stylus Electronic Printer, *Joint AIEE-IRE-ACM Computer Conference paper*, Dec. 1952.
(3) J. J. Wild, High-Speed Printer for Computers and Communications, ELECTRONICS, p 116, May 1952.
(4) J. T. McNaney, Data-Displaying Cathode-Ray Tube, ELECTRONICS, p 174, Aug. 1952.
(5) J. T. McNaney, The Charactron, *IRE National Conference paper*, May 1952.

By HENRY FOGEL*

and

SEYMOUR NAPOLIN

Radio Receptor Co.
Brooklyn, N. Y.



Tuning elements for preselector and oscillator employ plungers

Cavity Tuner for UHF Television

All 70 of the high-band channels are continuously tuned by varying the center-loading capacitance of a modified coaxial line section. Design avoids moving contacts and minimizes radiation from oscillator by inherent shielding

DEVELOPMENT of a tv receiver front-end to cover the uhf channels imposes severe requirements. After consideration of butterfly arrangements, coaxial lines with wiping contacts or capacitors and other devices, a modified resonant cavity was adopted as the basic tuning element.

The tuner shown in the diagram, Fig. 1, contains three cavities. Two of these function as a bandpass preselector and the third controls the local oscillator frequency. The preselector is essentially an overcoupled double-tuned transformer with a balanced 300-ohm antenna input and unbalanced output to the mixer.

Tuning of each cavity is accomplished by a metallic plunger traveling in a low-loss dielectric sleeve which varies the value of center loading capacitance. The plunger serves only as a transfer medium and makes no physical contact with the cavity or loading capacitor.

Suitably formed loops couple in and out of the cavity field with the degree of coupling controlled by physical dimensions and placement. The tuning plungers are ganged together and moved by a simple linkage that provides substantially linear frequency calibration. Dial and inter-cavity tracking are adjustable at three points by positioning the plunger, trimming the loading capacitance and by an additional mechanical means of changing the electrical length of the cavity.

The view of the complete converter shows the three cavities assembled to a small subchassis, with their tuning plungers attached to the ganged drive. This drive consists of a metal frame pivoted at one end and swung in an arc by a link mechanism against a spring.

Straight-line motion is imparted to the plungers by the rotation of the frame. The dial is concentric with the tuning knob and calibrated

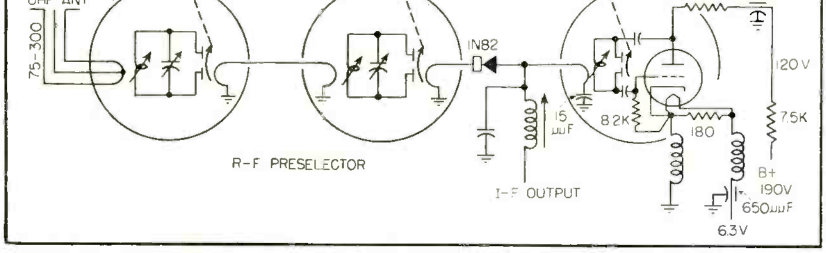


FIG. 1—Three cavities are employed, two for preselection and one for the local oscillator

* Now with Granco Products, Inc., Long Island City, N. Y.

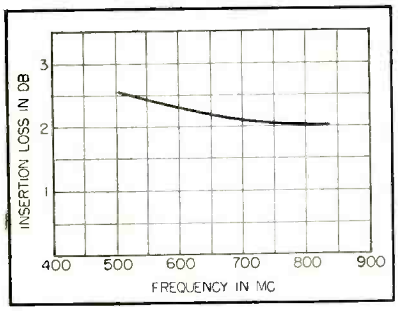


FIG. 2—Insertion loss for two cavities plotted against frequency

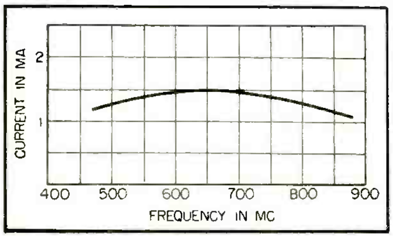


FIG. 3—Crystal injection current is nearly constant over the frequency range

directly in channel numbers. A metal wrap-around encloses the entire unit to guard against mechanical damage during handling, and act as a second r-f shield to reduce radiated interference.

The local oscillator, a Colpitts type, tunes below the signal frequency for double superheterodyne or converter applications. Mixing takes place in a low-noise diode, with the i-f signal appearing at vhf channels 5 or 6.

Tuning is controlled by a single knob which functions as both a channel selector and fine-tuning control. The complete uhf television band is covered by five turns of the tuning knob. A circular dial, linearly calibrated, rotates approximately 150 degrees.

In Fig. 1, the resonant cavity tuning elements are represented schematically by their lumped-constant equivalents to facilitate circuit analysis. Balanced 300-ohm antenna coupling is achieved simply by a loop located in the cavity field. Since the coupling is almost constant over the entire tuning range, antenna mismatch losses are minimized.

Selectivity

The skirt selectivity requirements at uhf are more severe than for vhf because of the relatively close spacing of signal and image frequencies and the multiple spurious responses which result from double conversion. Considerable selectivity may be obtained by using three or four tuned circuits; however, because of increased insertion loss and tracking errors, improvement in selectivity is accompanied by rapid degradation of noise figure. Fortunately, because of the high operating Q's possible at uhf, two tuned circuits provide adequate image and i-f rejection.

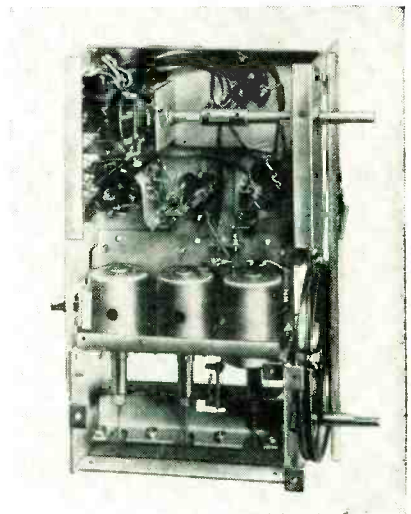
The double-tuned preselector shown has an image ratio better than 60 db, an i-f (80 mc) rejection greater than 90 db, with an insertion loss of approximately 2 db at 890 mc. A plot of insertion loss versus frequency is given in Fig. 2.

Radiation

Another measure of the effectiveness of a preselector is the value of end-to-end feed-through capacitance which generally determines the amount of oscillator voltage appearing across the antenna terminals. The preselector coupling throughout the tuner is primarily magnetic, and capacitance feed-through is reduced to negligible proportions. The attenuation at oscillator frequency is in the order of 45 db, which means that antenna radiation due to back-to-front coupling is less than 100 μv per meter.

Another source of oscillator radiation, that due to coupling around the preselector by stray magnetic and electrostatic fields, is minimized by careful layout and fully shielded construction, which effectively confines the r-f and oscillator fields within the metallic cavity walls.

A 1N82 low-noise silicon diode is used as a mixer. Diode rather than triode conversion was selected because better noise figures are possible, and as a result of the small injection voltages required, oscillator radiation is considerably reduced. In addition, the loose coupling between oscillator and mixer permits more stable oscillator performance. The preselector and oscillator outputs are linked by a common coupling loop which combines the fields of both cavities at the mixer input.



Ganged plungers move in and out of the cavities for tuning the complete uhf range

Oscillator Circuit

The 6AF4 local oscillator tunes below the carrier, to prevent reversal of the sound and picture position on the i-f response curve of the television receiver during double

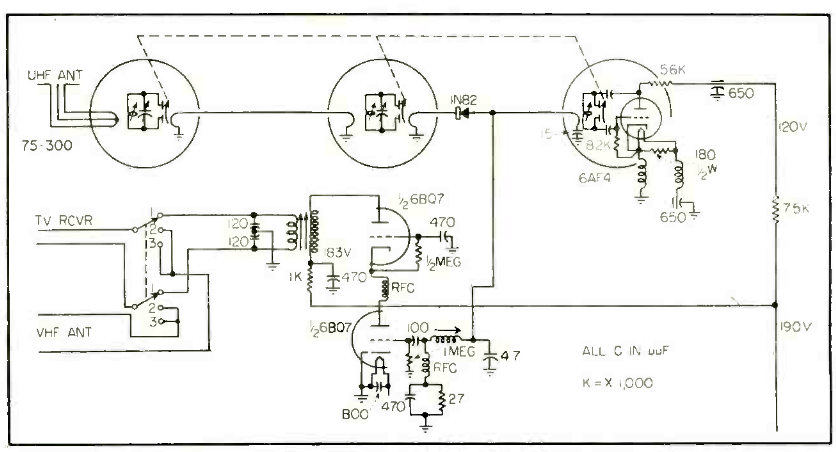


FIG. 4—Converter circuit includes cascode i-f stage

conversion. To assure stable oscillator performance all circuit elements are designed as an integral part of the resonant cavity, which results in almost constant injection current as shown in Fig. 3. This helps confine the oscillator field and substantially reduces radiated interference.

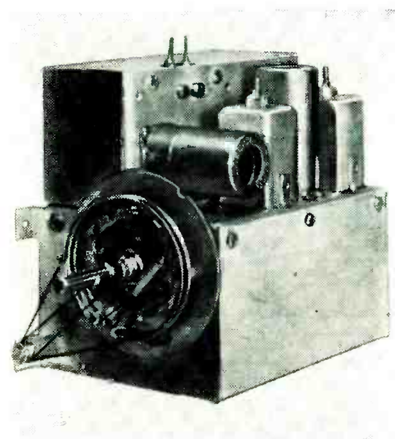
Although the uhf oscillator operates at a much higher frequency than a vhf oscillator, the permissible frequency drift on an absolute basis must be much smaller. This is the direct result of double superheterodyne operation, in which the additive drift of two local oscillators determines the overall frequency stability of the uhf receiver. Theoretically, assuming that the vhf tuner designer has taken full advantage of the permissible drift tolerance, the uhf oscillator must either be absolutely stable, or have a drift characteristic opposing that at vhf.

Fortunately, modern vhf tuners operate well within the allowable drift tolerance, and the television industry, in anticipation of the severe uhf requirements, is now producing sets using intercarrier sound circuits. While this eliminates the possibility of complete loss of sound due to drift, picture quality degradation and loss of sensitivity still remain.

Two factors generally influencing oscillator frequency stability are temperature changes and power supply fluctuations. The tuner local oscillator contains a temperature-sensitive element which varies the electrical length of the cavity, and holds the frequency substantially constant over a wide temperature range. Voltage sensitivity is reduced to a second-order effect by circuit design, and a regulated supply is therefore unnecessary for normal applications.

Output Frequency

For practical design purposes, vhf channels 5 and 6 were chosen as the intermediate frequency. Despite the fact that it is possible to receive weak transmissions in some scattered geographical locations on both these channels, high i-f attenuation through the tuner still permits interference-free uhf reception. Since the output tuned circuit is sufficiently broad to pass both channels, no readjustment of the oscillator is necessary to shift frequency, in the presence of strong local signals.



Cavituner is completely shielded front-end for uhf

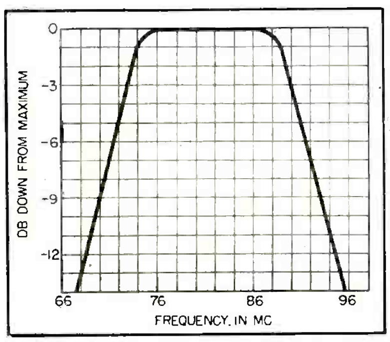


FIG. 5—Overall i-f response curve of converter

For those applications where the tuner is combined wtih a specially designed vhf tuner as an 82-channel front-end for new television receivers, no significant improvement in either noise figure or isolation can be expected from the addition of an i-f amplifier.

When used as a tuner or converter for existing television receivers, improved performance can be realized by the insertion of a cascode amplifier between the tuner output and the receiver input. Such a low-noise stage would provide needed gain, allow the tuner noise to dominate that of the vhf receiver, and further isolate the uhf and vhf oscillators. The individual tuning element is a modified, coaxial line section shorted at both ends, and center loaded by lumped capacitance to attain the necessary electrical length within small practical dimensions.

The complete circuit of a converter using the tuner and a cascode i-f amplifier is shown in Fig. 4.

The 6BQ7 cascode i-f amplifier has a noise figure of 6 db and power gain of approximately 15 db. Three tuned circuits are used to give a uniform response from 76 to 88 mc (channels 5 and 6) with relatively steep skirts to prevent spurious responses at vhf image frequency, and to sharply attenuate vhf oscillator feedback to the converter. Because of the broad flat-top response, no retuning is required whenever an alternate channel is selected.

An overall i-f response curve is shown in Fig. 5. Both the i-f response and power gain were measured with a 175-ohm generator to simulate the i-f impedance of the diode mixer. Layout and wiring of i-f connections to the mixer minimize parasitic "suck-outs" which adversely effect oscillator injection current.

Figures 6 and 7 provide supplementary data on bandwidth and noise figure.

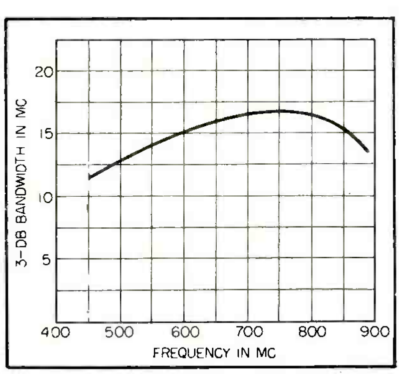


FIG. 6—Overall 3-db bandwidth for converter

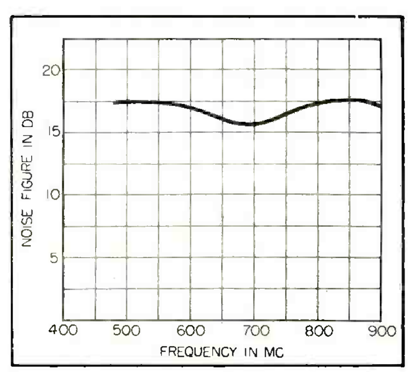


FIG. 7—Noise figure over the tuning range

Noise in Transistor

By EDWARD KEONJIAN and JOHANNES S. SCHAFFNER

General Electric Company
Syracuse, N. Y.

TRANSISTOR NOISE differs from other types such as thermal and shot noise, since the transistor noise power per unit bandwidth is approximately inversely proportional to frequency. Figure 1 shows this variation of the noise power per cycle bandwidth with frequency. One consequence of this type of noise spectrum is that each octave of the frequency range contains the same noise power.

In the equivalent circuit representation of the transistor it is convenient to represent the noise by adding two noise-voltage generators with rms voltages E_{ne} and E_{nc} as shown in Fig. 2. It is then assumed that the other elements of the equivalent circuit are noiseless.

Representative values for E_{nc} and E_{ne} for point-contact transistors are 100 μv and 1 μv respectively, measured at a frequency of 1,000 cps for a bandwidth of one cycle. Corresponding voltages for junction transistors are 5 μv and 0.05 μv respectively.

For practical applications, it is more convenient to express the noise characteristics of the transistor by giving its noise figure. The noise figure is defined as the ratio of the total noise power in the output (disregarding the noise originating in the load impedance) divided by that portion of the output noise that results from thermal agitation in the source resistance R_g. This noise figure provides a convenient way of comparing the noise properties of transistors.

This paper will appear in the *NEC Proceedings* for 1952.

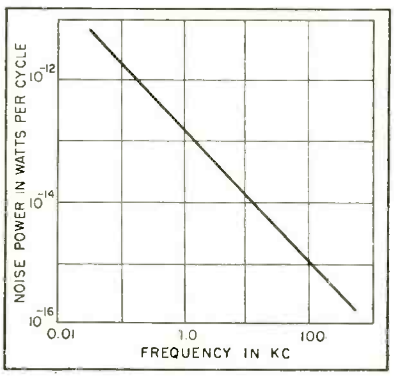


FIG. 1—Inverse relationship of transistor noise power per unit bandwidth and frequency

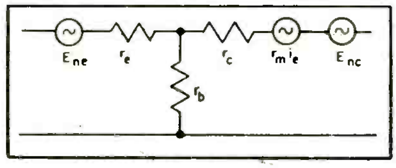


FIG. 2—Equivalent circuit of transistor including two noise-voltage generators

Figure 3 shows the variation of noise figure with frequency for two junction transistors. Representative values for noise figures, measured at a frequency of 1,000 cps are 40 to 60 db for point-contact transistors and 10 to 25 db for junction types transistors. Figure 4 shows the distribution of noise figure for 60 transistors of both types.

Mathematically, the noise figures for the three basic types of amplifier circuits may be expressed as follows: For grounded emitter

$$F = 1 + \frac{1}{4KTBR_g} \left[E_{ne}^2 \left(\frac{R_g + \alpha r_c + r_b}{\alpha r_c - r_e} \right)^2 + E_{nc}^2 \left(\frac{R_g + r_b + r_e}{\alpha r_c - r_e} \right)^2 \right] \quad (1)$$

For grounded base

$$F = 1 + \frac{1}{4KTBR_g} \left[E_{ne}^2 + E_{nc}^2 \left(\frac{R_g + r_e + r_b}{\alpha r_c + r_b} \right)^2 \right] \quad (2)$$

For grounded collector

$$F = 1 + \frac{1}{4KTBR_g} \left[E_{ne}^2 \left(\frac{R_g + r_e + r_b}{r_c} \right)^2 + E_{nc}^2 \left(\frac{R_g + r_b}{r_c} \right)^2 \right] \quad (3)$$

In these equations α, r_e, r_c, r_b and r_m are equivalent circuit parameters for the transistor. E_{ne} and E_{nc} are open-circuit voltages, R_g is source resistance, B is frequency band, K is Boltzmann's constant ($= 1.347 \times 10^{-23}$), and T is temperature in deg Kelvin. The addition sign in these equations expresses addition with attention to any correlation between E_{ne} and E_{nc}. If no correlation exists, then this operation may be replaced by simple addition.

The noise figure of a transistor depends on the operating point. For example, while the emitter noise is almost independent of the collector voltage V_c, the collector noise depends strongly on it. Figure 5 shows variation of the collector noise voltage for one-cycle bandwidth with the collector voltage V_c. The noise figure for point-contact transistors is almost independent of the collector voltage V_c as shown by the experimental curves in Fig. 6.

The noise figures of some junction transistors display the same independence of the collector voltage. The noise figure for most junction transistors, however, decreases with decrease in collector voltage, as shown in Fig. 7. Figure 8 shows the contributions to noise figure by the emitter and collector together with total noise figure. It is, therefore, necessary to operate the transistor at collector voltages falling into region *A* of Fig. 8.

Signal-to-Noise Ratio

The total noise power in a frequency band $f_2 - f_1$ is

Amplifiers

Particular recommendations for obtaining the optimum signal-to-noise ratio in point-contact and junction transistor amplifiers. Typical values and curves show how this type of noise figure varies with operating point of transistor and source impedance

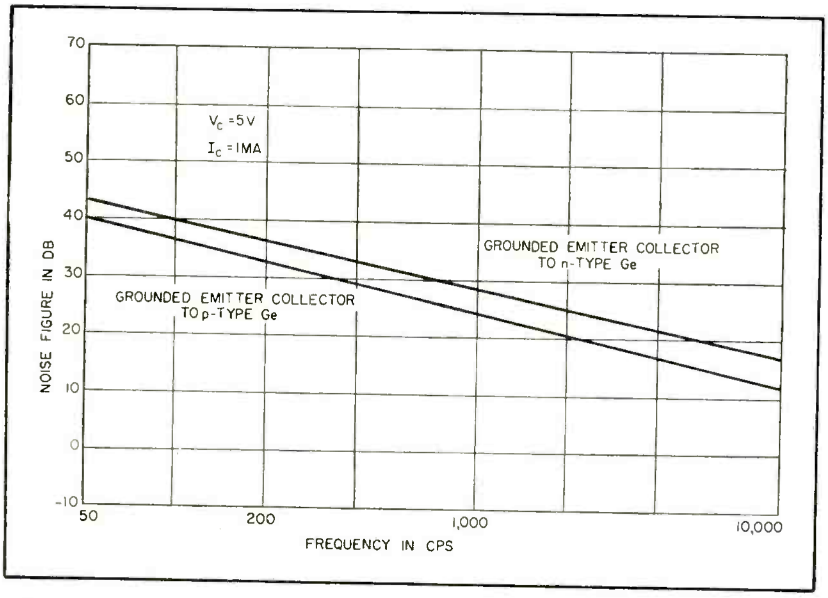


FIG. 3—Variation of noise figure with frequency for two different types of junction transistors

$$\int_{f_1}^{f_2} \frac{K}{f}\, df = K \ln \frac{f_2}{f_1} \qquad (4)$$

On the other hand, the thermal noise power due to R_g is proportional to the bandwidth $f_2 - f_1$. The noise figure for the bandwidth limited by the frequencies f_2 and f_1 is

$$F = 1{,}000\, F_o\, \frac{\ln f_2/f_1}{f_2 - f_1} \qquad (5)$$

where F_o is the noise figure at 1,000 cps for a bandwidth of one cycle. If

$f_2/f_1 \cong 1$

then

$$\ln \frac{f_2}{f_1} \cong \frac{f_2 - f_1}{f_1}$$

and

$$F \cong F_o\, \frac{1{,}000}{f_1} \qquad (6)$$

The noise figure may be considered fairly independent of the bandwidth if this bandwidth remains relatively small.

The expression for signal-to-noise ratio for the transistor amplifier may be obtained in the following manner. The noise figure in accordance with the definition is

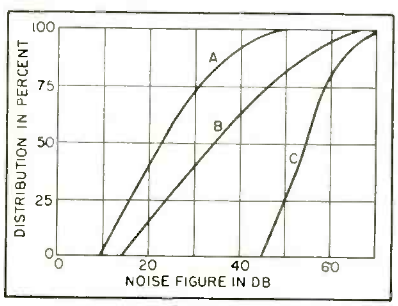


FIG. 4—Distribution of noise figure for 60 transistors of both types: *A*, junction transistors with $V_c = 1$ v and $I_c = 0.5$ ma; *B*, junction transistors at $V_c = 5$ v and $I_c = 1$ ma and *C*, point-contact transistors at $V_c = 10$ v and $I_c = 0.5$ ma

$$F = \frac{\text{noise power at output}}{\text{available noise power at input due to } R_g} \times \frac{1}{\text{transducer gain}} \qquad (7)$$

and the noise power at input will be

$$N = FKT \times (f_2 - f_1) \qquad (8)$$

Consequently, the signal-to-noise ratio

$$\frac{S}{N} = \frac{V_g^2}{4KT\,(f_2 - f_1)\, R_g\, F} \qquad (9)$$

or replacing F by F_o

$$\frac{S}{N} = \frac{V_g^2}{4\, R_g KT\, (F_o\ 1{,}000 \ln f_2/f_1)} \qquad (10)$$

From Eq. 10 it can be seen, that the quantity

$[1{,}000\ KTF_o \ln f_2/f_1]$

is equivalent to the available noise power at input. Let us call this power equivalent noise power P_o

$$P_o \cong 1{,}000\, KTF_o \ln f_2/f_1 \qquad (11)$$

If the base of the logarithm is now changed to 10 and values of K and T substituted, the equivalent noise power will be

$$P_o \cong 0.9 \times 10^{-17}\, F_o \times \log f_2/f_1 \ \text{(watts)} \qquad (12)$$

This equation shows that the noise power depends on the ratio of the frequencies f_2 and f_1 and not on their magnitudes.

Equation 12 for the equivalent noise power may be rewritten approximately as

$$P_o \cong 0.9 \times 10^{-17}\, F_o \times \log\left(1 + \frac{\Delta f}{f}\right) \ \text{(watts)} \qquad (13)$$

where Δf is the bandwidth and f the center frequency. This equation shows that for a constant bandwidth the noise power will decrease as the center frequency increases.

The signal-to-noise ratio may now be expressed as

$$\frac{S}{N} = \frac{V_g^2}{4\, R_g P_o} \qquad (14)$$

$$= \frac{V_g^2}{3.6 \times 10^{-17}\, R_g F_o \log f_2/f_1}$$

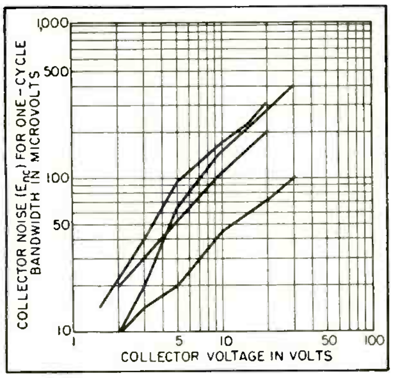


FIG. 5—Open-circuit collector noise voltage for four different point-contact transistors

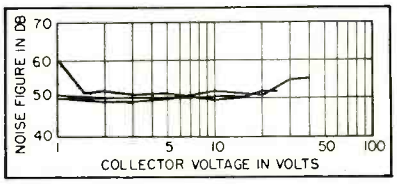


FIG. 6—Variation of noise figure with collector voltage for three different point-contact transistors

where V_g is the rms value of the signal voltage. Using this equation it is possible to determine the maximum permissible noise figure of a transistor for the first stage of an amplifier.

This is illustrated in Fig. 9 which is a plot of the Eq. 12 for different values of F_o.

Assuming that the available signal power is 10^{-8} watts in an audio band from 50 to 5,000 cps ($f_2/f_1 = 100$) and that the desirable signal-to-noise ratio must be not less than 40 db, P_n must be less than 10^{-12} watts. For the given ratio $f_2/f_1 = 100$. This corresponds to a maximum permissible noise figure of 48 db.

Similarly, in the case of an i-f amplifier with $f_2/f_1 = 1.1$, S/N = 50 db and with an available signal power of 10^{-11} watts, the maximum permissible noise figure will be 24 db.

For d-c amplifiers, if one assumes that the bandwith of the amplifier is limited by the frequencies $f_1 = 1/$ day and $f_2 = 10$ kc, and that available signal power is 10^{-10} watts, the maximum permissible noise figure of a transistor is equal to 21 db for the signal-to-noise ratio 40 db.

Amplifier Source Resistance

Equations 1, 2 and 3 give the noise figure for the three basic types of amplifier circuits. For a given operating point and given transistor, E_{ne} and E_{nc} are constant. A parameter

$$\rho = \frac{E_{ne}}{E_{nc}} \tag{15}$$

may be introduced, practical values for which are between 10^{-2} and 10^{-8}.

The equations for the noise figures are then: For grounded emitter

$$F = 1 + \frac{R_n}{R_g} \times \frac{\rho^2 (R_g + \alpha r_c)^2 + (R_g + r_e + r_b)^2}{\alpha^2 r_c^2} \tag{16}$$

For grounded base

$$F = 1 + \frac{R_n [\rho^2 \alpha^2 r_c^2 + (R_g + r_e + r_b)^2]}{R_g \alpha^2 r_c^2} \tag{17}$$

For grounded collector

$$F = 1 + \frac{R_n [\rho^2 (R_g + r_c)^2 + (R_g + r_b)^2]}{R_g r_c^2} \tag{18}$$

where

$$R_n = \frac{E_{nc}^2}{4 KT (f_2 - f_1)} \tag{19}$$

The only parameter of these equations that can be varied externally is the source resistance R_g. Figure 10 shows the variation of F with R_g for different values of the parameter ρ.

The noise figure F has a minimum for the following values of R_g:

For grounded emitter

$$R_g' \cong \left[\frac{\rho^2 \alpha^2 r_c^2 + (r_e + r_b)^2}{1 + \rho^2} \right]^{1/2} \tag{20}$$

For grounded base

$$R_g' \cong [\rho^2 \alpha^2 r_c^2 + (r_e + r_b)^2]^{1/2} \tag{21}$$

For grounded collector

$$R_g' \cong \left[\frac{\rho^2 r_c^2 + r_b^2}{1 + \rho^2} \right]^{1/2} \tag{22}$$

This minimum, however, is not very critical as it can be seen from the theoretical curves in Fig. 10 and the experimental curves in Fig. 11. Somewhat larger or smaller values of R_g may be used without an appreciable increase in amplifier noise.

Using Eq. 17 and 21 for the grounded-base connection, the minimum noise figure will be

$$F_{min} = R_n \left[\frac{2 (r_e + r_b)}{\alpha^2 r_c^2} + \frac{2 \rho^2}{\sqrt{\rho^2 \alpha^2 r_c^2 + (r_e + r_b)^2}} \right] \tag{23}$$

Now if the value of R_g is increased or decreased four times, the noise

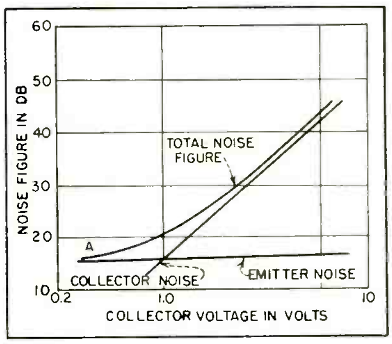


FIG. 8—Contribution to noise figure due to emitter and collector noise

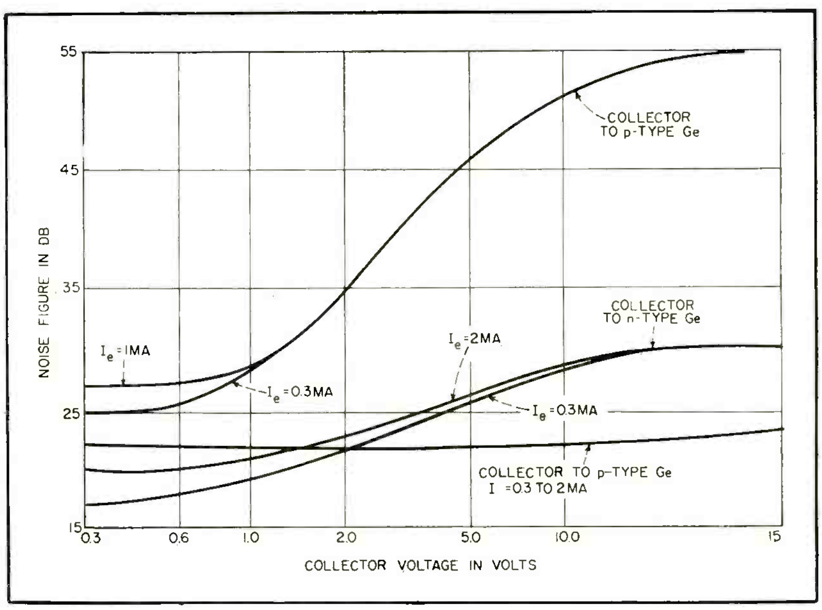


FIG. 7—Transistor noise versus operating point

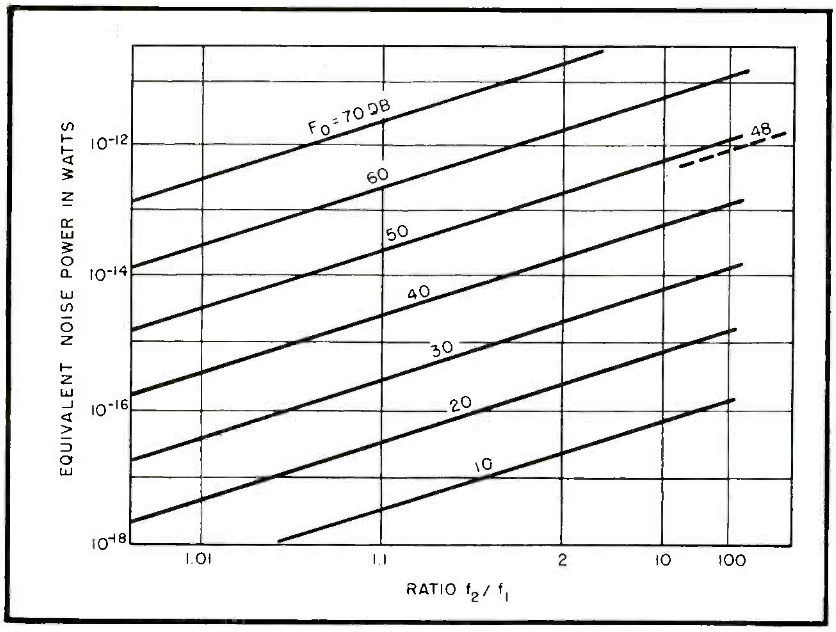


FIG. 9—Available equivalent noise power

figure will be

$$F_{min}' = R_n \left[\frac{2\,(r_e + r_b)}{\alpha^2 r_c^2} + \frac{17\,\rho^2}{4\sqrt{\rho^2\alpha^2 r_c^2 + (r_e + r_b)^2}} \right] \qquad (24)$$

which indicates that the noise figure changes at most 2.12 times or 3.2 db. This figure is actually much less for most practical cases.

The addition of a resistance in series with R_g or in parallel with the input of the transistor amplifier will not improve the signal-to-noise ratio.

Generally, in multistage transistor amplifiers, the first stage will contribute significantly to the noise figure. However, if the equivalent source impedance of the second stage differs very much from the value of R_g given by Eq. 20, 21 and 22 the noise of the second stage must also be taken into account.

The noise figure of a two stage amplifier is

$$F = F_1 + \frac{F_2 - 1}{G_1} \qquad (25)$$

where F_1 and F_2 are the noise figures of the first and second stage respectively and G_1 is the available power gain of the first stage. This available power gain has the following values: For grounded base

$$G_1 = \frac{\alpha^2\, r_c\, R_g}{(r_e + r_b + R_g)\,[r_e + r_b\,(1 - \alpha) + R_g]} \qquad (26)$$

For grounded emitter

$$G_1 = \frac{\alpha^2 r_c R_g}{(r_e + r_b + R_g)} \times \frac{1}{[r_e + r_b\,(1 - \alpha) + R_g\,(1 - \alpha)]} \qquad (27)$$

For grounded collector

$$G_1 = \frac{r_c R_g}{(r_c + r_b + R_g)} \times \frac{1}{[r_e + r_b\,(1 - \alpha) + R_g\,(1 - \alpha)]} \qquad (28)$$

The noise figure of the second stage depends on the operating point of the second transistor and the first stage output resistance. This output resistance can be changed by transformer coupling the two stages. This coupling will leave G_1 unchanged. Adjusting the transformer turns ratio so that the apparent source impedance of the second stage is that given in Eq. 20, 21 and 22, will reduce the influence of the second stage.

If the two stages are coupled without a transformer, one obtains the following approximate expressions for the grounded emitter stage: Assuming that in Eq. 1; $E_{ne}^2 >> E_{nc}^2$ and $R_g = R_{o1}$ (where R_{o1} is the output resistance of the first stage of the amplifier) and $R_{o1} >> R_e + R_b$, the noise figure of the second stage is

$$(F_2 - 1) \cong \frac{E_{nc2}^2}{4\,KTB} \times \frac{R_{o1}}{\alpha_2^2\, r_{c2}^2} \qquad (29)$$

The available power gain is

$$G_1' = \frac{\alpha_1^2\, r_{c1}^2\, R_g}{(r_{e1} + r_{b1} + R_g)} \times \frac{1}{[r_{e1} + r_{b1}\,(1 - \alpha_1) + R_g\,(1 - \alpha_1)]} \qquad (30)$$

First stage output resistance is

$$R_{o1} = r_{c1} \times \left[\frac{r_{e1} + r_{b1}\,(1 - \alpha_1) + R_g\,(1 - \alpha_1)}{r_{e1} + r_{b1} + R_g} \right] \qquad (31)$$

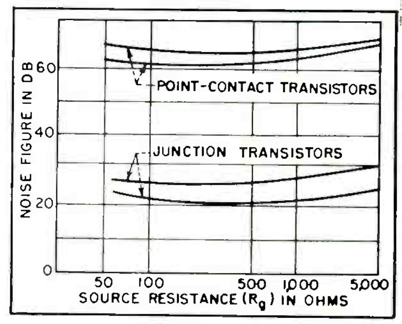


FIG. 11—Comparison of noise figure in point-contact and junction transistors

and therefore

$$F = F_1 + \frac{E_{nc2}^2}{4\,KTB} \times \frac{[r_{e1} + r_{b1}\,(1 - \alpha_1) + R_g\,(1 - \alpha_1)]^2}{\alpha_2^2\, r_{c2}^2\, \alpha_1^2\, R_g} \qquad (32$$

This equation permits calculation of the contribution of second stage to overall noise figure for direct or R-C coupled amplifiers.

Noise in transistor amplifiers is similar to contact noise insofar as it depends strongly on the frequency. Total noise power is not proportional to amplifier bandwidth but depends on the ratio of the frequencies limiting it.

This work was supported by the Air Material Command, Signal Corps and Bureau of Ships under contract AF 33-16001-17793.

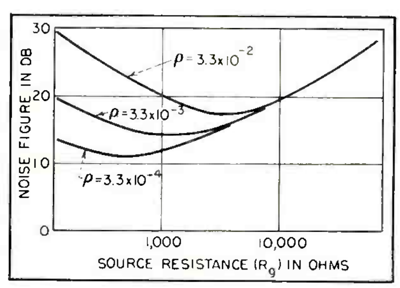


FIG. 10—Variation of noise figure with source resistance for different values of E_{ne}/E_{nc}

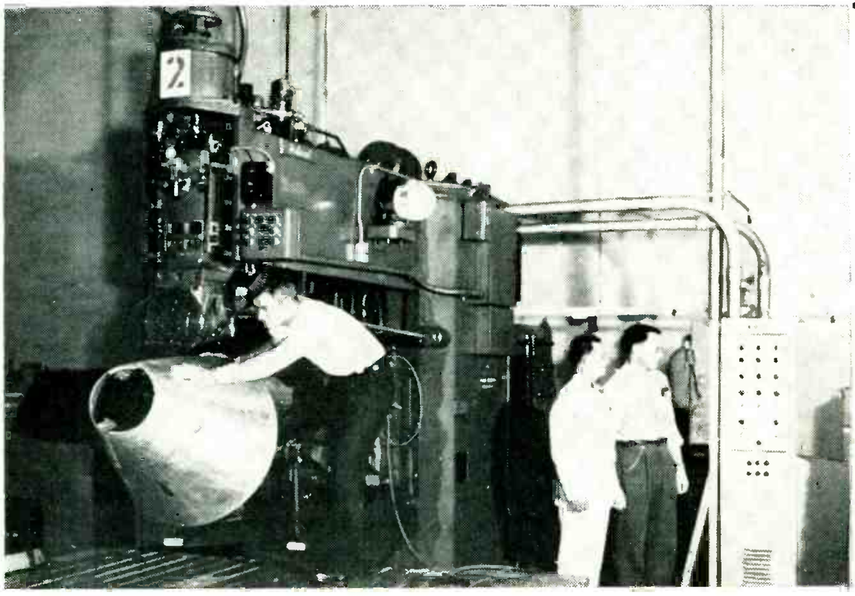
BIBLIOGRAPHY

E. Keonjian and J. S. Schaffner, An Experimental Investigation of Transistor Noise, *Proc. IRE*, p 1,456, Nov. 1952.

H. C. Montgomery, Transistor Noise in Circuit Applications, *Proc. IRE*, p 1,461, Nov. 1952.

Frequency Changer for

By M. E. BIVENS
Control Engineering Department
General Electric Co.
Schenectady, N. Y.



Three-phase resistance welding control (right) used with a spot-welding machine at a West Coast aeronautical plant

THREE-PHASE POWER of one frequency, usually 60 cycles, may be changed electronically to single-phase power of lower frequency. This practice eliminates the annoying blinking of lights caused by the large intermittent load of a resistance welder on an inadequate power supply. Quality of welds is improved by elimination of these voltage dips when several welding machines are operated randomly on the same lines.

One cause of the heavy load is that resistance-welder loads usually are highly inductive and have a low power factor at 60 cycles. The welding transformer secondary circuit of a large press-type welder is essentially a very-low-resistance loop. In some cases, the welding current is largely reactance limited and only part of the kva demand is used for heating.

Changing to a lower frequency decreases the reactance drop, improves the power factor, reduces the required secondary voltage and reduces the kva demand and line drop. Distributing the demand current on three lines, instead of on two lines, further reduces the line drop.

The frequency-changing principle is shown in Fig. 1. A cycle of the l-f single-phase output is started with a l-f half cycle, arbitrarily called a positive half cycle. This l-f half cycle is started by drawing power through a power tube, from what is designated as the *A* phase of the three-phase power supply (lines 1 and 2). Instead of allowing this phase to continue to energize the load at 60 cycles, the load is transferred to phase *B* by means of power tubes when the phase-*B* voltage of corresponding polarity exceeds that of phase *A*. Similarly, the load is next transferred from phase *B* to phase *C*, then to phase *A* and so on to produce a continuous load voltage of positive polarity for the first half cycle of the low frequency.

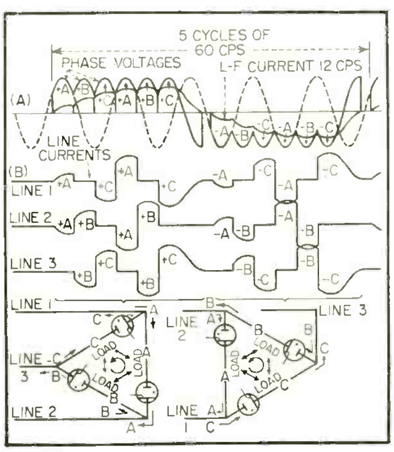


FIG. 1—Basic principle of converting three-phase power to single-phase low-frequency power by using power tubes

Load voltage is made up of 120-deg segments of positive voltages from the three phases. Load current is composed of 120-deg blocks of unidirectional currents drawn successively from the three phases as shown in Fig. 1A. The power lines carry alternating current as shown in Fig. 1B. The distinct build-up of the load current as shown by the waveform sketch is for an inductive load (welder load) and is a characteristic of the current rise when d-c is applied to an inductive circuit.

During the l-f half cycle, the load transformer must be capable of developing a continuously increasing flux to generate the required unidirectional back emf or induced voltage. After a few cycles of applied rectified 60-cycle three-phase voltage, the load is disconnected from the power supply. At the end of the positive l-f half cycle, and when the phase-*A* voltage reverses, the load is reconnected to phase *A* through a power tube of opposite polarity so as to cause the load transformer to induce a secondary voltage of negative polarity to start the negative l-f half cycle.

Load Transfer

By means of power tubes, the load is transferred from phase to phase at the proper instant to provide a continuous load voltage of negative polarity to make up the

Resistance Welding

Direct conversion from three-phase 60-cycle power to single-phase low-frequency power improves power factor and reduces kva demand and line drop compared to the more commonly used 60-cycle single-phase machines

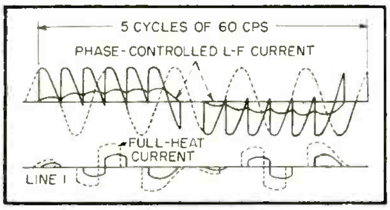


FIG. 2—Phase-controlled power tubes determine the effective value of the single-phase low-frequency voltage

negative l-f half cycle during a few cycles of the 60-cycle supply.

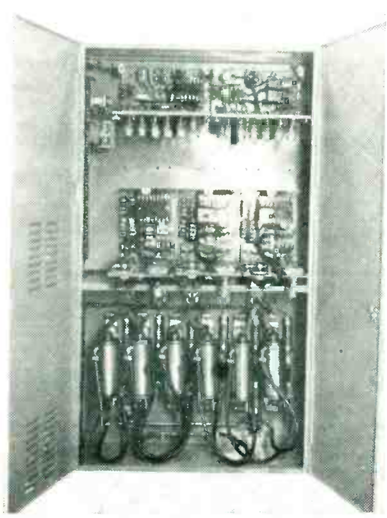
Each l-f half cycle is started by drawing power from phase *A* and is terminated by drawing power from phase *C*. In the case illustrated by Fig. 1, power is fed to the load during two cycles of the 60 cycles, with one-half of a 60-cycle between l-f half cycles. The whole l-f cycle has a duration of 5 cycles out of 60 cycles or a fundamental frequency of 12 cycles.

Heat Control

Power tubes, used for transferring the load from phase to phase as previously explained, also provide a convenient means of adjusting the effective value of the applied l-f voltage. This heat control is effected by delaying the transfer from one phase to the next as shown by Fig. 2.

The transfer is shown in Fig. 1 as occurring at about 30 deg on the phase voltages, thus utilizing the maximum envelope of the three phase voltages. In Fig. 2, the transfer is shown as occurring at about 65 deg on the phase voltages and producing about 50-percent maximum current or 25-percent heat. The range of current control from 100 down to 20 percent (100 to 4-percent heat) requires adjusting the transfer or commutation from about 30 deg to 110 deg on the phase voltages. Figure 2 also shows the current in line 1 which is composed of the currents of the *A* and *C* phases. For reference, the full-heat current is shown dotted.

Figure 3A shows a case where the duration of applied unidirectional voltage during the l-f half cycles, designated as the pulse time, is increased to 3 cycles of the 60 cycles for a welding frequency of 8-4/7 cps. With other factors the same, the welding transformer must be capable of developing a larger amount of flux for 3 cycles than for 2 cycles because it must maintain the same rate of increase in flux for the longer time interval of a l-f half cycle. Size of the welding transformer is determined by the pulse time. For example, Fig. 3B also has a welding frequency of 8-4/7 cps, but has a pulse time of 2 cycles and can use a smaller welding transformer.



Front view of welder control unit, with doors open

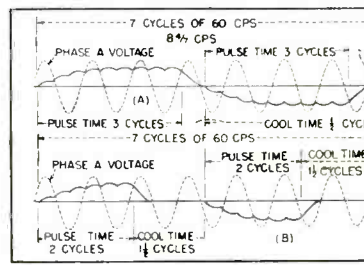


FIG. 3—Illustration of terms pulse time and interpulse time

Figures 1, 2 and 3 show l-f welding current as applied to produce a spot weld requiring one or more l-f cycles of current. The reasons for using different pulse times as shown by Fig. 1A and 3A, or for using different time intervals (designated as interpulse time) between l-f half cycles as shown by Fig. 1A and 3B, are somewhat as follows:

Benefits from reduction in kva demand are greater when using lower welding frequency as in Fig. 3A but the lower transformer frequency requires a larger welding transformer. In general, the optimum low frequency is considered as being 8-4/7 or 12 cps, with a pulse time of 2 or 3 cycles.

There are several uses for different time intervals between the l-f half cycles as shown by Fig. 1A and 3B. Thin gauges of metal may be welded by using a single l-f half cycle. In some cases, seam welding may be done by the continuous application of l-f half cycles and by using a time interval of a few cycles of 60 cps between l-f half cycles. Thus, the interpulse time interval between l-f half cycles in Fig. 1A, 3A and 3B is much longer

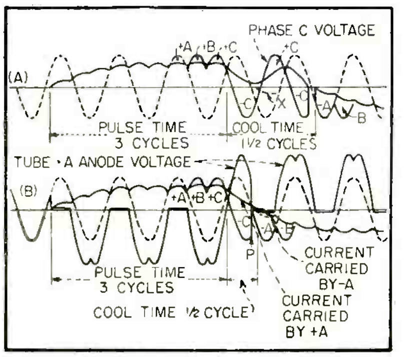


FIG. 4—Cause of commutation faults (A) and prevention of commutation faults by applying inversion operation (B)

than for seam welding.

When spot welding is done by means of a single l-f half cycle, successive spot welds should be made using welding current of opposite polarity, known as antipolar half-cycle operation. This practice avoids energizing the welding transformer with a series of unidirectional voltage impulses which might cause saturation of the welding transformer. If unidirectional l-f half cycles are used for spot welding, the welding transformer should be premagnetized with flux of opposite polarity during the intervals between welding.

Commutation Faults

Certain conditions of spot welding with full l-f cycles may require using more than ½-cycle interpulse time, as shown in Fig. 4A. A long pulse time, a high percentage current setting and a secondary circuit having high inductance may, at the end of a l-f half cycle, cause the current from the C phase to drag out. These conditions would keep the load connected to phase C until phase C again becomes positive.

Starting the negative l-f half cycle at point X while the positive current persists will result in a commutation fault. The supply currents, being limited only by resistance of transformer primary windings and leakage reactance between windings, would be excessive and several times their normal magnitude. The commutation fault may be prevented by increasing the interpulse time interval between l-f half cycles as shown in Fig. 4A. Another method of avoiding commutation faults, which provides a more continuous flow of welding current, is the use of inversion as shown in Fig. 4B.

Inversion

Inversion operation consists of controlling the conductivity of the power tubes so that at the end of a l-f half cycle, the energy stored in the load and welding transformer continues to be forced back into the supply to extinguish the current. Otherwise, the load and welding transformer would again draw power from the C phase. As shown in Fig. 4B, inversion operation is accomplished by transferring the phase-C drag-out current (at point P) to the phase-A power tube which has been operating during the l-f half cycle. A voltage of opposite polarity to the preceding l-f half cycle is maintained on the primary of the welding transformer to accelerate the decay of primary current.

At point P in Fig. 4B, the phase-A voltage is zero and the phase-A power tube cannot be fired on the phase-A voltage. If phase C is still connected to the load by drag-out current through the C power tube, the phase-C voltage is induced in the anode circuit of the A power tubes. During that part of the cycle, the anode voltage of the phase-A power tubes is the difference between the phase-A and phase-C voltages. Because of the induced transformer voltage, there is considerable positive anode voltage to refire the phase-A power tube at the time the phase-A voltage is zero.

Immediately after point P and during the time that the drag-out current is being carried by the $+A$ power tube, the anode voltage of the $-A$ power tube is negative. The grid of its firing tube may be turned on so that the next l-f half cycle starts as soon as current of the preceding half cycle is extinguished. In contrast with the case of Fig. 4A where a welding frequency of 8-4/7 cps is desired but a welding frequency of 6.67 cps must be used to prevent a commutation fault, the addition of inversion operation as shown in Fig. 4B permits using the 8-4/7-cps frequency with a more steady flow of welding current.

Control Operation

The mode of l-f control operation is outlined by the schematic diagram of Fig. 5. All control tubes are small thyratrons. Larger thyratrons are used for firing the ignitron power tubes. Control is a-c operated in that all tubes have a-c anode voltages. This frequency-changing control may be separated into five functional sections: the sequence control, low-frequency timer, trailing exciters, firing tubes and power tubes (with the welding transformer). The control functions of each of these sections and the relationship of section operations will be explained with reference to Fig. 5.

As shown by Fig. 5, the sequence control and low-frequency timer operate from phase-A control voltage. Governed by the sequence control, the squeeze time allows the welder electrodes to close on the work before welding current is applied. The weld interval is the duration of low-frequency welding current. The hold time maintains the electrode pressure on the work while the weld is cooling. The off

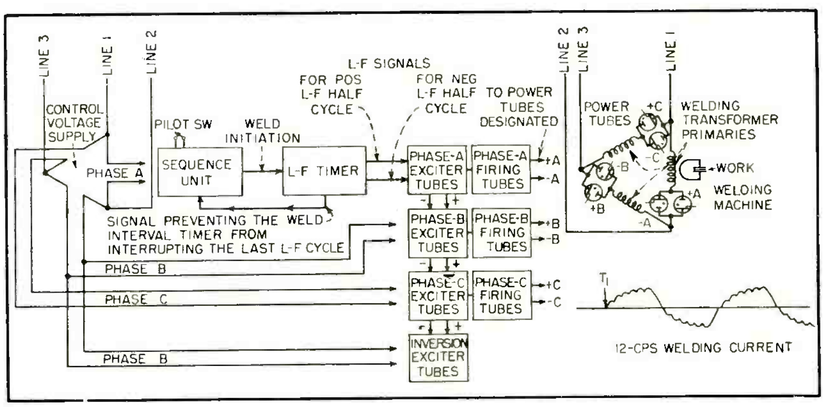


FIG. 5—Control and power circuit sections and basic mode of operation

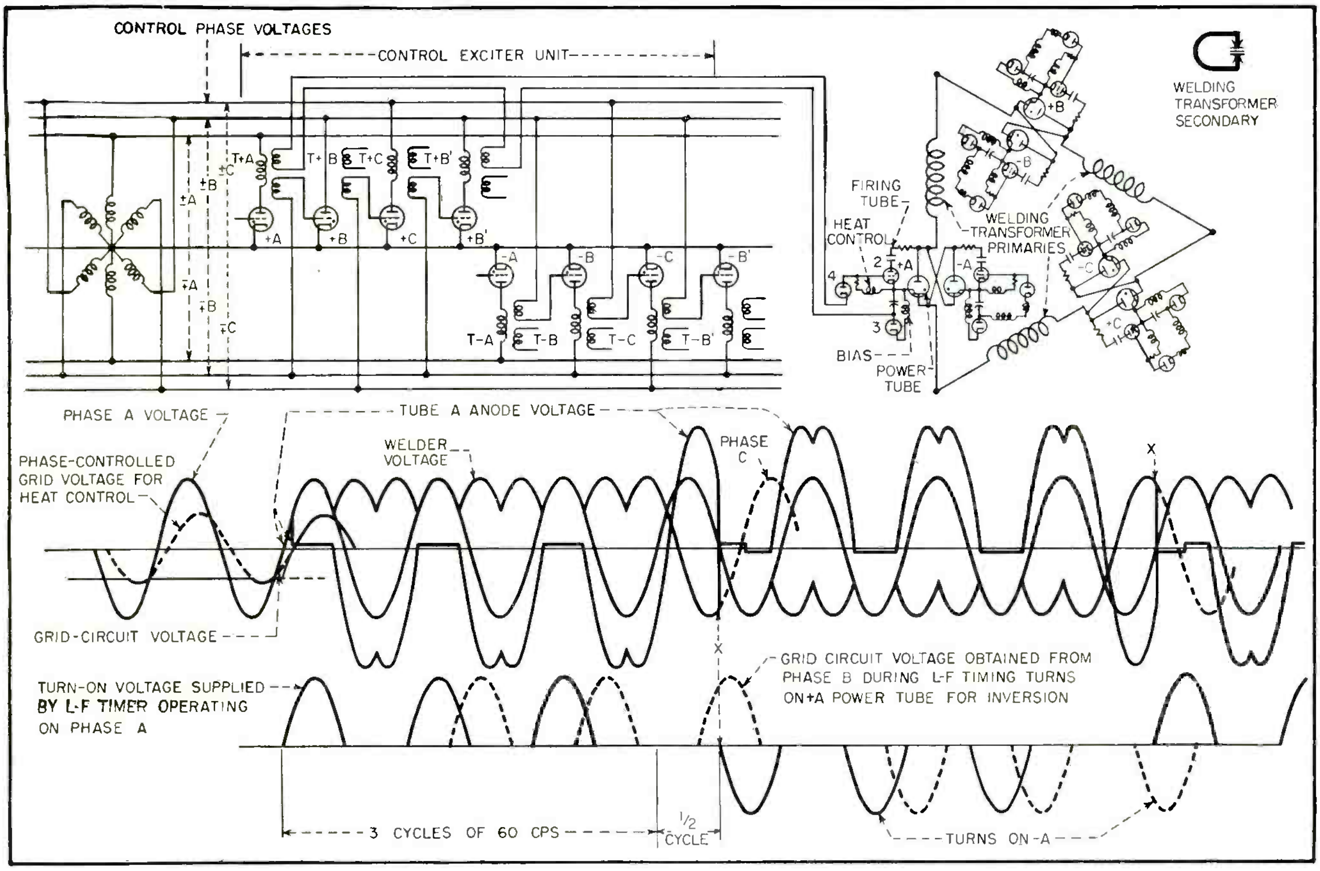


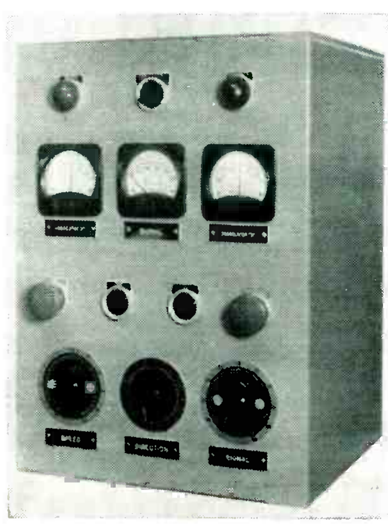
FIG. 6—Details of exciter unit circuit and power circuit, including firing tubes

time, used only for repeat operation, is the time that the electrodes remain open for the removal of the welded parts and the placement of new parts to be welded.

The l-f timer controls the duration of the l-f half cycles (pulse time) and the time interval between l-f half cycles (interpulse time). It also insures that each weld starts with a full positive l-f half cycle and is ended with a full negative l-f half cycle to provide complete l-f cycles of welding current, except where l-f half-cycle welding is being done.

In response to the l-f timer, the exciter section sets up a pattern of three-phase control voltages or signals for turning on the firing tubes in the proper order. The control operation thus branches out into three-phase operation in the exciter section. Inversion control also originates in this section. The $+A$ exciter tube controls all the other tubes in the $+$ circuit branches (phases A, B, C) extending toward the power circuit. The $-A$ exciter tube controls all the other tubes in the $-$ circuit branches extending toward the power circuit.

The turn-on voltages from the exciter unit, applied in the grid circuits of the firing tubes, are really releasing voltages rather than turning-on voltages because the operation of the firing tubes further depends upon phase-controlled voltages in their grid circuits for heat control (percent current). The firing tubes turn on the ignitron power tubes to phase-control the



Operator's control station, showing control operation adjustments

three-phase power applied to the welder and to refire the A power tubes at the right time for inversion operation.

In this case, the load consists of the welding transformer having three primary windings and one secondary winding on a common magnetic core. It may be considered as a single-phase welding transformer having three primaries connected to the three-phase power supply through time-controlled and phase-controlled power tubes to compose the single-phase l-f output.

Circuit Details

The power circuit, including the welding transformer, power tubes and firing tubes, is shown in the upper right corner of Fig. 6. Igniter current of each power tube is controlled by the firing tube connected between anode and igniter. Since each power tube and its firing tube have the same anode voltage, except at the instant while the igniter current flows, the combination may be thought of as grid control on the ignitron.

During standby, the anode voltages are the phase voltages. During three-phase operation, a much different condition exists. Consider the A power tubes, for example. During welding, the anode voltage is the difference between the phase-A voltage and the voltage of the operating phase induced through transformer action in the primaries of the welding transformer. This is shown in the waveform sketch of Fig. 6. This condition must be recognized when considering tube ratings and should be kept in mind when considering inversion operation.

All of the firing tubes are phase-controlled for heat control. The grid circuits of the A firing tubes provide the additional feature of inversion. An A firing tube and its grid circuit is shown in Fig. 7 for the analysis of firing-tube grid-circuit operation.

Figure 7A shows the essential components of the grid circuit. The component circuits are shown separately in the successive figures. Figure 7B shows the negative d-c grid-bias voltage provided by rectifier 3 and applied by switching tube 4 to keep the firing tube nonconductive during standby. Figure 7C shows the phase-shifted sine-wave component of voltage applied to the grid to trigger the firing tube at the desired point in the anode voltage wave. These component voltages of the grid circuit exist simultaneously during standby and are shown combined in Fig. 7D. In this case, during any time in the cycle the grid potential of the firing tube is at which ever potential is more negative, the d-c bias or the sine-wave phase-controlled voltage component.

In Fig. 7E, a half cycle of sine-wave turn-on (or releasing) grid voltage in phase with the firing-tube anode voltage is applied to raise the cathode potential of switching tube 4 above the cathode potential of the firing tube. The firing tube is then permitted to become conductive in accordance with the phase-controlled grid voltage or heat setting.

In Fig. 7F, the turn-on grid voltage is obtained from phase-B control voltage and the firing tube is not triggered until the phase-A voltage has decreased to about zero

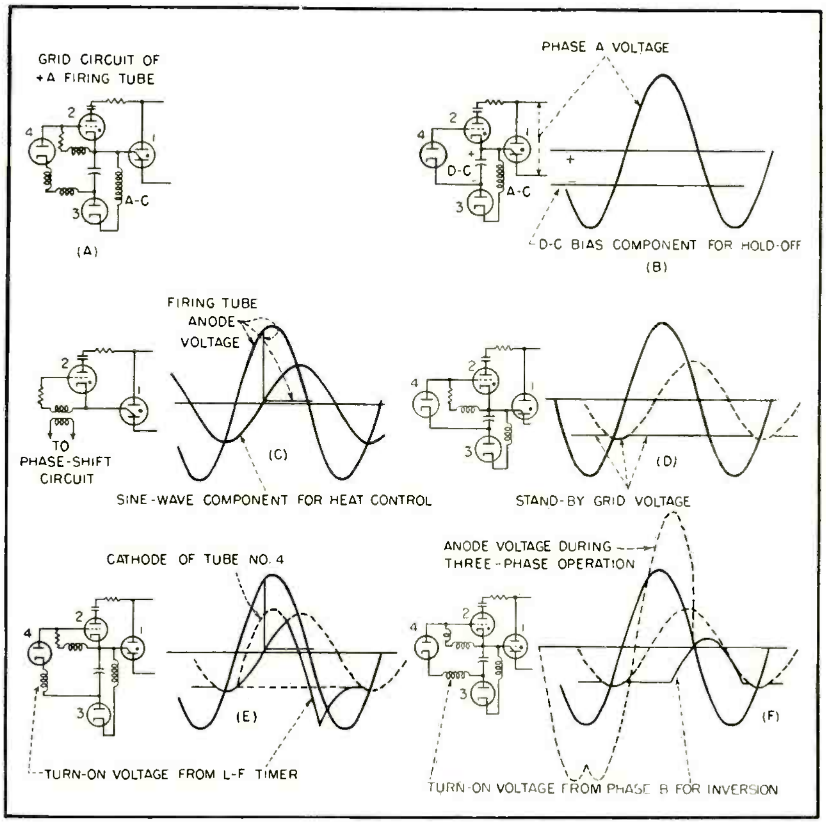


FIG. 7—Analysis of firing-tube grid circuit for turn-on, heat control and inversion

at the end of the positive half cycle of anode voltage. However, at this time there is considerable anode voltage as previously explained. At the end of a l-f half cycle, if A firing tube has not been triggered for heat control and if the phase-C power tube continues to carry current, the A power tube is fired to provide inversion operation.

Exciter Unit

With reference again to Fig. 6, the exciter tubes turn on and control the order of firing of the firing tubes. The $+A$ and $-A$ exciter tubes respond in accordance with the l-f grid-supply voltage patterns made up by the l-f timer. The $+A$ exciter tube, with its trailing $+B$ and $+C$ tubes, turn on the positive half cycle of l-f welding current. The $+B'$ exciter tube, trailing the $+C$ exciter tube, provides the half cycle of voltage from phase B to turn on the $+A$ firing tube for inversion operation at the end of the positive l-f half cycle. The $-A$, $-B$, $-C$ and $-B'$ exciter tubes operate in similar manner to produce the negative l-f half cycle of welding current.

The l-f timer is composed of electronically interlocked electronic timing circuits. Operation of the l-f timer may be explained best by first considering Fig. 8. This circuit embodies all of the basic circuit operating principles in the l-f timer.

With reference to Fig. 8A, the anode voltage of thyratron tubes 1 and 3 are in phase but are 180 deg out of phase with the anode voltage of thyratron tube 2. Each tube has an a-c sine-wave grid bias, 180-deg out of phase with its anode voltage and supplemented by the conventional d-c self-rectified bias. When the initiating switch is closed, tube 1 will conduct during the next positive half cycle of its anode voltage as shown by E_1 of Fig. 8B. The anode circuit is inductive and tube 1 will continue to conduct for a portion of a half cycle after the anode supply voltage has reversed and become negative. During this time, after the anode supply voltage has reversed, the anode of tube 1 is maintained positive by the inductive anode current feeding back into the control voltage supply.

During the carry-over of tube 1, the grid of tube 2, connected to the anode of tube 1, is held positive and tube 2 trails as shown by E_2. Tube 2 may start conducting as soon as its anode voltage becomes positive. It does not have to wait until tube 1 stops. Similarly, tube 1 will now trail tube 2 if the initiating switch is opened. The operation of tubes 1 and 2 may be initiated by closing the initiating switch but cannot be stopped by opening the switch.

If the self-rectified bias component of the grid voltage applied to tube 3 has a very short time constant, tube 3 will trail tube 2 immediately. As shown, the self-rectified bias of tube 3 is adjustable (C_t and R_t) and, for the case of the waveform sketch, is set to provide a grid voltage as shown by the curve designated E_t, timing grid voltage. During the next positive half cycle of anode voltage on tube 3 after tube 2 starts conducting, the grid of tube 3 is held negative by the negative d-c timing voltage and tube 3 does not trail tube 2 immediately. After a time delay, shown as set for one cycle, the timing voltage decays sufficiently to allow the grid of tube 3 to become positive at point P and tube 3 conducts during the next positive half cycle of anode voltage. The time constant of the timing circuit may be adjusted so that tube 3 will not start conducting until several cycles after tube 2 starts conducting.

Tube 3 has a neutralizing transformer in its anode circuit. This transformer is equivalent to a reactor having a secondary winding. Transformer T_3 secondary voltages are shown by the curve designated E_{3TS}. One secondary of transformer T_3 feeds an impulse of this voltage back into the grid circuit of tube 2 to neutralize the positive grid-voltage component derived from the carry-over of tube 1. Tube 2 cannot trail tube 1 during the next half cycle after tube 3 conducts.

If the initiating switch has previously been opened, the nonconduction of tube 2 will cause tubes 1 and 3 to stop and the circuit comes to rest. If the initiating switch has been maintained closed, tube 1 will continue to conduct and the nonconduction of tube 2 will stop only tube 3. During the half cycle that tube 2 does not conduct, timing capacitor C_t recharges by grid current from tube 3. During the next half cycle, tube 3 does not conduct. Then tube 2 starts conducting again and thus reinitiates the operation. Tube 3 operates periodically during every third cycle of its positive anode voltage. The R-C circuit may be adjusted for several cycles between conductions.

The circuit may be extended so that the anode potential of tube 3 triggers periodically other tubes connected similarly, or a secondary of transformer T_3 may be used to initiate or cause certain control functions to be performed in other circuits. Other patterns of signal voltage may be supplied by providing transformers in the anode circuits of tubes 1 and 2. By the use of these circuit operating principles, almost any kind of sequencing or timing-voltage pattern based on 60-cycle control operation can be provided. This will be evident during the explanation of the l-f timer operation.

It should be observed that this circuit operation is synchronous. That is, the initiating tube 2 and timing tube 3 must start conducting at the beginning of their positive half cycles of anode voltage or they cannot conduct at all. This is because the grid voltage abruptly goes negative soon after the anode voltage becomes positive.

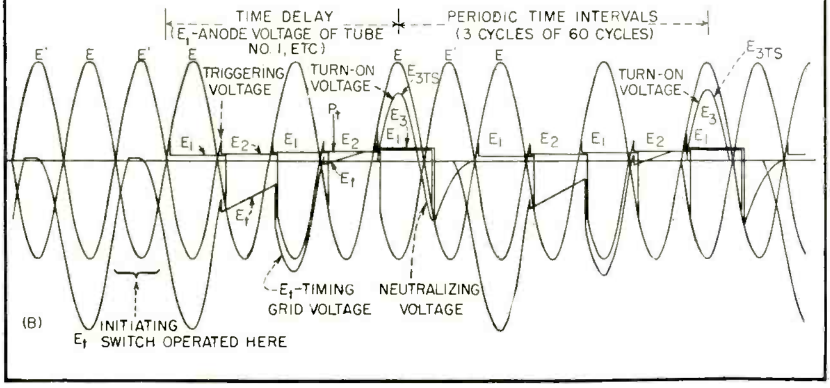


FIG. 8—Basic timing circuit used in low-frequency timing section

Low-Frequency Timer

Figure 9A shows the circuits of the l-f timer, including sequence control tubes 4 and 5 that are directly associated with l-f operation. Figure 9B shows the time relationship of the control-tube operations. This is an 8-4/7 cycle welding frequency having 3-cycle pulse time and one-half cycle cool time.

With reference to Fig. 9A and 9B, the l-f circuit operation is as follows: At the end of the sequence squeeze time, when the welder electrodes have closed on the work, tubes 4 and 5 operate simultaneously. Tube 5 initiates the weld interval. Tube 4 initiates the positive l-f half cycle of welding current by triggering the $+A$ exciter tube and initiates l-f timing by triggering tube 11. Tube 4 also prevents weld-interval timer-tube 6 from trailing tube 5 in case the weld-interval R-C timing circuit times out during the l-f cycle.

Because of the inherent ½-cycle delay of one tube trailing another, there is one-cycle inherent delay between tubes 4 and 12. For an 8-4/7 cycle welding frequency having 3 cycles of 60-cps pulse time, three times around on the three phases, the inherent one-cycle delay between tubes 4 and 12 is supplemented with a two-cycle R-C delay designated as pulse time No. 1. This allows the $+A$ exciter tube to

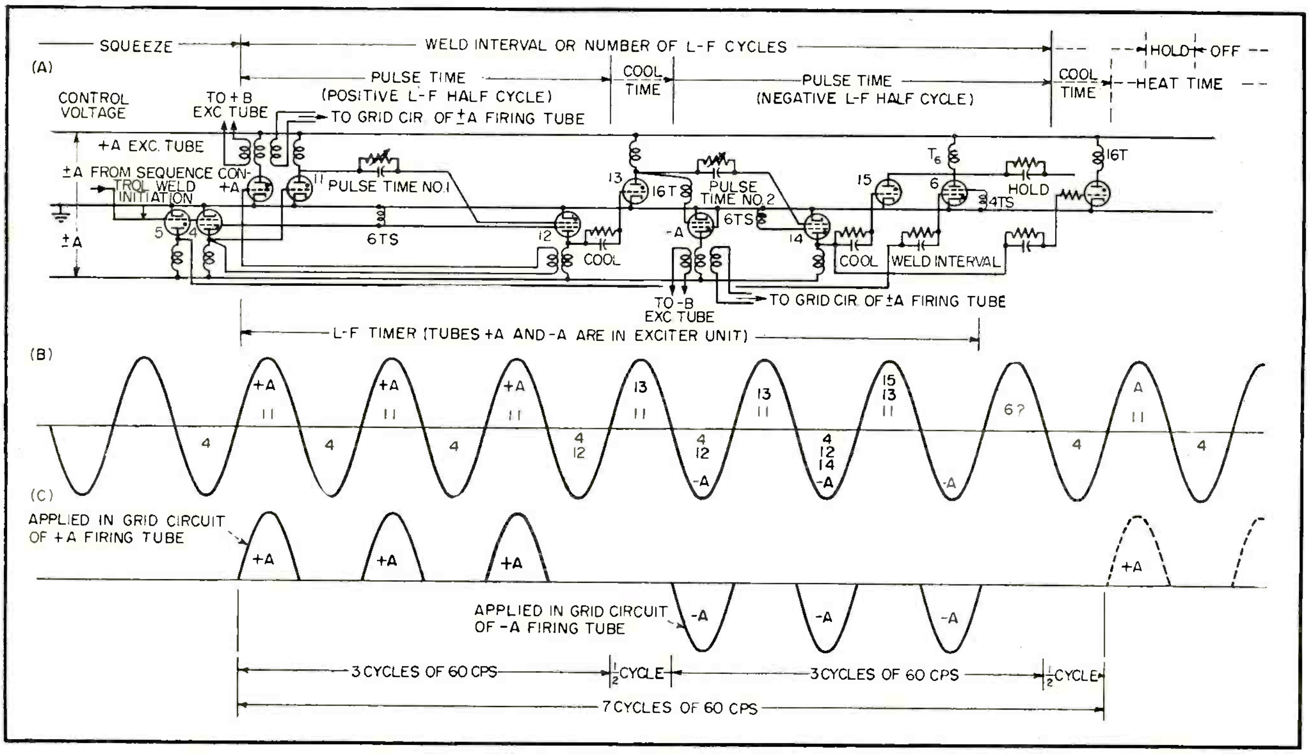


FIG. 9—Low-frequency timing circuit

operate three times in succession, as shown by the waveform sketch Fig. 9C. Tube 12 then conducts and stops the $+A$ exciter tube from trailing tube 4. This operation, including inversion operation which originates in the exciter unit, terminates the positive l-f half cycle of welding current.

For minimum permissible interpulse time of ½ cycle (60 cps) between l-f half cycles, there must be one full 60-cps interval between conductions of the $+A$ and $-A$ exciter tubes. The $-A$ exciter tube must be turned on for the pulse time of 3 cycles of 60 cps. The voltage patterns for three successive conductions of the $+A$ exciter tube and three successive conductions of the $-A$ exciter tube must be antipolar. Tube 13 is allowed to trail tube 12 without time delay and the $-A$ exciter tube trails tube 13 to start the negative l-f half cycle of welding current.

A one-cycle R-C delay between tubes 13 and 14 allows the $-A$ exciter tube to conduct once before tube 14 conducts, and this exciter tube trails tube 13 a second time while tube 14 conducts. Tube 15 trails tube 14 without time delay. Tube 15, by energizing transformer T_6, stops tubes 4, 12 and 14 from trailing their respective leading tubes but the $-A$ exciter tube trails tube 13 for the third time (three times around on three-phase operation).

Tubes 11, 13 and 15 that were trailing tubes 4, 12 and 14 are stopped. None of these tubes conduct during the next cycle (of 60 cps) after tube 15 operates. The weld-interval initiating tube 5 in the sequence control continues to operate. Tube 4, stopped by tube 15, gives tube 6 a chance to operate if the weld-interval R-C timing circuit has timed out. This completes one cycle of l-f operation.

If the weld interval has not elapsed to limit the l-f welding current to one l-f cycle, tube 6 will not conduct to keep transformer T_6 energized after it has been energized for one-half cycle by tube 15. Since tube 6 does not respond, tube 4 starts conducting again and reinitiates the next l-f cycle of welding current and tube 4 again blocks tube 6 from operating during the next l-f cycle.

When the weld-interval R-C circuit does time out, tube 4 holds off the operation of tube 6 until the l-f cycle is completed. When the weld interval has elapsed during the l-f cycle and when tube 15 stops tube 4 at the end of the l-f cycle, weld-interval timer-tube 6 is released to keep T_6 energized. The anode of tube 6, which is connected to the anode of tube 15, prevents tube 4 from reinitiating any more l-f cycles of welding current. Therefore the welding transformer is energized for full l-f cycles. Tube 16 is required to terminate the negative l-f half cycle when the interpulse time exceeds 1½ cycles.

Tube 6 also initiates the hold-time during which the welder electrodes remain closed with full pressure on the work while the weld is cooling. From the foregoing description of the l-f timing circuit operations, one may visualize the general scheme of providing the sequence control functions of squeeze, weld interval, hold and off periods by means of a group of similar interlocked component timing circuits.

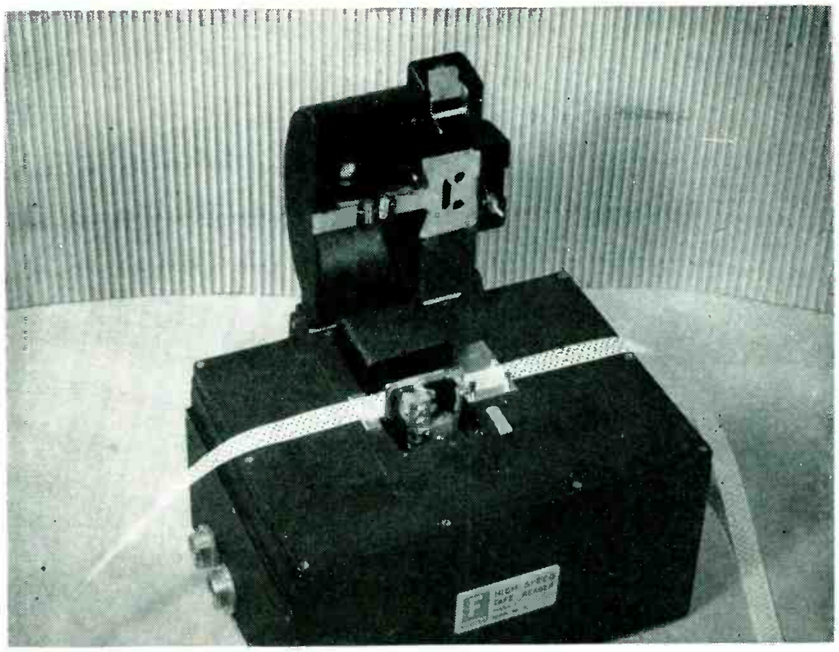
Bibliography

W. K. Boice, Circuit Analysis of Frequency-Changer Welders, *Welding Journal*, Oct. 1949.

F. L. Brandt, R. T. Vredenburgh, L. S. Wilkins, M. S. Shane, P. L. Nies and C. N. Clark, Discussion of Circuit Analysis of Frequency-Changer Welders, *Welding Journal*, Feb. 1950

C. B. Stadum, Low-Frequency Converters, *Welding Engineer*, Aug. 1950.

W. K. Boice, Are You Up to Date on Resistance Welding? *Welding Engineer*, Sept. 1950.



Tape reader, with lamp housing lifted to show feed mechanism

By B. G. WELBY
Development Engineer Computer Group Ferranti Ltd., Moston, England

Intermittent-Feed Computer Tape Reader

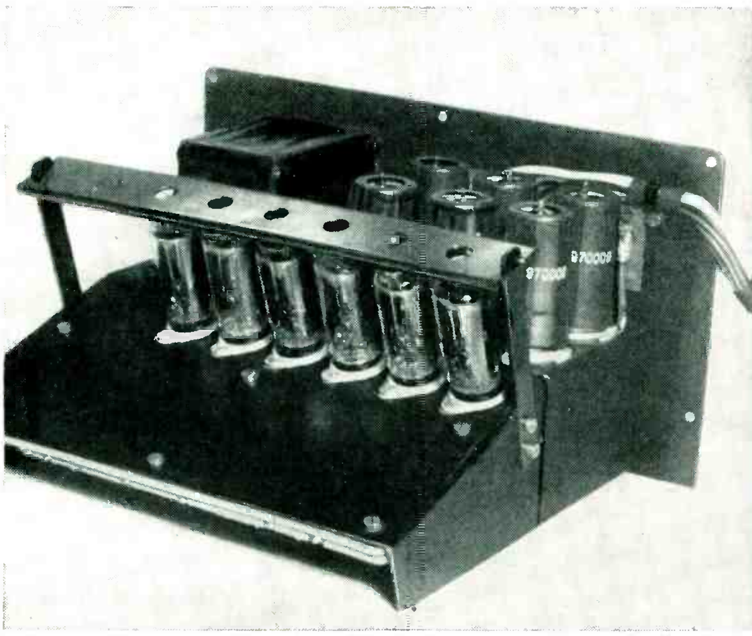
Five-phototube input system for digital computers reads teleprinter punched tape at speeds up to 200 five-hole characters per second. Intermittent tape drive uses clutch and brake solenoids fed by signal derived from sixth phototube located under tape sprocket holes

WHILE the storage and arithmetic units of a digital computer are extremely rapid in operation, a limit to the overall speed of computation is often set by the comparatively slow speed of the input-output system.

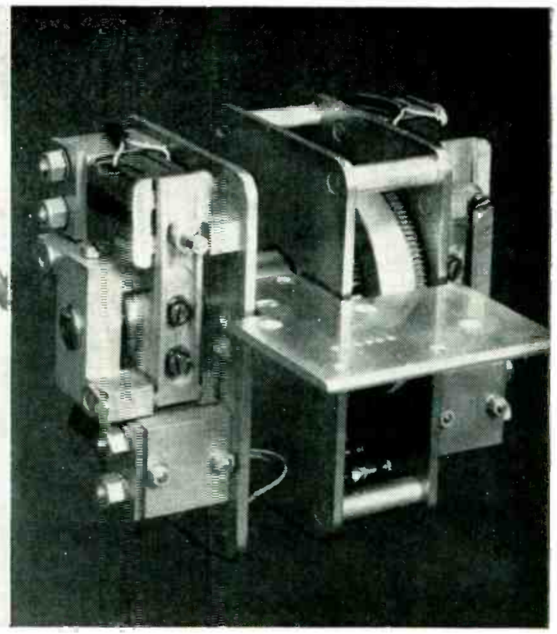
With this point in mind, the tape reader described has been developed for use in the input system of the Ferranti Digital Computer (Mark I), the first of which was installed in the University of Manchester, Manchester, England, and the second in the University of Toronto. Five-unit teleprinter tape is used and the tape reader is capable of operation at speeds up to 200 characters per second. One character is represented by a single row of holes across the tape. Provision is made for the tape to be stopped at each character and, after reading has been completed, to be moved forward to bring the next character into place.

The present tape reader adopts a friction drive arrangement in which the tape is driven by means of a drum held firmly against the tape by a pair of spring-loaded rollers. Wear on the tape through the use of such a drive is negligible. A tape which becomes twisted or is otherwise prevented from passing through the tape reader in a normal manner is able to slip in the mechanism without being torn. A loop of tape has been passed through the tape reader 10,000 times without signs of wear. Splicing of the tape is not a critical operation. A photoelectric reading system has been adopted, which obviates the necessity for metallic contacts and uses the sprocket holes in the tape in a rapid and efficient tape-positioning arrangement.

The general arrangement of the drive mechanism is indicated in Fig. 1. A differential gear is driven by a continuously running induction motor. To one of the output shafts of the gear is attached the



Six phototubes of system are in foreground, with cathode follower stages and power transformer behind. Optical system is in main housing, not shown



Tape feed assembly; brake drum and braking solenoids are at left, and clutch drive system is at right

tape-feed drum and a drum known as the brake drum. To the second output shaft of the gear is connected another drum known as the clutch drum. With this arrangement, the sum of the velocities of the two output shafts is equal in value to twice the velocity of the input shaft. If one of the output shafts is held stationary, the other will achieve a velocity equal to twice that of the input shaft. Rotation of the tape-feed drum is controlled by electromagnetically operated brakes on the brake drum and clutch drum.

The braking mechanism is illustrated in Fig. 2. In the off position, the brake shoes are held lightly against the drum and only a slight movement of the armatures is required for braking. The greater part of the force produced by energizing the electromagnets is thus utilized in forcing the brake shoes against the drum. Since each armature is held close to the core of its electromagnet, a small air gap is possible, giving a high gap flux and economy in magnetizing current.

Brake Design

The air gap is of the order of 0.002 inch in the brake drum system and 0.01 inch in the clutch drum. The armatures are made of soft iron and are designed to have a rigid construction with low inertia. The core is built of Radiometal laminations. The coils have an inductance of 2½ henrys and a resistance of 80 ohms.

A pull of ¾ lb is exerted by each electromagnet on its armature and the measured braking force at each brake shoe is 1½ lb; with a coefficient of friction estimated at 0.4 this results in an effective braking force on each drum of 1.2 lb and a braking torque of 0.48 lb-in. The drums are constructed of stainless steel since a plated surface would, when worn, tend to produce a nonuniform surface. A resin-bonded fabric (Tufnol) has been used for the brake shoes and has shown no sign of wear after many months of service.

The two braking systems are controlled by a bistable triggered circuit, the state of which decides whether the brake or the clutch will be operated upon. The inertia of the moving parts has been kept as low as possible in order that rapid and efficient braking and acceleration of the tape can be obtained. The inertia of the two drums and the associated moving parts is calculated to be 0.015 lb-in.[2] Applica-

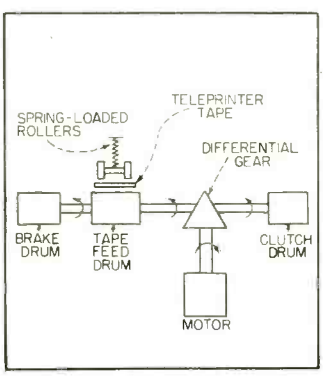


FIG. 1—Tape feed mechanism

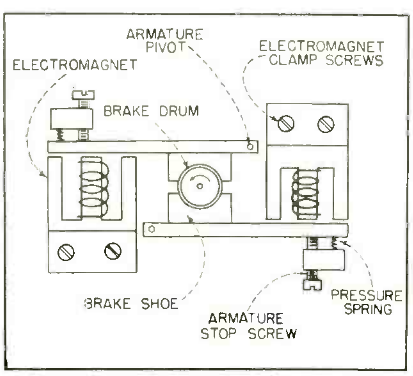


FIG. 2—Arrangement of brake

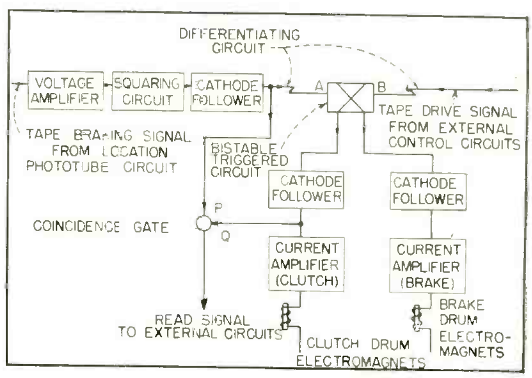


FIG. 3—Electronic control system for tape feed

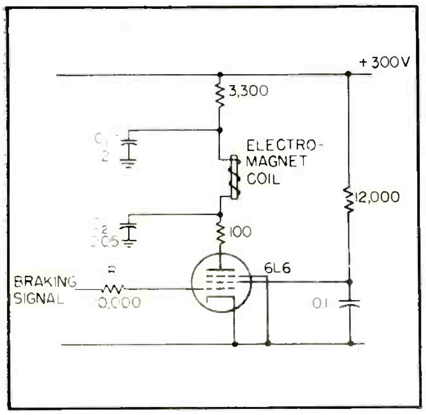


FIG. 4—Solenoid control circuit

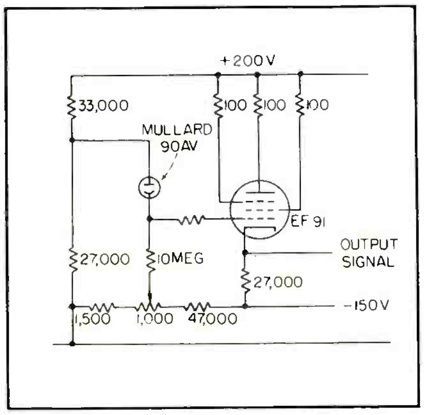


FIG. 5—Photoelectric reading stage

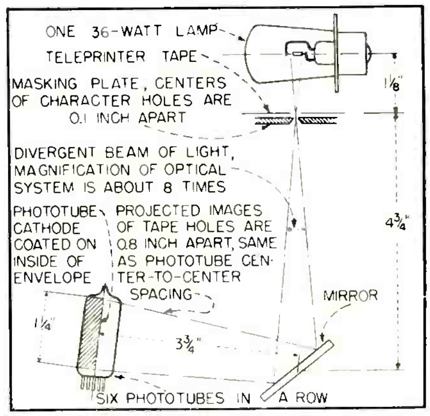


FIG. 6—Optical system of reader

tion of braking torque stops the drum in 0.004 sec. This represents a displacement of 0.04 in. of the tape. Due to delay in operation of the electromagnet, a further 0.005 in. displacement must be taken into account. If braking is commenced when a character is just entering the reading position, the tape will be stopped while the character is located centrally in the reading position. From a stationary position, full speed may be reached and the next character made available for reading within six milliseconds.

Tape-Feed Control System

One system of tape feed which has been devised is indicated in Fig. 3. Sprocket holes in the tape are used to control the braking systems. Entry of a character into the reading position over the masking plate holes initiates a tape-locating signal which operates the brake drum system. The signal is applied to a squaring circuit and thence to a cathode follower whose output is connected to one input of the triggered circuit. By this means, the locating signal produces a trigger pulse at A which applies the appropriate output of the triggered circuit to the brake-drum electromagnet circuits.

A read signal will be given to the external circuits only when two negative-going signals are applied simultaneously to the inputs of the coincidence gate at P and Q. If for any particular character the tape does not stop in the correct position, the signal at P will no longer be present and, although the triggered circuit will be set, no read signal will be transmitted. When reading is completed, a signal is applied to B, resetting the triggered circuit and causing the clutch mechanism to operate and the tape to move forward.

It is essential that the buildup of the current in the electromagnet coils be as rapid as possible. To insure this, a large voltage must be applied initially across the coils. Referring to Fig. 4, the grid of V_1 has a large negative potential in the absence of a signal from the triggered circuit. When a braking signal is applied, the grid potential of V_1 quickly becomes zero. This action will result in a rapid fall of anode potential and, since point P is initially at plate supply potential, there is applied across the coil a sudden large change of voltage. Due to the presence of C_1, the voltage across the coil tends to be maintained and there is a consequent rapid rate of increase of current in the coil. The time taken for the current to build up to its maximum value is 0.5 millisecond. When V_1 becomes cut off again, in the absence of a signal, C_2 limits the rate of decay of current through the coil and hence limits the back emf.

Photoelectric Circuits

Six phototubes are provided in the tape reader, each being connected to a cathode follower. Five of these phototubes are associated with the positions of the five digits of a character on the tape. The sixth or reader location phototube is associated with the sprocket holes and is used to control the movement of the tape.

A typical phototube circuit is shown in Fig. 5 along with the optical system, which uses a single 36-watt prefocussed lamp. By means of the pinhole projection principle, images of the cylindrical (coiled) filament of the lamp are formed by the holes in the tape so as to cover the entire area of the appropriate phototube cathodes.

Blue-sensitive phototubes have been found most suitable for this tape reader. With tubes having a sensitivity of 45 μa per lumen, a signal change of at least 12 volts is available due to the presence of light through a hole.

The tape-reader unit comprises the tape-feed mechanism, the optical projection system and the phototube circuits together with their cathode followers. Provision is made for viewing the tape in the reading position. The tape may be left stationary in the tape reader for long periods without deterioration by heat from the lamp.

Although the tape reader was designed for a specific purpose, it should be readily adaptable for many other applications of a similar nature and in telecommunications. A model of this tape reader has been developed to accommodate either 5-unit or 7-unit teleprinter tape.

The author wishes to express his thanks to the following members of the Computer Group at Ferranti Ltd.: B. W. Pollard for his guidance and helpful suggestions, G. Fox for his help in the production design of the tape reader and D. F. Chatt for his assistance in the preparation of this article.

Ultrasonic Recorder

Torpedo-borne recorder continuously measures running depth by transit time of ultrasonic pulse reflected from ocean's surface. Lock-out bars false echoes arising from scattering. Output level holds when echoes are lost due to roll and pitch

By C. E. GOODELL
Naval Ordnance Laboratory
White Oak, Maryland

INSTANTANEOUS running-depth of a torpedo may be found by recording transit time of ultrasonic pulses reflected by the air-water interface at the surface of the ocean. An ultrasonic transmitter and receiver with necessary timing circuits is mounted in the exercise head of the torpedo as shown in Fig. 1. An output voltage, proportional to the torpedo's running depth is fed to an external recording device located immediately forward of the battery compartment. The exercise head is a dummy head with which the torpedo is fitted for testing and practice as contrasted to the war head that packs the torpedo's explosive Sunday punch.

The photographs show the acoustic transducer mounted on the torpedo's dorsal surface and the ultrasonic-recorder chassis withdrawn from its cylindrical housing. The recorder operates on a carrier frequency of 400 kc.

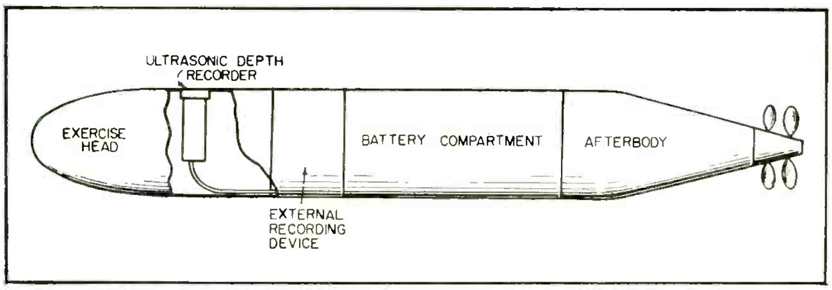


FIG. 1—Test torpedo fitted with exercise head. Cut-away shows depth recorder in place. Strip-chart recorder is forward of battery compartment

How Deep Does A Torpedo Run?

Study of torpedo performance on a test range requires knowledge of the torpedo's instantaneous depth throughout its run. The hydrostat, generally used for torpedo-depth measurement, operates much like an aneroid altimeter and responds only to average change of a rapid fluctuation.

The depth sounder responds to rapid fluctuations but indicates depth with respect to the ocean floor, a poor reference surface for torpedo-depth measurement. In deep water, the ocean floor may be out of range of a sounder suitable for installation in a torpedo.

The ocean's surface has been chosen as reference plane for torpedo-depth measurement despite surface irregularities that produce an inherently poor reflecting surface. Naval Ordnance Laboratory has developed an ultrasonic echo-ranging instrument that uses this air-water interface as a reflector.

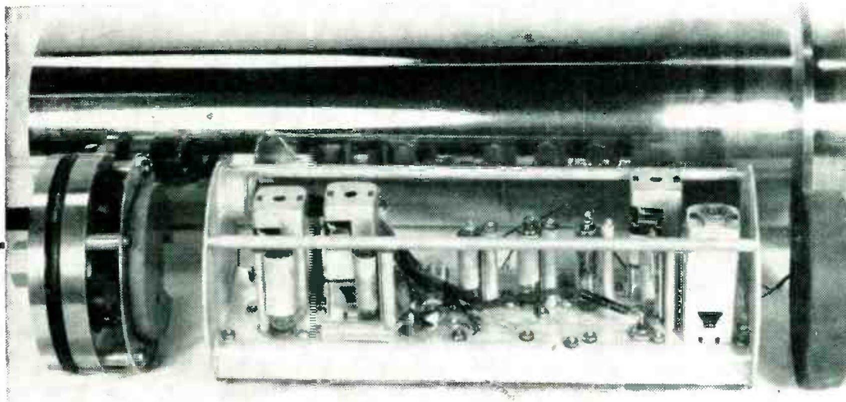
Reflection Problems

Air-water boundary, used as a reflector, is neither of regular shape nor unchanging with time. Variability of surface waves, travel of the torpedo, and large-scale temperature stratifications cause variations in pulse transit time. This appears as jitter in the return pulse position and an apparent fluctuation in depth.

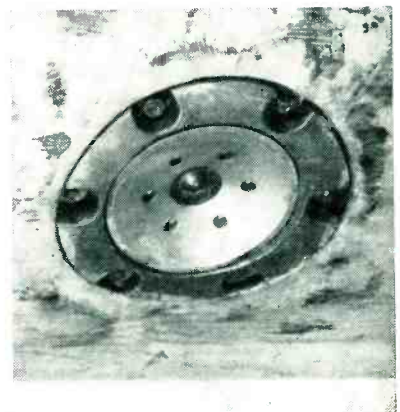
Return-pulse amplitude fluctuation is also troublesome. This is caused by factors having to do with the propagation of sound in water and factors characterizing reflective properties of the air-water interface. The fluctuation in intensity, at a given point, is due to the reinforcement or cancellation of many signals arriving from different reflectors.

The effects of wave troughs upon echoes can be compared to dispersion of light by a convex mirror, while wave peaks act as a concave mirror. The net effect causes loss of echo. Other factors that affect

Gages Torpedo Depth



Depth recorder chassis is mounted in watertight cylinder with acoustic transducer forming top of can



Acoustic transducer is located on torpedo's dorsal surface

seriously return echo detection are noise properties of vehicle, pitch and roll of vehicle and directivity of the transducer.

Figure 2 is a block diagram of the depth recorder. Pulse width and repetition interval are set by a highly unbalanced free-running multivibrator. The ratio of repetition interval to pulse width is 50 to 1. Absolute repetition time determines the maximum depth that can be recorded while pulse width determines both minimum recordable depth and the required amplifier bandpass for most consistent echo detection.

The multivibrator provides three separate signals for recorder actuation. One signal turns on the gated oscillator. Coincident with this, a second signal turns off the tuned r-f amplifier and blocks the thyratron shield grid. The third signal, corresponding to the leading edge of the other pulses, sets the Eccles-Jordan trigger circuit in the on state.

Transmitter

The r-f pulse generated by the gated oscillator excites a tuned power amplifier, which in turn drives the acoustic transducer. The output of the power amplifier is also applied, through a diode limiter, to the input of the tuned r-f amplifiers. However the limiting action of the diodes and the off gate applied to the second stage of the tuned amplifier prevent signals from appearing at the amplifier output during the transmit interval.

Receiver

After an unlocking interval, which follows the transmitted pulse, the tuned amplifiers become active and await the echo signal from the transducer. Unlocking time is controlled by the time constant R_1C_1 (Fig. 3). After an interval corresponding to the time required for the pulse to travel to the air-water surface and return, an echo signal will appear. Since the signal is, in general, smaller in amplitude than the transmitted pulse, limiting by the diodes is practically nonexistent. The echo is amplified and the negative envelope obtained by a germanium-diode detector. The pulse is further amplified and inverted in a triode amplifier. Figure 4 illustrates waveforms present at various points in the circuit.

Because of the irregular char-

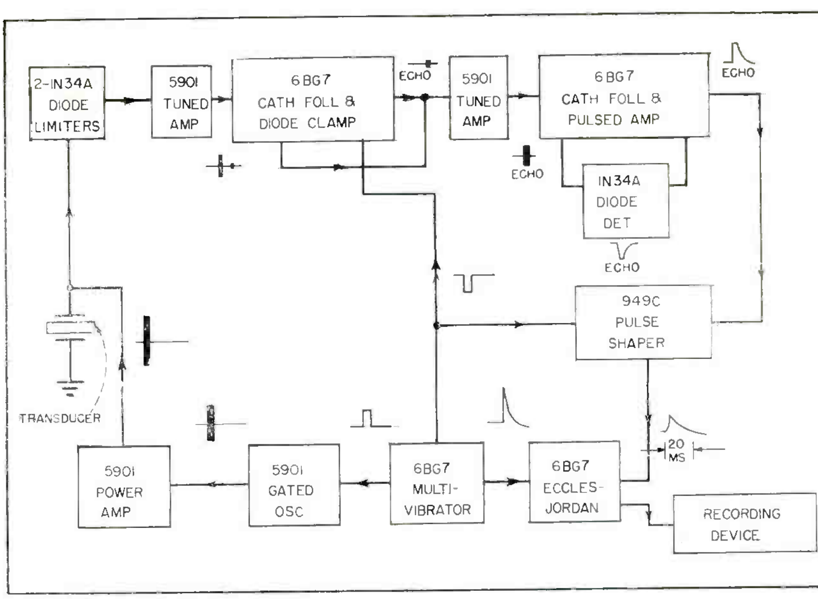


FIG. 2—Depth recorder employs ultrasonic transceiver. Variable-width pulse from Eccles-Jordan measures transit time of ultrasonic pulse reflected at air-water interface

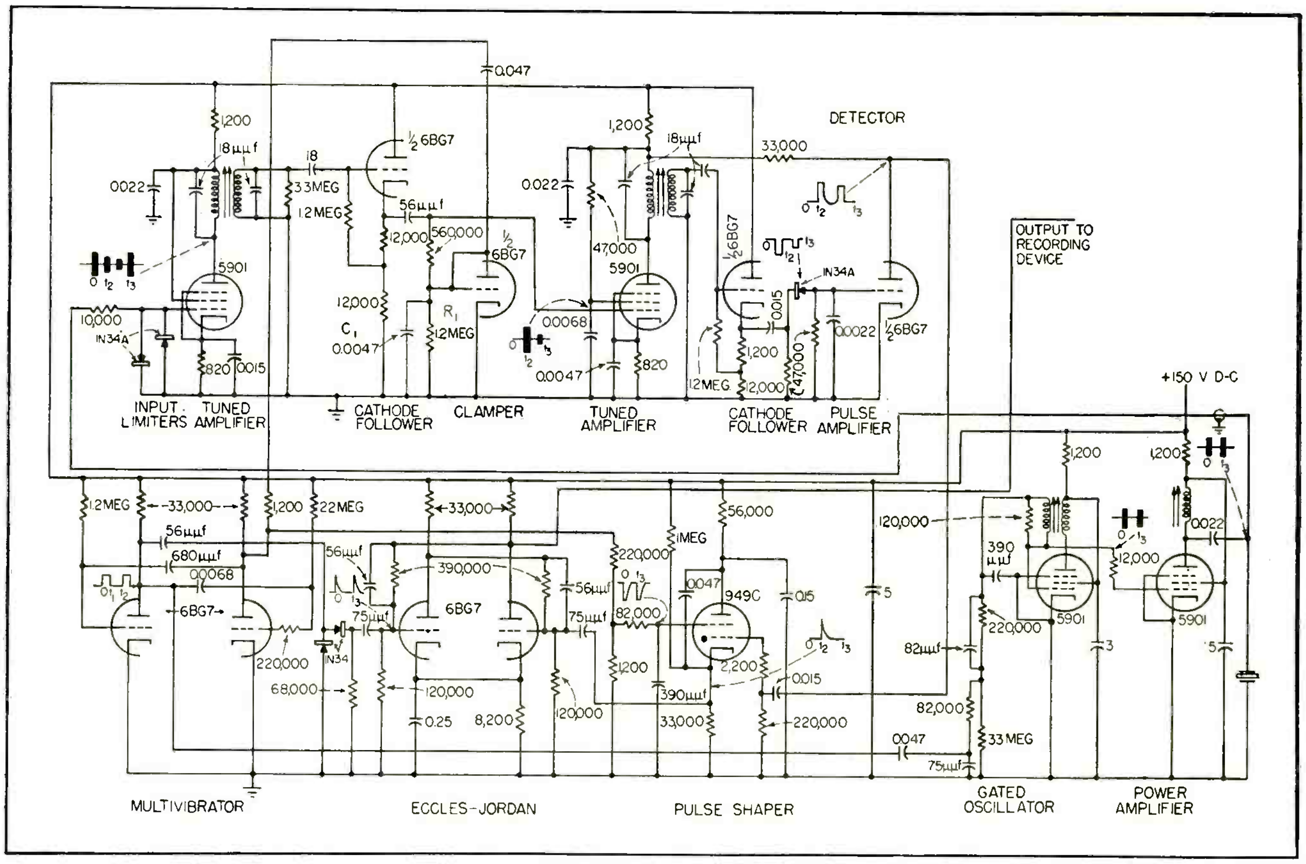


FIG. 3—Free-running multivibrator keys transmitter oscillator and Eccles-Jordan while disabling receiver and pulse shaper during main bang. Shortest-path echo fires thyratron to turn off Eccles-Jordan

acter of the air-water interface, there are many points on the surface that reflect signals and no single echo signal exists. The main or shortest-path echo is followed by a series of irregular echoes of diminishing amplitude as shown in the photograph. To prevent these false echoes from activating the recorder circuits a lock-out device is employed following the pulse amplifier.

The leading edge of the shortest-path echo fires a thyratron that immediately prevents any false echoes from effecting the timing circuits for a period determined by the time constant R_2C_2, in Fig. 3. This time constant is normally adjusted for 20 percent of the repetition interval since experience has shown that any false echoes appearing after that time are of such small amplitude as to cause no malfunction of the recorder.

The trigger spike from the thyratron circuit returns the Eccles-Jordan circuit to the off state. Thus a square wave of constant height whose width is proportional to depth is generated. An increase in depth results in a square wave of increasing width. The Eccles-Jordan is always in the correct state at the start of each pulse-repetition interval even if no echoes were received during the previous interval.

Integrated Output

To utilize the intelligence in the square wave it must be converted into depth indication that can be recorded for later analysis. One

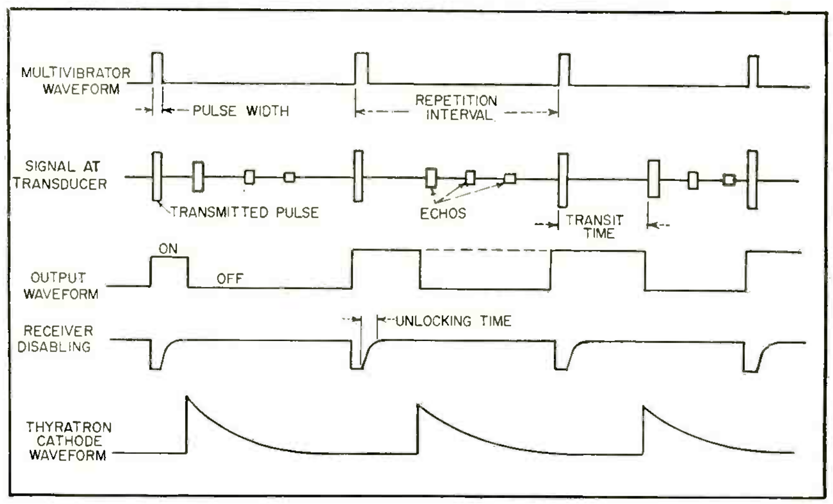


FIG. 4—Waveforms illustrate how multivibrator imitiates recorder operation. Exponential decay of pulse provides 20-millisecond lock-out of spurious echoes

method is to integrate the square wave to produce a d-c potential proportional to depth. This signal could then actuate a conventional strip-chart recorder. However, if loss of echo occurs, there will be a sudden increase in apparent depth. However, if it is known that the torpedo cannot possibly change depth as suddenly as might be indicated, and if loss of echo occurs infrequently, this error can be resolved.

Another method that more clearly indicates malfunction of the recorder is to record the square wave on moving film. Any loss of echo is indicated immediately by a sudden widening of the square wave that returns to normal width within the next frame. This system is unsatisfactory from the standpoint of record analysis in that it requires point-by-point scaling of depth indications on a considerable quantity of film.

Boxcar Demodulator

A method that shows promise of accurate depth recording utilizes a modified boxcar demodulator. Figure 5 shows the operation of this circuit. A capacitor, C_1, is charged linearly in each pulse-repetition interval from a potential $V = V_0$ at $t_0 = 0$ to V at time t, where it is clamped until the end of the interval. Time $t - t_0$ corresponds to pulse transit time. At the end of the pulse-repetition interval, potential V is transferred to another capacitor, C_2, whose potential remains clamped throughout the next repetition interval while C_1 is returned to V_0. In the event that C_1 charges to $\overline{V}$ (maximum value of V) indicating loss of echo, C_2 maintains the potential determined during the preceding interval, and C_1 is again discharged to V_0.

Extrapolation is effected over a repetition interval for which no new information is available. This type of demodulation also provides filter action that essentially suppresses the pulse-repetition frequency and harmonics.

Demodulator requirements could be simplified if loss of echo could be completely eliminated. This is not possible, although, the probability of echo detection would be much enhanced by reducing the threshold setting of the thyratron. In this way more complete phase cancellation of echoes from two or more reflecting points would be required if malfunction of the recorder were to occur. However there is a limit to sensitivity increase that can be tolerated. This limit is set by the noise properties of the vehicle in which the recorder is carried.

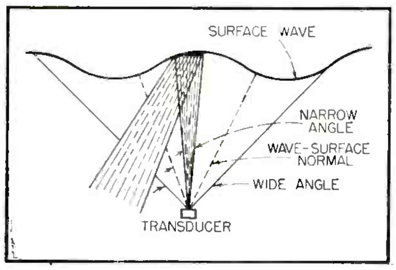
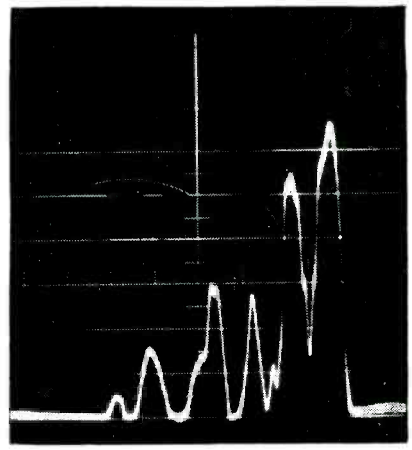


FIG. 6—Transducer sacrifices directivity to reduce loss of echo due to torpedo roll and pitch



False-echo return due to scattering at air-water interface. Lock-out bars all but shortest-path echo

Some increase in sensitivity can be accomplished by narrowing the bandwidth of the tuned amplifiers thereby effectively filtering out a greater number of noise-frequency components. However the limit to the amount of bandwidth reduction that can be tolerated depends upon pulse rise time. Too narrow a bandwidth results in an excessive rise time and decreases accuracy of transit-time measurement. A compromise must therefore be reached between the noise rejection and sensitivity.

Transducer Directivity

If the directivity pattern of the transducer employed is too narrow, loss of echo may result from the absence of a wave-surface normal. This is shown in Fig. 5. Torpedo roll and pitch, shallowest depth of operation and, to some extent, maximum length and height of surface waves encountered are factors determining the required minimum transducer angular coverage. For depth determination below five feet in water having surface waves 10 feet long and 1.39 feet high, a total transducer angle of 100 deg appears adequate. Because of reduced transducer sensitivity near the outer fringes of the radiation pattern, a transducer having a 150 deg radiation pattern is employed.

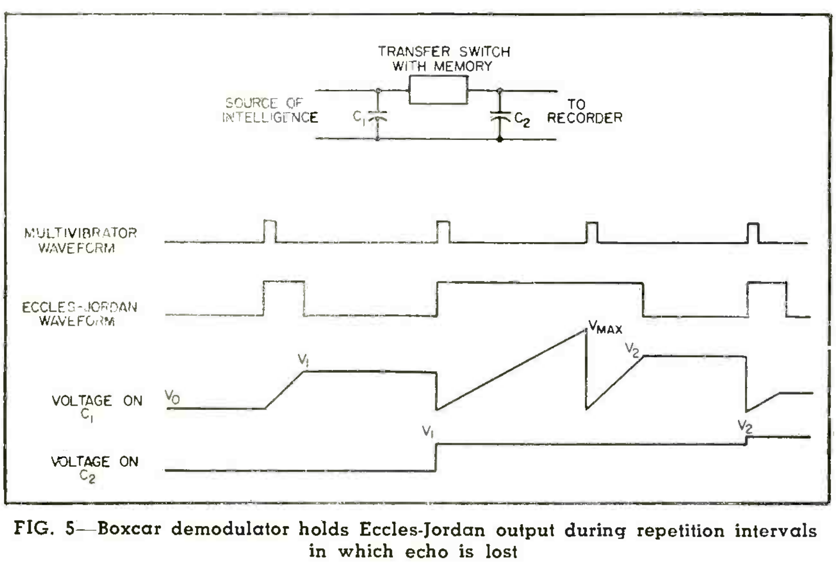


FIG. 5—Boxcar demodulator holds Eccles-Jordan output during repetition intervals in which echo is lost

Cathode-Ray Tube Plots—Transistor

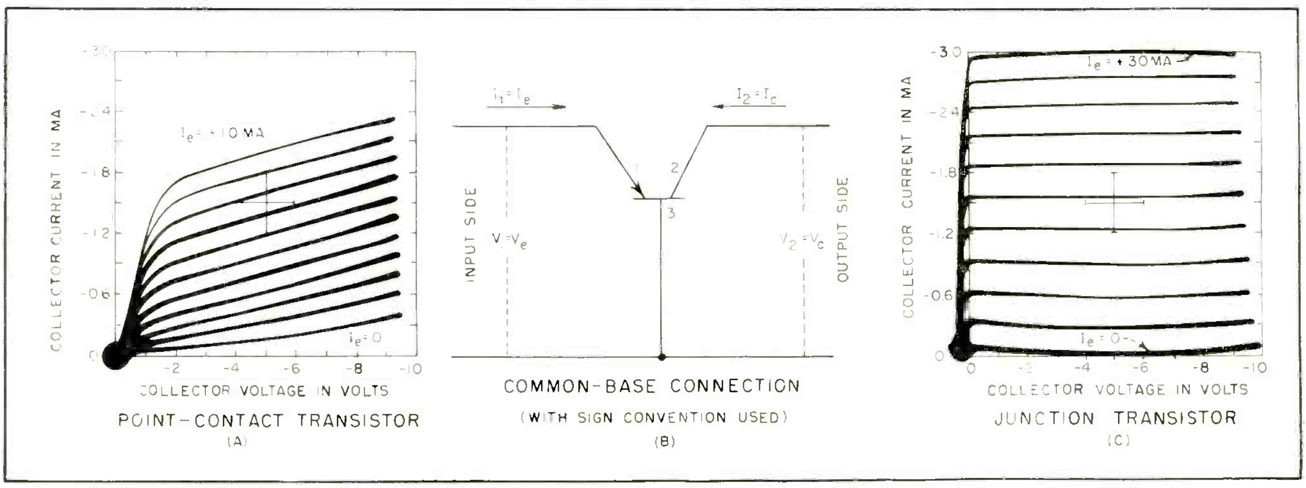


FIG. 1—Transistor output characteristics. Schematic (B) shows common-base connection used in deriving curves for point-contact transistor (A) and junction type (C)

Either point-contact or junction transistors can be tested and new power transistors under development will be handled. Electrode and transfer characteristics, automatically displayed on oscilloscope, may be photographed to provide circuit-design data

By J. KURSHAW, R. D. LOHMAN and G. B. HERZOG

David Sarnoff Research Center
RCA Laboratories Division
Princeton, N. J.

TRANSISTOR CHARACTERISTICS are displayed automatically on a cathode-ray oscilloscope by the transistor-curve tracer to be described. The instrument accepts either point-contact or junction transistors. Both sweep and bias sources are designed to accommodate transistors of greater power-handling ability than those currently available although data gathering in the microwatt range was also a design objective.

Nine current ranges are available with full-scale deflections from 0.1 milliampere to one ampere. Full-scale sweep voltage ranges from 0.1 to 300 volts are provided with a 1,000-volt sweep range available at reduced current. The 1,000-volt sweep is also useful for determining peak back voltage on rectifiers.

Constant-current bias is provided in steps from 0.1 microampere to one ampere and constant-voltage bias is provided in steps from 0.1 millivolt to 10 volts.

The photograph shows a front-panel view of the transistor-curve tracer, which consists of four separate chassis: oscilloscope, sweep chassis, bias and d-c supplies. The transistor is connected to the receptacles at the right of the sweep chassis and its characteristics displayed on the oscilloscope face of

Curves

the chassis below.

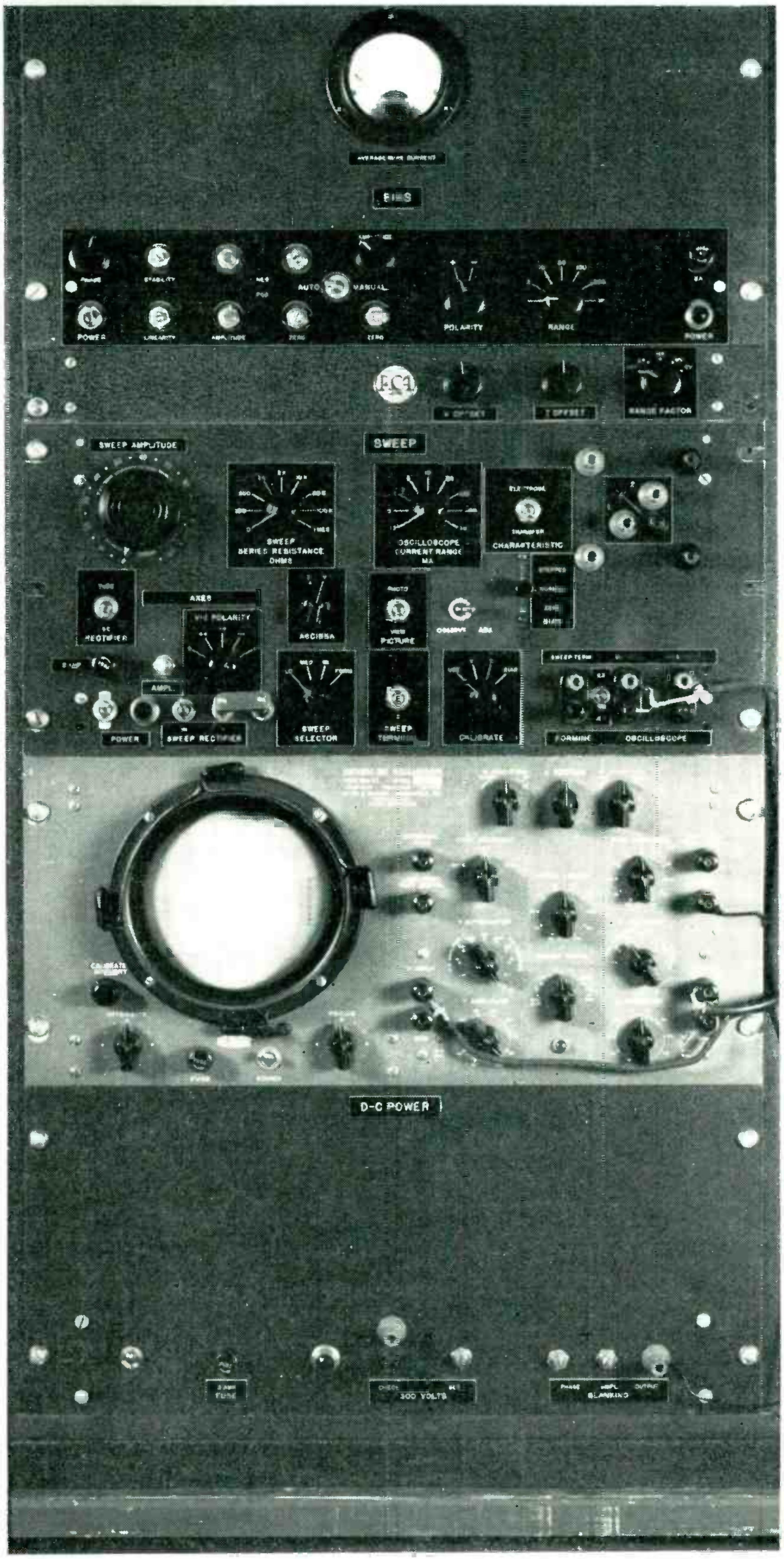
Either all four quadrants of a volt-ampere coordinate system can be displayed simultaneously or the entire scope face may be used to display one quadrant. Each of eleven curves in a family is automatically traced in sequence as the running parameter of the system is stepped. The long-persistance crt screen gives continuous presentation suitable for photographing and the coordinate axes are displayed with superimposed calibrations.

Transistor Characteristics

Some transistor characteristic curves obtained by photographing the scope illustrate the versatility of the curve tracer. Figure 1A is a family of curves showing collector characteristics of a point-contact transistor operated with common-base connection shown in Fig. 1B. A similar family of curves for a junction transistor is shown in Fig. 1C. In both cases, the emitter current, I_e, is varied in discrete steps to give the family of curves. Bias range for the point-contact transistor is one-third that of the junction transistor. The junction transistor's unity current gain may be contrasted with the greater current gain of the point-contact transistor.

To obtain maximum use of the scope face only one quadrant is displayed. For convenient comparison with other characteristics, the curves are shown in the first quadrant although both abcissa and ordinate are negative as indicated.

Figure 2 shows some characteristics of junction transistors with common emitter connection shown in Fig. 2B. Collector characteristics, Fig. 2A and C, are obtained as the base current is stepped from zero to -30 μa. Figure 2A shows one quadrant only while Fig. 2C



Curve tracer consists of four separate chassis. Transistor is connected to triple receptacle at right of sweep chassis; characteristics are displayed on scope face is a four-quadrant display.

Transfer characteristics of the junction transistor are shown in Fig. 2D where collector current is plotted against base voltage as emitter current is varied from zero to −30 microamperes in three-microampere steps.

Requirements

A transistor is a three-terminal device whose behavior may be described completely by two equations relating its electrode voltages and currents. In functional notation, $V_1 = R_1\ (I_1, I_2)$ and $V_2 = R_2\ (I_1, I_2)$ where voltages and currents are defined in Figs. 1B and 2B. Since the two functions R_1 and R_2 are not readily represented analytically over extended ranges of their argument, it is desirable to display them graphically. The information contained in these graphs can then be applied to design problems in which the transistor is a circuit element. This information may be displayed with a minimum number of curves by plotting feedback transfer characteristic (I_2 vs V_1, with I_1 as a running parameter), and output-electrode characteristic (I_2 vs V_2, with I_1 as a running parameter).

The first set can be used to determine input power requirements and feedback effects. The second set is useful in deriving output characteristics such as power delivered to a load, distortion, and efficiency. The slopes of these curves, as well as of corresponding curves with I_2 as the parameter, also furnish information useful in analyzing small-signal, low-frequency behavior of a transistor. For point-contact transistors, it is convenient to use the base as the common connection and let 1 and 2 stand for emitter and collector (Fig. 1B). For simple junction transistors, base and collector are often preferred as 1 and 2, with the common (Fig. 2B) emitter circuit.

Visual representation of the functions on a d-c oscilloscope may be obtained by biasing one electrode with constant current and sweeping the other with alternating voltage. If, after each trace, the bias is stepped to a new value, an entire family of characteristics may be displayed sequentially. If the oscilloscope tube has long persistence, the display will appear continuous. The equipment to be described consists of multirange sweeping and biasing circuits with provisions for single and multiple displays.

Other families of characteristics may also be desired. For example, $I_1 = G_1\ (V_1, V_2)$ and $I_2 = G_2\ (V_1, V_2)$ are equivalent to the equations previously given and sometimes more useful. Their representation requires constant-voltage bias which is also provided.

Sweep Circuits

A block diagram of the curve tracer is shown in Fig. 3. There is a sweep power supply (Fig. 4) consisting of a variable-output transformer and one of three additional transformers, which provide a continuous range of alternating sweep voltages from 0 to 1,000 volts. The maximum current available is one ampere at zero to nine volts or zero to 300 volts and 0.1 ampere at zero to 1,000 volts. A rectifier is included in series with the transformers to permit unidirectional sweep. Switch S_3 selects either an electrode or a transfer characteristic for display.

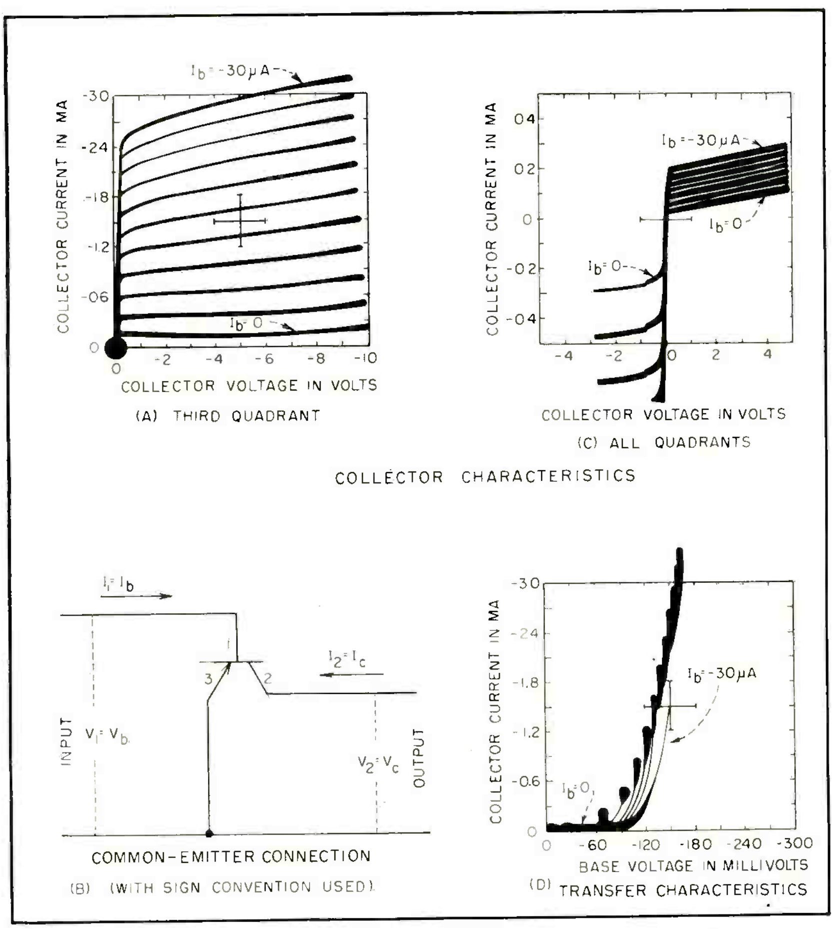


FIG. 2—Collector and transfer characteristics for junction transistor with common-emitter connection (B). Collector curves are shown for negative current and voltage (A) and for all quadrants of volt-ampere coordinate system

Positive-Current Bias

The transistor under test can be supplied with constant-current bias from a current-regulated source. Figure 5A shows a simplified schematic of the supply connected to deliver positive current with respect to ground to the load R_o. To keep one side of R_o at ground, the rest of the circuit must have a different common return point as shown. The circuit is almost the same as a conventional degenerative voltage regulator.

However, to maintain constant current in the load R_o, the load is connected in series with the feedback resistor R_f, rather than in parallel with it. A reference voltage, V_R, is applied to the grid of V_1, while a voltage proportional to the load current I_o is applied to the grid of V_2. The output at the plate of V_2 is proportional to $V_R - I_o R_f$ and appears at the grid of V_3 after amplification by the d-c amplifier. The impedance of V_3 thus changes until load current, supplied by a separate, unregulated supply, assumes a value very nearly equal to V_R/R_f. The differential output resistance of the regulator is approximately

$$r_{out} = r_{p3} + R_f \left(1 + \frac{\mu_1 \mu_3 \, A R_1}{2 \, r_{p1} + R_1}\right)$$

where: μ_1 = amplification factor of V_1 or V_2, r_{p1} = plate resistance of V_1 or V_2, μ_3 = amplification factor of V_3, r_{p3} = plate resistance of V_3, A = gain of the d-c amplifier and R_1 = load resistance for V_2.

The extremely high output impedance results in almost constant output current over a large range of load resistance R_o. Full-scale current ranges of 0.1, 0.3, 1, 3, 10, 30, 100, 300 and 1,000 milliamperes are provided by switching R_f and V_3. Within any one range, the current is set by varying V_R, which has a maximum value of 10 volts. Thus, the voltage fed back to V_2 and the grid bias required for V_3 can be kept within reasonable limits. The voltage required across the load R_o at any current I_o depends on R_o. In practice, this output voltage is limited to that which corresponds to the intersection of the load line $(R_f + R_o)$ and the zero grid-bias line on the plate characteristic of V_3. Increasing either I_o or R_o beyond these values would require a positive grid-bias on V_3 which is not a suitable operating condition. About 50 volts are available on all ranges. Automatic over-voltage protection is provided since the regulator saturates at higher voltages under conditions of high I_o and R_o.

Negative-Current Bias

Figure 3 shows that the circuit has been arranged to permit the transistor to have one terminal connected to oscilloscope ground. It is therefore necessary that the feedback voltage across R_f be derived with respect to a common point other than ground. This common point must be maintained throughout the d-c amplifier and the reference stage. Capacitance C_1 (shown dotted in Fig. 5) between common and ground, together with R_f and R_o, form a closed loop around which objectionable hum currents may be induced. As long as these currents pass through both R_f and R_o, they furnish an error signal to the regulator and are, for the most part, suppressed. However, the regulator is ineffective in reducing these currents if either ground or common is placed at the junction of R_o and R_f. These considerations lead to the circuit of Fig. 5B when negative bias currents are required. With suitable switching and inversion of the reference voltage V_R, the circuit operation is equivalent to that giving positive bias current.

Zero output current is obtained when V_3 is biased to cutoff. However, with the positive output connection of Fig. 5A, hum currents may still flow through R_o and R_f while V_3 remains inactive. By bleeding current through V_3 by means of V_a and R_a, conduction is maintained even at zero load-current in R_o and R_f. Hum currents are then suppressed in the usual manner. A similar bleeder is desirable for the negative output connection as shown in Fig. 5B, to help maintain linearity near zero load current conditions.

To supply constant-voltage bias for a transistor imposes problems

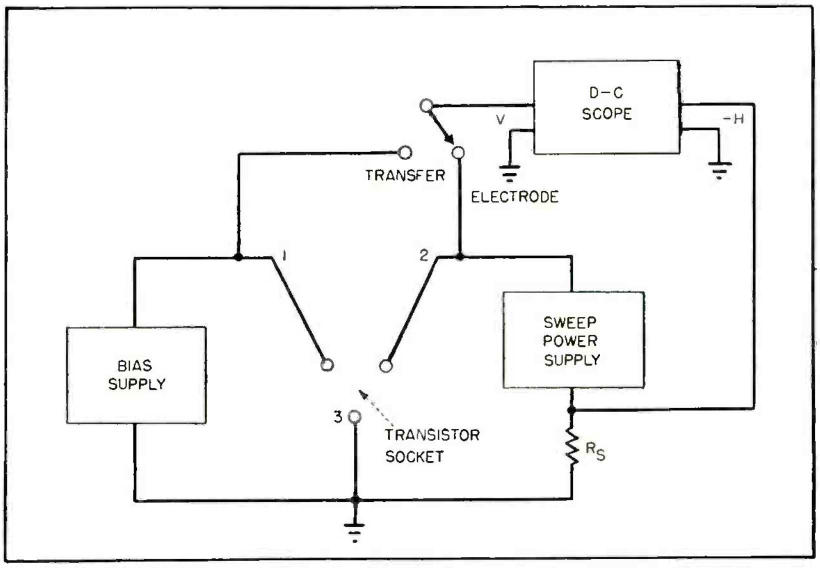


FIG. 3—Block diagram of curve tracer. Either electrode or transfer characteristics may be displayed. Sweep voltage is applied to one electrode while stepped increments of bias are applied to the other

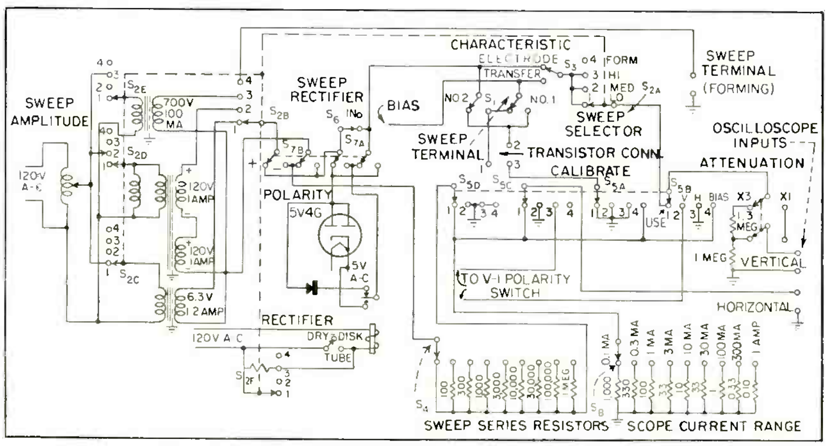


FIG. 4—Sweep voltage is obtained from transformers. Rectifiers select proper portion of alternating voltage waveform to produce desired display

not normally encountered in electronic voltage regulator design. For example, the emitter input impedance of a transistor may be tens of ohms and the maximum voltage required less than one volt.

Constant-Voltage Bias

The simplest way to provide regulated voltage to such a load is to take the regulated current from the bias supply described above and feed it into a fixed low resistance shunting the load. Thus, a one-ohm resistor adds voltage ranges from one millivolt to one volt at one-ohm internal impedance. To provide a 10-volt range, a 10-ohm resistor is also made available. Higher voltage ranges are not provided and would best be obtained directly from a conventional voltage regulator. An adjustable offset voltage, derived from a battery, can be added to the regulated bias voltage and is useful for automatic operation.

Microampere Bias Supply

Since junction transistors are commonly operated in a base input circuit, it is desirable to take characteristic curves with base current as parameter. With transistors having a low leakage current and current gain near unity, the total bias range of interest may be only a few microamperes. The current regulator already described cannot readily be arranged to provide such low currents because conventional tubes used for V_3 in Fig. 5 are not suited to the task. However, for these low currents, the direct method of using a voltage in series with a high resistance is especially suitable. The voltage is obtained as previously described. Ten volts are used in series with resistors varying from 10 megohms to 10,000 ohms to give microampere ranges from one to 1,000. An adjustable offset current is obtained here by adding a battery-derived voltage to that supplied by the electronic regulator.

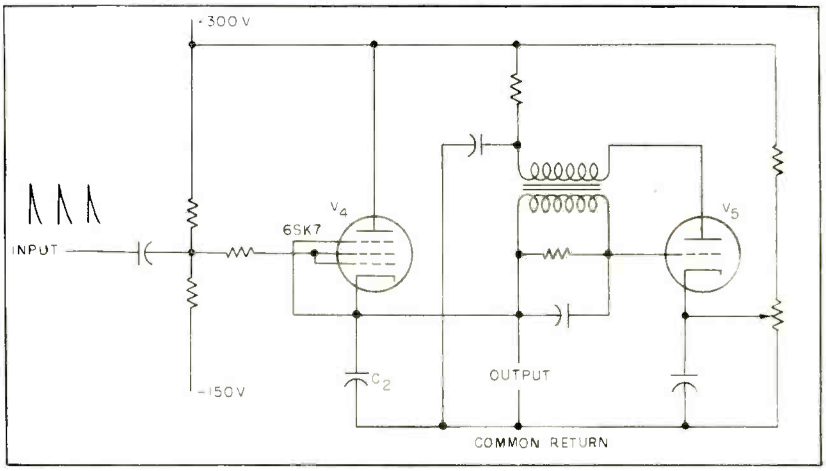


FIG. 6—Staircase generator steps bias current automatically to display family of transistor characteristics

Step Generator

A family of curves may be displayed sequentially if the bias current is stepped after each sweeping trace. The current steps are obtained by causing the voltage V_R to have a staircase waveform. The circuit for providing such a staircase is shown in Fig. 6. The charging tube V_4 is normally biased below cutoff. Sharp pulses at the input, derived from alternate half cycles of line voltage, drive the grid slightly positive and cause a charge to flow into the capacitance, C_2. An analysis of circuit operation shows that the necessary conditions for equal steps are readily met.

The staircase is applied to the grid of the discharge tube, V_5, a modified blocking oscillator biased below cutoff. The steps continue to build up until the blocking oscillator fires. The resulting grid current then discharges C_2 and allows the cycle to repeat.

The electrode connections used in V_4 are unconventional, but were determined empirically for best performance.

Transformers with an electro-

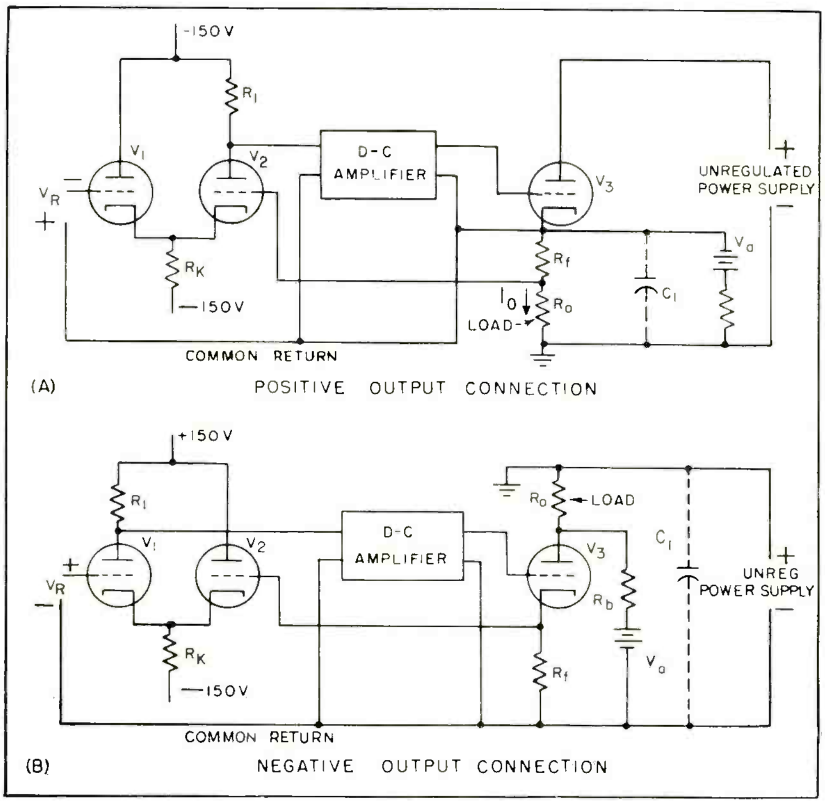


FIG. 5—Current regulator supplies either positive or negative constant-current bias to transistor's unswept terminal

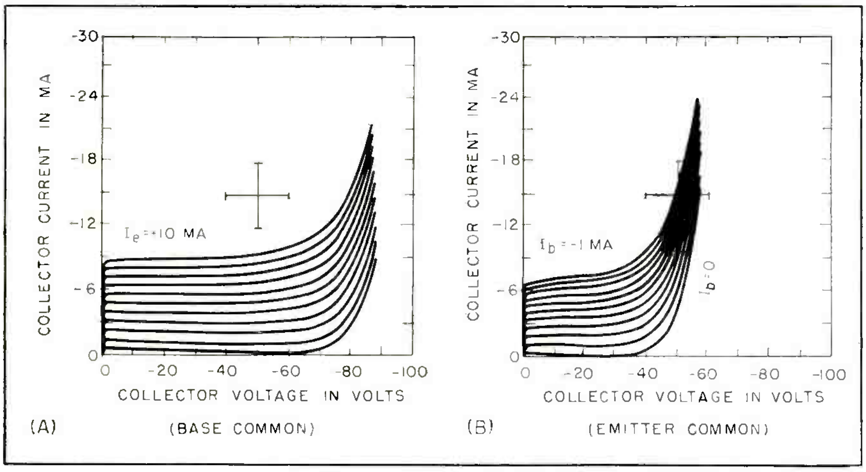


FIG. 7—Transistor-curve tracer implements study of collector breakdown voltage under varying bias conditions

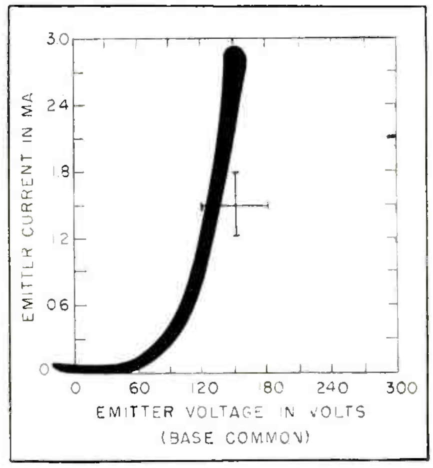


FIG. 8—Family of emitter characteristics

static shield are used to avoid spurious sweep voltages at low-level operation. Grounds to each chassis are made at a single point. The chassis are strapped together and to a good ground. Use of two phases of a three-phase distribution system simplifies phase-shifting in the blanking circuit. Precision resistors are used at all points that determine calibration of the pattern.

Construction Details

An interlock box fits over the test terminals to protect the transistor and the operator. This box must be in place to energize the 1-kv sweep transformer. If the box is removed, a relay disconnects and shorts the bias supply. If this were not done, the bias source would increase to its maximum voltage under the open circuit condition before a transistor is plugged in. On inserting a transistor with the interlock operating, the single characteristic for zero bias current will be displayed. By closing a spring-return switch, the complete family of curves may be viewed without replacing the interlock box. The transistor is protected from transients when switches are set to different ranges or polarities by the use of short-circuiting-type switches.

The oscilloscope has been provided with an illuminated scale to permit photographing calibrated axes along with the characteristic curves in a single exposure. An engraved transparent plastic disk is fiitted under the camera-mounting bezel and illuminated at its edges with small lamps. Intensity of illumination is set by a control on the oscilloscope panel.

As supplied, the X-amplifier of the oscilloscope has about one-tenth the gain of the Y-amplifier. To decrease the voltage drop required on the current sampling resistor R_s (Fig. 3), more X-amplifier gain is desirable for the current display. The X-amplifier of the oscilloscope is, therefore, replaced with one equivalent to the Y-amplifier. A new centering control for this amplifier has been added to the oscilloscope panel; the X-amplifier gain control was not brought out to the front panel since it is reset only during calibration. The decade Y-attenuator of the oscilloscope, relabelled V-attenuator, is used in setting the voltage-scale calibration and has been supplemented with a three-times attenuator (Fig. 4).

Operation

The family of characteristics to be viewed is selected by choosing the terminal to be swept and utilized for the current deflection signal (terminal 1 or 2) and by choosing independently whether the same terminal is used for the voltage deflection (electrode characteristic) or the other one (transfer characteristic). Bias is automatically supplied to the unswept terminal.

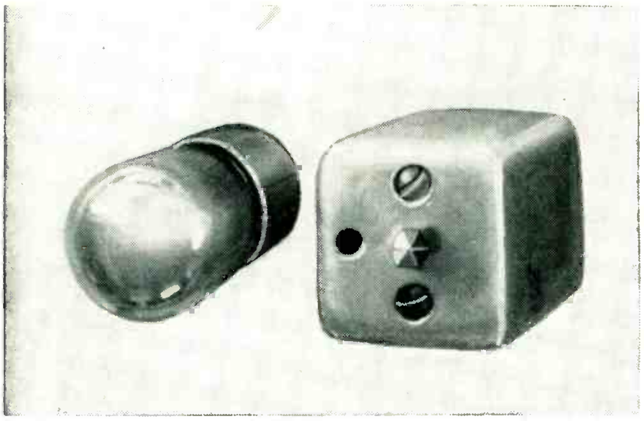
The circuit can be adjusted for different numbers of bias steps, but ten steps plus zero are preferred for a simple relation between the maximum and the incremental values of bias. Manual control of the bias supplied by the current regulator is also provided. The panel meter then reads the bias current. Under automatic operation, this meter reads the average current, normally the value of the middle step, and can be used to monitor the stepping circuit. Meter damping has been added externally.

Accuracy is limited in practice by the linearity of the step generator. The steps can be checked on the oscilloscope and adjusted for d-c level, amplitude, and linearity. Stabilized power supplies with good long-time behavior are used to maintain adjustment of the step generator.

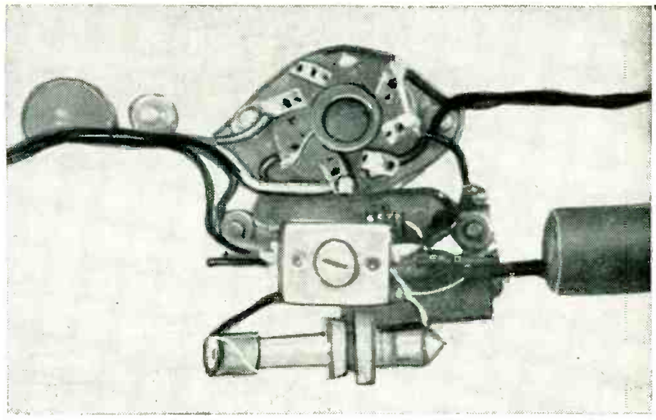
Studies of collector breakdown voltage and the influence of bias conditions are implemented by the curve tracer. In the collector family (Fig. 7A), breakdown voltages of the order of 80 volts are obtained when constant-current emitter bias is used. When the emitter is common and constant-current bias is applied to the base, the breakdown voltage is reduced to about 50 volts as shown in Fig. 7B.

Characteristics other than collector families are readily obtained. Figure 8 shows an emitter family with collector voltage as the parameter. All the curves are virtually coincident and appear as a single broad line. To obtain these curves, terminal 1 was swept rather than terminal 2.

Frequency Discriminator



Top view of narrow-band discriminator



Under-chassis view of modified circuit

DISCRIMINATION of narrow-band frequency modulation provides greater output when accomplished by a modified Foster-Seeley circuit than when a standard discriminator is used. The circuit, shown in Figure 1, is identical with the conventional circuit except for two component values.

Because of limited linearity, the circuit is not intended as a substitute for present circuits in general f-m work but for reception of frequency-shift-keyed teleprinter signals and narrow-band f-m voice communication. It has been possible to get solid copy on fsk teleprinter signals using only 150 cps shift. When measured at 425 cps shift, output of the modified discriminator exceeded by 2½ times that of the original circuit.

Foster-Seeley Circuit

Figures 2A, 2B and 2C illustrate vector voltages within the Foster-Seeley circuit for conditions at center, below-center, and above-center frequency respectively. Figures 2D, 2E and 2F show resultant rectified voltages and total output voltage under the same conditions.

At center frequency, primary and secondary of T_1 are both tuned to resonance. The voltage appearing across the secondary is 90 degrees out of phase with the primary voltage . The voltage across L is almost in phase with the primary voltage.

As the frequency shifts in either direction, the phase of the secondary voltage with respect to the primary voltage deviates from 90 degrees, either increasing or decreasing depending upon whether the frequency shifts upwards or downwards.

The voltage across L remains almost in phase with E_p, regardless of applied frequency. Thus, the only vector that changes with respect to E_p is E_s.

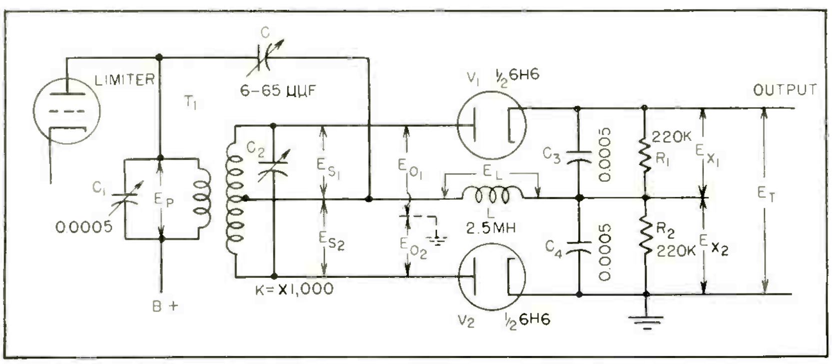


FIG. 1—Conventional discriminator is modified for narrow-band f-m by changing values of L and C to resonate above T_1 primary

In the modified circuit, the values of L and C are changed such that their resonant frequency will be slightly above that of the primary of T_1, instead of much below as in the Foster-Seeley design. The LC combination is tuned above center frequency an amount that will cause a difference of phase between E_P and E_L of 45 degrees.

Center Frequency

To get zero output at center frequency, the secondary of T_1 must be tuned below center frequency enough to allow 45 degrees phase difference between E_p and E_s. This results in 90-deg phase shift between E_s and E_L, the same as at center frequency in the unmodified circuit. The vectors are shown in Fig. 3A, 3B and 3C. The output voltages are shown in Fig. 3D, 3E and 3F.

Variable Output

As the applied frequency changes, the phase relations of E_L to E_p and E_s to E_p change equal amounts in opposite directions. Vectors E_L and E_s both move in opposite directions as the frequency is varied, while in the original circuit, only E_s moves.

For a given frequency shift, output from the modified circuit is about twice that of the Foster-Seeley discriminator. The output is a linear function of frequency for about one percent of center frequency. When used at an i-f of 456

for Narrow-Band F-M

Modified discriminator provides increased output for narrow-band f-m and frequency-shift-keyed teleprinter signals. Schematically identical with Foster-Seeley design, circuit requires changes in values of two components and special tuning procedure

By E. C. MILLER

Chief Engineer KWEI
Weiser, Idaho

kc, it will work satisfactorily for a maximum shift of 4 kc. This is adequate for voice communication and more than enough for fsk teleprinter.

Tuning Procedure

It is not necessary that the phase shift of LC and T_1 both equal exactly 45 deg at center frequency, if the sum of their phase shifts equals 90 deg. This simplifies alignment and adjustment can be accomplished as follows:

Tune C_1 to resonance at center frequency.

Tune C_2 to resonance about one or two kilocycles below center frequency.

This can be done by setting C at minimum capacitance, applying the necessary signal to the input of the preceding i-f amplifier and measuring the d-c voltage at the output of the discriminator while tuning C_2 for maximum output voltage.

Finally, set the signal generator to center frequency, and adjust C for zero voltage at the discriminator output.

The circuit is now adjusted for phone work.

If a strong fsk signal is available, it should be tuned in and with the vertical plates of a scope connected to the discriminator output, C and C_2 may be adjusted simultaneously until maximum deflection is obtained.

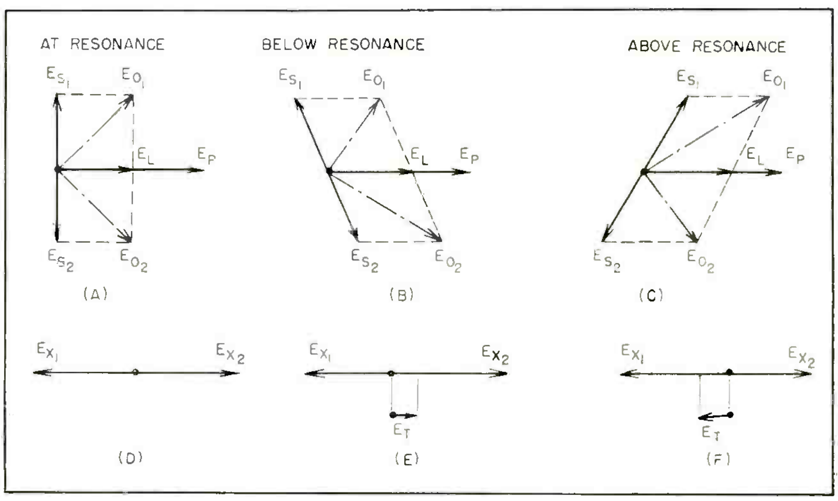


FIG. 2—Vector voltages, resultant rectified voltages and output voltages for standard discriminator

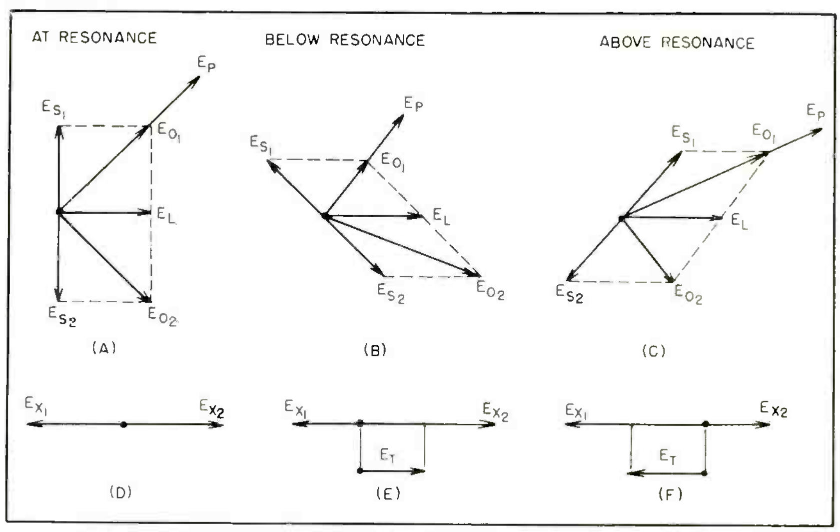


FIG. 3—Voltages for modified Foster-Seeley circuit show increased output for slight frequency deviation

New Developments in

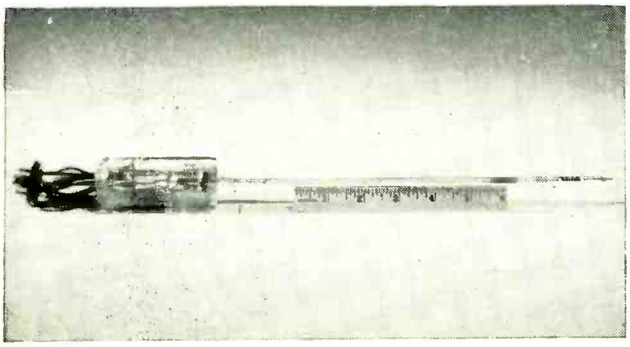


FIG. 1—Conventional traveling-wave tube with low-noise gun operates at 500 volts beam potential

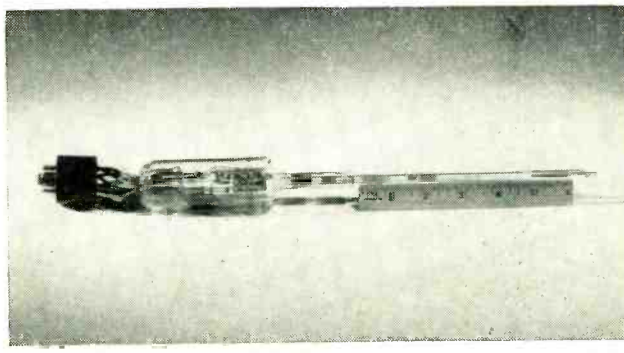


FIG. 2—Short tube uses folded-back antenna, bypass sleeve for input and collector for output coupling

PRACTICAL UTILITY of the traveling-wave tube[1] as an amplifier above 3,000 mc was questioned by some engineers following announcement in June 1946 of its development. Recent performance data of operational significance show that the traveling-wave tube is not only here to stay but is at present a factor of consequence in microwave systems design. Since the use of traveling-wave tubes can be divided naturally into considerations of low-level and high-level amplifiers, a description will first be given of research work leading to a very low-noise, low-voltage, input-stage amplifier at 3,000 mc. Comparisons are made with other types of microwave amplifiers. Next, operating data are given for low-voltage, medium-power amplifiers with fairly good efficiencies, intended for use in commercial microwave relaying at 2,000 mc. Mention will be made of narrow-band types with filter-helix circuits, and of packaged designs.

Low-Noise Amplifier

In general, work in this field has been conditioned by the probable requirements of communications service. In the case of the input-stage amplifier, consideration must be given to the fact that the type 416A triode is available, which gives about 10-db gain at microwaves with noise factors in the region of 14 db at 4,000 mc. Crystal mixers are in use that give noise factors of about 10 db. To compete fully, the twt must not only give greater bandwidth and gain, but also comparable noise factor, since this receiver characteristic greatly influences transmitter design.

For some time, attempts to reduce the noise factor of the helix-type twt below about 15 db met with no success. However, an extended series of analyses[2] of shot noise in long electron beams indicated that the noise originating from a space-charge-limited cathode, had the aspect of a standing wave in space, with alternate minima and maxima of shot noise recurring axially along the beam. Analysis and experiments showed that if the helix in a conventional twt amplifier were so placed that the beam began to interact with the applied signal near a noise minimum, the noise factor of the tube would be improved. Furthermore, optimum electrode arrangements and voltages for guns were found that produce a low-noise beam.

Tube Constructions

Two typical low-noise traveling-wave tube constructions are shown in Fig. 1 and 2. The new design of Fig. 2 is a shortened version of the tube design of Fig. 1. Its cross-section is shown in Fig. 3. The input coupling antenna and sleeve are folded back and the collector is used as the output coupling sleeve to reduce the tube length to a minimum.

Table I indicates relative performance data for the twt and competing types in the 3,000-to-4,000-mc range. It is noteworthy that the operating voltage of the twt has been brought down to a low level strongly recommended by systems engineers in the interest of economy, reliability and compactness of equipment.

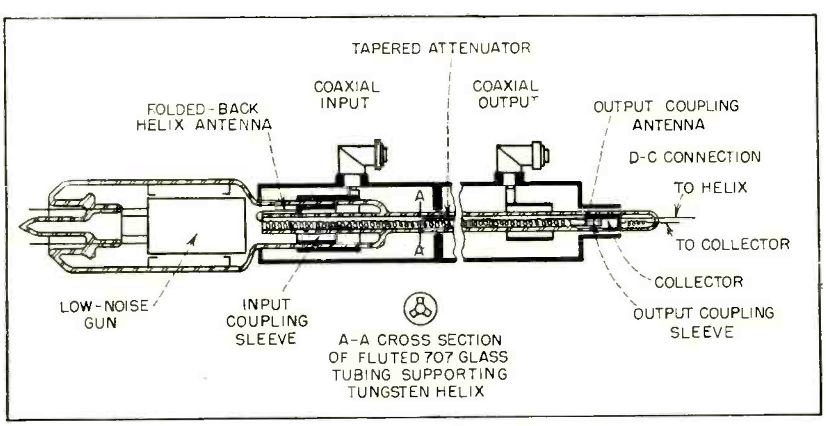


FIG. 3—Cross section of the tube shown in Fig. 2 with coaxial input and output matching transformers

Traveling-Wave Tubes

Continuing research on low-noise tubes shows promise of noise factors between 8 and 9 db at 3,000 mc for wide-band amplifiers. Power amplifiers delivering several watts r-f output power at 2,000 mc will make possible improved microwave radio-relay service

By W. J. DODDS, R. W. PETER and S. F. KAISEL*

RCA Laboratories Division
Princeton, New Jersey

Analytical investigation of an electron gun such as that shown in Fig. 4 with three accelerating electrodes *B*, *C* and *D* indicated that the first and second electrodes *B* and *C*, have to be at very low potentials, and the distance *B-C* has to be such that the noise current has a minimum at *C*, while the corresponding noise velocity fluctuations are a maximum at *C* as illustrated. Rapid acceleration of the beam up to helix potential at *D* reduces the velocity fluctuations considerably. Experimental tests on nine tubes of the type shown in Fig. 1 with this three-electrode low-noise gun yielded consistently low-noise factors.

There are some further basic requirements that have to be met in order to keep the noise factor at a minimum: (1) The emission should be space-charge limited over the entire cathode area. (2) No beam current (much less than one percent) should be intercepted in the gun or in the beginning of the helix. (3) No input signal power should be lost in the tube input region by reflection or attenuation. (4) No oscillations of any kind should exist in the tube.

Heavy Emission

The first requirement calls for a homogeneously emitting and well-activated cathode. To obtain a smoothed beam from an oxide-

* Now with Electronics Research Laboratory, Stanford University, Stanford, Calif.

Table I—Microwave Performance Data

Tube type	Frequency in mc	Noise factor in db	Gain in db	Bandwidth in mc	Plate voltage in volts
Traveling-Wave Tube....	3,000	8 to 9	≈20	200	500
Traveling-Wave Tube....	3,000	9 to 10	≈20	500	500
Triode (416A)..........	4,000	14 to 20	10	100	250
Crystal Mixer..........	4,000	8 to 15	−6 to −8	8	....

Table II—Traveling-Wave Tube vs Triode

Tube type	Frequency in mc	Gain in db	Power output in watts	Efficiency in percent	Voltage in volts
Traveling-Wave Tube....	2,000	10	1.5	14	350
Traveling-Wave Tube....	2,000	16	5	16	600
Traveling-Wave Tube....	2,000	20	10	28	1,400
Triode (2C39-A)........	2,000	3 to 5	5	10	500

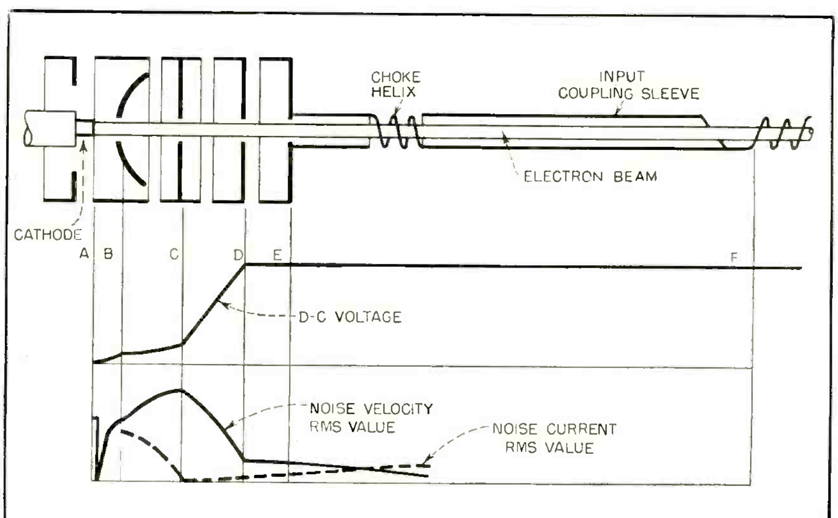


FIG. 4—Design principles employed in low-noise electron gun with three accelerating anodes

Table III—Filter Helix Tubes

Frequency in mc	Gain in db	Power output in watts	Efficiency in percent	Noise figure in db	Voltage in volts
1,975	10	4.5	22.5		800
3,300	17	1/3	15		800
6,000	20				950
3,000	20			8	540
3,000	35			5	540

coated cathode, it was found necessary to have about ten times more emission current available than needed.

The second condition is extremely important as it can be computed that 1 percent current intercepted at the first helix turn will result in 10 db additional partition noise in the amplifier. The low-noise tubes quoted here have 0.096-in. inside-diameter helices enclosing 0.035-in. minimum diameter beams. The maximum beam diameter depends mainly upon the magnetic focusing field. This helix-to-beam-diameter ratio was found to be a good compromise between low partition noise and a large gain factor.

To meet the last two requirements a new wide-band coax-to-helix transformer of the form shown in Fig. 3 was developed. It consists of a short resonator in which the electric field is concentrated in a gap. The helix antenna is placed into this gap and excited by the field. If its radiation resistance and the helix impedance are adjusted to be equal, a wide-band match is obtained. The wide-band character of the circuit is seen from Fig. 5, which shows the cold insertion loss and the gain of a tube of the type of Fig. 2 and 3. A useful frequency bandwidth of 30 percent is obtained.

The frequency dependence of the noise factor of two low-noise twt amplifiers with three-electrode guns is shown in Fig. 6. Both are low-voltage tubes of the type shown in Fig. 1. The gun voltages were adjusted for best noise factor at 3,000 mc. A noise factor of less than 10 db was obtained over a frequency band between 2,800 and 3,300 mc in tube I. A noise factor of less than 9 db was measured between 2,900 and 3,100 mc in tube II. With the three-electrode low-noise gun of Fig. 6 it is possible to construct an S-band microwave amplifier with a noise factor of less than 10 db and a gain in the order of 20 db over a ±10-percent frequency band.

Noise Measurement

The noise-factor measurements were made with a gas discharge noise source[3], which is the essential part of a continuously monitoring noise-factor meter described elsewhere.[4] The absolute accuracy of this standard is within ±0.5 db as obtained by comparison with a hot waveguide, the relative probable error of the noise factor measuring system is less than ±0.1 db.

Power-Amplifier Tubes

Another general application possible for the twt is as a microwave power output tube. In the regions above 2,000 megacycles the gain-bandwidth figure for triodes begins deteriorating. Ability of triodes to deliver sufficient power with long life and reliability is likewise compromised. The klystron suffers somewhat in that it is difficult to obtain large bandwidths consistent with adequate gain and efficiency, a major difficulty being the high voltages required.

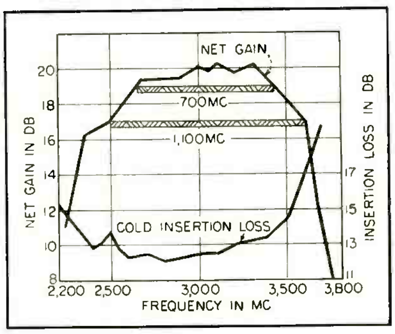


FIG. 5—Net gain and cold-insertion loss curves vary owing to imperfect match between helix and coaxial input and output lines

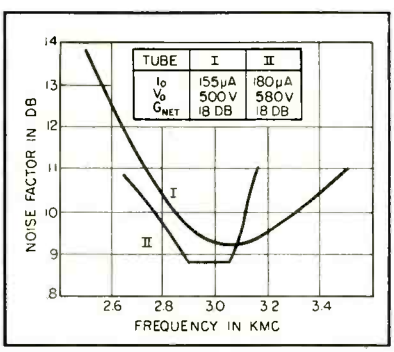


FIG. 6—Noise figures of two tubes as function of frequency

It was felt that long life might well be achieved in the twt compared to the triode because of the fact that the cathode is practically isolated from the beam collector

FIG. 7—Medium-power tube compared with type 6L6

and less subject to contamination; the collector is not part of the r-f circuit and can be cooled more conveniently. No part of the r-f circuit need intercept direct current that would aggravate any heating due to signal currents. A typical specification for a relay system at 2,000 megacycles requires a power amplifier to deliver 5 watts or more with over 10-db gain at a maximum voltage of 750 volts.

Since the present status of high-level theory is quite unsatisfactory, a largely experimental approach was made to determine what could be done to satisfy this application. The data in Table II indicate some results obtained with experimental traveling-wave tubes as compared with triodes, in a relay system under development for use in the 1,750-to-2,250 mc band.

Figure 7 shows a traveling-wave power amplifier for operation in the vicinity of 2,000 mc, in comparison with a standard 6L6. The twt length in this case is only slightly greater than seven inches. The reduction in size from that of the usual tubes designed for this frequency and voltage has been effected by folding the input-coupling antenna back over the helix. Later designs have incorporated this feature in the coupling antennas at both ends of the helix.

Filter-Helix Tubes

In many applications the extreme bandwidth characteristics of the helix circuit is not utilized. This makes possible the use of a narrow-band interaction circuit. Fundamentally, artificial attenuation is required in helix-type traveling-wave tubes because of the difficulty in securing reflectionless helix terminations over the very wide amplification band of this type of tube. It is generally assumed that at some point in the helix amplification band, complete reflection will occur at one or both ends.

To prevent this reflection from resulting in regenerative oscillations, attenuation is introduced that exceeds the net gain of the tube. This condition automatically prevents oscillation at any other frequency for which the terminal reflections are large. If, instead of a uniform helix, another form of interaction circuit is used for which the phase velocity of the growing wave can be made to coincide with the electron-beam velocity over a narrow frequency range only, amplification can be limited to this narrow range. One need not, then, be concerned about large terminal reflections outside this range, since those waves are not amplified.

Because, as a rule, good matching is possible within limited frequency ranges, it now becomes possible greatly to reduce the artificial attenuation. In fact, it is often possible to depend entirely upon the unavoidable losses in the transmission structure to provide the attenuation needed since perfect match over a finite frequency band can never be achieved. Because circuits of the type desired, wherein the phase velocity is fairly uniform over a narrow frequency band and changes rapidly outside this band, behave like band-pass filters, tubes employing such structures have been designated filter-type tubes. Certain of their characteristics are listed in Table III.

Uniform transmission lines, which are wide band in performance, are distinguished from iterated filter networks, which are narrow band. The former has uniform impedance and the latter has localized repetitive changes in its impedance. This suggests that by introducing the feature of nonuniformity into a helix the desired goal of filter-type behavior can be achieved while retaining the advantages of the helix. Such a circuit has been designated a filter helix.

Various means of accomplishing this result suggest themselves. Figure 8 shows a helix loaded once in each turn with a capacitive element. In this structure the beam travels through the openings in the capacitive loading disks. Figure 9A shows a structure in which the objective is attained by coupling an external filter helix to a plain inner beam-interaction helix. By making changes in the outer helix, the range of operating frequencies can be selected. A filter-helix circuit can be made by introducing the repetitive impedance discontinuities as sudden changes in pitch shown in Fig. 9B. A low-level amplifier for 3,000 mc, made according to this principle, and utilizing the increased impedance characteristic of this structure, gave a noise factor slightly below 8 db at 20 db gain, and a noise factor slightly below 8.5 at 35 db gain.

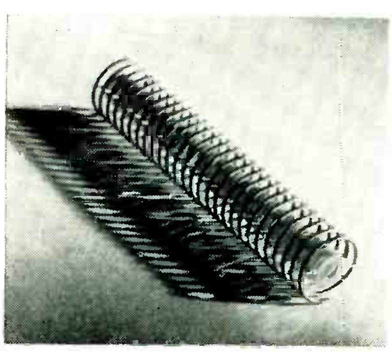


FIG. 8—Internal structure gives filter characteristic

An added advantage of filter-helix structures is that they can be considerably more rugged than the conventional helix designed for the same frequency. This is exemplified by the helix of Fig. 8, which was designed for a medium-power amplifier at 1,900 mc. When incorporated into a tube, 4.5 watts output was obtained with 22.5-percent efficiency.

Figure 10 is a schematic phase velocity versus frequency characteristic for a filter helix. The operating data given above are for region I (the first passband) although successful tests have been made in region II (the second passband).

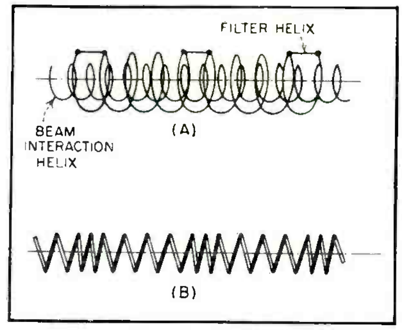


FIG. 9—External filter helix (A) can be changed to select operating frequency of tube containing inner helix or impedance discontinuities can be introduced by changes in helix pitch (B)

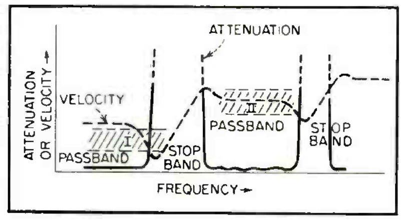


FIG. 10—Phase velocity versus frequency for a filter helix

Focusing Magnet

A necessary adjunct in the use of present traveling-wave tubes is a magnet to generate a focusing field for constraining the relatively long electron beams from striking the helix. An electromagnet is not attractive as a systems component because of its excessive size, weight and power consumption. Electron-optical data on the tube shown in Fig. 7, placed in a magnetron-type electromagnet with hollow pole pieces, indicate that permanent focusing magnets can be designed by standard procedures to permit packaging the twt in a manner analogous to the standard practice for radar magnetrons.

A portion of the work on the low-noise amplifier was done under the sponsorship of the Signal Corps under Contract No. DA36-039-sc-5548.

REFERENCES

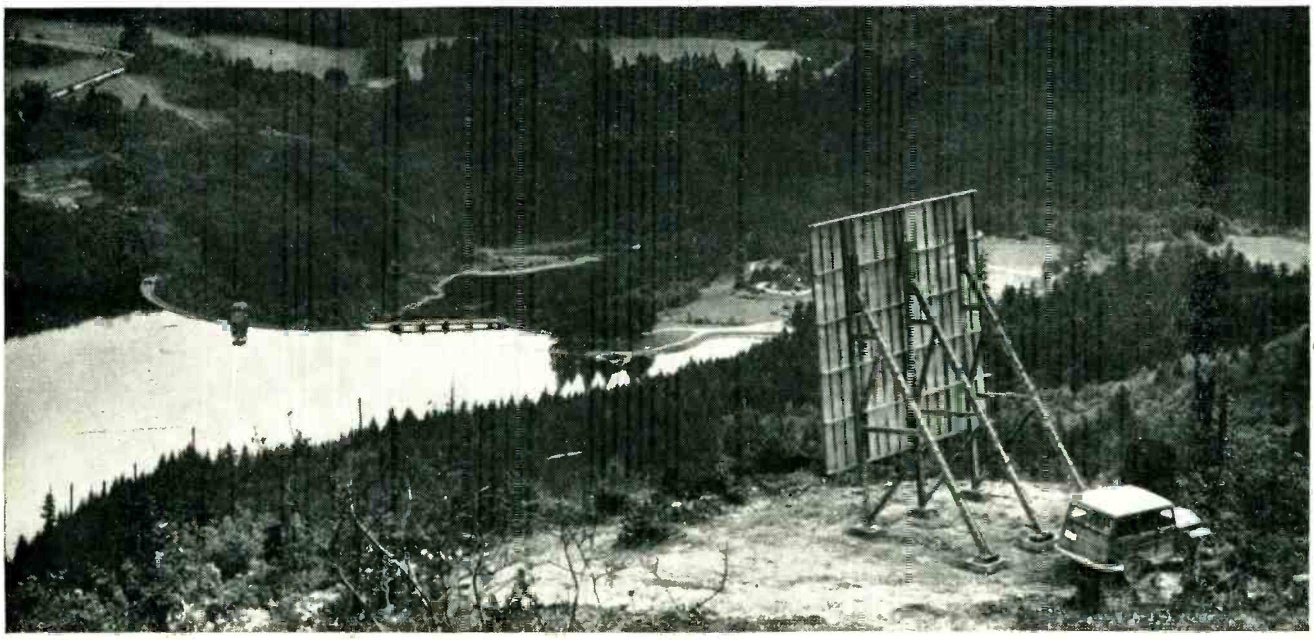
(1) J. R. Pierce, "Traveling-Wave Tubes," D. van Nostrand.

(2) R. W. Peter, Low-Noise Traveling-Wave Amplifier, *RCA Review*, 13, p 344, Sept. 1952.

(3) H. Johnson, K. R. DeRemer, Gaseous Discharge Super-High-Frequency Noise Sources, *Proc IRE*, 39, p 908, Aug. 1951.

(4) R. W. Peter, Direct-Reading Noise-Factor Measuring Systems, *RCA Review*, 12, p 269, June 1951.

Passive Repeater



Signal path from the passive repeater (right, compared with jeep) lies over Merwin Dam to the station just visible (upper left)

BECAUSE intervening hills prevent direct line of sight, a passive repeater was built to reflect microwave beams around a bend in the Lewis River in western Washington. By this means, the Pacific Power and Light Company can control its new 100,000-kilowatt installation at Yale Dam from the control room at existing Merwin Dam, some twelve miles down river.

The most economical and reliable communication medium in this rugged country was found to be a microwave system in the 6,700-megacycle band, including full duplicate standby radio-frequency equipment and automatic switchover circuits. The equipment utilizes a frequency-division multiplexing system with separate frequency-modulated subcarriers for each voice channel. The microwave carrier frequency is modulated by all the subcarriers. Usage of the channels is shown in Fig. 1.

System Requirements

A glance at the contour map of Fig. 2 shows why it was necessary to use a passive repeater, defined as a large reflector (or a periscope combination of two large reflectors) which passively receives and retransmits a signal similarly to an electronic repeater, but without adding power. The usual electronic repeater cannot be used since a power line to this isolated spot would prove about as expensive and vulnerable to outages from natural causes as a multiple-pair cable between the two stations. Then, too, access to the location can be had only by laborious hill climbing on foot or, in good weather, by jeep over an unused logging trail.

The repeater attenuation may be evaluated by use of a well-known propagation equation that relates the received power P_r to the transmitted power P_t, the effective areas of the receiving and transmitting antennas A_r and A_t, the distance s, and the wavelength λ

$$P_r = P_t\, A_r A_t / s^2\, \lambda^2$$

Since a passive repeater is a reradiator of energy rather than being analogous to an optical mirror, it can be considered first as a receiving antenna and then as a transmitting antenna reradiating the received power and this equation is applicable to each of the two legs of the total path. Hence, power received by the repeater P_r is

$$P_r' = P_t\, A_r' A_t / s_1^2\, \lambda^2$$

And the power received from the repeater P_r is

$$P_r = P_t'\, A_r A_t' / s_2^2\, \lambda^2$$

Since the repeater receives and transmits with the same surface and its efficiency approximates one-hundred percent

$$A_r' = A_t' = A$$

and

$$P_t' = P_r'$$

Hence

$$P_r = P_t\, A_r A_t A^2 / s_1^2 s_2^2\, \lambda^4$$

Extension of this equation to a path containing N passive repeaters makes it of the form

$$P_r = \frac{P_t\,(A_r A_t A_1^2 A_2^2 \ldots A_N^2)}{(s_1^2 s_2^2 \ldots s^2_{N+1})\, \lambda^{2N+2}}$$

However, in this case only one passive repeater was to be used. Hence, the total attenuation in decibels, being a ratio of the transmitted power P_t to the received power P_r, becomes

$$\alpha = -10 \log [A_r A_t A^2 / s_1^2\, s_2^2\, \lambda^4]$$

With no passive repeater, the attenuation over a path of this same length is

$$\alpha_o = -10 \log [A_r A_t / (s_1 + s_2)^2\, \lambda^2]$$

And, by subtraction, the attenuation due to the passive repeater is

$$\alpha_R = -10 \log [A^2 (s_1 + s_2)^2 / s_1^2\, s_2^2\, \lambda^2]$$

Bends Microwave Beam

Perforated aluminum screen of 480-sq-ft area picks up 6,700-mc beam and reradiates it with only 7-db loss. Repeater located on hillside effectively bends telemeter and telephone signals 1,800 feet below optical horizon

By HENRY MAGNUSKI and THEODORE F. KOCH

Chief Engineer, Microwave Research

Assistant Manager, Microwave Systems Engineering

Motorola, Inc., Chicago, Ill.

It can be seen that the passive-repeater attenuation can be reduced by increasing the reflector area or the frequency (decreasing the wavelength) while maintaining the other factors constant. Since the location of the reflector in the center of the path will give the greatest attenuation, it should be located as close as possible to one of the terminals.

The fading margin is defined as the difference between the path attenuation at which minimum communication can be maintained (105 db in this case) and the actual path attenuation. For conservative design, the fading margin chosen was 33 db, making the design objective a path attenuation of 72 db.

Antenna Sizes

Effective area of the 40-inch diameter receiving and transmitting antennas (with an efficiency of 0.624) is 5.45 square feet and the average wavelength used is 0.148 feet (corresponding to 6,645 megacycles). In this system, the distances were 1.236 miles and 11.052 miles. Hence, the required effective area of the passive repeater was calculated to be 384 square feet.

The effective area of the passive repeater is, of course, its projected area times its efficiency. Since the energy passing through the perforations of a microwave reflector has been measured as 0.1 percent of the incident energy and it is estimated that 0.1 percent of the incident energy is converted to heat, the efficiency of a flat reflector can be taken as 99.8 percent. In this

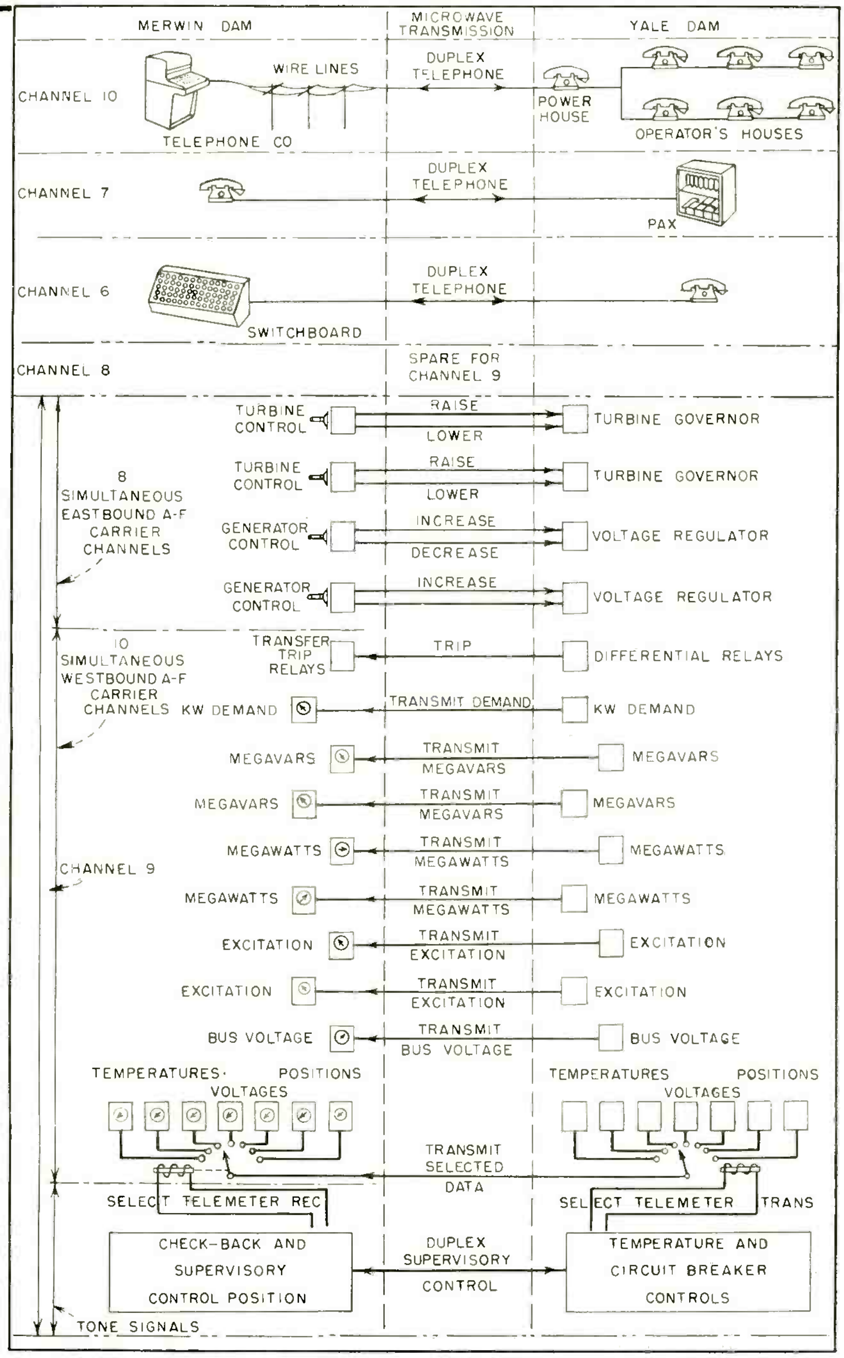


FIG. 1—Channel utilization in microwave control systems between Merwin and Yale dams shows functions possible with five existing subcarrier channels. Seven additional channels, not yet installed, can be made available

installation, the included angle between the incident and reflected beams was found to be 75.81 degrees. From this, it was calculated that the actual area required for the passive repeater was 488 square feet. The standard reflecting surface used in such installations is one-sixteenth inch aluminum sheet, four feet by six feet, perforated with 0.200-inch holes spaced one-quarter inch apart to reduce the wind resistance. Twenty of these sheets can be arranged on a twenty by twenty-four foot surface to provide 480 square feet, very close to the calculated area.

Since the passive repeater is relatively small and distant, it receives only a small fraction of the power transmitted to it. Still, it adds a very high gain to this power in the retransmission, as is shown by the equation for the gain G

$$G = 4\pi A / \lambda^2$$

With this gain of 217,000, the beam leaving the repeater will be very narrow, in accordance with the approximate formula

$$B = 60\,\lambda/L$$

where B is the beam angle between the half-power points in degrees and L is the effective length of the reflector in the plane under consideration. From this it is apparent that the beam width is a function only of the wavelength and the repeater dimensions (assuming a parallel incident beam or appropriate shaping of the reflector surface for a considerably diverging beam.) Since the paths to both terminals slant downward at different angles, the effective length in the vertical plane is 19.9 feet, resulting in a beam height of 0.45 degrees. That in the horizontal plane is 18.9 feet, yielding a beam width of 0.47 degrees.

Propagation Assumptions

While microwaves are generally thought of as traveling in a straight line and can be so regarded for most practical purposes, under varying atmospheric conditions the beam is actually curved around the earth with radii of curvature varying from approximately twice the earth's radius to infinite (true line-of-sight propagation). The radius is normally assumed equal to four times that of the earth in a so-called standard atmosphere. Calculations on this basis show that the receiving antenna will remain well within the one-db points of the reflected beam, even for extreme beam curvatures.

To satisfy the laws of reflection, the passive repeater must be so positioned that the angle its face makes with the beam from one station is equal to the angle it makes with the beam to the other station. Since both terminals are at lower altitudes than the passive repeater, it was necessary to tilt the reflecting surface forward. The amount of this tilt and the geographic bearing of the face were calculated readily by establishing a system of rectangular co-ordinates, using the center of the passive repeater as the origin and visualizing a horizontal plane, a vertical north-south plane, and a vertical east-west plane mutually intersecting at the origin. The various distances involved were taken as shown in Table I.

The angle between the face of the passive repeater and the horizontal is given by

$$\cos^2 H = (du + ct)^2 / 2\,dt\,(aw + bv + cu + dt)$$

and the bearing of the face is given by

$$\tan B = (dv + bt)/(dw + at)$$

The site chosen is only as far up the hill as was necessary to provide sufficient clearance and is athwart the unused logging trail at a place where it is nearly level. Hence, no tree removal or even brush clearance was required, it being necessary only to set the concrete foundation piers in the proper position. The ground in front of the passive repeater drops so quickly that there is no danger of growing brush obscuring the reflector. This location at the edge of a relatively level area of a number of acres is expected to make it unlikely that snow will drift against the reflector face, since its lower edge was placed five feet above ground.

Table I—Co-ordinates for Measuring Tilt

Passive Repeater (Origin) to

Distance[1]	First Antenna	Second Antenna
North-south	a	w
East-west	b	v
Vertical[2]	c	u
Air line	d	t

(1) Parallel distances measured in the same direction from the origin may be taken as positive, while one of any pair measured in opposite directions must be negative.

(2) Must be corrected for curvature of the earth by use of the formula $h = 0.667\,m^2$, when h is the correction in feet and m is the distance between the points in miles. Add h when the passive repeater is higher than the antenna and substract when the antenna is higher.

Effect of Hydrometeors

So-called silver thaws are not uncommon in the area and may coat the reflector with ice. Being a good reflector in itself, ice will affect the signal only to the extent it roughens the surface and then in accordance with the formula given later for calculating the effect of surface roughness.

Slush, or wet snow, does interfere considerably with reflection, but it is considered unlikely that it can adhere to the forward-tilted surface.

It is to be noted that total obscuration of half the surface will result in nothing more than a 6 db drop in received signal strength. The system design fading margin of 33 db, then, assures that the threshold of limiter action will be reached only after the reflecting surface is reduced to 2¼ percent of its total area or eleven square feet.

Reflection will approximately double any horizontal angular movement of the passive repeater and will multiply vertical movement by 1.6. This effect combines with the narrow beam angle previously calculated to require that the structure be rigid enough to resist vertical distortion beyond 0.14 degrees and horizontal distortion beyond 0.12 degrees, even when coated with ice and buffeted by sixty-mile-per-hour winds, since it is desired to maintain the loss below 3 db under these conditions.

The design used to satisfy all of the above conditions is an aluminum structure, similar to a large billboard, supported by three A-frames, the back legs of which are built of three six-inch channels welded so their backs partially enclose a two-by-six inch box section, which is completed by welding in a two by one-quarter inch strip. The

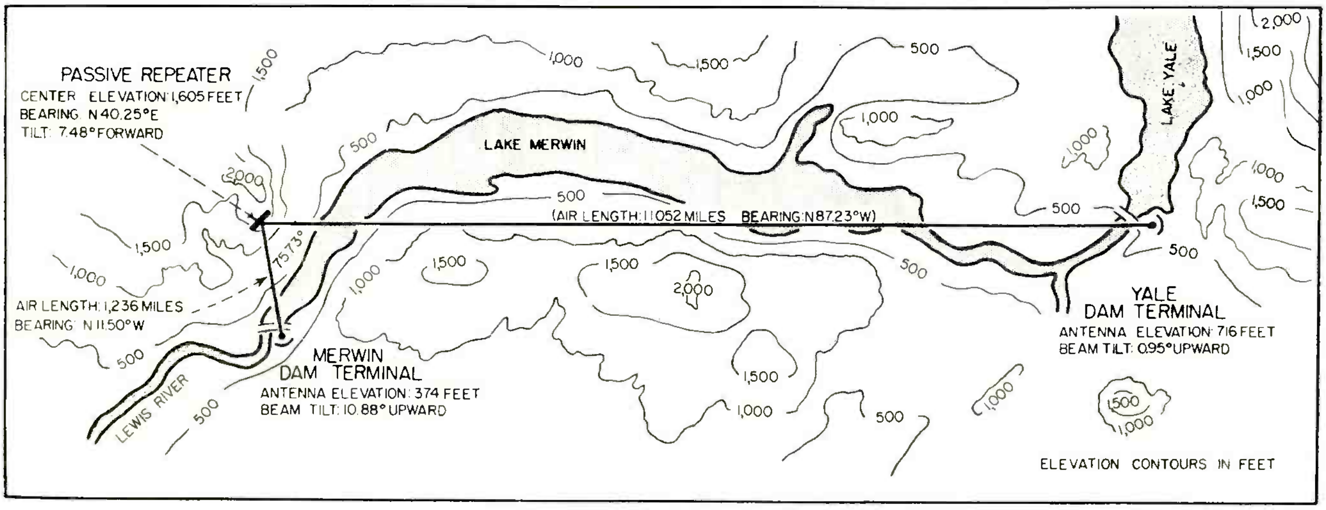


FIG. 2—Map of Lewis River, Washington, region shows how topography affects microwave control and communications between new Yale Dam and existing Merwin Dam downriver

front legs consist of two six-inch channels welded on opposite sides of a similar box and the cross braces are two-by-six boxes made from a six-inch channel with a one-quarter inch plate welded in the open side. These fit neatly into the front and back legs. The A-frames are tied together by six five-inch channels that constitute the backing for the reflecting panels. The whole structure is designed for bolted assembly in the field and the perforated sheet aluminum reflecting surface is shop-attached with drive screws to shop-welded six-by-twenty-foot panels. These are made of three-inch channels with two by one and one-half inch angles to stiffen the one-sixteenth inch sheet.

Flatness Factor

Since a surface as large as this cannot be made truly flat, it was necessary to calculate the effect of its lack of flatness. The energy reflected from a surface displaced forward or backward from its neighbors will be out of phase with the remaining energy by an angle P in degrees

$$P = (360)\ 2h/\lambda \sin R$$

where h is the displacement in feet and R is the angle between the surface and the incident beam. This shows that a spot displaced 0.177 inch will reflect energy ninety degrees out of phase with the main reflection, thus neither adding to nor subtracting from the main beam. This was taken as the limiting case and the flatness tolerance was specified as one-eighth inch.

Aluminum was chosen for the structural material so any tendency to buckle due to thermal stresses would be avoided by the uniform rate of thermal expansion or contraction of the entire structure. In addition, by specifying all aluminum hardware, the possibility of electrolytic corrosion was eliminated, periodic protective coatings were made unnecessary, and individual structural elements were light enough to make for ease in transportation and erection.

To be prepared for contingencies and to permit reasonable tolerances in fabrication and erection as well as allowing adjustment to prove the accuracy of the calculations, the base of each leg was equipped with slotted holes through which the studs anchored in the foundation passed. These provided for bearing changes of up to one and one-half degree in either direction from the midpoint. Alterations in tilt were made with jack screws in each foot and shims were provided to allow permanently securing the structure at a tilt of one degree more or less than planned.

Optimum alignment was accomplished by first adjusting each of the terminal antennas to give peak limiter readings on a transportable microwave set temporarily activated at the repeater site.

With the passive repeater in the position calculated by the formulas presented, a strong terminal-to-terminal signal was present, and it was necessary only to scan the structure through a small portion of the built-in adjustments to insure optimum positioning. The final position varied from the calculated by 0.02 degree in bearing and 0.05 degree in tilt.

Test Results

Actual attenuation in each direction over the installed path was measured by substituting a calibrated i-f amplifier successively for each of those in the main and standby microwave receivers at each terminal. The average measured value of 72.0 db agreed very closely with the calculated attenuation for the actual system of 72.1 db and proved definitely that the increase in attenuation due to the passive repeater is very small, only 7.0 db in this case. The actual fading margin available is 33 db, equal to the design objective.

The formulas cited demonstrate that the high microwave frequencies (in the 6,700-megacycle band) used on this system have special value when a passive repeater is required. Lower frequencies would have resulted in a higher path attenuation or a considerably larger passive repeater. Putting this installation in service has also proved that it is practical to assume an efficiency very close to unity for a passive repeater in future systems if careful attention is paid to achieving flatness in structure design, fabrication, and erection.

Multiplier Phototube

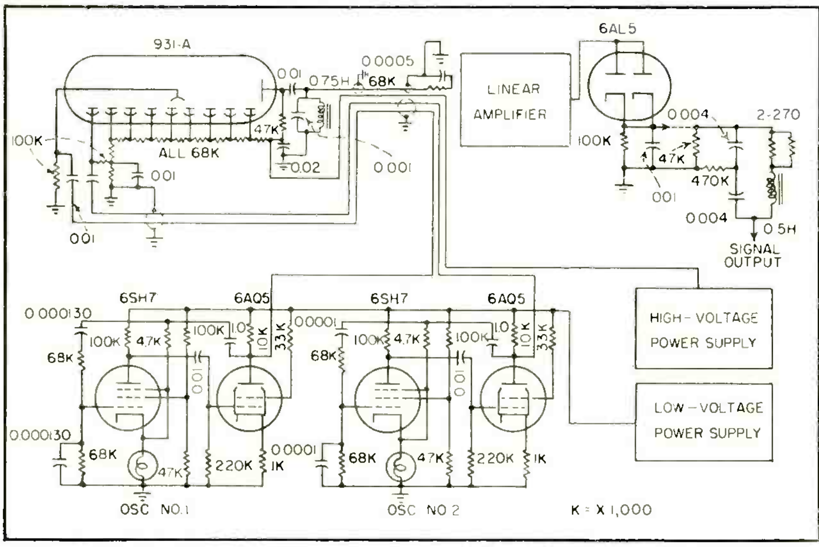


FIG. 1—Block-schematic diagram of the signal converter

By DOUGLAS A. KOHL

Departments of Surgery and Radiology University of Minnesota Medical School Minneapolis, Minnesota

RECORDING SLOWLY VARIANT signals or even steady-state values concurrently with rapid fluctuations is often necessary in research projects to obtain an accurate representation of the instantaneous behavior of a certain factor.

In biophysical research such information is contained frequently in the intensity modulation of small light sources. A multiplier phototube is generally used to convert these light fluctuations to a varying current. Conventionally these current variations have been amplified by d-c amplifiers. The low sensitivity and zero-drift problems of d-c amplifiers in this application have been circumvented by interrupting the light beam with a mechanical chopper and using a-c amplifiers but it is difficult to attain a wide bandwidth with a mechanical chopper.

Signal Converter

The multiplier phototube may be used in a heterodyne-type circuit to avoid use of mechanical choppers and to obtain bandwidths extending from d-c to kilocycles. The principle of operation is illustrated in the circuit of Fig. 1.

In addition to the d-c dynode voltages applied to the multiplier phototube, two a-c voltages differing in frequency are injected into the photocathode and first dynode respectively. These voltages cause the collection efficiency and amplification of the tube to vary as the time function of their instantaneous sum. Anode current is thus a function of light incident on the photocathode and the gain variation of the electron multiplier.

The signal contains the original frequencies as well as the sum and difference frequencies. The difference frequency is utilized as the carrier and is amplitude modulated in accordance with the light intensity.

Bandwidth Considerations

The filter at the anode of the phototube consists of a simple parallel-resonant capacitor and high-Q toroid inductor in conjunction with an R-C leg to furnish greater high-frequency attenuation. Selection of circuit Q is governed by bandwidth considerations for the signal amplification channel.

The difference-frequency carrier is amplified in a fixed-frequency amplifier. It is desirable to make the response characteristic of the amplifier as flat as possible within a bandwidth compatible with overall frequency response and amplifier noise requirements. It is also desirable to establish the low-frequency cutoff point at a value greater than 120 cps to allow freedom from line frequency pickup. The upper frequency cutoff point is less than the lower of the two oscillator frequencies, assuring good refection ratios for those voltages.

A diode detector with R-C load re-establishes the signal with the carrier-frequency ripple superimposed upon it. In general, the difference frequency is much higher than the upper cutoff frequency of the desired signal transmission band and a simple R-C diode load thus furnishes very little distortion. In the event that the difference frequency is low compared to the bandwidth, a ripple rejection filter on the output is desirable.

The choice of the oscillator frequencies is also dependent upon the desired signal-channel bandwidth in that it determines how high the Q of the input filter can be and still give satisfactory rejection to the oscillator frequencies. It is also feasible in multistage and feedback amplifiers to shape the frequency-response characteristic sufficiently to provide satisfactory rejection ratios.

The light detector is contained in a light-tight pickup unit connected by cable to the power supply and amplifier chassis. The amplifier is located as far as possible from the oscillators to minimize stray voltage amplification which in effect raises the lower limit of sensitivity of the signal converter.

This circuit operates with the phototube high-voltage positive off

Signal Converter

Intensity modulation of small light sources is converted to alternating voltage by use of a multiplier phototube giving bandwidth from zero cycles into the kilocycle region. Bandwidth is greater than that obtainable with mechanical choppers

ground to allow the oscillator injection capacitors and wiring to be conveniently electrostatically shielded from the anode circuit. The parallel-resonant circuit is located in the pickup so that the inductor will not pick up any stray magnetic fields of power transformers in the main chassis.

The oscillators are the familiar Wien bridge R-C feedback type and may be constructed side-by-side without shielding with no interaction although the oscillator voltages to the pickup must be fed through shielded conductors within the cable. It is desirable to regulate the B voltage applied to the oscillators to provide positive assurance that the oscillator voltage amplitude can be held constant by the range of compensation of the pilot-light variable-resistance element. The oscillator relative frequencies were chosen to match the highest Q of the inductor and, in this instance, provide a large enough bandwidth.

Performance Characteristics

The mechanism of the carrier modulation for low light levels is shown graphically in Fig. 2 by the envelope patterns taken from the phototube anode. The envelope repetition rate is 5,000 cps. The first pattern, created with no incident light, is representative of the interference of two oscillator voltages due to shunt capacitance formed by the proximity of pins in the cable connectors, tube bases and other circuit configurations. Effect of this stray pickup is to cause a slight nonlinearity in the variation of the d-c component of the complex envelope as shown by the other patterns.

The peak-to-peak amplitude of the waveforms maintains a linear relationship with the light input but the output of the peak-reading half-wave detector shows a deviation from the linear characteristic. The deviation is really a change in slope and it is equally valid to utilize the linear portions on either side of the knee of the curve which occurs at 1.1 microlumens. The higher light-level portion may be utilized by employing a base light, or small constant light source, within the light field to furnish a residual output just beyond the knee.

Envelope Patterns

The waveforms of Fig. 2 were taken from the signal converter used as the pickup device for an electrokymograph design used with a constant-potential x-ray machine. The bandwidth requirement of this electrokymograph, d-c to 2,000 cps is easily obtained. The frequency response was determined by mechanically interrupting the light from a d-c light source with a variable-speed motor-driven disk with 200 radial slits along its periphery. The peak-to-peak amplitude of the signal at the anode of the tube shows no frequency dependence in this range. The use of a bridged-T five-kilocycle filter to eliminate the ripple results in the amplitude decrease with increasing frequency.

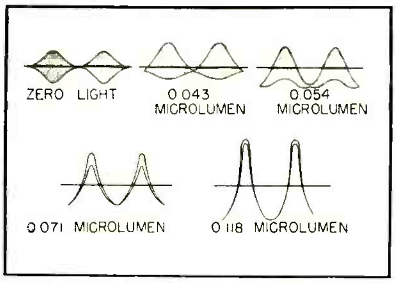


FIG. 2—Envelope patterns at the anode of the multiplier phototube

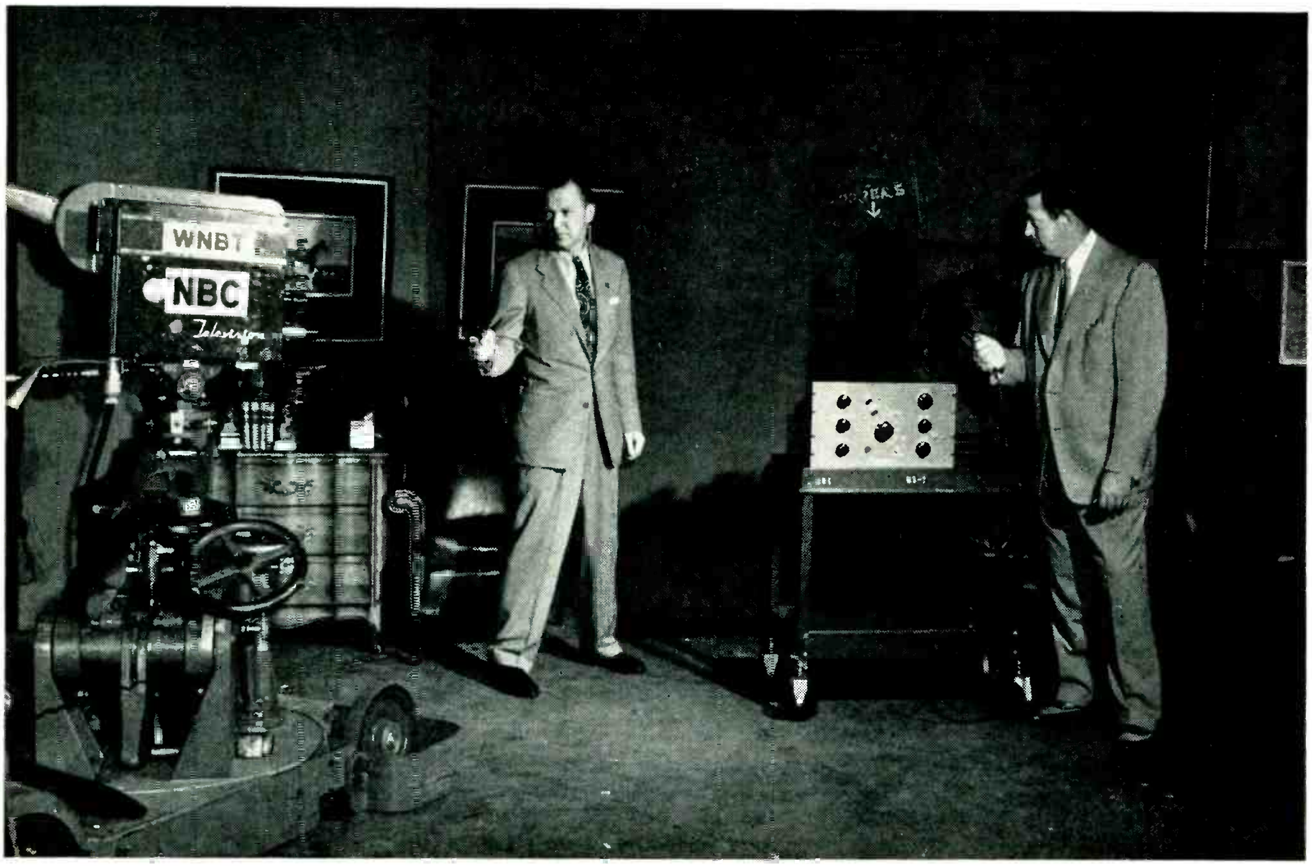
Rejection of the oscillator frequencies of 15 to 20 kc is at least 3,500 to 1 at the output of the phototube anode filter and 15,000 to 1 at the grid of the first amplifier. With an operating voltage of 700 volts on a 931-A phototube, the overall signal-to-noise ratio is 40 with an anode current of 10 microamperes. The noise component due to the random phase shift of the oscillators is the equivalent of a signal-to-noise ratio of 65 under the same conditions. This phase-shift noise is approximately 15 times larger than the dark-current noise of the phototube itself.

Stability of the system is essentially that of the multiplier phototube high-voltage supply which should have regulation better than 0.001 percent for each percent change in line voltage and comparable long-time stability. After a 15-minute warm-up time for the oscillators and the carrier amplifier, the sensitivity drift is 0.03 percent per hour.

This system is applicable not only to measurements involving light measurements directly but also to problems where the conversion of the signal information to light may be accomplished efficiently with fidelity. Not only does the multiplier phototube add its inherent high-gain advantages but the signal information may be amplified and handled in a high-level mode in the carrier amplifier with complete freedom from 60-cycle pickup and line hash.

The greatest single advantage of this converter is that it offers an all-electronic method of obtaining high-fidelity amplification of signals requiring a wide bandwidth including d-c.

Gunshot Generator



Method of using gunshot generator during television drama. Engineer at right holds single-shot pushbutton in hand and presses it when television detective Martin Kane pulls trigger of unloaded gun

By J. L. HATHAWAY and R. E. LAFFERTY
Engineering Development
National Broadcasting Co., Inc.,
New York, N. Y.

IN A LARGE Radio City studio, television detective Martin Kane faces this week's criminal. Millions of viewers expectantly wait for the story to reach its climax. Suddenly Kane whips out his pistol and pulls the trigger . . . ptzz. The exposion has all the roar of a wet cap.

This is certainly not the climax the director of the show expected, nor does it conform with the thoughts of the audience. For most viewers, twenty-five minutes of drama is forgotten for a few seconds of humor. It is not funny, however, to television broadcasters. Breaking the continuity of a dramatic story with unscheduled comedy is disastrous.

Why did the shot fail? An investigation by the Engineering Development Group of the National Broadcasting Company has disclosed a multitude of possible reasons. In some instances the fault was not at all technical but simply a case of fright. Some actors, and a few actresses, have complained that as they were about to pull the trigger, they were seized with the thought that the pistol was loaded with actual bullets and were therefore afraid to fire the gun.

Technical Fizzes

Other reasons for gunshot failures are mostly technical. The mechanical condition of the gun and particularly the firing pin, the cap, the type of powder and the loading in the cartridge all contribute to the quality of the report. The condition of a gun can be checked prior to its use, but unfortunately, the only satisfactory test for a blank cartridge results in its destruction. Efforts, therefore, were directed toward a more reliable powder, and for reasons that will be discussed later, a longer burning powder. This approach resulted in the selection of large-caliber cartridges for desirable burning characteristics and reliability. Reports from pistols using these special blanks were so loud, however, that many actors refused to use them. Even

for Television Studios

Guns loaded with blank cartridges sound unreal, occasionally misfire and often scare performers in acoustically dead television drama studios. To offset this, a new electronic unit automatically reinforces weak shots or generates the entire sound effect for revolver, machine-gun and cannon fire, as well as ricochet effects

these cartridges occasionally misfired and moreover, there seemed to be little correlation between the loudness of the report within the studio and that of the reproduced sound.

It is axiomatic in both the broadcasting and motion-picture fields that loud studio shots do not necessarily produce loud sounds for the ultimate listener. In any medium where the amplitude must be controlled to prevent an overload of the system, high-intensity sound of extremely short duration is heard, when reproduced, as low-intensity sound of short duration. In such systems of limited volume range, the apparent loudness can be increased only by increasing the duration of the sound. Thus, long-burning powders of medium intensity reproduce louder than high-intensity, short-burning powders after both reports are transmitted through a broadcasting system.

Need for Reverberation

Still another problem, peculiar to the medium of television, is the special acoustical treatment required in the studios. In other studios, such as those for radio broadcasting, tape or disc recording, or motion-picture sound, extraneous noise can be minimized during the actual production and excessive reverberation of speech avoided by reducing the microphone working distance.

In television, quite large microphone distances are frequently unavoidable. Furthermore, the desired sound must compete with considerable background noise. The combined motion of actors and actresses to and from stage sets, stagehands with scenery and props, dolly pushers moving cameras and microphone booms, lighting men, floor managers and many others makes for a relatively high ambient noise level.

The television broadcaster must combat background noise with directional microphones and acoustical absorbing materials located on the studio walls and ceiling. By radio broadcasting standards, the result is a dead studio. Reverberation would allow gunshots to persist and increase their apparent loudness. The lack of it, coupled with amplitude restriction of the audio system, is deleterious to realistic gunshot reproduction.

As a possible remedy for the anemic shot reproductions, a small reverberation chamber was constructed. The large chambers which are normally used for special effects with speech and music were tried for this purpose with considerable success, but the demand for these on other effects was so great that programs involving gunplay were unable to depend on their availability.

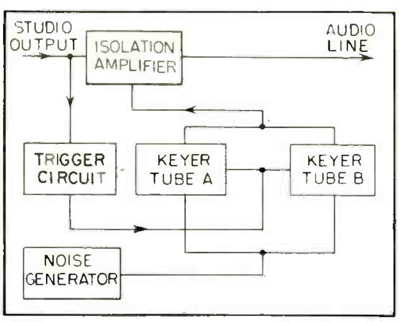


FIG. 1—Block diagram showing portion of generator used to furnish reverberation to gunshot by inserting a decaying random-noise signal after the actual shot signal

Although considerable attention was given to the elimination of pronounced resonant effects in the small chamber, several objectional peaks in the medium-frequency region were evident while at other frequencies the reverberation time was insufficient. These defects forced a new approach which resulted in the design and construction of an electronic shot reinforcer and shot effects generator.

Gunshot Reinforcer

A study of various pistol shots showed the sound of a shot to be largely a function of the bore and length of the gun barrel, the nature of the powder and its burning rate and the loading of the cartridge. The wave envelopes of most shots, however, have steep fronts and trailing edges that decay slowly. The acoustical energy within the envelope is generally heterogeneous, and in this respect resembles noise. Further investigation proved that noise, properly controlled, could be made to simulate a pistol shot effectively.

The first use of this principle was in a reinforcer unit in combination with an actual gunshot. Because it is the reverberation of the shot that is insufficient in television studios, the arangement of Fig. 1 was designed to insert a decaying random-noise signal automatically after the actual pistol shot. This equipment has been successfully used for some time, and several additional units have

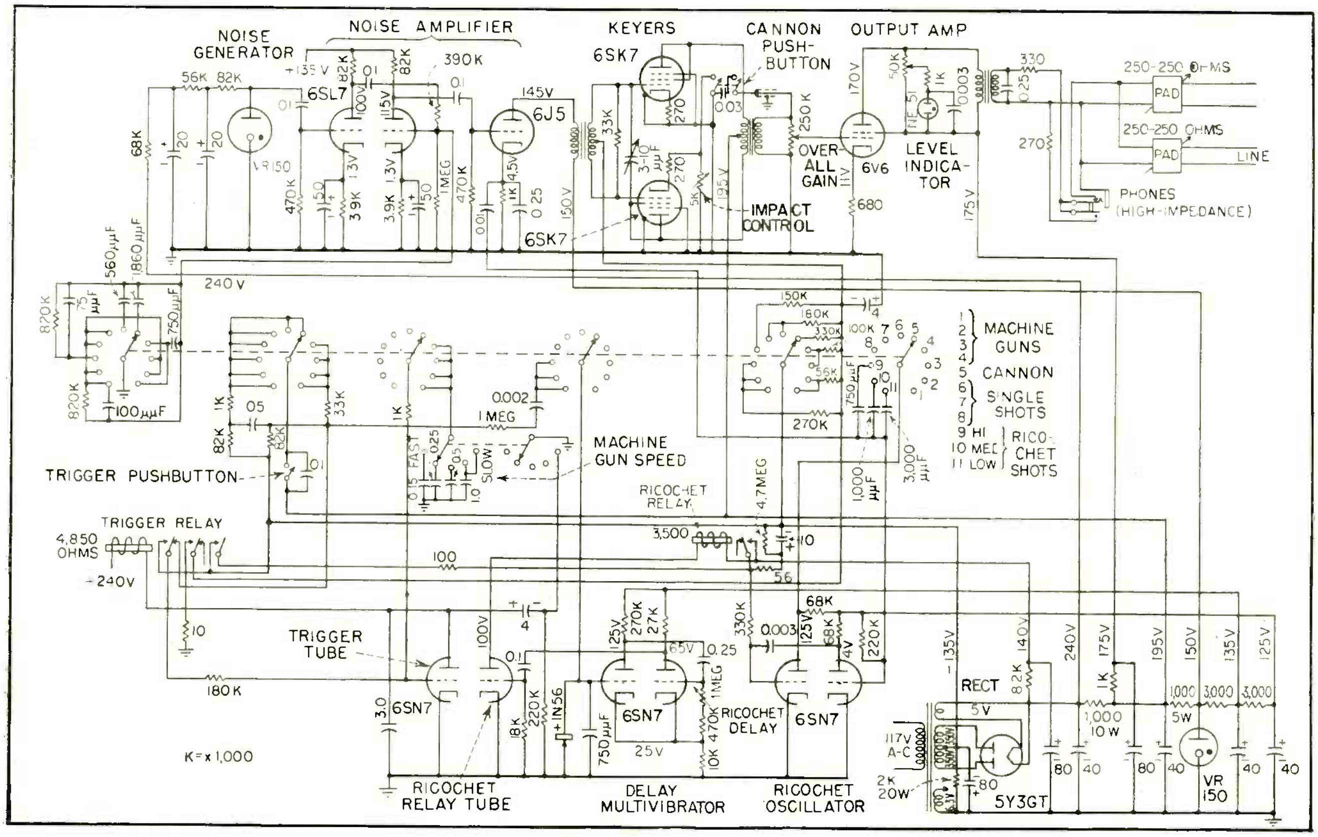


FIG. 2—Complete circuit diagram of gunshot generator, with all values of components indicated

been installed in various locations.

The gun shot reinforcer is inserted in the outgoing line of a studio prior to the start of the program and carries the entire audio output of the studio. It is level-actuated and hence completely automatic in its operation. When a gun is fired in the studio, the trigger tube actuates a relay, which removes the excessive bias from a pair of push-pull amplifier tubes normally held at cutoff. The output of a noise generator, after filtering, is continuously applied to the grids of these same amplifier tubes.

After the keyer tubes are pulsed into operation they are slowly returned to the cutoff state. The reproduced effect of the sudden noise pulse with a slow decay is essentially that of a gunshot. If the push-pull keyer tubes are purposely unbalanced to a slight degree, the d-c thump component when the bias is suddenly removed produces an impact with the shot to further enhance its realism.

The trigger tube and circuit design are such that, assuming a fixed gain adjustment, extremely loud sounds with steep wave fronts cause the reinforcer to fire, whereas shouts and screams only a foot from the microphone do not.

Gunshot Generator

The steps from an automatically triggered shot reinforcer to a versatile manually operated shot generator were fairly obvious. The level-acutated trigger circuit was first replaced by a pushbutton. Unbalanced keyer tubes gave the synthetic shot an initial impact followed by the decaying noise to simulate the effect of reverberation. The length of the shot is controlled by varying the recovery time of the keyer tubes. These are normally held at cutoff by a large negative voltage, fed to the grids through an R-C filter consisting of a 4.0-μf capacitor and a resistor. The value of this resistor serves as an excellent adjustment of recovery time. Actually the rate of noise decay is a function of the cutoff characteristic of the keyer tubes and several other factors. Constants are so chosen as to produce essentially a logarithmic decay of sound output.

The characteristics of shots may be altered by another factor, namely the frequency response of the noise amplifiers preceding and following the keying. If the high-frequency components of the noise are attenuated and the length of the shot increased, large-caliber arms can be simulated. Carried to an extreme, the effect of distant cannon fire can be realistically produced.

Machine-Gun Simulation

Once single shots are generated, an additional possibility becomes apparent. When the trigger button is pushed a number of times in quick succession, an excellent machine-gun effect results. The requirement of manual dexterity can be eliminated from the operation by using a low-frequency oscillator to trigger the shots repeatedly. The rate of fire is adjustable by varying the frequency of this oscillator. When a variable-bandwidth filter in the noise amplifier is simultaneously adjusted, a number of machine gun effects are readily obtained, ranging from a light-weight 0.45-caliber machine

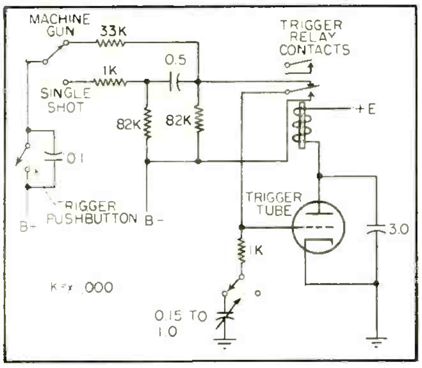


FIG. 3—Circuit used to obtain either single-shot effect or machine-gun sounds

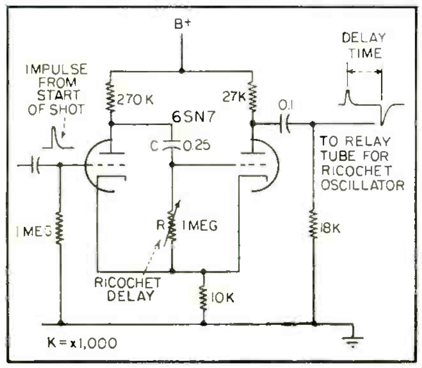


FIG. 4—Delay multivibrator circuit in simplified form, with pulse waveform

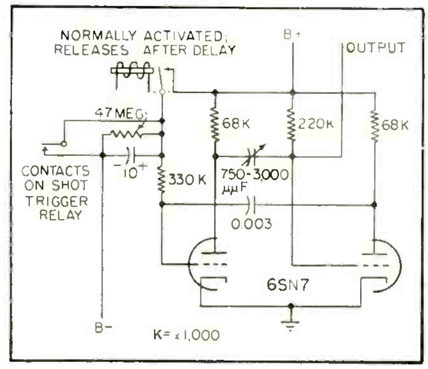
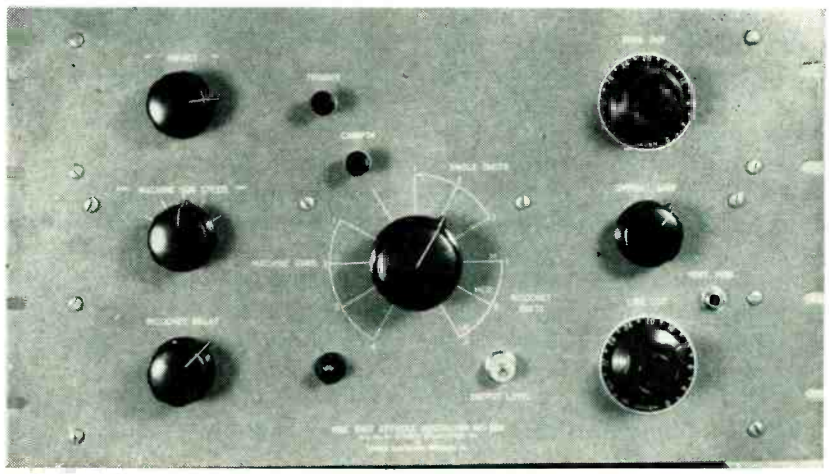


FIG. 5—Ricochet delay relay circuit and associated double-triode oscillator



Front-panel controls of generator permit quick setting to give variety of shot effects

gun (tommy gun) to a large 40-mm anti-aircraft gun (pom-pom gun). Thus, a master switch is provided to select the shot length and also establish the bandpass characteristic of the noise amplifier. Fewer high-frequency noise components are amplified when the length of the shot is increased. This conforms with the character of natural reverberation where the high frequencies are quickly attenuated by air, making the reverberation principally a medium and low-frequency phenomenon.

Because the controls for the rate of machine-gun fire and shot length are independent, a variety of effects is possible. Experience has shown, however, that some combinations are anomalous. The rapid chatter of a Thompson submachine gun, for example, is out of place with the roar of a 40-mm anti-aircraft gun.

Ricochet Effect

A further embellishment which increases the flexibility of the shot effects generator is a ricochet effect. This is accomplished with a free-running resistance-capacitance oscillator which generates a harsh whine. The sequence of events is as follows: A shot with long decay time is generated in a normal manner, while at the same time a pulse initiates a single-cycle delay multivibrator. At the completion of the cycle the ricochet oscillator is activated through a mechanical relay and its output mixed with the decaying noise of the shot. The overall effect is a loud report with reverberation, then, after a short delay, a whine of decreasing frequency and amplitude. A control is provided to adjust the delay before the start of the ricochet from about 0.1 to 0.75 second.

An interesting point developed concerning the whine of a ricocheted bullet. This whine is generally produced by a bullet that wobbles irregularly or spins end-over-end in its flight after striking, but not entering, a solid object. The frequency variation of the whine depends on Doppler effect as well as the changing rate of spin. Marksmen agree that the pitch may increase at first, then decrease, or it may steadily decrease. The average person, however, has only heard ricochets through the medium of motion pictures. A survey of several films indicates that only one type of ricochet whine has been used extensively—the gradually decreasing pitch.

It was apparent, after a brief listening test, that the movies have educated us to accept this ricochet. Rather than oppose public opinion, the shot-effects generator was designed to conform with the accepted version. To provide some variety, ricochets of three different pitches may be selected.

Complete Circuit

A few refinements were incorporated in the final design, shown in Fig. 2. For example, functions are preset with the master switch and only one pushbutton is required to fire the shots. Thus a remote pushbutton can be used to trigger from a distant point in the studio if desired. Operating errors are minimized in equipment which can be preset, as opposed to equipment in which several switches must be thrown at a critical time. An overall volume control is provided as well as separate faders for feeding the line and speaker.

To permit headset monitoring and last-minute selection and adjustment, a phone jack is provided which disconnects both output feeds. Thus, the control settings as well as overall performance may be checked during a show. Output level may be adjusted by means of the neon-tube indicator if necessary. Maximum output from each channel is +8vu at 250 ohms impedance.

While many of the circuits function in a straight-forward manner, several warrant some attention. For example, the desirable feature of a single pushbutton was achieved with the relatively simple circuit of Fig. 3. With this, when single shots are needed, a master switch connects a resistance-capacitance coupling network between the pushbutton and the trigger circuit.

Rear of generator, showing the four preset controls for shot amplitude, trigger adjust, keyer balance and amplifier gain

When the button is pressed, a single voltage pulse of positive polarity is fed through normally closed contacts on the trigger relay to the grid of the relay tube. This positive pulse causes a surge of current to flow through the tube and relay, energizing the latter. This action results, by way of the make contacts, in the application of a large negative voltage on the grid which returns the tube and relay to the normal state.

Unless the grid receives another pulse of positive voltage, the tube remains in this condition. Holding the button down after firing a single shot does not produce additional shots by virtue of the resistance-capacitance coupling network.

If the action in the studio calls for a machine-gun effect, the master switch on the shot-effect generator is positioned to connect the positive voltage through the pushbutton and a resistive network to the grid of the relay tube. Consequently, this tube, in conjunction with the relay, oscillates as long as the pushbutton is depressed since there is no capacitor in series with the positive source of voltage as in the case of the single-shot circuit. The frequency of oscillation is determined by a combination of resistance and capacitance in the grid circuit of the relay tube.

Delay Circuits

Consider now the ricochet effect, where for realism, a short delay must exist between the shot and the start of the whine. The circuitry consists of a single-shot multivibrator which accomplishes the delay, plus a relay tube and relay that turns on the ricochet oscillator to produce the actual whine.

The delay portion of the shot-effects generator is shown in simplified schematic form in Fig. 4. The d-c positive pulse that initiates the shot is also coupled to the first grid of the delay multivibrator. The plate of this tube then feeds a negative pulse to the second grid, cutting it off. The delay time is equal to the time this tube remains at cutoff and is a function of the time constant, RC. When C discharges sufficently to bring the second grid into the conduction region, the cycle is completed and this tube is snapped into heavy conduction. By virtue of the interconnection of the cathodes, the first tube is then returned to its normal condition of cutoff, completing the cycle with a large negative swing at the second plate. This pulse is partially differentiated by the coupling network and fed to the grid of the relay tube, causing it to release the relay momentarily.

Fig. 5 shows the ricochet delay relay and the oscillator which it activates. A high negative bias on the first grid of this resistance-capacitance oscillator maintains it normally inactive. When the relay momentarily opens, however, the 10-μf capacitor is positively charged, causing oscillations to start. Frequency is a function of the magnitude of voltage applied to the grid. As the capacitor discharges, the pitch decreases. The output of this oscillator is mixed with the synthetic reverberation of the shot and the amplitudes of both signals decay logarithmically through the keyer tubes.

Because the ricochet oscillator continues to function until the voltage on the 10-μf capacitor drops below ground potential, a means is provided to discharge this capacitor quickly, permitting other ricochet shots to follow in rapid sequence. Otherwise, during the delay period between the second shot and its ricochet, low-pitched oscillations remaining from the previous shot would be heard. A pair of open contacts on the triggering relay is therefore connected across this capacitor. Each time a shot is fired, these contacts close to discharge the capacitor quickly.

Principles learned during the development of these instruments, coupled with a little imagination, point the way to the creation of many electronic sound effects. The only limitations would appear to be those imposed by size and cost. Present knowledge makes feasible such effects as distant thunder, large or small bells, wind and waves, sirens, screaming shells, creaking doors or wheels, audience applause and many other similar effects.

Gated Decade Counter Requires No Feedback

Combining convenience of decade system with reliability of binary, gated decade counter uses electronically-switched gate instead of critical clamping and feedback networks. Bias range is same as for binary system. Resolution is limited only by resolution of binaries

By E. L. KEMP

Los Alamos Scientific Laboratory
Los Alamos, New Mexico

VARIOUS COMPUTER and counter systems make use of the Eccles-Jordan binary circuit as a pulse divider. Since a scale of two is not compatible with the decimal system, feedback is often used to convert the normal binary sequence to a decade. Typical decade systems using feedback are: the Potter decade[1] and the sixteen-minus-six decade.[2] In both systems, use of feedback makes the decade bias range less than the bias range of a binary system using no feedback. The gated decade overcomes this disadvantage by using a switched gate.

General Description

Bias range for this decade is the same as the bias range of a binary system. This type of decade has no critical clamping or feedback networks. It depends solely upon the binary operation of the circuit to accomplish the permutation of binary to decade counting. Resolution of the system is limited only by the resolution of the binaries. The gated decade lends itself inherently to four-light interpolation; it has been used successfully in a nuclear scaler and is adaptable to any type of counting.

The gated decade contains five stages. The decade divides by sending eight pulses into one storage system and two pulses into another, then resetting. Eccles-Jordan binaries are used as storage devices. An electric-switch-type gate circuit is used to control the direction of pulse flow through the decade.

Figure 1 is a block diagram of the gated decade. The first eight pulses go into the first binary, the gated amplifier and the second and third binaries. The eighth pulse activates the gate so that the ninth and tenth pulses go into the second system consisting of the gated amplifier and the gate-control binary. The tenth pulse resets the decade. The output from the gated decade is taken from the gate-control binary.

Gate Operation

The gate controlling the direction of pulse flow through the decade uses two tubes as shown in Fig. 2. One tube is used as an amplifier and the other as an Eccles-Jordan binary. The action of the gate may be best understood by reviewing briefly the operation of the binary circuit. It is a characteristic of

TAXPAYERS' DIVIDEND

Vast sums spent for atomic weapons development forge a vital link in our national defense. An additional payoff for the engineer comes in the form of equipment and techniques developed in atomic research that are useful in many diverse fields.

Introduced in a nuclear scaler used at Los Alamos, this improved counting circuit is adaptable to any type of counting operation

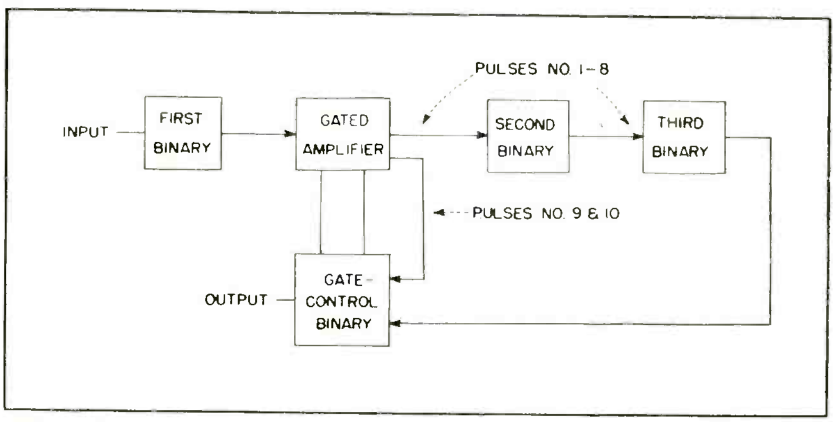
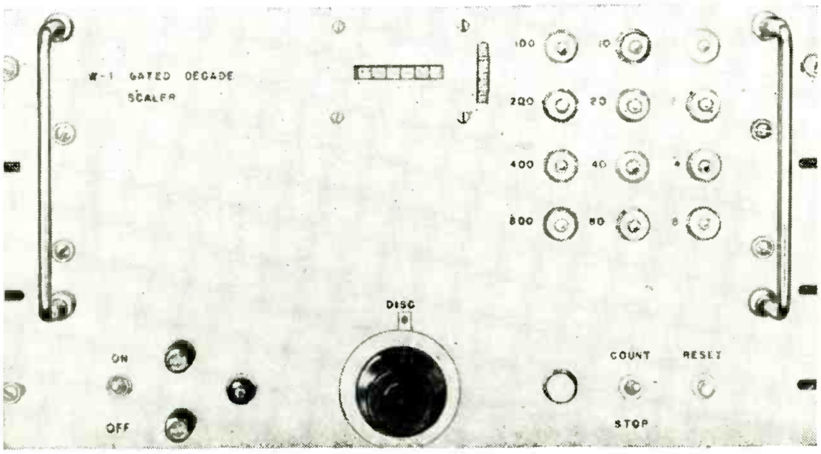


FIG. 1—Decade counter uses electronically-switched gate. Eighth input pulse trips gate; tenth pulse resets counter



Nuclear scaler using gated decade has set record for reliable operation

this circuit that the grid of the conducting plate is at cathode potential or zero bias. Conversely, the grid of the nonconducting plate is beyond cutoff. When the binary is flipped, the grids reverse their potentials. A binary can be flipped with negative input pulses.

Figure 2 shows the grids of the gated amplifier fed in parallel. It should be noted also that they are returned through isolating resistors to grids of the gate-control binary. Thus the conducting plate of the amplifier corresponds to the conducting plate of the gate-control binary. The other plate of the amplifier is likewise cut off corresponding to the state of the binary. A pulse entering the gated amplifier may be passed in the direction dictated by the state of the gate-control binary.

The cathode bias for the gate tubes may be taken from a cathode resistor as shown in Fig. 2. The dotted lines in Fig. 2 indicate an alternative bias scheme, which uses a negative supply for biasing the grids of the gate. Figure 3 illustrates the negative supply method.

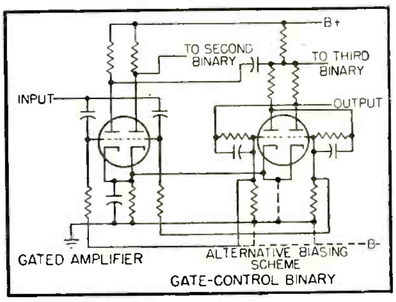


FIG. 2—Gated amplifier with paralleled grids is switched by gate-control binary

A schematic drawing of the gated decade is shown in Fig. 3. All the binaries are capacitor-coupled through common plate impedances. C_d and R_d form a differentiating network between the first binary and the gated amplifier and the subsequent binaries.

Circuit Description

There is a crystal diode in series with the coupling capacitor from the third binary to the gate-control binary. The action of this diode is to prevent the output from plate *A* of the gated amplifier from feeding into the third binary. The output of the gated decade is taken from a plate of the gate-control binary.

The operation of the gated decade may be better understood by following pulses through the circuit. The plate waveforms shown in Fig. 4 refer to the labeled stages in the schematic drawing.

The input pulses are converted into square waves by the first binary. These square waves are differentiated by C_d and R_d and fed into both grids of the gated amplifier. Plate *B* of the amplifier inverts the positive input pulses and feeds them into the second binary and subsequently into the third. The eighth pulse causes the third binary to send out a negative pulse which flips the gate-control binary. The ninth pulse is negative when

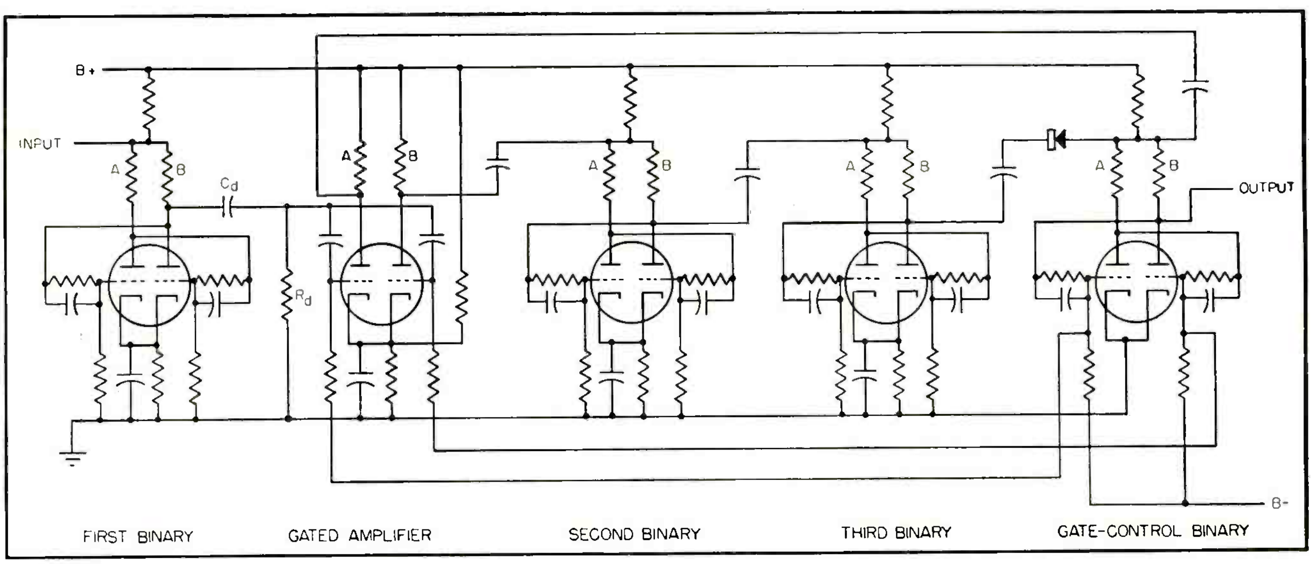


FIG. 3—Counting operation may be traced from circuit schematic. Eighth pulse flips third binary, which, in turn, flips gate-control binary. Gated amplifier feeds tenth pulse to gate-control binary resetting decade and producing output pulse

entering the gated amplifier, so it is rejected. The tenth pulse which is positive is inverted by the amplifier and fed into the gate-control binary which then flips back and resets the decade. The output to drive another decade is taken from plate *B* of the gate-control binary.

It should be observed from the waveforms that the gate-control binary and the gated amplifier have the time from the end of pulse eight to the start of pulse ten in which to be reset. This is also true for the time between pulse ten and pulse two. The resolution time of the decade can therefore be as fast as the resolution time for the first binary if care is used to design the gate-control binary with a resolution no more than twice the resolution time for the first binary.

Nuclear Scaler

The gated decade circuit has been used successfully in the scaler shown in the photograph to count particles in radioactive decay. The familiar four-light interpolation scheme was used. Figure 5 shows the schematic of the scaler.

The scaler contains a regulated power supply, a discriminator, three decades and a mechanical register. The scaling factor is 1,000. The resolution of the instrument is two microseconds. The discrimination range is from 10 volts input to 100 volts. The maximum counting speed, which is set by the register, is 700,000 counts per minute. The power supply is regulated and delivers 125 ma plate current for the whole instrument. The instrument has been extremely reliable, giving satisfactory performance for as long a period as three months of 24-hour daily operation.

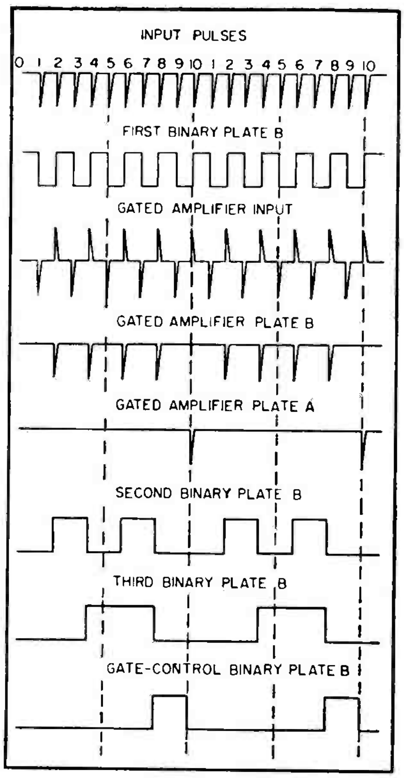


FIG. 4—Plate waveforms

References

(1) J. T. Potter, Electronics, p 110, June 1944.
(2) I. E. Grossdoff, *R.C.A. Rev* 7, p 428, 1946.

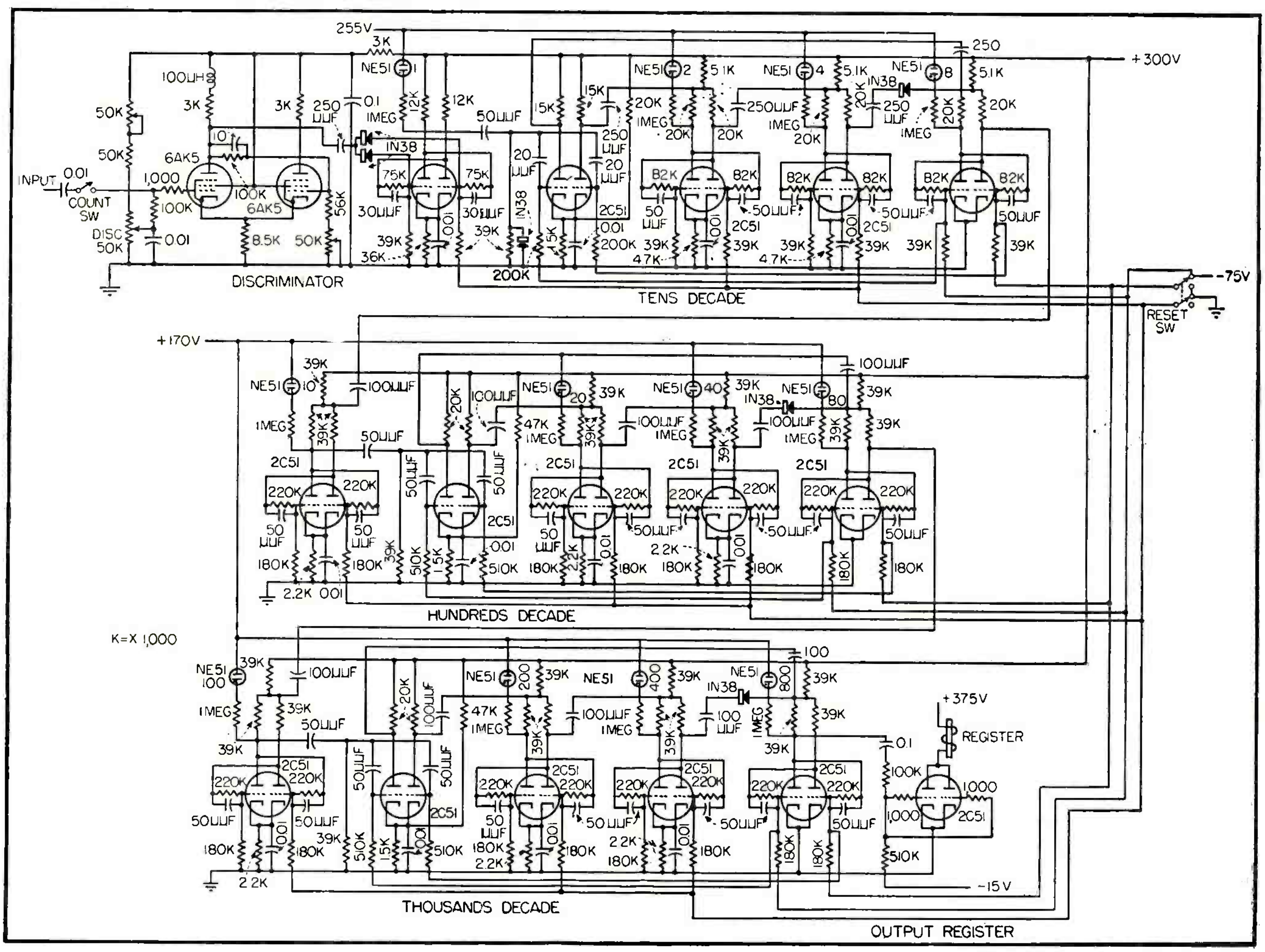


FIG. 5—Nuclear scaler uses input discriminator and three gated decades to count particles in radioactive decay. Four-light interpolation is used

Vacuum-Tube T-Pad

By ED C. MILLER
Chief Engineer
N. R. C. S.
Weiser, Idaho

In a T-pad, such as is illustrated in Fig. 1A, it is possible to make R_1 equal to the input impedance and R_2 equal to the output impedance, if the loss of the pad is greater than 20 db. This approximation is permissible since the calculated values of these resistors so nearly approach (but never quite equal) their respective impedances.

It is then possible to calculate the maximum value of R for a loss of 20 db and, by varying this resistance from zero ohms to the calculated maximum, to produce an attenuation of any amount from infinity to 20 db with one variable element.

In the electronic attenuator circuit to be described, R is replaced by the plate-to-cathode resistance of a vacuum tube, and attenuation is controlled by changing its positive d-c grid voltage. The characteristics of most low-power triodes are such that with proper plate voltage, an approximately logarithmic change in plate current, and therefore plate resistance, is produced by a linear change in positive grid voltage.

Figure 1B illustrates the basic circuit with the addition of a rectifier to provide a grid voltage corresponding in amplitude to the a-c signal. Because of the logarithmic change in plate resistance caused by a linear change in grid voltage, the output of Fig. 1B will be constant, though the input changes appreciably.

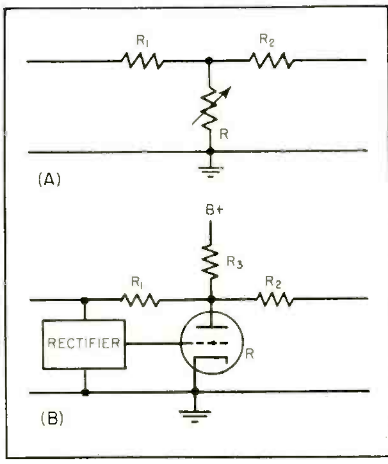


FIG. 1—Replacing it with signal-biased vacuum tube provides signal compression

Limitations

At first look it would appear that the range of input changes for which constant output would be maintained would be unlimited. There are limits, however.

On one hand, because R and R_3 are in parallel as regards the a-c signal, the ratio of R_3 to R (at minimum attenuation of 20 db) must be at least 10 to 1. On the other hand, the plate current fails to increase in log fashion when the plate voltage approaches the value of the d-c grid voltage. The range available with a 6J5 triode is about 20 db.

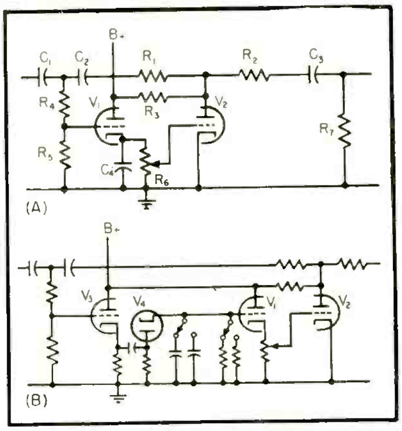


FIG. 2—More elaborate circuits prohibit distortion by input loading and extend frequency response

Grid current is drawn by the limiting tube because the grid voltage increases in a positive direction with increasing input signal. If this changing current were supplied by the a-c signal, distortion would result. In Fig. 2A, the grid voltage is supplied by the d-c plate supply, but is proportional to the signal level. To further insure that the input will not be loaded, the grid of the cathode-follower-rectifier V_1 is attached to a voltage divider, instead of directly to the input. Capacitors C_1, C_2 and C_3 are merely isolating capacitors, and C_4 filters the rectified signal.

Adjustment of the zero compression point for individual tubes may be done by making R_1 equal to 10 times the plate-to-cathode resistance of V_2, with the grid of V_2 connected to the cathode of V_1, and by making R_3 equal to R_1. A simpler way is to use equal fixed values for these resistors and to adjust the grid voltage of V_2 to the point where the plate-to-cathode resistance is 10 percent of R_1. This can be done with R_6. In practice R_6 can be set to give a reading of 10 percent of the plate supply voltage, as measured with a vtvm at the plate of V_2 with no signal applied.

Frequency Response

The frequency response of this circuit is limited on the high end by the plate-to-cathode capacitance, and on the low end by the time constant of C_4R_6 and the grid-to-cathode resistance. With C_4 chosen to give sufficiently rapid compression and sufficiently long release for speech, the response is flat from several hundred kc down to 100 cycles with rising distortion below 200 cycles.

Where better low-frequency response and variable compression and release are desired, the circuit of Fig. 2B may be used. The lowest frequency of this design is limited by the d-c transient produced by sudden input amplitude fluctuations.

By using a remote-cutoff pentode as the first succeeding amplifier and operating it at fairly high bias, these transients will not adversely affect the overall performance. If frequencies below 200 cycles are not desired, as in communications work, the time constants of $C_1(R_4 + R_5)$ and C_3R_7 of Fig. 2A, should be short enough to attenuate the lower frequencies. Tubes that have proved satisfactory for V_2 are the 6J5, 6C5, 6SL7, 6SN7, 6SQ7, 6SF5 and 6SC7.

For the satisfactory operation

Logarithmic Attenuator

Circuit provides basis for communications-type speech compressor using vacuum tube in leg of T-pad to limit speech peaks logarithmically and provide high percentage of modulation for a-m transmitter. Complete modulator is described

of any volume compressing unit, there must be an input amplitude up to which no compression takes place. If this were not so, the output would be held at zero. In the present circuit V_1 performs this function along with controlling the grid voltage to V_2. The cathode bias supplied by R_6 can not completely cut off current flow in V_1. Until the negative half-cycle of the applied signal is of sufficient intensity to cause cutoff when added to the cathode bias, the d-c voltages at the top of R_6 and at the grid of V_2 will remain unchanged. After this level is exceeded, the cathode voltage will follow, in a nearly linear manner, the signal amplitude.

Operating Conditions

Plate supply voltage is not critical, and if V_1 and V_2 are supplied from the same source the voltage may vary from 150 to 500 volts. It should be remembered that an attenuator introduces a loss in the circuit to which it is connected. This loss varies from 20 db at no compression to 40 db at maximum compression. The 20-db loss can easily be regained by the addition of a single stage of amplification following the compressor.

The signal level at which logarithmic compression takes place will vary with different tubes. For a 6SL7GT, used for V_1 and V_2, compression will begin at about three volts rms at the input.

This volume limiting circuit has many applications in various audio circuits, but its simple construction, easy adjustment and low cost readily adapt it to use at a low-level point in a speech amplifier for modulating a communications transmitter.

Figure 3 shows the schematic of a modulator using the circuit. It was designed to supply about 50 watts output with 700 volts plate supply to the class B tubes.

The high-impedance crystal communications microphone output is amplified by V_1 sufficiently to operate the electronic attenuator or limiter at up to 20-db compression without clipping. No gain control is used before the limiter because the mike output for almost any operator works into the compression level range. The only change in the limiter from that already described is the insertion of SW_1 across R_6. When this switch is open, normal limiter action takes place. Closing it shorts out the input to the high-impedance rectifier so the grid voltage on the limiter V_{2B} remains at the value for zero compression, that is, a fixed attenuation of 20 db. This switch allows the modulator to be used with or without compression. Pentode V_3 is used to compensate for the 20 db loss inserted by V_2. A 6SJ7 with the values shown does this easily with enough to spare to drive a 6V6GT as a low-power power amplifier. The gain control in the grid of V_4 is used to adjust the modulation to the desired amount with the compressor in operation.

Adjustment

Adjustment is achieved by setting R_9 to make the voltage at the plate of V_{2B} equal to ten percent of that at the plate of V_{2A} as measured on a vacuum-tube voltmeter, with SW_1 closed. Then, with SW_1 open, one talks into the microphone sufficiently loud and close to cause the vtvm connected to the plate of V_{2B} never to exceed 50 percent of the voltage present when SW_1 is closed.

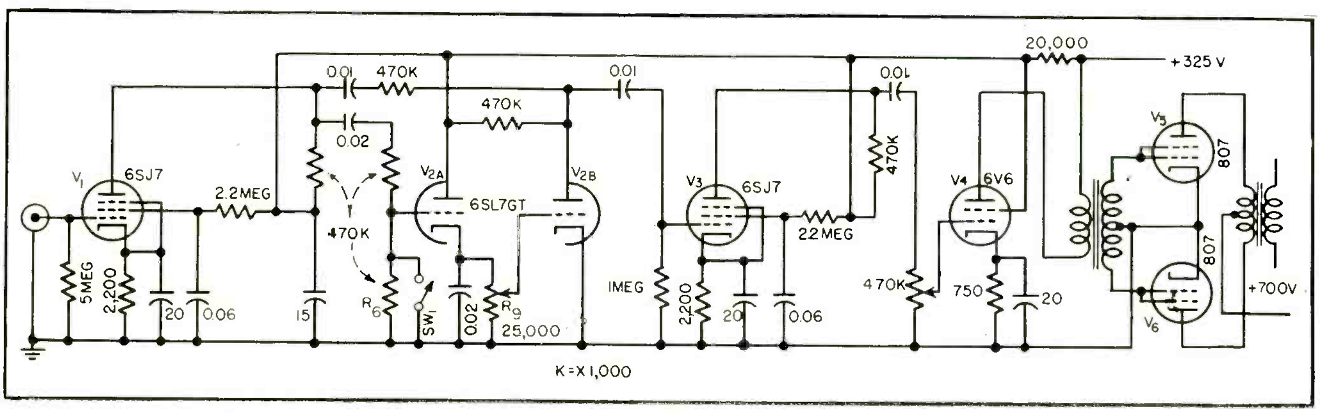


FIG. 3—Typical 50-watt modulator built around compressor circuit. Resistor R_2 (Fig. 1) can be omitted for speech work

Graphical Solution of Sky-Wave Problems

Chart shows relationship between great-circle distance, virtual height of reflection, equivalent path distance, angle of departure and angle of incidence at ionosphere so any three can be found if other two are known

By R. A. HELLIWELL

Assistant Professor
Department of Electrical Engineering
Stanford University
Stanford, California

IN RADIO communication problems involving transmission by means of sky-waves reflected from the ionosphere it is often necessary to relate: (1) great-circle distance between transmitter and receiver, (2) virtual height of reflection, (3) equivalent path distance between transmitter and receiver, (4) angle of departure, and (5) angle of incidence at the ionosphere. It is the purpose of this paper to present a simple graphical method whereby these factors can be determined rapidly without recourse to the analytical expressions. If any two factors are given, the other three can be found.

It is assumed that propagation can be represented by a ray and that the characteristics of the actual path of the ray can be represented with sufficient accuracy by the so-called equivalent path, shown in Fig. 1 as the lines *AB* and *BC*. The height h' of the apex *B* is called the virtual height, and *D* is the great-circle distance between the end-points *A* and *C*. The angle β between *AB* and the tangent at *A* is called the vertical angle or angle of departure. The ionosphere is assumed to be horizontally stratified and earth's magnetic field effects are neglected. The path is therefore symmetrical about the midpoint, and the angle of arrival is equal to the angle of departure.

Graphical computations are facilitated with the aid of the sky-wave transmission chart shown in Fig. 2. This is simply a vertical cross-section of the earth's atmosphere up to a height of 600 km. Great-circle distance *D* on the earth's surface is plotted against virtual height h' appearing at left with the chart held sideways.

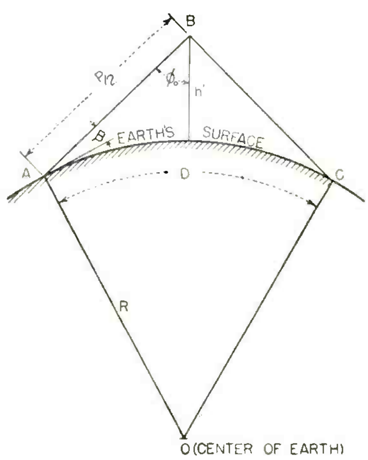


FIG. 1—Diagram shows geometry of sky-wave propagation

The vertical angle β is determined by aligning a straight edge with the origin and the midpoint of the equivalent path (co-ordinates h' and $D/2$) and reading the upper scale. The angle of incidence ϕ_0 is interpolated in the family of curves of constant ϕ_0 plotted on the chart. Secant ϕ_0 is read from the conversion chart below the main chart.

Since there are five basic variables (D, P, h' β, and ϕ_0) only two of which can be independent, there are ten possible combinations of independent variables. For any given pair of variables, the other three are determined from the chart. The procedure is illustrated in the following example for a selected pair of variables (*D* and h').

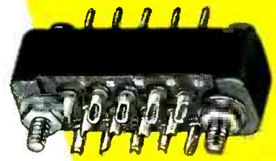
Example

Problem: Given a great-circle distance *D* of 3,000 km and a virtual height h' of 310 km, find the vertical angle β, the angle

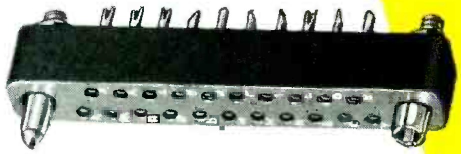
(Continued on p 152)

Cinch
MICRO CONNECTORS

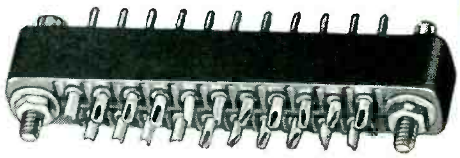
. . . ***MINIATURIZED*** **MICRO CONNECTORS THAT SAVE SPACE, WEIGH LESS AND ARE MORE EFFICIENT**



14 pin Plug & Socket
54A17923 — Socket
54B17924 — Plug



Designed for "miniaturization" requirements in aircraft equipment. Skilfully made of materials to meet most exacting needs of Armed Forces installation.



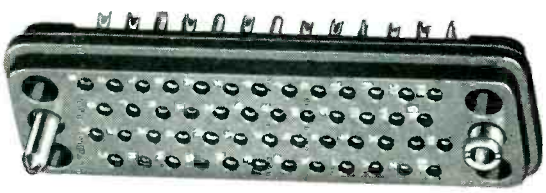
21 pin Plug & Socket
54A17976 — Socket
54B17977 — Plug

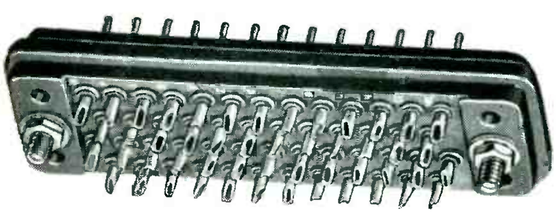
Molded *miniaturized* connectors, 14, 21, 34 and 50 contacts available in low loss material for chassis mounting applications.

The utmost in service assured by the production methods that have made CINCH the standard in electronic components.

CINCH experience indicated in the wide variety of designs and materials assures you the connector for your purpose.

CONSULT CINCH!





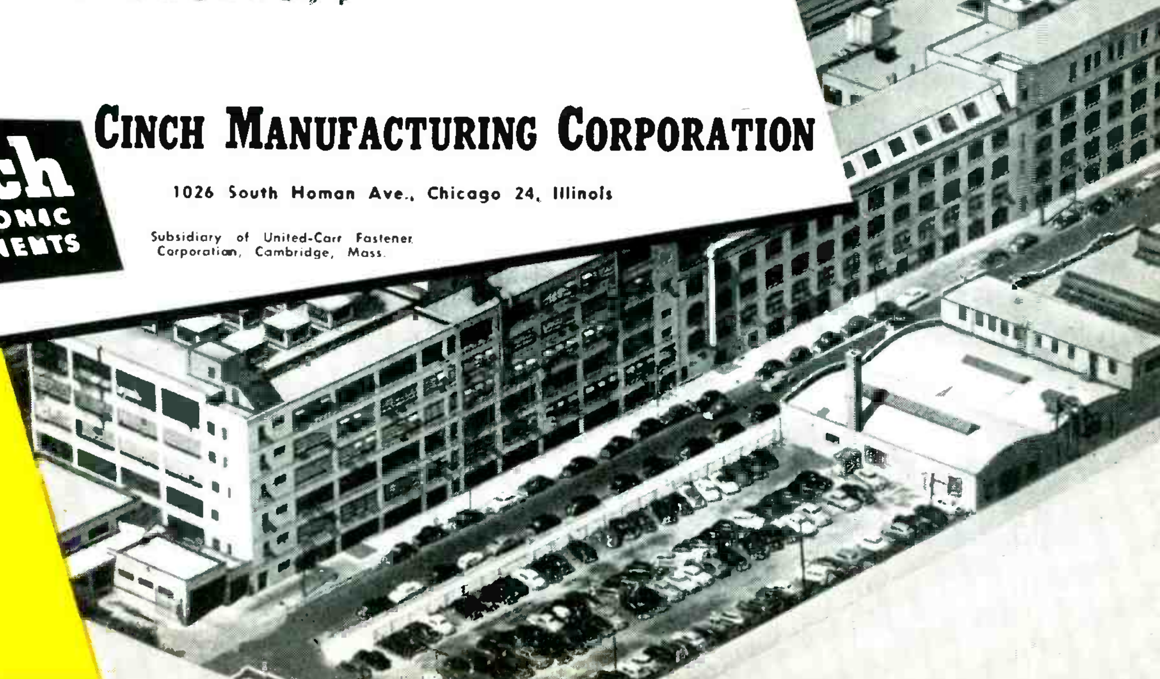
50 pin Plug & Socket
54A17907 — Socket
54B17908 — Plug

Cinch
ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.



Cinch Electronic Components are available at leading jobbers—*everywhere*

Sky-Wave Problems (continued from p 150)

of incidence ϕ_o at the ionosphere, sec ϕ_o, the path distance P, and the transmission time t.

Solution: Locate the apex of the path at $D/2 = 1{,}500$ km and $h' = 310$ km on Fig. 2. Align straight edge with origin and apex. Read $\beta = 4.5$ degrees on the upper scale. Read $\phi_o = 72$ degrees by interpolating in family of curves of constant ϕ_o. Obtain sec $\phi_o = 3.2$ from conversion scale. Obtain $P = 3{,}140$ km by measuring distance from origin to apex, using the height scale on the chart, and multiplying result by 2. The transmission time $t = 10{,}470 \times 10^{-6}$ seconds is obtained by dividing the path distance P by the speed of light (3×10^5 km per sec).

The author wishes to acknowledge the helpful comments of A. M. Peterson.

Appendix

Some of the more important analytical expressions, based on Fig. 1, are given below for reference. Others can be derived readily.

$$\phi_o = \tan^{-1} \frac{\sin \frac{D}{2R}\frac{180}{\pi}}{1 - \cos \frac{D}{2R}\frac{180}{\pi} + \frac{h'}{R}}$$

$$\beta = 90 - \phi_o - \frac{D}{2R}\frac{180}{\pi}$$

$$h' = R\left[\frac{\cos\beta}{\cos\left(\frac{D}{2R}\frac{180}{\pi} + \beta\right)} - 1\right]$$

$$D = 2R\left[\cos^{-1}\left(\frac{R}{R+h'}\cos\beta\right) - \frac{\pi}{180}\beta\right]$$

$$P = 2 \times \sqrt{2R(R+h')\left(1 - \cos\frac{D}{2R}\frac{180}{\pi}\right) + h'^2}$$

where D = great circle distance in km
h' = virtual height in km
P = path distance in km
β = vertical angle in degrees
ϕ_o = angle of incidence in degrees
R = earth radius (6,367 km)

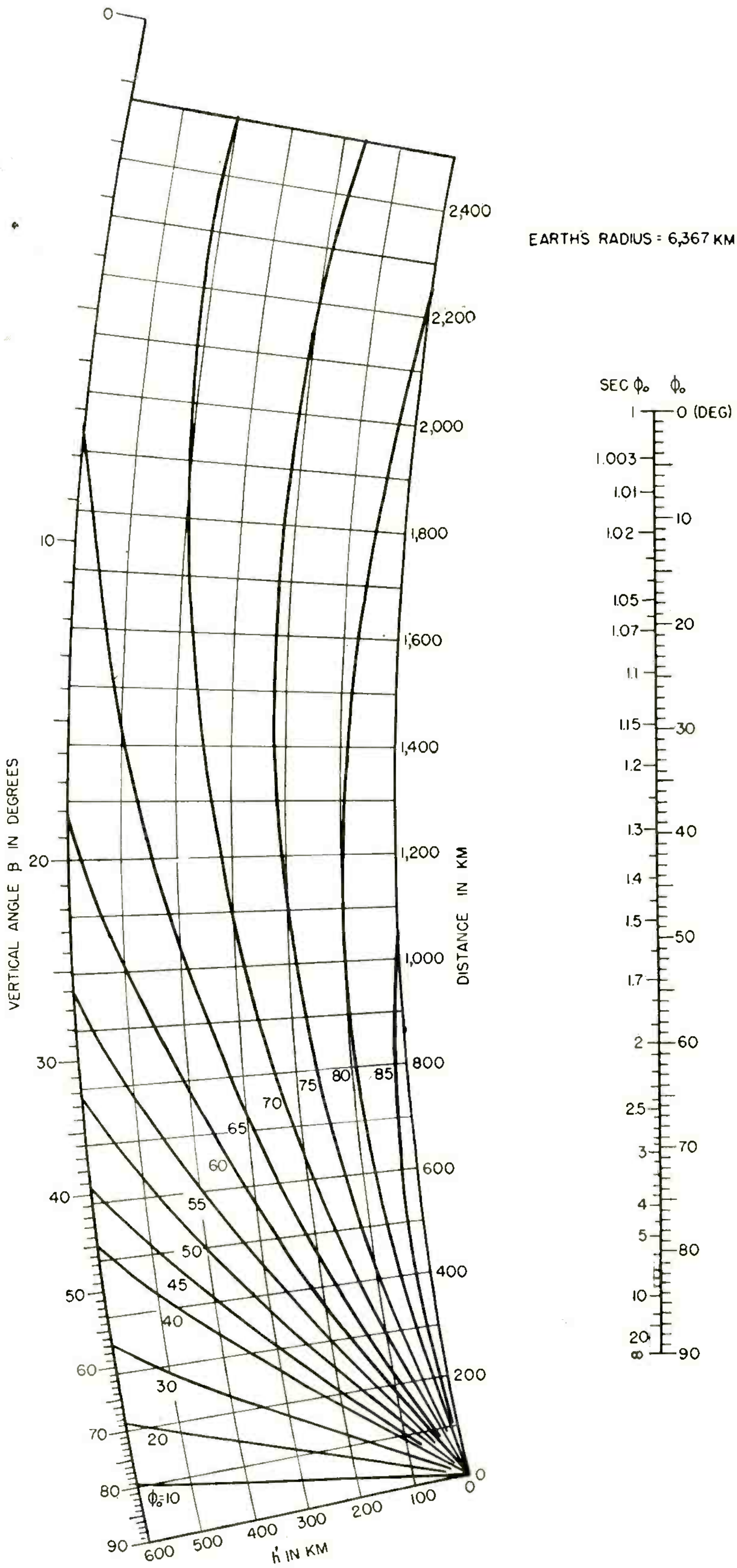


FIG. 2—Sky-wave transmission chart relates great-circle distance $D/2$ (see Fig. 1), virtual height, path distance, vertical angle and angle of incidence

MALLORY
wire wound Potentiometers and Rheostats

Military and Commercial Types

To meet the exacting requirements of military specifications, Mallory potentiometers are especially designed to conform to specification JAN-R-19 for the following types:

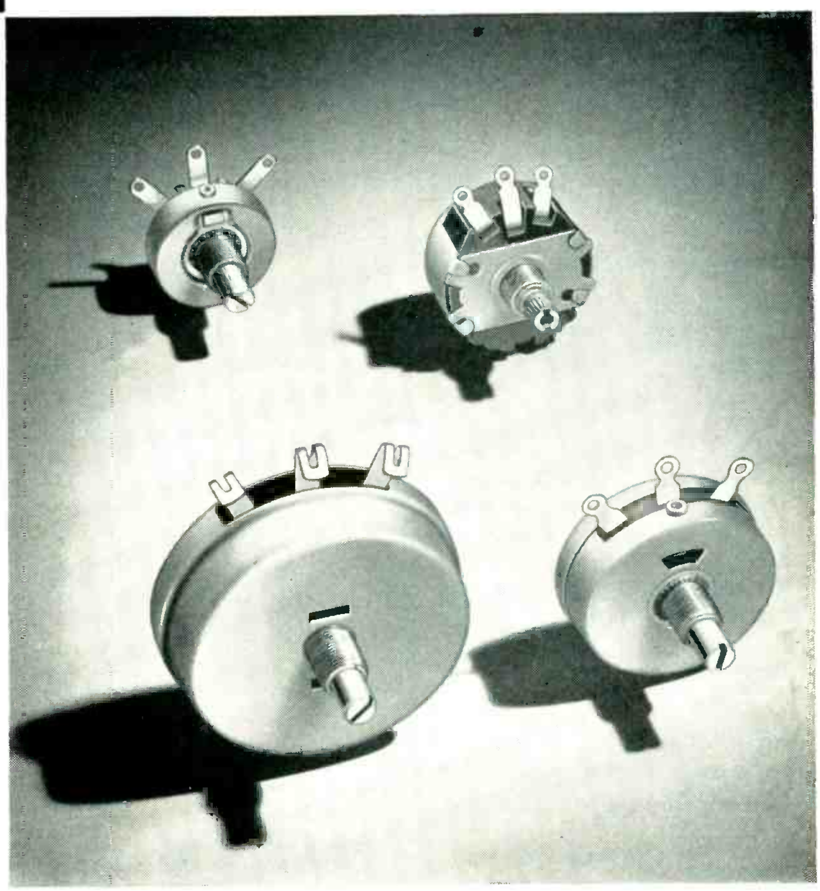
RA20—2 watts—Insulated rotor
RA25-RA30—4 watts—Insulated rotor

In addition, Mallory C and QC controls of the 2-watt grounded rotor type—formerly covered by specification JAN-R-19, style RA15—are also available.

Into these military-type potentiometers go the same engineering know-how and production skill that has made Mallory potentiometers the standard of quality in industrial and electronic fields.

Precision built Mallory potentiometers and rheostats are used extensively in precision test equipment . . . special medical and laboratory electric and electronic devices . . . and in numerous applications for aircraft, marine and radio transmitting and receiving equipment.

Expect more . . . Get more from **MALLORY**



New Technical Information Bulletin Available

New Mallory Bulletin 76-3 contains complete data on both Military and Commercial Type Rheostats and Potentiometers. Write for your copy today.

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 Dry 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.

ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by ALEXANDER A. McKENZIE

OTHER DEPARTMENTS featured in this issue:

Type 6X4 Tube Applications

By Walter R. Jones
Panel on Electron Tubes
Research and Development Board
New York, N. Y.

Beginning with this issue, ELECTRONICS will publish a number of specialized tube application notes as they become available. This material results from activities of the Applications Subcommittee of the Panel on Electron Tubes, Committee on Electronics, Research and Development Board, with headquarters at 346 Broadway, 8th Floor, New York, N. Y. Working as teams, two or three tube applications engineers from the industry, together with a Service representative, have been investigating proposed uses of tubes in military equipment. Typical data obtained is presented below.

ONE OF THE MOST FREQUENT PROBLEMS encountered in military electronic equipment involves application of type 6X4 tubes in capacitor-input circuits at a power-supply frequency of 400 cycles. The problem arises because sufficient impedance is not included in each plate circuit to limit the steady-state peak plate current and the hot-switching current to their respective rated maximum values. When either of these currents exceeds the maximum safe rating, the tube may become permanently damaged and the power transformer and first filter capacitor may also be ruined.

To avoid many tedious calculations, three charts have been calculated that fulfill criteria for safe operation for type 6X4 operated with capacitor input. If the proposed operating point falls within the shaded area of all three charts, then the circuit should give reliable operation. Figures 1 and 2 are based on the assumption that the maximum safe peak steady-state current is 210 ma per plate, while Fig. 3 is based on the assumption that the maximum allowable hot-switching current is 1.8 amperes.

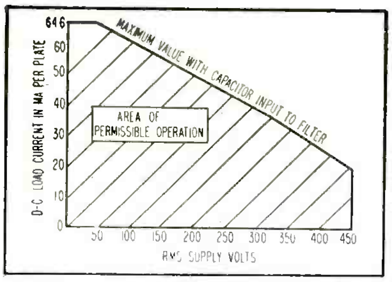


FIG. 1—Operation for 6X4 with 210 ma maximum safe peak steady-state current per plate

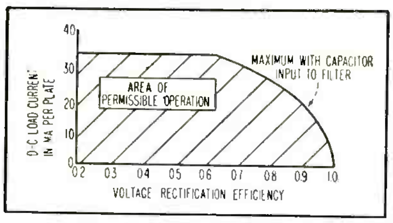


FIG. 2—Load current vs efficiency for 6X4 for 210 ma peak steady-state current

It is only necessary to make three measurements at maximum line voltage or primary supply voltage.

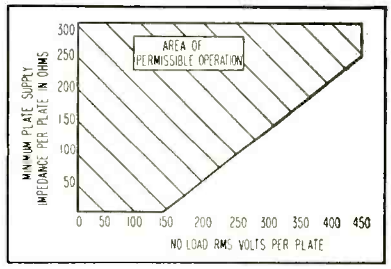


FIG. 3—Operation for hot-switching current of 1.8 amp

These measurements are:

(A) d-c load current (divide this value by 2 if full-wave circuit is employed).

(B) d-c voltage at input to filter

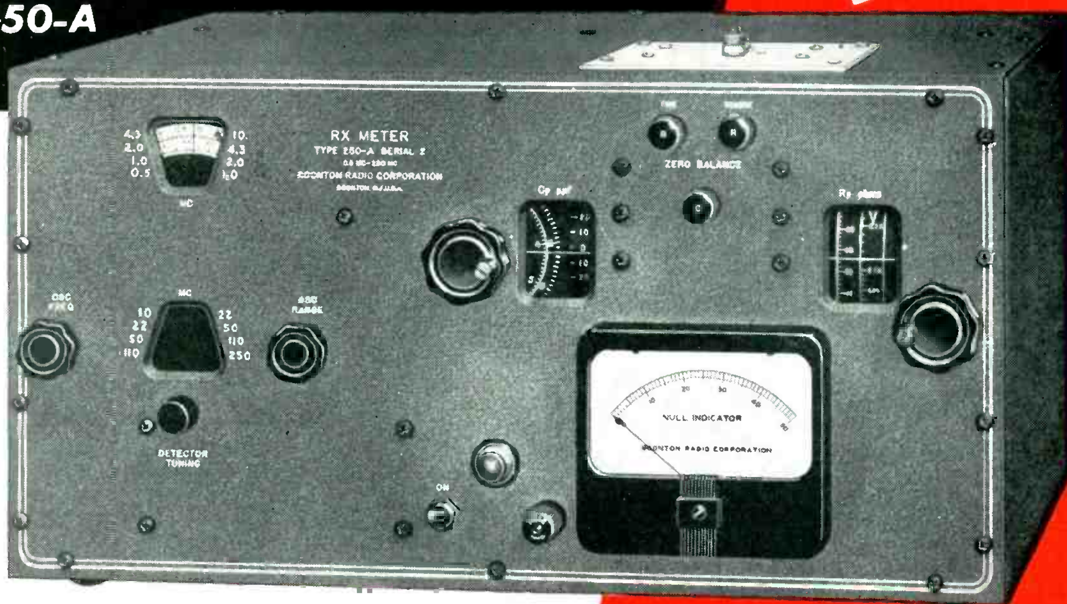
(C) a-c rms no-load voltage across transformer secondary (half of winding if full wave circuit is employed). A high resistance voltmeter must be employed in order that the true no-load voltage is obtained. Fig. 4 indicates where these measurements are made. A calculation of rectification efficiency is made by dividing

$$(B)/1.4\ (C)$$

The operating point can thus be located on Fig. 1. If this point falls within the area of permissible operation then the operating conditions can be checked on Fig. 2. In the event that the proposed conditions satisfy both charts then it can be certain that the maximum safe steady-state peak current will not be exceeded. If the point is outside the area of permissible operation, the operating conditions should be changed so that the new

NEW RX METER....

TYPE 250-A



FREQUENCY RANGE: 0.5 mc to 250 mc

The 250-A RX Meter is a completely self-contained instrument for use in measuring the equivalent parallel resistance and capacitance or inductance of two terminal networks over a wide frequency range. It includes an accurate continuously tuned oscillator, high frequency bridge, "unbalance" detector and null indicator.

All variable components of the bridge are high quality capacitors, which are driven by carefully designed anti-backlash gear trains. The Capacitance indicating dial can be read to 0.05 mmf, and the Resistance indicating scale is expanded to cover 28 inches in length. No corrections are required over the frequency range for the Resistance readings.

USES

The 250-A RX Meter can be used to measure the equivalent parallel resistance and capacitance of resistors at high frequency. If the reactance is inductive the value can be determined. By very simple formulas the equivalent series parameters can be deduced. The instrument will also measure components which are primarily inductive or capacitive. The characteristic impedance, attenuation and velocity of propagation of transmission lines can be determined.

Specifications

FREQUENCY: 0.5 mc to 250 mc in eight ranges.
Rp RESISTANCE RANGE: 15 to 100,000 ohms.
Cp CAPACITANCE RANGE: +20 μμf to —100 μμf.*

*Capacitance range may be increased to ±120 μμf by use of external coils or condensers.

FEATURES

- Measures equivalent parallel resistance and capacitance or inductance of two terminal networks.
- Operates over a Wide Frequency Range.
- Includes self-contained oscillator, bridge, detector and null indicator.
- Null Indicating Meter has automatic gain control which maintains on scale readings under all conditions to avoid meter damage and permit indication of proper direction of adjustment for reaching bridge balance.
- Wide spread resistance dial scale covering total of 28 inches.
- Power Supply internally regulated.

BOONTON RADIO Corporation
BOONTON · N · J · U · S · A ·

Want more information? Use post card on last page.

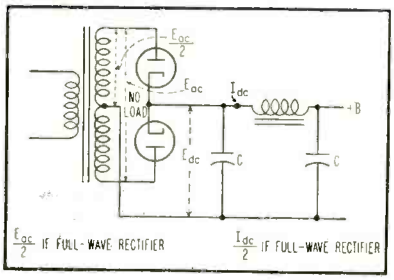


FIG. 4—Reference diagram for measurements described in text

point falls within the shaded area.

The simplest method of altering operating conditions is to add sufficient series resistance in the center lead or in each plate lead of the transformer to bring the rectification efficiency within the necessary limits. These charts are computed on the basis that 150 ohms per plate, the rated value, has been added to the circuit.

Assuming the proposed operating conditions indicate Fig. 1 and 2 are satisfied, there remains still one more condition—the safe value of hot-switching current that would flow in the circuit. Hot-switching current is that current that would flow if the filter becomes shorted or in the event that the circuit is turned off long enough to permit the input filter capacitor to discharge and is immediately turned on again while the cathode is still hot enough to conduct, such a current flows.

Figure 3 indicates the minimum plate supply impedance per plate required for safe operation for any given a-c plate supply voltage. A simple although not completely accurate method of determining the minimum plate supply impedance per plate is to measure the value of d-c resistance for half the transformer secondary winding (for full-wave operation) and add to that value the additional resistance supplied to the circuit to meet the conditions of Fig. 2. If this value of total resistance is not as high as indicated in Fig. 3 additional resistance should be added to satisfy this condition.

If the conditions indicated in all three charts are complied with, the power-supply problems, regardless of the power-supply frequency and the value of input capacitance to the filter, will be greatly reduced. It is true, of course, that the regulation will be worse with the additional resistance but for a given supply voltage and a given resistance a definite amount of current must flow. The analysis given above holds for sine-wave input. If the waveform differs from this, the peak currents may even be higher than indicated.

Transistor Organs

By James D. Fahnestock
Associate Editor, Electronics

Commonest among the point-contact transistors available today at reasonable cost is the Western Electric 1698, a point contact version intended primarily for use in switching circuits. One or more spares can be applied, in conjunction with a handful of inexpensive parts, to a number of applications—one of which is the electronic organ shown in the accompanying photograph. Several versions are described, including one circuit that permits the playing of any two notes on the keyboard simultaneously with only one set of frequency-determining capacitors and two transistors.

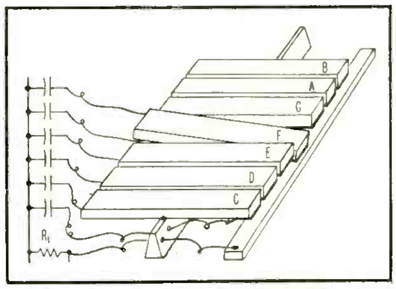


FIG. 2—Wooden keys of toy piano are modified as shown to serve as spst switches for playing notes of transistor organ

The basic circuit employed is shown in Fig. 1. This circuit is a simple relaxation oscillator that provides a pleasing tone in the headphone. Volume is sufficient to be heard all over a large-size room. The exact values of capacitors must, of course, be determined by trial and error. Any desired note may be obtained, by applying the proper value of capacitance across the emitter resistor R_1, from a few cycles per second up through the entire audio range. Output decreases slightly with frequency,

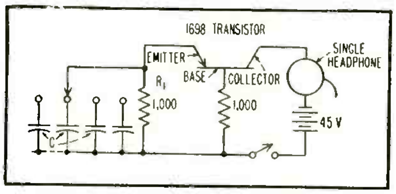
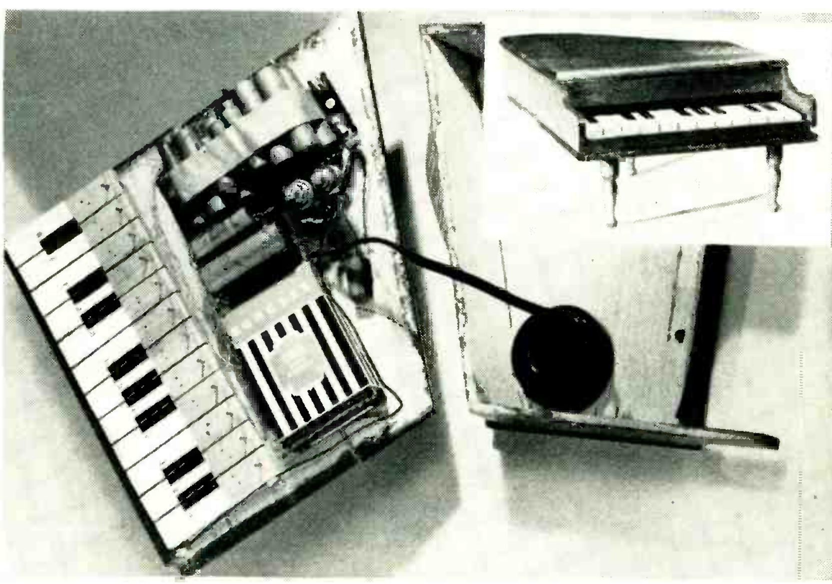
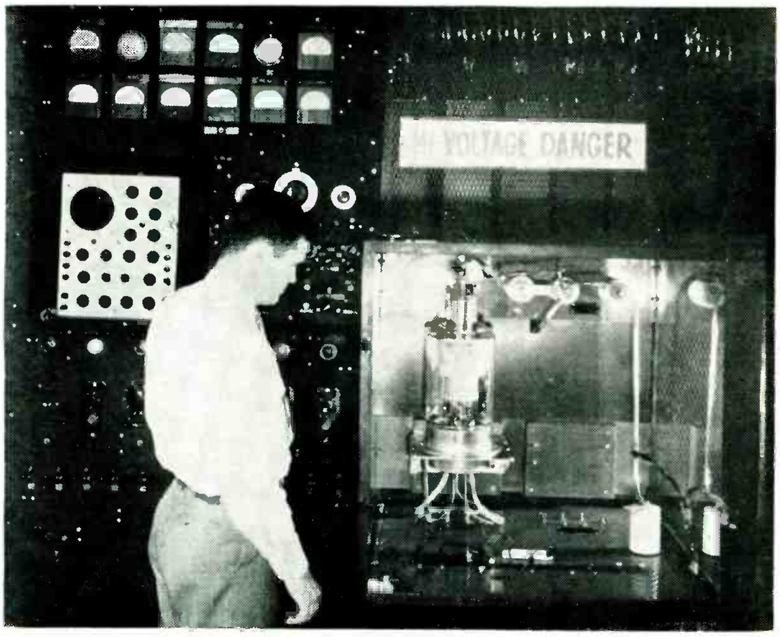


FIG. 1—Circuit of R-C oscillator for toy transistor organ



Transistor organ uses a toy piano case and keyboard (see inset upper right) for all components and battery shown in principal photograph. Single headphone is mounted against top (at right)

THE FRONT COVER



The large tube undergoing test is a type VC-1257, 38,000 peak kilowatt hydrogen thyratron developed by Chatham Electronics Corp. for the Signal Corps. Presently used to generate high-amplitude pulses 1 to 100 μsec long for radar and cyclotron applications, the tube is rated at 2,000 amperes peak and 2 amperes average anode current.

A hydrogen reservoir of powdered titanium hydride hidden within the base permits adjustment of operating pressure within the main bulb to optimum for any operating conditions. This feature provides a source of hydrogen capable of supplying 50 times original tube volume and eliminates gas clean up.

however, so for loud tones, the low notes are preferred.

Different ranges may be obtained by varying R_1, but different values of capacitance are needed to obtain frequencies in musical progression.

The experimental unit shown in the photograph was made from a child's toy piano by removing the resonant rods and hammers and modifying the keys as shown in Fig. 2. Thin strips of brass were tacked to the ends of each key and a strip of brass running below the metalized tips of the keys serves as a common bus.

With appropriate capacitance values connected by small flexible wires to each key notes of the scale can be played. Interesting combinations of low notes can be synthesized by depressing combinations of keys simultaneously, which parallels clusters of capacitors to produce low frequencies.

Two-Note Organ

Considerably more flexibility can be obtained at the cost of some added complexity as illustrated in Fig. 3. With the arrangement shown, combinations of two notes may be played with a single keyboard and a single set of frequency-determining capacitors, and two transistors.

Collector current averages 3 to 5 ma, which is well within the limits of the 1698 transistor, and allows for long life of the 45-volt battery.

In experimenting with values for C and R_1, it is advisable to place a 0 to 5 ma meter in series with the collector to protect the transistor against accidental overloads. The value of 1,000 ohms for R_1 will work for most 1698's, but variations may be desired for changing range, or for tuning up with instruments. A 5,000-ohm potentiometer was used in the experimental organ shown, but it is usually set at the 1,000-ohm value. An octave is covered by eight sets of capacitors ranging from about 0.75 to 0.25 μf. The switch is provided in the collector lead to disconnect battery when organ is not in use, since some battery current flows when no keys are depressed.

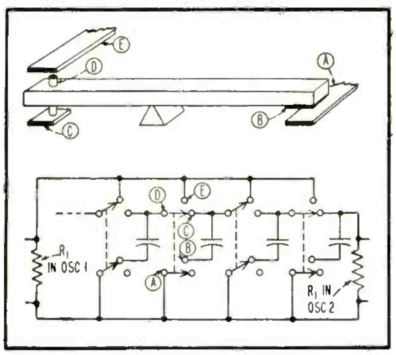


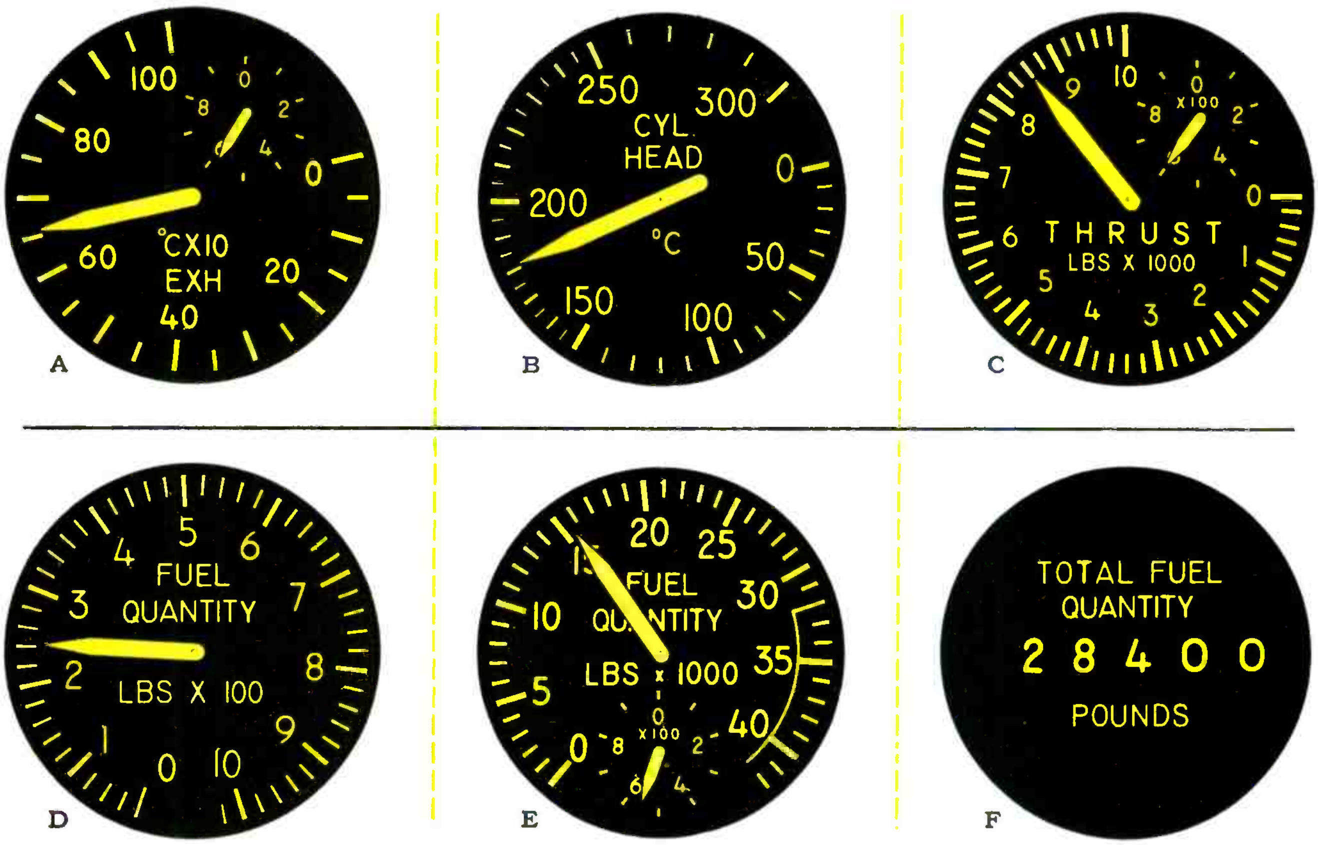
FIG. 3—More elaborate keyboard permits playing of two notes simultaneously with a single set of frequency-determining capacitors. Circled letters on key refer to points on circuit below

PERTINENT PATENTS

EACH WEEK many hundreds of patents are granted to inventors in all of the arts to which patents apply. A survey of recently issued patents made over an arbitrarily selected period of four months during 1952 reveals that of all the patents issued in any week the average number of those applicable to the electrical and electronic arts represents 12 percent of the total. A maximum of 14 percent of all patents was electrical or electronic in the week containing the largest relative number of these patents. The minimum number represented 8 percent of the total.

Patent Groupings

A recent innovation on the publication of patents granted by the U. S. Patent Office is the breakdown



Do you know this panel of experts?

These Avien gages tell a story that may shape your future—especially if you're an engineer.

Remember the days of "ball and needle" instruments?

The men in today's cockpits need far more accurate gages of fuel and other quantities. Instrumentation has become a new science – a science in which Avien is a vital part.

Every month, Avien produces over 10,000 major instrument components for the aviation industry.

We'd like you to meet some of our panel members:

A–Jet Tailpipe Thermometer, first to use the servo principle. Result: long scale and a gage unaffected by lead characteristics.

B–Cylinder Head Temperature Indicator. Again, first to use the servo principle for long scale and greater accuracy.

C–Jet Engine Thrustmeter that computes gross thrust from measurements of tailpipe pressures and ambient pressures.

D–One of more than fifty Avien fuel gages. It measures fuel quantity by weight, eliminates moving parts in fuel tank.

E–Avien fuel gage with a "sensitive" or vernier indicator to provide readability to 0.1% of contents.

F–Counter Indicator, also readable to 0.1% of tank fuel. You can see how it tells the fuel story at a glance.

Avien has made these gages smaller, simpler, lighter, more reliable, more accurate.

Sound engineering made them that way. Hard work and hard thinking made them that way. Individual responsibility – all the way from drawing board to control board – made them that way.

Avien is an engineering operation. Engineers are the "works" here, not the gears. And we're welcoming new members, engineers who can work head-to-head with some of the hardest-hitting men in this business.

If you are an engineer of allied experience, we offer: 1–High pay. 2–Interesting assignments, and the chance to follow through on every good idea you produce. 3–More money and more work, as you earn it.

Modern plants? Of course. Employee benefits? All of them. But most important, Avien offers work! Important, rewarding, fascinating – and *not easy*.

If this makes sense to you, send us a detailed resume before the day is over.

Avien

AVIATION ENGINEERING CORPORATION

34-56 58th STREET, WOODSIDE, L. I., NEW YORK

Want more information? Use post card on last page.

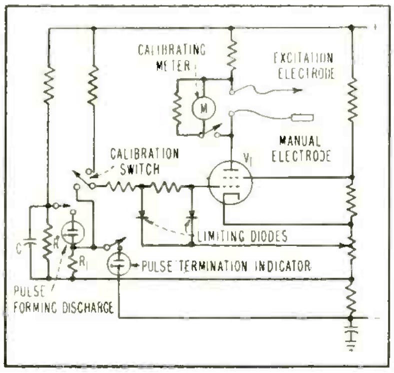


FIG. 1—Pulser used to determine health of tooth pulp

now included in its *Official Gazette*. The publication groups all mechanical and general patents in one section and all chemical patents in a second. Electrical patents (including electronic devices and circuits) are in a third grouping. In each of the sections other than electrical there may be included occasionally devices that are electrical or electronic in nature. As an example, phonograph pickups, motors and record changers have been found in the mechanical and general section. Semiconductor devices, particularly those features dealing with the structure of the materials employed, crop up in the chemical section.

New Patent Law

A new Patent Law of 1952 went into effect January 1953. This law modifies previous law and codifies the several laws pertaining to patents into U. S. Code section 35. There will be, accordingly, changes in the rules of practice in the prosecution of patents before the Patent Office and in the operation of the

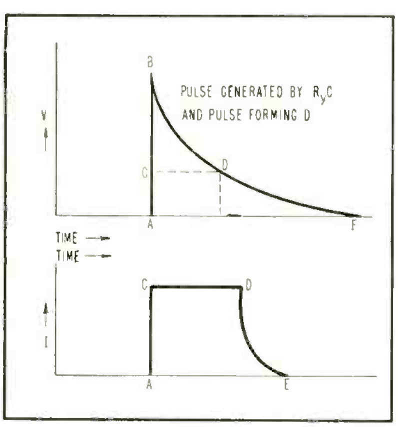
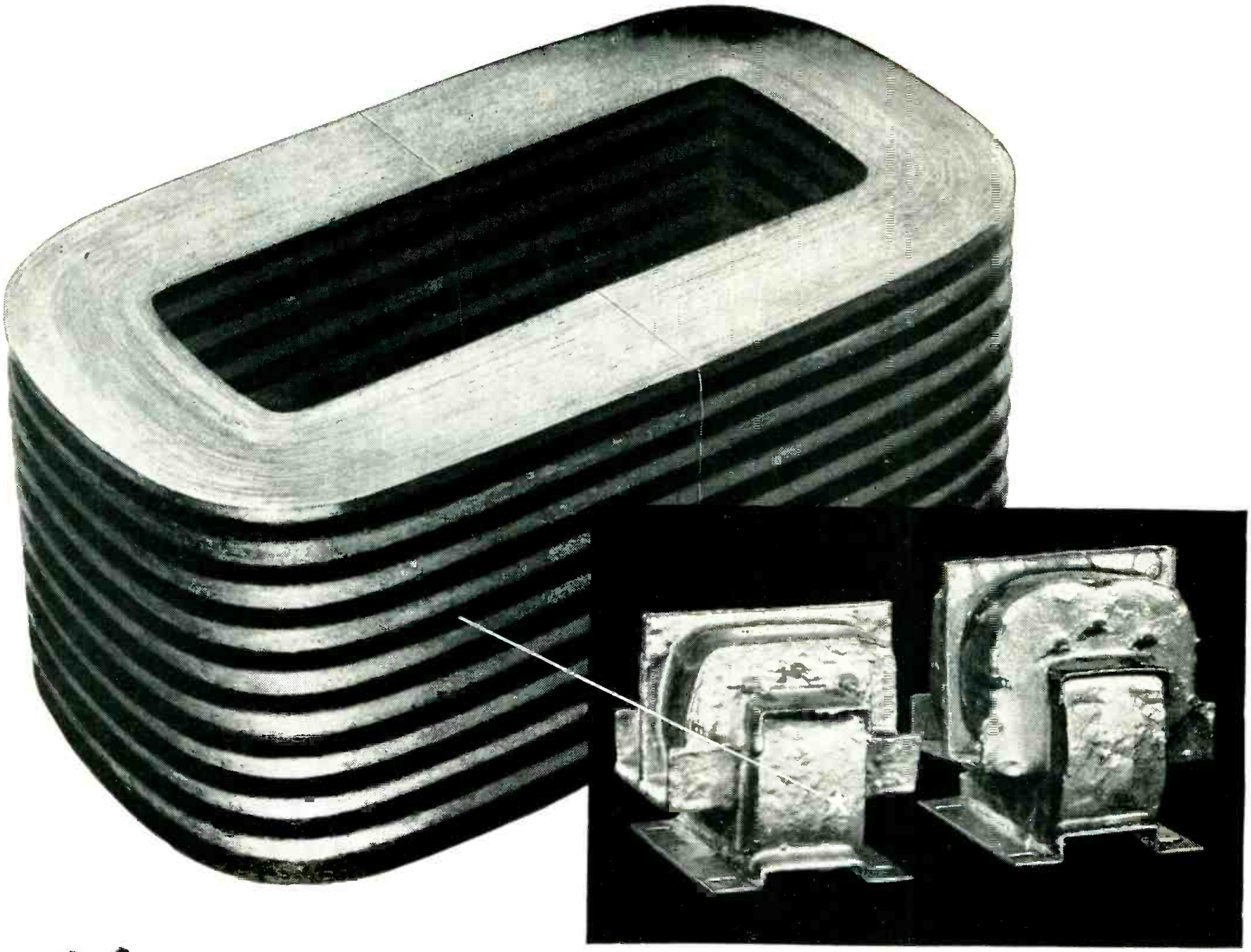


FIG. 2—Pulse forms required for dental testing



New HIPERSIL CORE

cuts air-borne transformer size and weight

Transformer weight reduced 25%, size cut 20% in a single unit of air-borne electronic equipment. This is the mark set by a new lightweight Hipersil® Core designed by Westinghouse for the Navy Bureau of Aeronautics.

Adaptable to commercial as well as military use, the new core makes possible more powerful equipment within the size and weight limitations of previous models. A special silicon steel, rolled to a new 4-mil thinness, with grain structure super-oriented by a refinement of the Hipersil process, achieves the size and weight reductions.

Hipersil Cores cut size and weight in *all types* of electrical and electronic transformers. They combine highest permeability with lowest losses in a wide range of sizes (1 through 5 and 12 mils). Two-piece assembly simplifies transformer manufacturing, cuts fabricating costs. Greater flux-carrying capacity, increased mechanical strength help to make them the best core on the market. For specific information on how to apply Hipersil Cores to your product, write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-70632

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

Westinghouse

WESTINGHOUSE

HIPERSIL CORES

*Quality Controlled** TO THE HIGHEST STANDARDS OF THE INDUSTRY

CHESTER
plasticord-plasticote
WIRES and CABLES

***Quality Control works 2 ways at CHESTER**

It's a fact and here's why! First, Chester quality control engineers certify every phase of manufacture from raw material to finished product packed for shipment. No detail is too small or unimportant to merit their full attention. Second, quality in turn governs production — not a single foot of Chester wire or cable is ever "hurried through" to meet a shipping date or heavy schedule. Extra shifts, not faster production is the method used to break bottlenecks at Chester.

This two way quality control is just one of many important reasons why electrical and electronic men, in increasing number, specify Chester wire and cable for an extra measure of reliability. Why not check your requirements with Chester today.

FOR EVERY APPLICATION —

JAN-C-76 • 80°-90°-105°C
Hook-Up Wire • Shielded Wire and Cable Flexible Cords • Coaxial Cable • Television Lead-In Cable • Gas Tube High Tension Cable • Oil Burner Ignition Cable • Blasting Wire • Thermostat Cable • Bell and Office Wire • TW Building and Fixture Wire

"Chesty" says —
Rely on Plasticord and Plasticote – write for the new Catalog today

CHESTER CABLE CORP.
C H E S T E R, N E W Y O R K

MANUFACTURERS OF QUALITY WIRE AND CABLE FOR EVERY ELECTRICAL AND ELECTRONIC REQUIREMENT

Want more information? Use post card on last page.

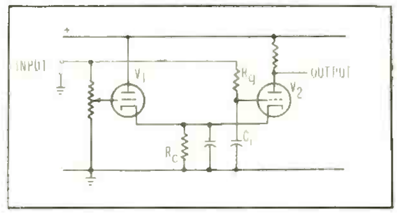


FIG. 3—Pulse-width discriminator circuit

rules regarding infringement and contributory infringement. Manufacturers of electronic equipment and component parts, would do well to have their patent departments inform them about details of the new laws.

Dental Pulser

Active interest has been shown by ELECTRONICS readers in the diagnostic applications of electronic devices in medicine. The grant of U. S. Patent 2,603,753 to Karl N. Axelssohn, and Carl H. Bjorn, of Djursholm, Sweden for an "Apparatus for Examining Teeth" is in line with this interest. In Fig. 1 the circuit diagram of the apparatus is shown. In Fig. 2, there are shown waveforms of the output of the device as applied in dental pulp testing.

A pulse of current generated by the device is used to excite the patient's tooth to determine whether the pulp is dead or anaesthetized. The strength of the current *AC* of Fig. 2. at which the threshold of feeling is observed is the measure of the state of health of the pulp. If no reaction is observed at a level of 40 to 60 μamp this is evidence of anesthetization or necrosis of the pulp.

There is a definite requirement of a steep rise in the initial pulse period, but the decay period does not necessarily have a similarly steep fall. The pulses, however,

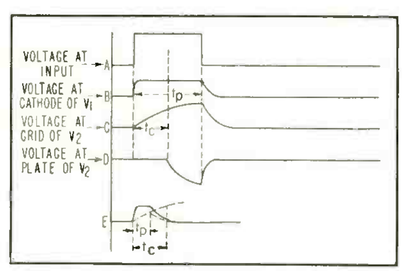


FIG. 4—Waveforms show operation of discriminator

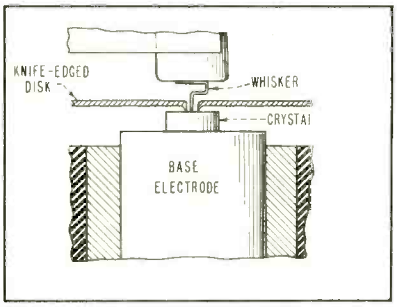


FIG. 5—Mounting and contacts for crystal triode

must be unidirectional and have a substantially rectangular shape, rising to the intended value steeply and remaining at this level for a predetermined period, which in practice is 5 to 40 milliseconds.

The circuit for generating the pulse may be any well-known pulse generator device. The inventors' preferred embodiment is shown in Fig. 1. A pulse having the shape ABE is generated across resistor R_1 by RC network and the gas-discharge tube acting as a relaxation oscillator. The pulse applied to the amplifier grid is limited by the diodes shown to a shape *ACDE*. The output of the amplifier is applied through electrodes one of which contacts the tooth and the return circuit electrode is held in the patient's hand.

Pulse Width Discriminator

Patent 2,609,501 has been granted to G. B. Guthrie Jr., assigned to the United States of America as represented by the Secretary of War, for a "Pulse Width Discriminator Circuit." The circuit of this invention is shown in Fig 3. A group of representative waveforms is shown in Fig. 4. The circuit will accept only pulses of a critical duration t_c or greater and is independent of the amplitude of the pulse. Tube V_1 is normally conducting; V_2 is nonconducting by virtue of the drop across the common

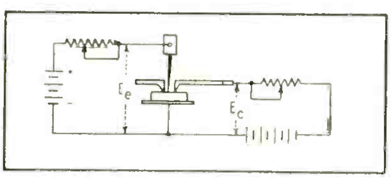
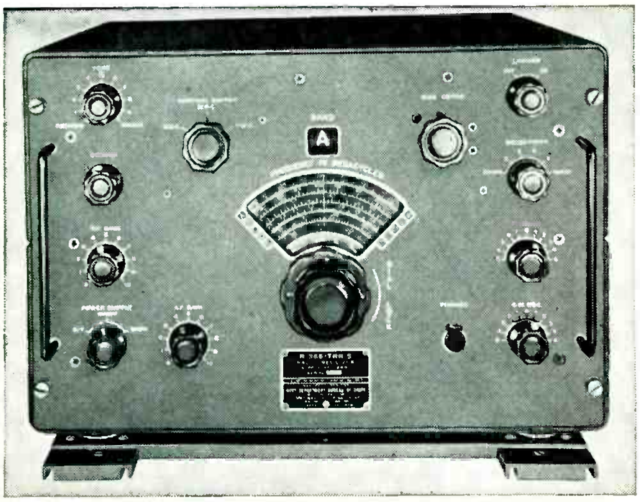


FIG. 6—Circuit of the disk-contact crystal triode

BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

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



Radio Receiving Set, R-366/TRR5, a 14-tube superheterodyne with a frequency range of 540-30,000 kilocycles covered in five bands. Courtesy Espey Mfg. Co., New York

Communications Receiver Uses Copper-base Alloys for Rugged, Trouble-free Service

Hard practical experience gained during extreme service conditions in World War II and the present Korean War dictated the necessity of using strong, dependable, corrosion resisting materials in the construction of the R-366/TRR5 radio receiving set designed for use by the United States Marine Corps. Ocean spray, wide temperature and humidity ranges, rough handling, and a minimum of maintenance care are a few of the many points which required consideration.

It is only natural that copper-base alloys due to their resistance to corrosion, ease of machining, ability to take plating, and lack of magnetic properties should play an important part in the construction of this receiver. For example, brass is used for brackets, mounting hardware, gears, bushings, solder lugs, control shafts, tube socket bases, shields, etc.

For dependable electrical and mechanical contacts, hot tinned brass (70% copper, 30% zinc) solder lugs are used exclusively on all terminal boards. They are easy to manufacture, take solder well and offer high resistance to corrosion.

Band Switching Assembly

A highly efficient positive acting band switching arrangement for trouble-free service is one of the main features of this receiver. The coils are completely enclosed fully protecting them from dirt and damage from handling. Screw studs made from free machining brass rod (approximately 61% copper, 3.4% lead, remainder zinc) support the tuning slugs used for adjusting the various circuits and are located on the ends of the two large housings for making adjustments without opening the sealed units and exposing the coils. The complete assembly is suspended between two cast bronze brackets for rigidity.

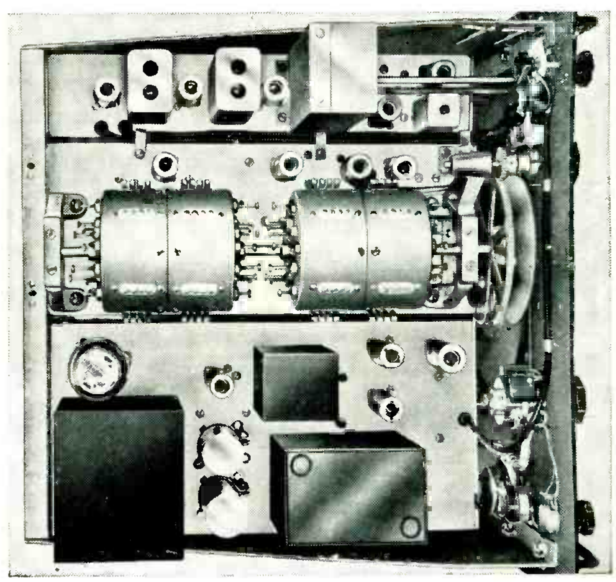
The band selector switch operates through a geared mechanism consisting of a brass gear (approximately 62.25% copper, 2% lead, balance zinc) and an indexing device which rotates the two coil housings, changing their beryllium copper supported coin silver contact points and connecting the 32 phosphor bronze (approximately 95% copper, 5% tin) shorting fingers. In this manner, the desired coils are connected into the circuit and the unused ones completely disabled.

Brass Tube Shields

Fifteen nickel-plated cartridge brass (70% copper, 30% zinc) tube shields are used to prevent unwanted voltages from being picked up or radiated by the various tubes. The shields are fastened to nickel-plated brass shield bases which are formed to the tube sockets. The shields themselves are removable to allow tube changing.

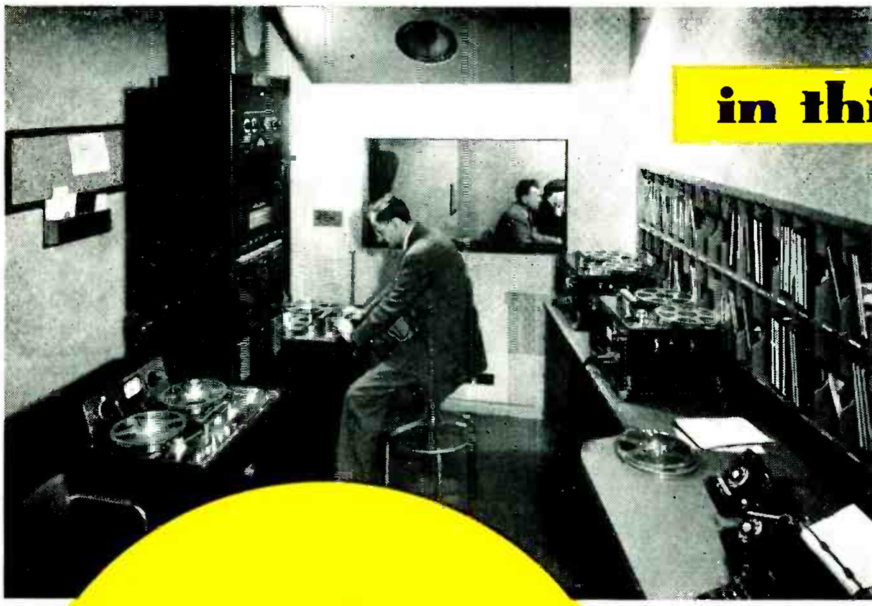
Bridgeport Brass Service

Bridgeport Brass supplies a wide range of copper-base alloys used in the electronic field. As a special service to electronic manufacturers, our Laboratory will be glad to assist in choosing the proper alloys for the many different applications found in their field. Call or write to your nearest Bridgeport representative. (9417)



Top view of receiver R-366/TRR5 showing Band Switching Assembly, which has brass gears, cast bronze mounting brackets, and phosphor bronze shorting fingers. Other brass parts illustrated are tube shields, control shafts, tuning slugs, and mounting brackets. Courtesy Espey Mfg. Co., New York

Want more information? Use post card on last page.



in this room...

there's no room for doubt

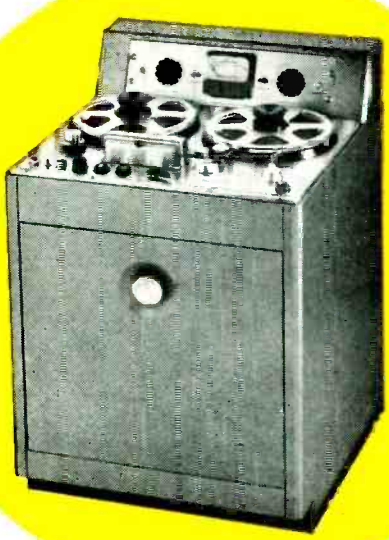
There can be no room for doubt in the continuity and fidelity of your broadcast. Precisely the reason you demand — and get — the best in transmitting and studio equipment.

Nor should you compromise with quality in the tape recorder you select.

In AMPEX Recorders you will find the same matchless reliability and performance you expect of your transmission equipment... and for the same reason — they are engineered to the highest *professional* standards.

AMPEX
brings you these cost-saving operating advantages:

- **UNINTERRUPTED SERVICE**
  Under the demand of heavy-duty programming, AMPEX Recorders deliver thousands of hours of unbroken service. Recently a set of AMPEX heads was returned from Honolulu for routine replacement after 11,000 hours continuous use, 17 hours a day. The heads were still within AMPEX specifications for new heads and had several thousand more hours of use remaining.
- **MINIMUM "DOWN TIME"**
  AMPEX Recorders are designed for thousands of hours of continuous operation with minimum "down time," resulting in low maintenance costs and protection from sudden broadcast failures.
- **ACCURATE TIMING**
  AMPEX split-second timing accuracy protects your programs and commercials from embarrassing time overlaps.
- **HIGHEST FIDELITY**
  Even when programs are repeatedly transcribed from one tape to another, there is no noticeable build-up of noise level, "wow" or distortion.
- **LONG LIFE**
  AMPEX Recorders are designed and built for years of service dependability. Its recordings match established NARTB standards. When you have an AMPEX, you have a machine built for years-ahead performance.



IF YOU PLAN FOR TOMORROW, BUY AN AMPEX TODAY

AMPEX

MAGNETIC RECORDERS

AMPEX ELECTRIC CORP.
934 CHARTER STREET • REDWOOD CITY, CALIF.

cathode resistance R_c.

A signal as shown in waveform *A* applied to the input of V_1 appears at the cathode as shown in waveform *B*. At the grid of V_2 the waveform of *C* appears because of the integrating action of R_g and C_1. When at time t_c the voltage across C_1 equals the amplitude of the pulse appearing on the cathode of V_2 (same as cathode of V_1), V_2 becomes conducting to produce a negative output pulse as at *D*.

If, however, the pulse duration t_p is less than the time required for capacitor C_1 to reach the critical value at which the grid of V_2 will be more positive than the cathode, then V_2 will not conduct and not pass the pulse. This condition of operation is shown in waveform *E*.

Knife-Edge Transistor

In the transistor fields patents are currently appearing in rapid succession. Recent patent 2,610,234 granted to A. H. Dickinson, assignor to the International Business Machines Corp., for a novel "Crystal Triode" is of some interest as an indicator of development trends in this art.

To overcome disadvantages of two point contacts in the conventional transistor, Dickinson's transistor employs a whisker as the emitter element and a knife-edged cylinder attached to a disk. The disk surrounds the whisker tip in a construction that can be seen in Fig. 5. A circuit connection that can be used for this crystal is shown

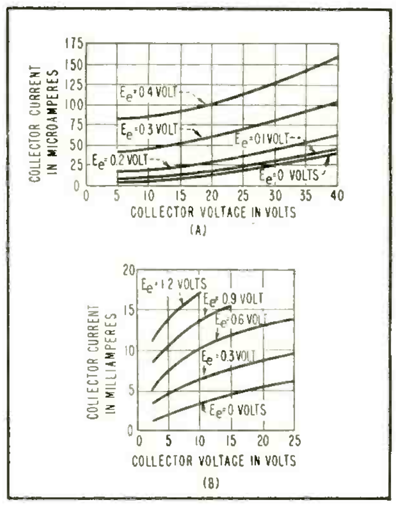
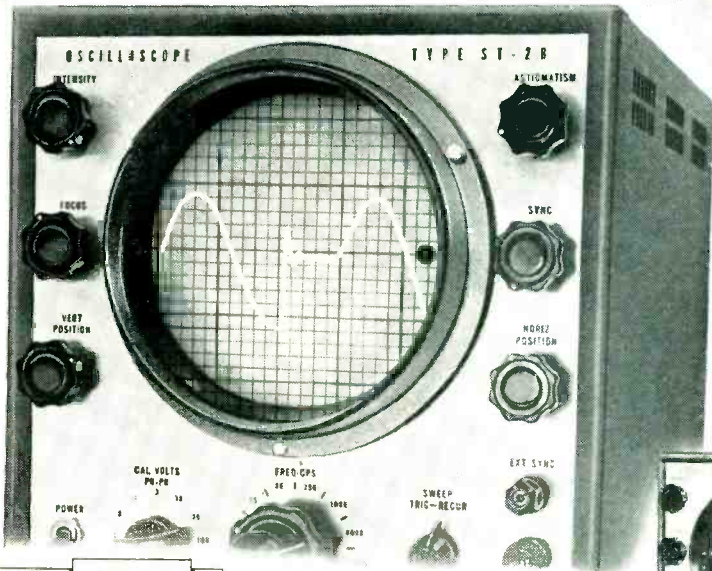


FIG. 7—Collector voltage versus collector current



ELECTRONICS PARK—G-E HEADQUARTERS FOR ELECTRONICS RESEARCH

More Applications Per Dollar—

Identical, Highly Stable D-C Amplifiers! Better High Frequency Response than any other scope in its field!

FROM low level DC measurements requiring good stability to observing wave forms with significant components as high as 1 mc, the ST-2B gives outstanding service. Designed to permit a choice of short, medium or long persistence CR tubes, the unit incorporates identical direct coupled vertical and horizontal amplifiers. Filaments and screens on the first amplifier stages are regulated. Vertical selector switch allows choice of probe, calibration, AC or DC inputs.

SPECIFICATIONS—MODEL ST-2B

FREQUENCY RESPONSE

Vertical Amplifier
DC—0 to 400 kc, +0, −20%, not more than 50% down at 700 kc.
AC—10 cycles to 400 kc, +0, −20%, not more than 50% down at 700 kc.
Probe—2 cycles to 400 kc, +0, −20%, not more than 50% down at 700 kc.
Response independent of gain or attenuator setting.

Horizontal Amplifier
DC—0 to 400 kc, +0, −20%, not more than 50% at 700 kc.
AC—10 cycles to 400 kc, +0, −20%, not more than 50% down at 700 kc.
Response independent of gain or attenuator setting.

SENSITIVITY

Vertical .... AC—10 mv. rms/inch
DC—28 mv. dc/inch
Horizontal .... AC—15 mv. rms/inch
DC—42 mv. dc/inch
Probe .... 130 mv. rms/inch
Deflection Plates Direct
Vertical .... 22 volts rms/inch
Horizontal .... 25 volts rms/inch

SWEEP

Range—Triggered or recurrent—2 cycles to 30 kc (may be extended downwards by adding external capacity across panel jacks).
Sync—±Internal, ±line and −Ext. (requires −.3 volts peak to peak for external sync). Sync limiter on recurrent position.
Sweep Expansion—At least 4 times tube diameter.

PHASE SHIFT—Negligible phase shift between amplifiers from 0 to 300 kc.

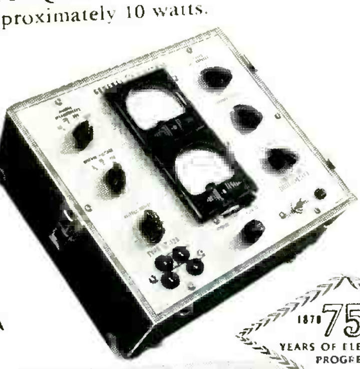
BLANKING—Z-axis blanking requires 20 volts peak to blank.

CALIBRATION—Eight voltages available by selector switch: .1, .3, 1, 3, 10, 30, 100 and 300 volts peak to peak ±15%.

DIRECT CONNECTIONS TO DEFLECTION PLATES—Available through capacitors—internal positioning circuits still function.

GERMANIUM DIODE CHECKER

For use in laboratories, quality control groups, service shops. Measures the static characteristics of diodes. FORWARD RANGES: Current—0.3, 1.2, 6 and 12 milliamperes full scale. Voltage—.3 and 1.2 volts full scale. INVERSE RANGES: Current—60, 120, 300 and 1200 microamperes full scale. Voltage—3, 12 and 120 volts full scale. POWER REQUIREMENTS: 105-125 volts, 50/60 cycle, approximately 10 watts.



Type ST-12A

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

General Electric Company, Section 423
Electronics Park, Syracuse, N. Y.
Please send me a copy of the following bulletins:
☐ ST-2B (ECL-4)   ☐ ST-12A (ECL-3)

NAME ....
COMPANY ....
ADDRESS ....
CITY .... STATE ....

GENERAL ELECTRIC

Want more information? Use post card on last page.

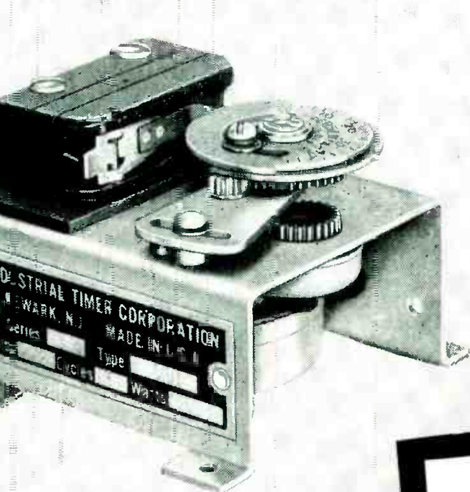
These Industrial Timer Corporation timers provide accurate and highly dependable instruments for control of a single operation or multiple operations (simultaneously or in sequence).

OUTSTANDING FEATURES ARE:

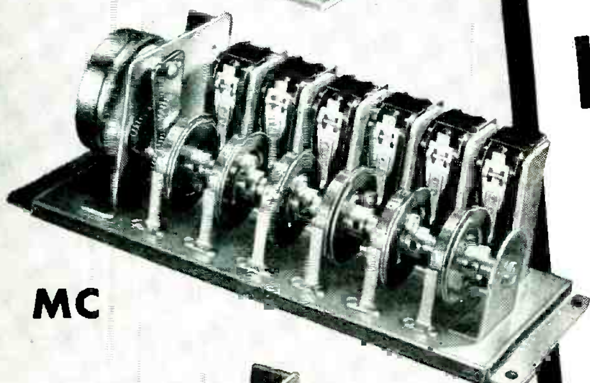
(1) the wide range of over-all time cycles obtainable from any one model;

(2) the ease with which over-all time cycles can be changed;

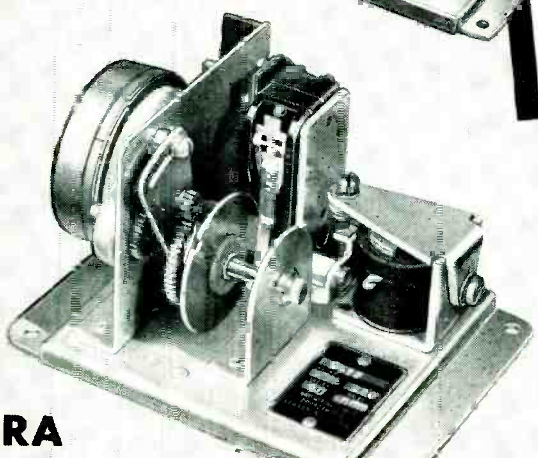
(3) the simplicity with which individual cams can be adjusted for ON and OFF periods, and positioned in specific timing sequence.



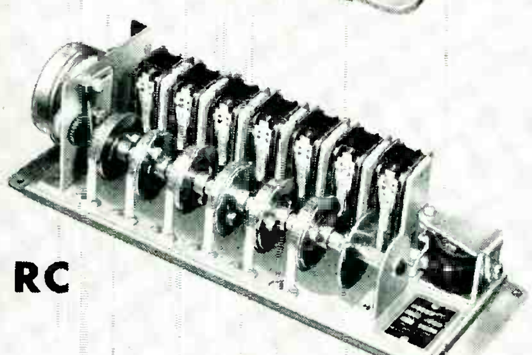
CM



MC



RA



RC

Highly Dependable

Synchronous Motor Driven

Cam Timers

Series CM CAM RECYCLING TIMERS

The Series CM Cam Recycling Timer repeats a definite electrical ON and OFF time cycle continuously. The cam is coupled to the motor by means of a simple gear and rack assembly—and the over-all time cycle can be easily changed by substituting gear racks. (Bulletin 33)

Series MC MULTI-CAM TIMERS

The Series MC Timer is identical to the CM Timer, but operates 2 to 6 circuits. All cams are mounted on a single shaft, which assures a common time cycle for all circuits. Each cam, however, is independently adjustable for a specific timing sequence. (Bulletin 34)

Series RA SINGLE CYCLE CAM TIMERS

The Series RA Timer provides a single time cycle upon being actuated electrically from remote control. A pawl on the cam eliminates necessity for prolonged closing of relay switch when starting. (Bulletin 35)

Series RC SINGLE CYCLE MULTI-CAM TIMERS

The RC is identical to the RA, but operates from 1 to 6 additional circuits. Thus it provides all the features of the Series MC Timer, plus the single cycle control afforded by the RA. (Bulletin 35)

Send us specifications, and we shall make recommendations based on your particular needs. Bulletins sent free on request.

MANUFACTURERS OF THESE AND OTHER TIMERS AND CONTROLS FOR INDUSTRY— Time Delay Timers • Manual Set Timers • Tandem Automatic Recycling Timers • Running Time Meters • 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.

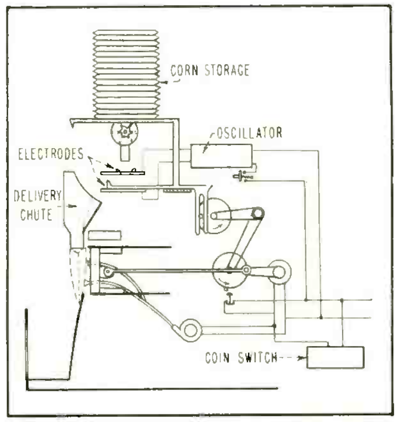


FIG. 8—Corn popper uses r-f to explode kernels in plastic bag. Alternative system pops corn, bags it later

in Fig. 6 on p 165.

Performance of the Dickinson crystal triode is indicated in the curves of Fig. 7, which compare the output vs input characteristics of the Dickinson crystal with typical crystal triodes previously reported.

More output voltage for a given input signal and a lower output impedance are claimed by Dickinson, and in view of the latter characteristic a greater response at higher frequencies of operation.

Corn Popper

Use of electronics for automatically popping corn in a coin-operated vending machine is the subject of patent 2,603,142 granted to C. C. Miller of Altadena, Calif. for "An Apparatus for Popping Corn by High Frequency Radiation."

A measured quantity of corn kernels already sealed in their plastic container are passed through the dielectric field of an r-f oscillator and the kernels are popped instantaneously. A diagram of this mechanism is shown in Fig. 8.

Transistor Amplifier

Patent 2,609,459 granted to G. Bergson, assignor to the Radio Corp. of America, for a high-input

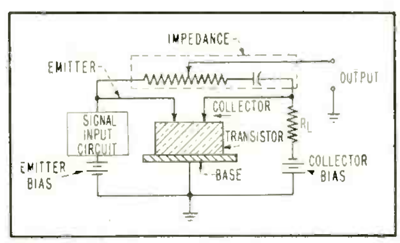
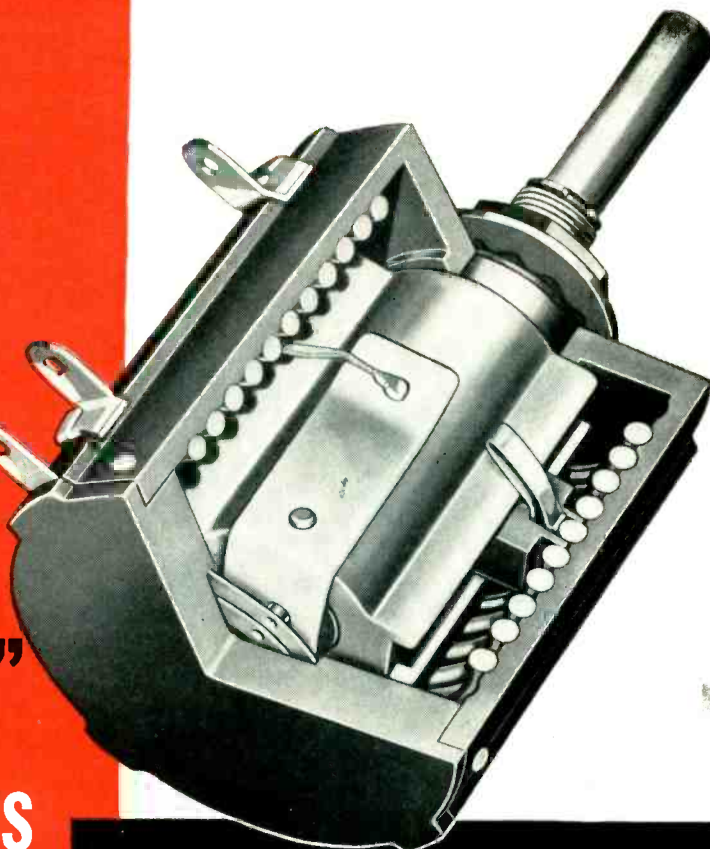


FIG. 9—Transistor amplifier uses impedance between emitter and collector

Series AJ Helipot models are only ¾" in diameter and 1⅜" long; weight 1.0 oz. Ten-turn 18" slide wire gives adjustment accuracy of 1/3000 in a 100-ohm unit—1/6500 in a 50,000-ohm unit.

Helipot achieves "HIGHEST PRECISION" with DRIVER-HARRIS RESISTANCE WIRE



Cutaway view of Model A 10-turn Helipot precision helical potentiometer. Resistance element 45" long is contained in case 2" x 1-13/16" diameter. On element are wound 3000 to 9800 turns of resistance wire, depending on total resistance value required. Adjustment accuracy is 12 to 14 times that of conventional single-turn potentiometer of equal diameter.

To win consumer preference and assure customer satisfaction, Helipot Corporation is guided by a basic policy that has proved as effective as it is simple. It is: (1) to produce components of the highest precision, and (2) to realize the economies inherent in mass production.

By following these objectives, Helipot has become the world's largest maker of precision potentiometers, producing the widest selection of single-turn and multi-turn units available anywhere.

States Helipot: "Our policy of mass producing the highest precision potentiometers practicable, in order to deliver top quality at moderate cost, is reflected in the fact that standard linearity accuracy of all our stock models, selling competitively, is held to ±0.5%. Our reliance on Driver-Harris alloys such as Nichrome V, Advance, and Karma to provide resistance windings for many of our products constitutes a strong endorsement of Driver-Harris skills and reliability."

Driver-Harris takes particular pride in having played so important a role in the Helipot story, and is fully conscious of the responsibility the confidence of this famous manufacturer imposes.

Nichrome*, Advance*, and Karma* are at your service, too; as are more than 80 other alloys developed exclusively by Driver-Harris for application in the electrical and electronic fields. We feel confident that, like Helipot, you will realize outstanding advantages by putting one or more of them to work for you. Let us have your specifications. We'll be glad to make recommendations based on your specific requirements.

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

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

Sole producers of Nichrome, Advance, and Karma

Driver-Harris Company

HARRISON, NEW JERSEY

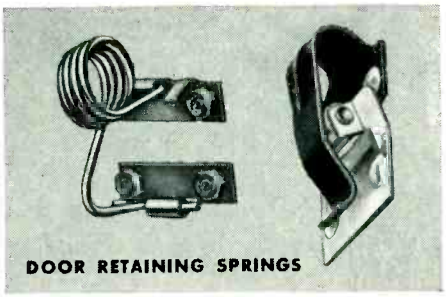
BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

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

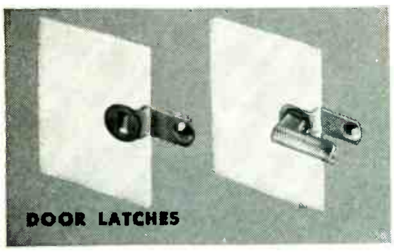
MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

Want more information? Use post card on last page.

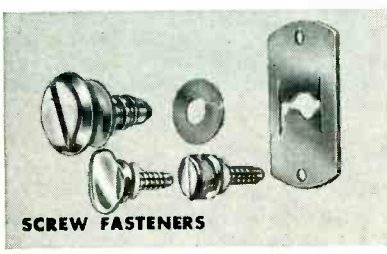
when you think of fastening think... SOUTHCO®


DOOR RETAINING SPRINGS

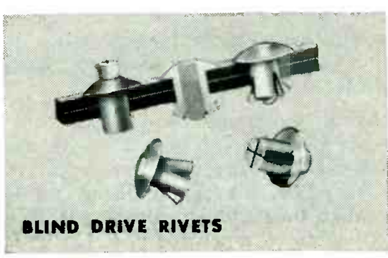
Here is help in securing the *right* fastener for your particular needs in metal-to-metal and metal-to-wood applications. SOUTHCO engineers work with you to find the standard or special fastener that means lowest overall costs.

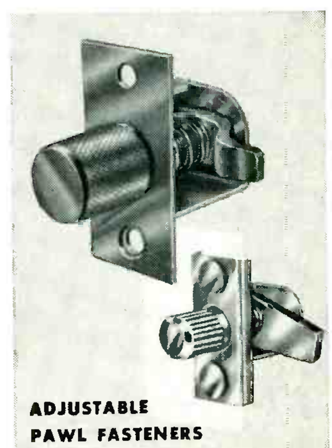

DOOR LATCHES

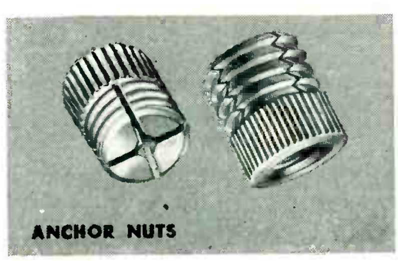
Holding power, speed and ease of installation, elimination of special tooling, convenience of use in opening and closing applications . . . each factor involved is analyzed to assure the best fastener at lowest possible cost. When special designs are indicated, the experience and background of SOUTHCO engineers in solving thousands of fastener problems can be of special value to you.


SCREW FASTENERS

When you are faced with a fastener problem, write SOUTHCO DIV., South Chester Corporation, 1417 Finance Bldg., Philadelphia 2, Pa. District Offices are located in principal cities.


BLIND DRIVE RIVETS

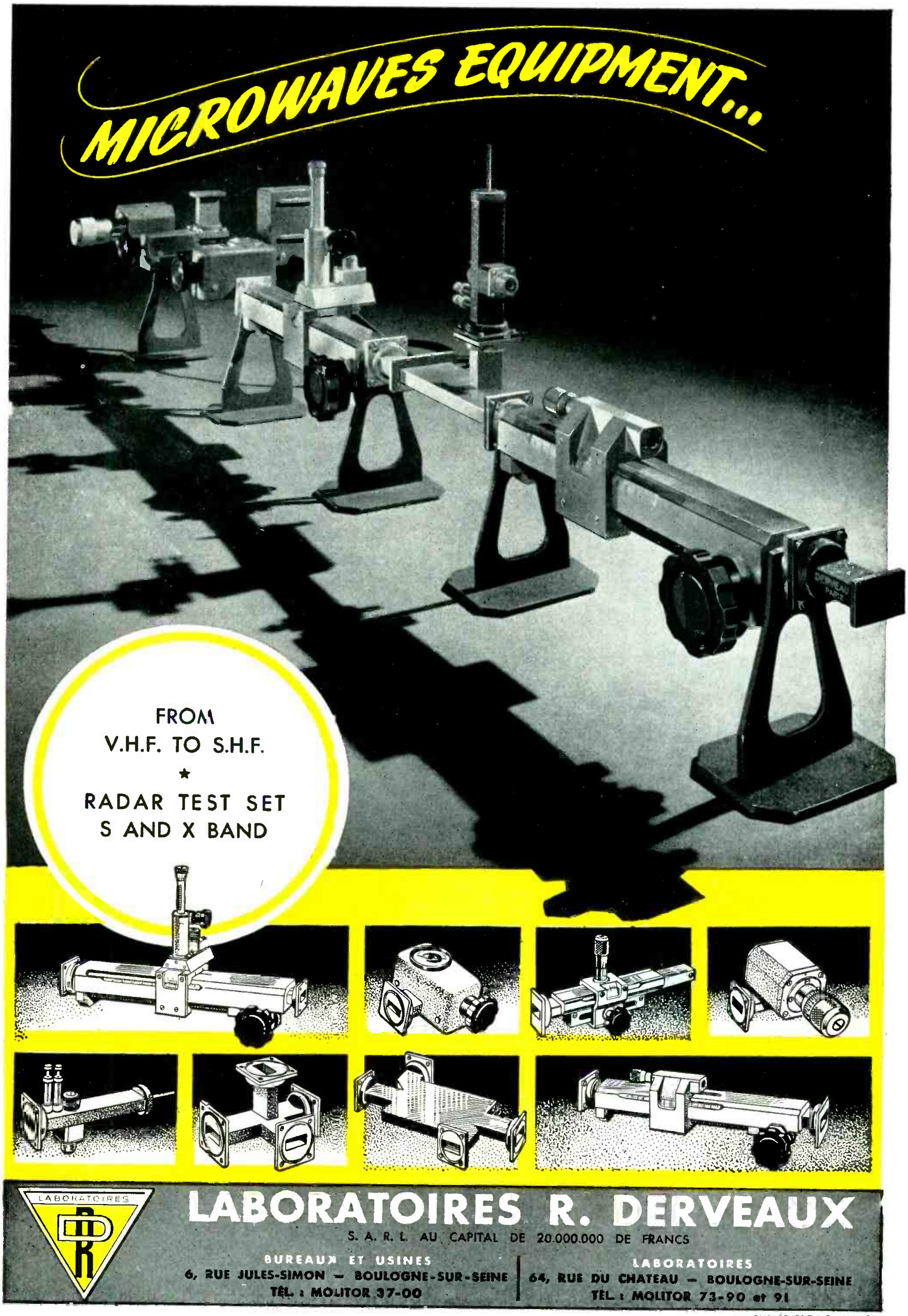

ADJUSTABLE PAWL FASTENERS


ANCHOR NUTS

SOUTHCO® FASTENERS

OFFICES IN PRINCIPAL CITIES . . .

WHEREVER TWO OR MORE PARTS ARE FASTENED TOGETHER, STANDARD AND SPECIAL DESIGNS FOR IMPROVED PERFORMANCE AND LOWER PRODUCTION COSTS



Ag. PUBLÉDITEC-DOMENACH

impedance transistor amplifier describes circuit means for accomplishing the claimed results.

By the insertion of an impedance between the emitter and collector electrodes, as shown in Fig. 9, Bergson shows that when the output is taken from a point on this impedance the input impedance of the transistor amplifier is raised to a much higher level. Improvement results in the operation of transistor amplifiers by reduction of the loading effect of the normally low input impedance shown by previously disclosed transistor amplifiers.

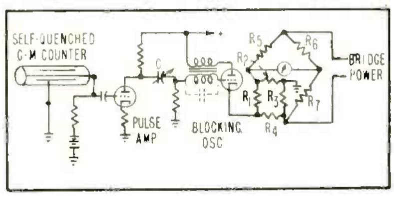


FIG. 10—Frequency meter measures discharge of Geiger tube

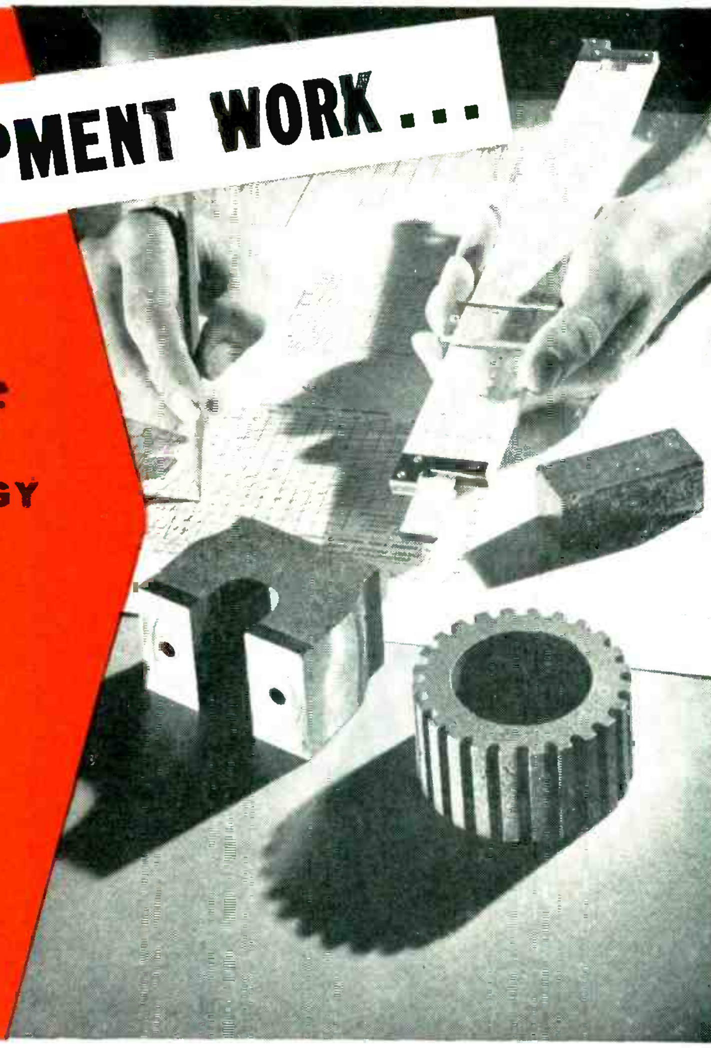
Briefly the operation of the high-impedance transistor amplifier may be described as follows. The output is derived from load resistor R_1 in the collector circuit of Fig. 9. A part of the output current flows to the emitter circuit and opposes the emitter current to raise the input impedance and increase the gain of the amplifier.

Frequency Meter

A rather unusual frequency meter of particular application to Geiger-Muller tubes is the subject of patent 2,609,512 granted to H. Conviser, assignor to Bendix Aviation Corp.

The frequency meter is illustrated in Fig. 10. In operation ionization of the G-M tube applies a pulse of negative polarity across capacitor C on to the grid of a stable free-running blocking oscillator to quench the oscillator for the duration of the pulse. During this quenched interval the cathode bridge R_1, R_2, R_3 and R_4 made up of temperature-sensitive resistors and forming an arm of the Wheatstone bridge averaging circuit, will no longer have a potential across it to unbalance the bridge and provide

FOR YOUR DEVELOPMENT WORK . . .



Permanent Magnets

WITH 16% GREATER ENERGY

INDIANA HYFLUX* ALNICO V

*The permanent magnet material that offers an energy product averaging 5½ million BH max or more, with 5¼ million guaranteed.

Whether your problem is new design or product improvement, take advantage of the greater energy product INDIANA HYFLUX Alnico V offers!

These exclusive, new, super strength permanent magnets mean lower production costs, more compact design and higher efficiency for your products.

What's more, INDIANA HYFLUX — with its 16% greater energy product — costs not a penny more than regular Alnico V!

Here's still another bonus you'll enjoy! THE INDIANA STEEL PRODUCTS COMPANY, world's largest producer of permanent magnets, offers free of charge its wealth of experience and "know-how" that has developed more than 30,000 permanent magnet applications.

Let INDIANA engineers help you with your design problems. They can supply — out of stock — many types and sizes of INDIANA HYFLUX Alnico V for your experiments, can suggest those best suited to your product.

INDIANA is the only manufacturer furnishing all commercial grades of permanent magnet alloys. You have a choice of cast, sintered, formed or ductile materials.

Why delay — write or phone INDIANA today. Ask for Catalog No. 11A-5 that describes stock experimental magnets.

INDIANA PERMANENT MAGNETS

THE INDIANA STEEL PRODUCTS COMPANY

VALPARAISO, INDIANA • • • Sales Offices Coast to Coast

SPECIALISTS IN "PACKAGED ENERGY" SINCE 1908

Want more information? Use post card on last page.

Need Precision Pots *NOW?*

CALL HELIPOT!

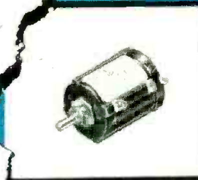
When you need top quality potentiometers *fast*, call Helipot . . . first in precision potentiometers!

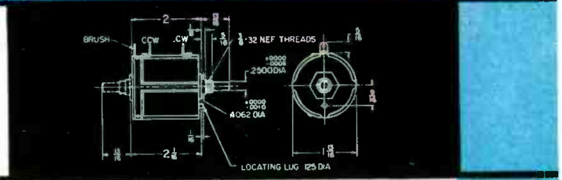
Shown on these pages are various types and ranges of Helipots—both single and multi-turn—that Helipot now stocks for immediate delivery. You can have stock prototypes immediately. On large orders for stock items, initial deliveries in substantial quantities will be made promptly, with balance on close schedule.

Prompt attention will be given your requirements for Precision Pots to your individual specifications.

Helipot's objective is to give you the same flexibility and efficiency as a department of your own company. Our trained personnel and unequalled facilities are ready to serve your needs, whether for standard units shown here or for special designs in quantity to meet particular applications.

For fast service, call the nearest representative listed below. Or write, wire or phone direct!





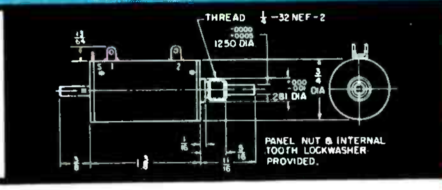
MODEL A HELIPOTS

The most widely adaptable of all multiturn Helipots. A 10-turn unit of convenient, compact size offering resolution accuracies 12 to 14 times that of conventional single-turn units of same diameter. 10-turn range permits direct decimal readings.

10-turns . . . Power rating 5 watts . . . Coil length 46.5″ . . . Linearity tolerances: ±0.5% (Std. all values), (±0.1% 5K and up, ±0.25% below 5K).*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
25-AZ	25	3,000	.00071
50-AZ	50	3,200	.00071
100-AZ	100	3,800	.00071
200-AZ	200	4,750	.00071
500-AZ	500	4,000	.00002
1,000-AZ	1,000	5,000	.00002
2,000-AZ	2,000	6,500	.00002
5,000-AZ	5,000	7,200	.00013
10,000-AZ	10,000	9,000	.00013
20,000-AZ	20,000	10,000	.00013
30,000-AZ	30,000	11,500	.00013
50,000-AZ	50,000	12,500	.00013
100,000-AZ	100,000	15,000	.00013
200,000-AZ	200,000	15,500	.00013
300,000-AZ	300,000	16,000	.00013



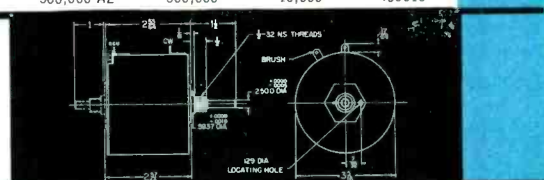
MODEL AJ HELIPOTS

The AJ is a high performance 10-turn helical potentiometer of miniature size (¾″ dia.) and light weight (1 oz.). Available with bushing mount (AJ) or servo mount (AJS), both with sleeve bearings. Servo mount also available with precision ball bearings (AJSP).

10-turns . . . Power rating 2 watts . . . Coil length 18″ . . . Linearity tolerance ±0.5% (Std.) . . . Starting torque 0.75 oz. in. . . . Wgt. 1 oz. . . . Dia. ¾″.*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
100-AJZ	100	3,000	.00071
500-AJZ	500	2,500	.00002
1,000-AJZ	1,000	3,400	.00002
5,000-AJZ	5,000	4,250	.00013
10,000-AJZ	10,000	4,000	.00013
20,000-AJZ	20,000	5,350	.00013
30,000-AJZ	30,000	5,450	.00002
50,000-AJZ	50,000	6,550	.00002



MODEL B HELIPOTS

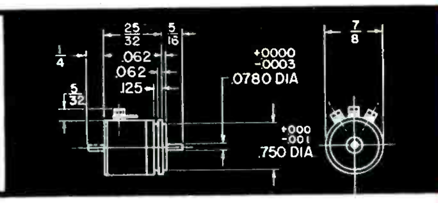
A large diameter (3-5/16″) 15-turn Helipot with 139″ slide wire length providing the highest resolution (.01% to .003%) and adjustment accuracy available today in a standard mass-production unit. Rugged, dependable, low in cost.

15-turns . . . Power rating 10 watts . . . Coil length 139″. . . Linearity tolerance ±0.5% (Std.).*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
1,000-BZ	1,000	10,900	.00002
5,000-BZ	5,000	19,600	.00002
10,000-BZ	10,000	17,700	.00013
25,000-BZ	25,000	21,800	.00013
50,000-BZ	50,000	25,400	.00013
100,000-BZ	100,000	34,100	.00013

Please note that 1000 volts is highest that may be applied across coil regardless of resistance value.



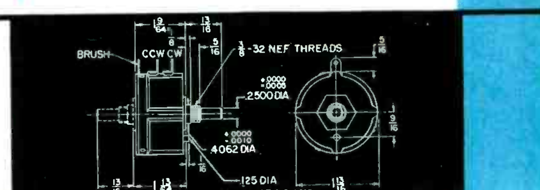
MODEL T HELIPOTS

A single-turn, continuous-rotation servo-mounting unit of minimum weight (0.56 oz.) requiring very small cubic space and operating with negligible torque. Shaft rotates on precision ball bearings—unit built throughout to highest possible precision.

1-turn . . . Power rating ½ watt . . . Coil length 2″ . . . Linearity tolerance ±0.5% (Std.) . . . Starting torque .015 in. oz. (Running torque is negligible) . . . Wgt. 0.56 oz.*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
1,000-TZ	1,000	705	various
2,000-TZ	2,000	750	various
5,000-TZ	5,000	800	various
10,000-TZ	10,000	1,650	various
20,000-TZ	20,000	1,500	.00002
25,000-TZ	25,000	1,500	.00002
30,000-TZ	30,000	1,400	.00002
50,000-TZ	50,000	1,400	.00002
100,000-TZ	100,000	1,500	.00002



MODEL C HELIPOTS

Identical in general design to Model A except has only 3 helical turns of resistance winding and proportionately shorter length. Ideal for high-accuracy applications with restricted behind-panel depths.

3-turns . . . Power rating 3 watts . . . Coil length 13½″ . . . Linearity tolerance ±0.5% (Std.) . . . Behind-Panel Length 1-9/64″.*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
10-CZ	10	1,000	.00071
50-CZ	50	1,390	.00071
100-CZ	100	1,100	.00002
500-CZ	500	1,850	.00002
1,000-CZ	1,000	1,360	.00013
5,000-CZ	5,000	2,500	.00013
10,000-CZ	10,000	3,100	.00013
20,000-CZ	20,000	3,900	.00013
30,000-CZ	30,000	4,400	.00013
50,000-CZ	50,000	4,250	.00013

*ON SPECIAL ORDER most of the above potentiometers are available with Rear Shaft Extensions . . . Extra Spot Welded Taps at any location . . . Ganged Assemblies . . . Special Temp. Coefficients, Resolutions, etc. Write for details!

Design details on above units subject to change without notice. Certified drawings available on request.

Engineering Sales Representatives are located near you to assure personal attention. Teletype connects our New York, Boston, Chicago and Los Angeles offices for rapid information on orders and deliveries. And our Mountainside, New Jersey plant, now under construction, will soon be in production to further assist you.

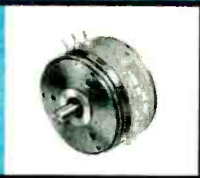
THE Helipot CORPORATION

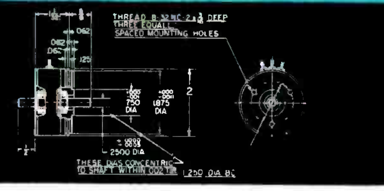
A Subsidiary of Beckman Instruments Inc.

SOUTH PASADENA 2, CALIFORNIA

"HELIPOT" AND "DUODIAL"—T. M. REG.

Helipot





MODEL J HELIPOTS

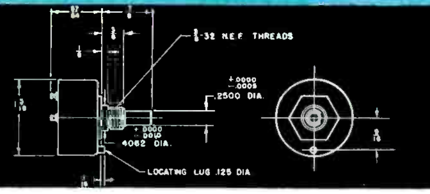
First production potentiometer equipped with ball-bearing shaft supports as standard and 3-way servo-type mounting. Ganged assemblies can be independently phased after installation without external clamps or brackets.

1-turn . . . Power rating 5 watts . . . Coil length 5½". . . 360° Cont. Mech. Rotation . . . Linearity tolerance ±0.5% . . . Starting torque 1.0 ± .25 oz. in.*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
100-JZ	100	630	.00002
1,000-JZ	1,000	875	.00017
5,000-JZ	5,000	1,300	.00017
10,000-JZ	10,000	1,475	.00017
20,000-JZ	20,000	1,900	.00017
30,000-JZ	30,000	1,975	.00017
50,000-JZ	50,000	2,260	.00002

Please note that 400 volts is highest that may be applied across coil regardless of resistance value.



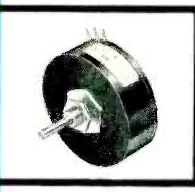
MODEL G HELIPOTS

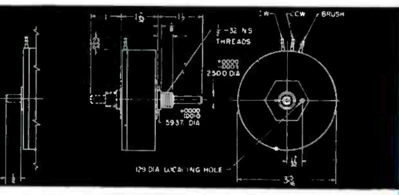
A small, extra rugged single-turn pot developed initially for aircraft servo mechanisms. Its compact size, high accuracy, long life make it ideal for many instrumentation and servo-mechanism applications.

1-turn . . . Power rating 2 watts . . . Coil length 3¼". . . 360° Cont. Mech. Rotation . . . Linearity tolerance ±0.5% (Std.) . . . Wgt. 2 Oz. . . . Dia. 1-5/16".*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
10-GZ	10	300	.00071
100-GZ	100	400	.00002
500-GZ	500	500	.00013
1,000-GZ	1,000	650	.00013
5,000-GZ	5,000	750	.00013
10,000-GZ	10,000	950	.00013
20,000-GZ	20,000	1,200	.00013





MODEL F HELIPOTS

A 3" dia. single-turn high-precision potentiometer with continuous mechanical rotation and minimum dead spot between electrical ends. Versatile in application. Ideal where continuous rotation simplifies circuitry.

1-turn . . . Power rating 5 watts . . . Coil length 9¼". . . Linearity tolerance ±0.5%.*

TABLE OF STOCK VALUES

Catalog No.	Total Resistance (Ohms)	Wire Turns	Temperature Coefficient
100-FZ	100	800	.00002
500-FZ	500	1,300	.00002
1,000-FZ	1,000	1,200	.00013
5,000-FZ	5,000	2,000	.00013
10,000-FZ	10,000	2,500	.00013
20,000-FZ	20,000	2,700	.00013
50,000-FZ	50,000	4,000	.00013
100,000-FZ	100,000	5,000	.00002

Please note that 400 volts is highest that may be applied across coil regardless of resistance value.

NOT CARRIED IN STOCK but quickly available on order

MODELS AN and CN HELIPOTS

Mechanically precise, highly linear potentiometers of same general dimensions as Models A and C, except have servo-mountings, ball-bearing shafts and are built to highest precision possible. Have approximately 2:1 advantage in linearity accuracies over corresponding A and C Helipots. (Model AN linearity tolerances as close as ±.025% in values of 5K and above.)

AN (10-turns) resistance ranges, 100 to 250,000 ohms . . . CN (3-turns) 30 to 75,000 ohms.

Write for full details on linearity tolerances, special features, etc.

MODELS D and E HELIPOTS

Large diameter (3-5/16"), wide range Helipots with extremely long resistance windings for highest possible resolutions coupled with close linearity tolerances.

Model D has 25 turns, 234" coil length, 9000° of rotation, is 4-9/64" deep behind the panel, and is available in ranges from 100 to 750,000 ohms.

Model E has 40 turns, 373" coil length, 14,400° of rotation, is 6-1/64" deep behind panel, resistances 200 to 1,000,000 ohms.

Write for full details on linearity tolerances, special features, etc.

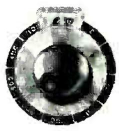
OTHER UNIQUE HELIPOT PRODUCTS

MODEL RA Precision DUODIALS

A beautiful, precision-built, multi-turn dial of compact dimensions (1-13/16" dia.) for all types of quality multi-turn installations. Features unique "jump" mechanism that keeps secondary dial stationary until primary dial has completed a full turn—then secondary dial "jumps" to new position. A vibration-proof lock holds dial settings whenever desired.

Black nylon knobs, satin aluminum dials, quality "feel" and appearance throughout. Available in 10-turn design for use with 3 and 10-turn Helipots and in RAJ version for use with small AJ Helipots.

Write for full details.



MODEL W DUODIALS

A large diameter (4¾") multi-turn dial ideal for primary control applications. The inner dial shows the exact position of the slider on any multi-turn Helipot while the outer dial shows the particular turn on which the slider is moving. Thus with 10-turn units, readings can be made directly in decimal equivalents of total resistance winding.

Since primary dial is direct-connected to shaft, backlash is eliminated.

Available in 10:1, 15:1, 25:1, and 40:1 Ratios for use with various Helipot models as well as with other multi-turn equipment.

Write for full details.

LABORATORY HELIPOT—MODEL T-10A

This unit combines in a handsome walnut case a 10-turn Helipot, an "RA" Duodial, and three-way binding posts for quickly setting up and changing experimental or temporary circuits. Ideal for laboratory and instruction purposes . . . is far more compact, simpler and 5 times faster to set than decade boxes.

Power rating 5 watts . . . Linearity 0.1% . . . Standard Resistance Ranges 100 . . . 500 . . . 1,000 . . . 5,000 . . . 10,000 . . . 20,000 . . . 50,000 . . . 100,000 ohms in stock. Other ranges on order.

Write for full details.

1. NEW YORK
B. B. Taylor
241 Sunrise Highway
Rockville Centre, New York
ROckville Centre 6-1014—6-1015
TWX: Rockville Centre NY 3685

2. ROCHESTER
E. A. Ossmann Corp.
3 Juniper Street
Rochester 10, New York
CUlver 7640

3. SCHENECTADY, N. Y.
E. A. Ossmann Corp.
DElanson 2319

4. BOSTON
Harold Gerber
25 Huntington Avenue
Boston 16, Massachusetts
COpley 7-1961
TWX: BS 168

5. PHILADELPHIA
James C. Muggleworth
506 Richey Avenue
Collingswood 6, New Jersey
COllingswood 5-3515

6. CLEVELAND
Howard N. Heasley
1940 East Sixth Street
Cleveland, Ohio
PRospect 1552

7. CHICAGO
Roy J. Magnuson
4258 West Irving Park Road
Chicago 41, Illinois
PAlisade 5-1170
TWX: CG 913-X

8. ST. LOUIS
Harris-Hanson Company
5506 South Kingshighway
St. Louis 9, Missouri
SWeetbriar 5584

9. FORT MYERS
Arthur H. Lynch & Associates
P. O. Box 466
Fort Myers, Florida
FOrt Myers 5-6762

10. LOS ANGELES
G. S. Marshall Company
40 South Los Robles
Pasadena 1, California
RYan 1-8345; SYcamore 5-2022
Helipot Home Office
TWX: Pasa Cal 7193

11. SEATTLE
Samuel N. Stroum
1612 Broadway
Seattle 22, Washington
FRanklin 7515—7516

12. DALLAS
J. Y. Schoonmaker Company
2011 Cedar Springs
Dallas 1, Texas
STerling 3335

13. DETROIT
S. Sterling Company
15310 West McNichols Rd.
Detroit 35, Michigan
Broadway 3-2900

14. SOUTH CENTRAL
Bivins & Caldwell
Security Bank Bldg.
High Point, N. C.
High Point 3672

15. CANADA
J. S. Root
290 Lawrence Ave. W.
Toronto 12, Ontario, Canada
ORchard 3003

EXPORT AGENT: Frathom Company, 33 West 42nd Street, New York 36, New York, BRyant 9-1296 an indication of the unbalance on the meter. The meter is adjusted to show the average of the pulses appearing at the output of the G-M tube.

Prediction of Electronic Failures

THE FAILURE of a tube or other component in an electronic device can happen suddenly or result from gradual deterioration. Possibility of sudden failure can be reduced only by improvement in design, but the nature of gradual deterioration makes possible the detection of a failing component before it becomes inoperative.

Detection of incipient failure in multistage equipment by input-output measurements is unreliable. Tolerances in overall measurements may mask changes caused by deterioration of a tube in one stage, and the point at which deterioration becomes detectable may practically coincide with the failure point. In order to make successful predictions a means of testing individual stages is necessary.

A technique developed experimentally by the National Bureau of Standards permits an unskilled maintenence man with a portable failure-prediction unit to test slightly modified equipment for failing components. The prediction unit includes a 3,000-cycle oscillator, voltage sensing circuits, a leakage detection circuit and an alarm light.

Measurement Procedure

In use, the unit is plugged into the device being tested and a multi-

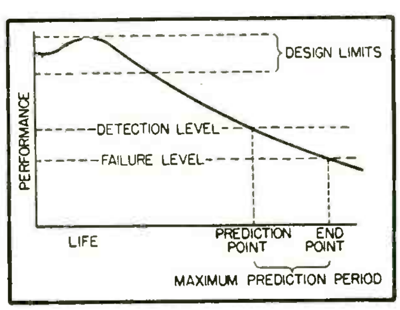
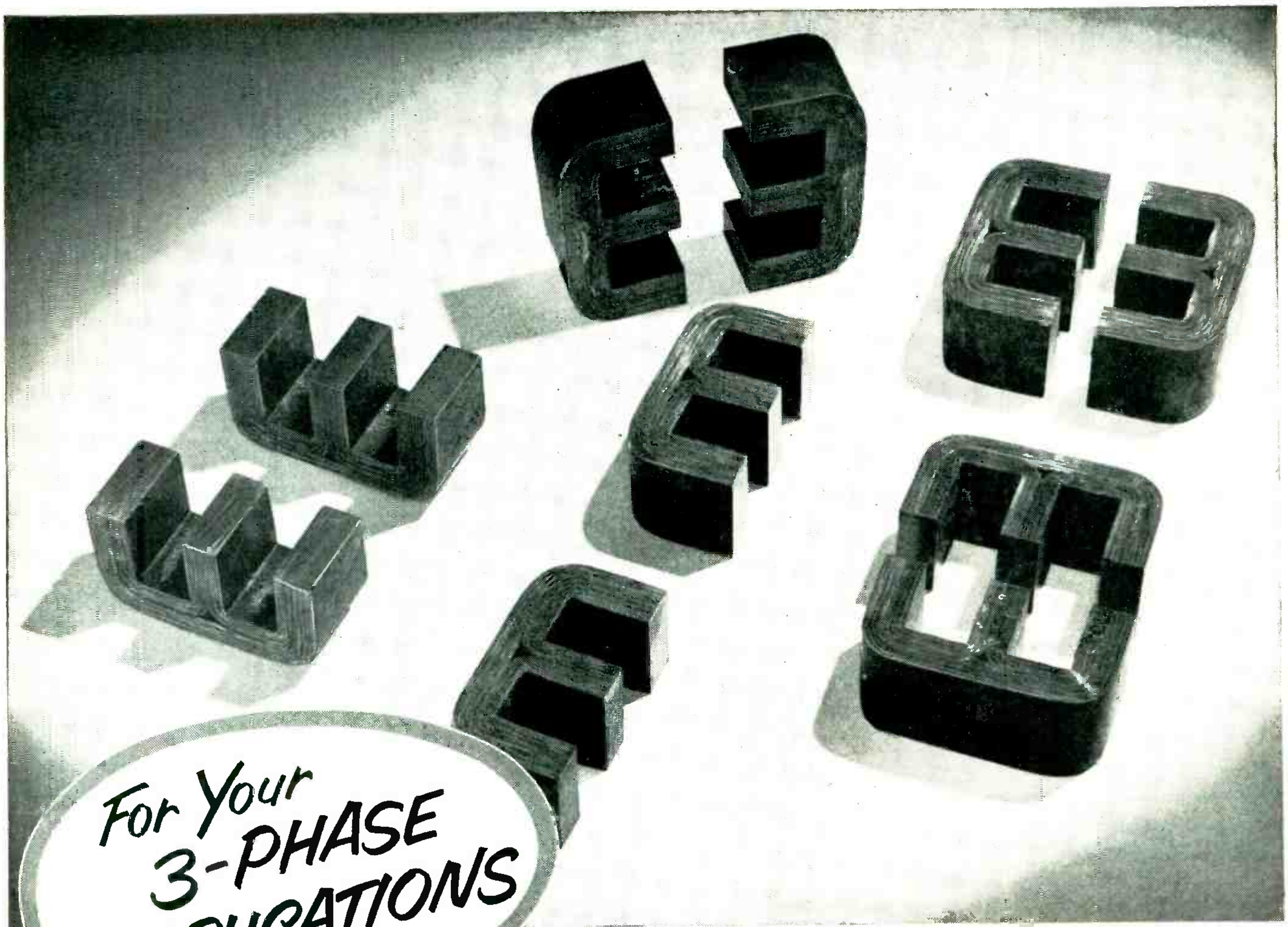


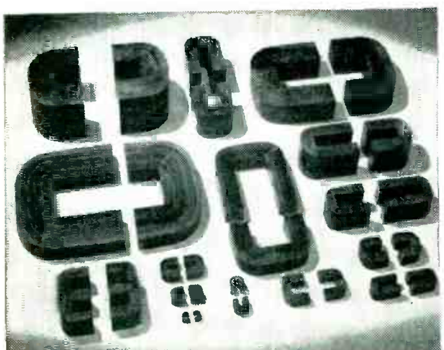
FIG. 1—Chart showing deterioration in performance during life of component. This type of curve is applicable to many types of components including tubes, resistors, capacitors or complete subassemblies

Want more information? Use post card on last page.



For Your 3-PHASE APPLICATIONS

Arnold E-CORES



C-Cores to meet any requirement

For your single-phase applications, Arnold "C"-Cores are available in any shape and quantity, and in any size from fractions of an ounce to hundreds of pounds . . . wound from Silectron strip in a wide range of ultra-thin and heavier gauges. (Sizes up to 10 lbs. in 12-mil strip; to any weight in thinner gauges.)

made from SILECTRON strip

(grain-oriented silicon steel)

The use of "E" cores, wound from grain-oriented silicon steel, results in weight and size reduction as well as higher efficiency and possible cost savings. "E" cores can be supplied in a variety of window sizes and core areas from 1, 2, 4 or 12-mil Silectron strip, for high or low frequency 3-phase applications. ● All Arnold cores are made by precision methods, and carefully tested under closely controlled conditions to assure highest quality and reliability. *We'll welcome your inquiries.*

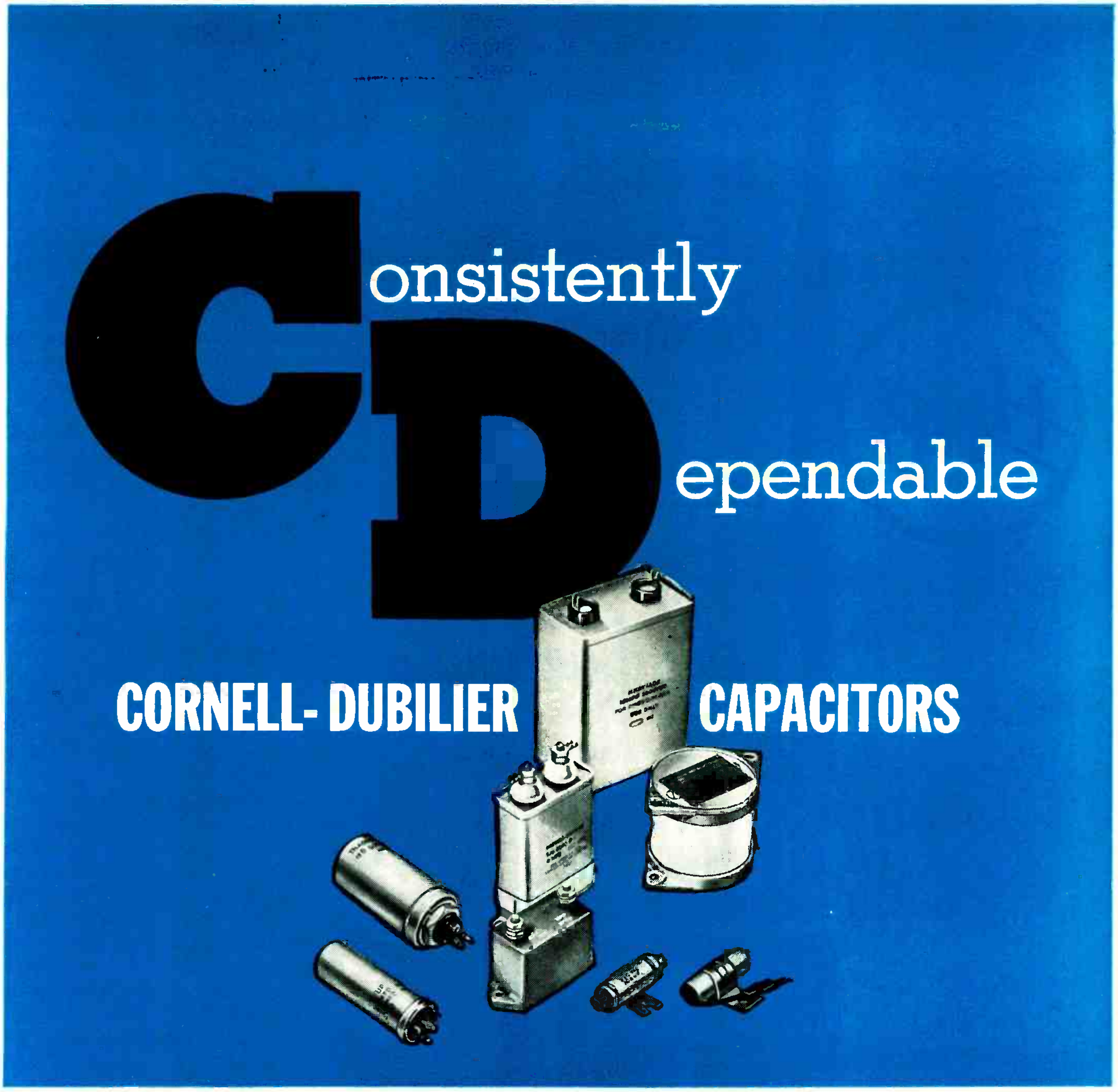
W&D 4437

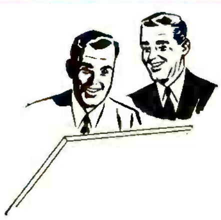
THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

Want more information? Use post card on last page





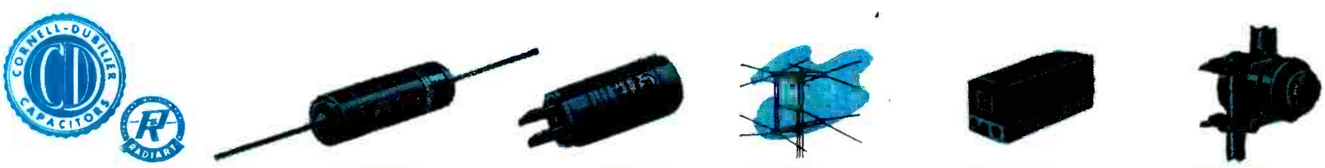
"Let's take this capacitor problem to C-D" About 3 times out of 4, we find that a capacitor problem submitted to us has come up before, and the solution is ready and waiting.

Coincidence? No, just that C-D is usually called on to tackle the capacitor problems of other companies engaged in the same type of work as your own.

If your problem is new or old, our engineers will be glad to collaborate with you. Cornell-Dubilier Electric Corporation, 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.

position switch is used to connect the tester with individual stages. Audio signals of different predetermined levels are applied to the grid of each stage. Each of the input signals is preadjusted so that the voltage-sensing circuit will actuate the alarm light if the gain of the stage has decreased by more than the safe amount. A separate three-position switch on the test unit allows capacitor-leakage sensing and voltage-and-current sensing, in addition to gain sensing.

In electronic equipment, the most common cause of failure is defective tubes. The failure predicting unit operates by sensing the decrease in transconductance of tubes in critical stages. To do this, the tube is operated as a resistance-coupled amplifier. A 3,000-cycle signal is applied and the sensing unit determines if the gain has fallen below the predetermined limit. Defects in components other than tubes will be detected by this test if their change affects the gain of the stage.

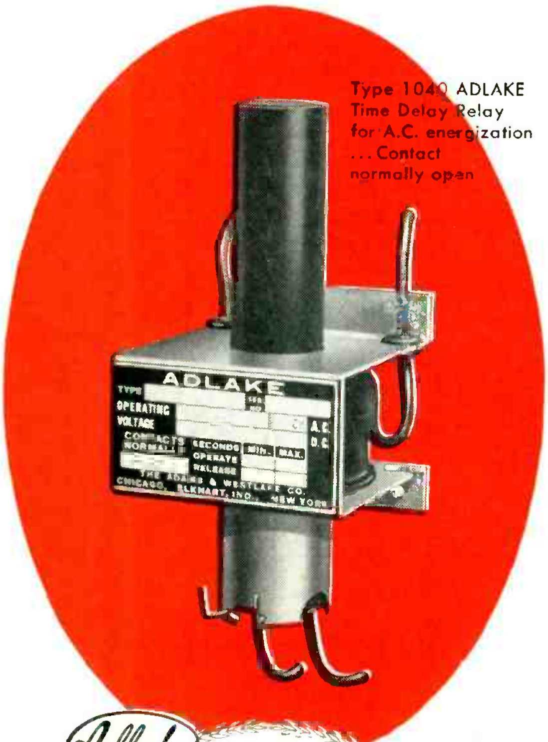
In developing the failure-prediction unit, six 18-stage military receivers were modified to permit insertion of the audio signal and measurement of gain. The receivers were then subjected to a 1,000-hour accelerated aging test. Temperatures were cycled between 10 C and 120 C with a total period of fifteen minutes. Voltages were maintained at 15 percent above design values and plate voltages were raised periodically to 150 percent of normal for one second, to simulate switching transients. Prediction checks were made every five hours.

In the thousand-hour test period, 79 tube failures occurred in the six 11-tube receivers. Of these failures, 65 were of the gradual and predictable type. There were 14 open and short circuits, six of which occurred during a 60-hour period when heaters and plates were cycled one minute on and one minute off. The other eight failures were spread over the remaining 940-hour period.

Of the 65 predictable failures, 58 were accurately predicted many hours before the receiver failed. Of the seven predictable failures not successfully predicted, four were in

Why

are more and more industries specifying ADLAKE Mercury Relays for Timing and Control Functions?



Type 1040 ADLAKE Time Delay Relay for A.C. energization . . . Contact normally open

. . . BECAUSE they are designed and built to meet the most exacting needs of industry! They've won their place by *proven dependability*—year in and year out—in jobs that conventional relays can do in an uncertain manner at best! For every ADLAKE relay is tested—and guaranteed—to meet specifications!

For instance, ADLAKE Mercury 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 generators . . . wherever sensitivity and dependability are required . . . ADLAKE Relays can always be counted on! Send for the ADLAKE Relay Catalog today . . . no obligation, of course. The Adams & Westlake Company, 1107 N. Michigan, Elkhart, Indiana.

EVERY ADLAKE RELAY GIVES YOU THESE PLUS FEATURES:

• **HERMETICALLY SEALED**—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation • **SILENT AND CHATTERLESS** • **REQUIRES NO MAINTENANCE** • **ABSOLUTELY SAFE** • **MERCURY-TO-MERCURY CONTACT**—prevents burning, pitting and sticking

. . . And every ADLAKE Relay is tested—*and guaranteed*—to meet specifications!

Adlake TRADE MARK — 96th year of serving the transportation and building industries

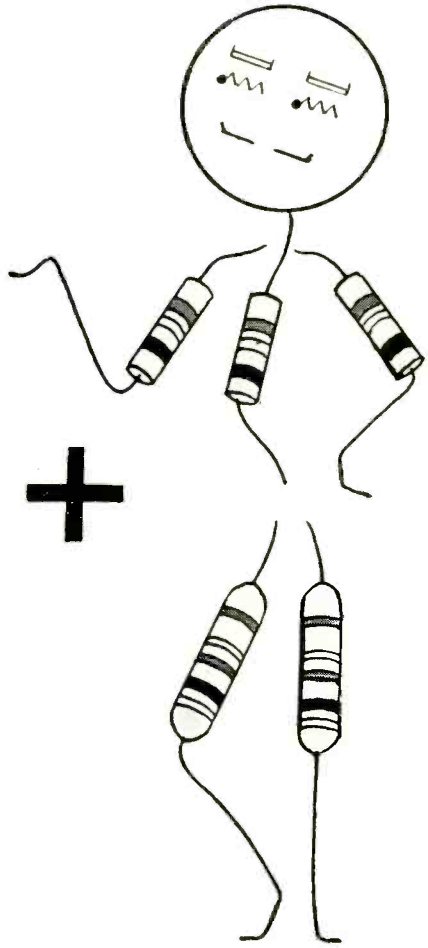
THE Adams & Westlake COMPANY

Established 1857 • ELKHART, INDIANA • New York • Chicago

Manufacturers of ADLAKE Hermetically Sealed Mercury Relays

Want more information? Use post card on last page.

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.

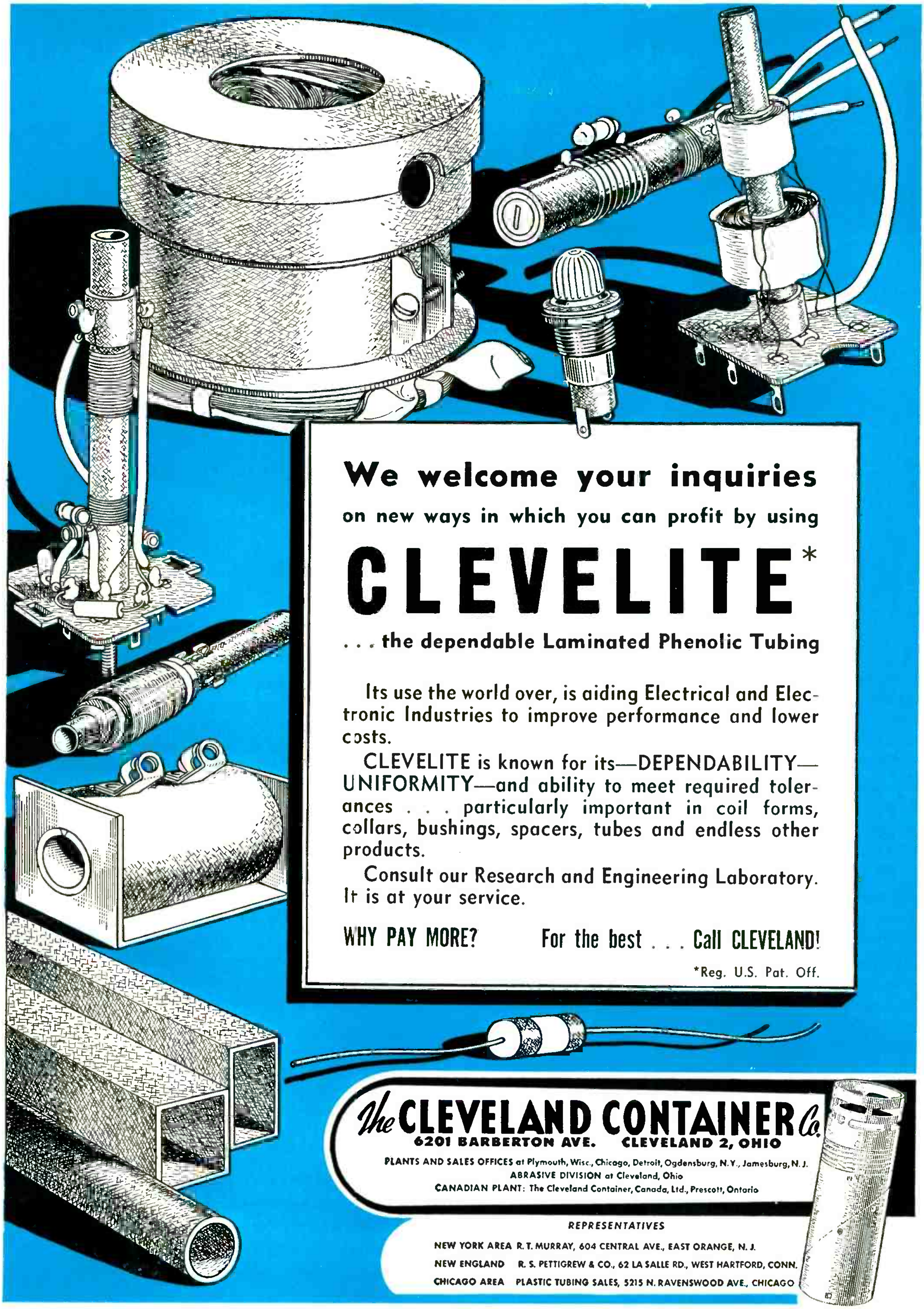
Also TYPE 2007
(4½" x 1½")
COMPLETELY SELF-CONTAINED INCLUDING VACUUM TUBE

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

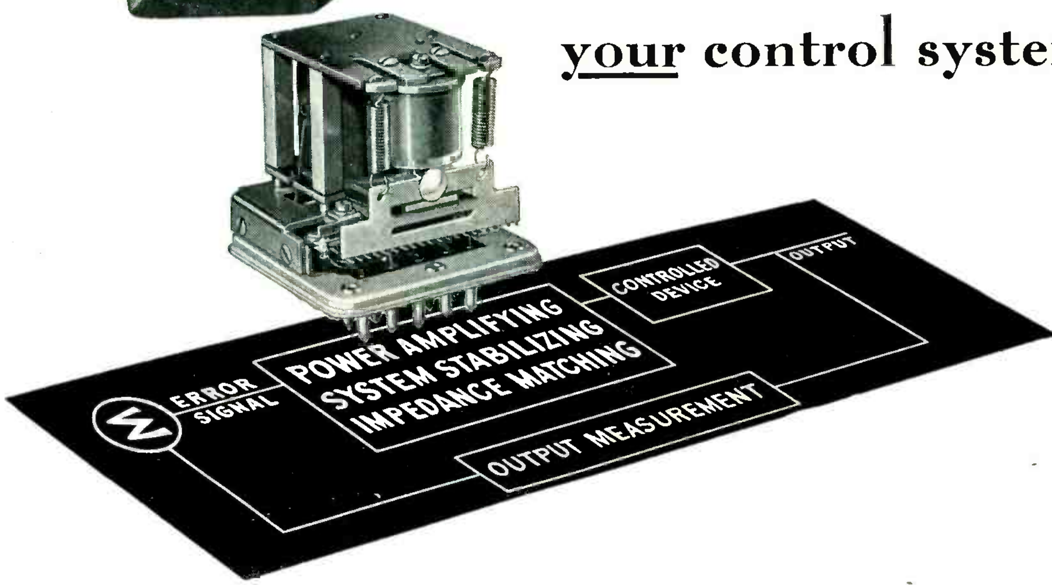
American Time Products, Inc.

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

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY


We welcome your inquiries
on new ways in which you can profit by using
CLEVELITE*
. . . the dependable Laminated Phenolic Tubing
Its use the world over, is aiding Electrical and Electronic Industries to improve performance and lower costs.
CLEVELITE is known for its—DEPENDABILITY—UNIFORMITY—and ability to meet required tolerances . . . particularly important in coil forms, collars, bushings, spacers, tubes and endless other products.
Consult our Research and Engineering Laboratory. It is at your service.
WHY PAY MORE?
For the best . . . Call CLEVELAND!
*Reg. U.S. Pat. Off.
The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO
PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, 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

7 Reasons why Regohm is a natural for <u>your</u> control system



This compact, electro-mechanical controller provides sensitivity, speed of response and system stabilization under severe operating conditions. Its design and operating features have made Regohm useful for automatic control systems in which heavier, more expensive and complex, but less accurate equipment had previously been the only available solution.

(1) SMALL SIZE · Regohm is a compact, plug-in device; lightweight, extremely rugged and position-free. The unit's small size does not limit its power-handling capacity. This makes Regohm a "natural" where economy of space and weight are your major considerations.

(2) POWER AMPLIFYING · Regohm is a high-gain electro-mechanical power amplifier. Milliwatt variations in signal energy can control energy changes millions of times greater.

(3) IMPEDANCE MATCHING · Signal and controlled circuits are isolated, both electrically and structurally. Signal coils may have ratings from 0.01 to 350 amperes. Controlled resistors on a panel in which Regohm is plugged, can have values from zero to infinity, depending on the controlled system.

(4) SYSTEM STABILIZING · A thoroughly reliable, sturdy dashpot aids in system damping. It can easily and readily be adjusted over a wide range to match the dynamic characteristics of the Regohm to those of your present system.

(5) ANALYTICALLY DEFINABLE · The response of Regohm is independent of the rest of the servo system. Its response characteristic can be expressed in terms of conventional "transfer functions." Regohm acts as an integrating error-rate proportional controller. No appreciable steady-state error can occur. Regohm's effect can be calculated in advance, simplifying design and facilitating prediction of performance.

(6) CONTINUOUS CONTROL · In "closed loop" systems a high-speed averaging effect occurs as Regohm's armature oscillates over a small amplitude. This provides intermediate values between step resistances and results in continuous, stepless control in systems operating at power frequencies and below.

(7) LONG LIFE · In properly engineered installations, Regohm's life is measured in years. Plug-in feature simplifies replacement and maintenance—there are no parts to renew or lubricate. Shelf life is substantially unlimited.

Our engineering and research facilities can help you apply Regohm to your servo system or regulator problem. Write for Bulletin 505.00, containing a complete discussion of Regohm's characteristics and applications. Address Dept. E ELECTRIC REGULATOR CORP., Norwalk, Conn.

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.

a single stage where parasitic oscillations interfered with measurements, one was masked by a change in value of an overloaded resistor and four were in stages not being checked. Failures in components other than tubes were negligible.

Although the principles on which this experimental work is based are not new, the success of the tests indicate that practical failure-prediction systems can be devised and that provisions for such systems should receive the serious attention of design engineers.

Milled Block Simplifies Microwave Construction

BY USING WAVEGUIDES cut in blocks of conductive material it is possible to reduce the bulk and complexity of microwave circuits. Sharper curves without spreading of the waveguide walls, and reduction of reflection losses in fitting mechanical components are also possible by this method.

Developed by Ferranti, Ltd., the circuit is made up of two mated milled blocks. Each block has rectangular channels half the width of the major dimension of the waveguide. When joined together the channels coincide to form complete waveguide and duplexer circuits. Guideways for t-r cells, crystals or probes can be milled where required.

The fact that the waveguides are divided through their centerline has no effect on electrical performance, and is convenient for

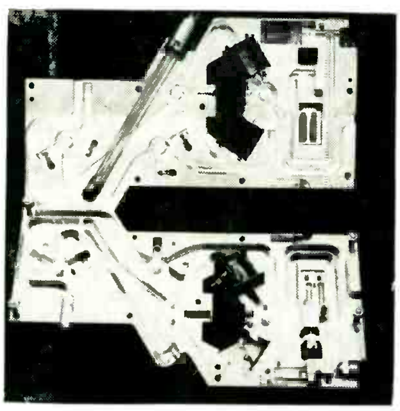
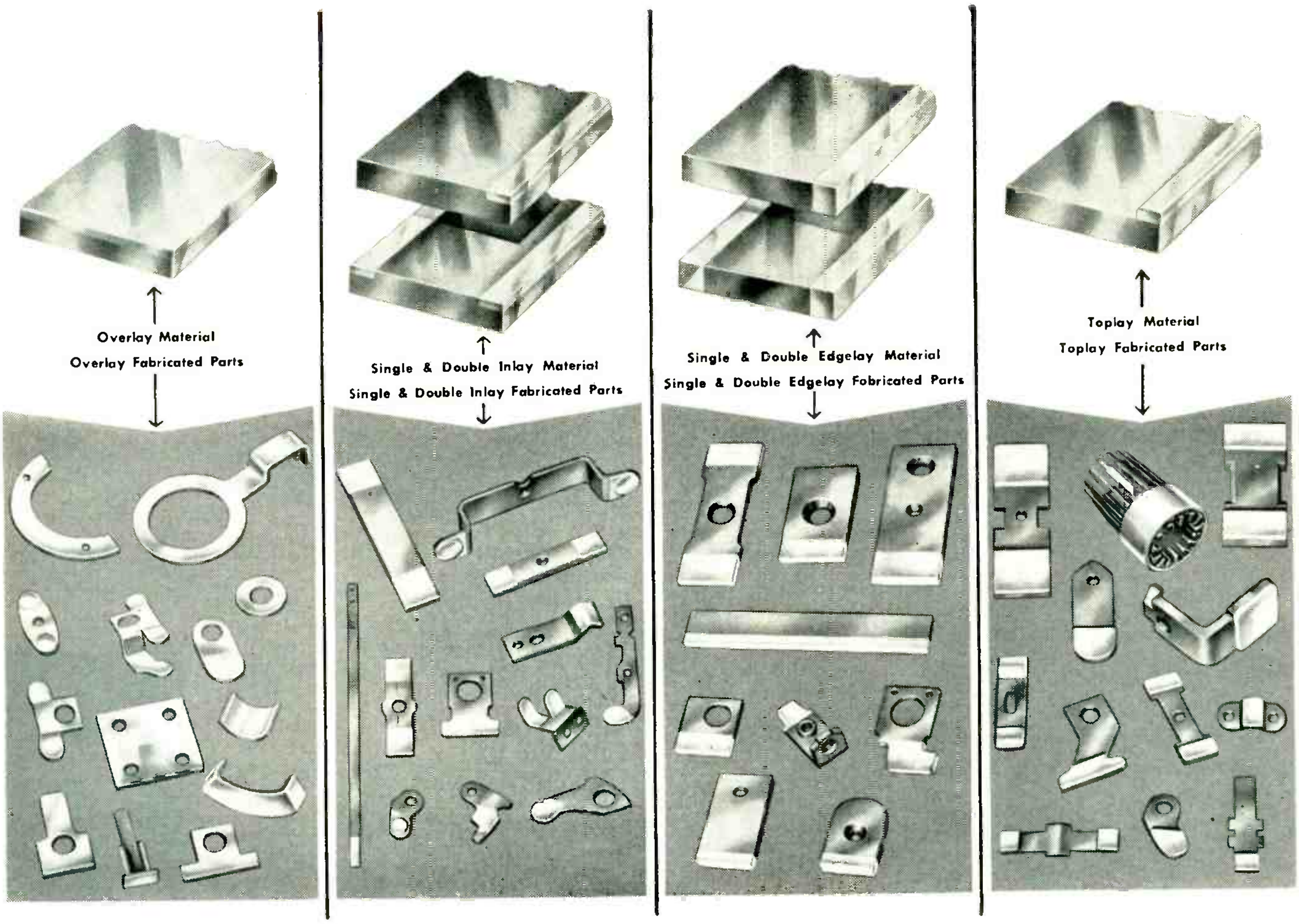


FIG. 1—Complex waveguide circuit cut in metal block. Spaces in block allow mounting of other components



GENERAL PLATE *Composite Contacts* give the Solution to Your Contact Problems

General Plate is a source of supply for precious and composite metal contacts, buttons, rivets, contact assemblies and contact materials.

Contacts of solid precious metals are economical where a small amount of precious metal is used. In applications requiring larger contacts, General Plate composite metal parts offer better performance, longer operating life and reduced costs in comparison with solid precious metal types. These advantages are obtained by combining the physical and electrical properties of the precious metal with the greater strength and lower cost of the base metal.

General Plate produces overlay, inlay, edgelay and Top-Lay contact materials by bonding a precious metal layer or stripe to practically any malleable base metal. Composite contact materials make it possible to manufacture complete contact assemblies to close tolerances by simple blanking and forming operations.

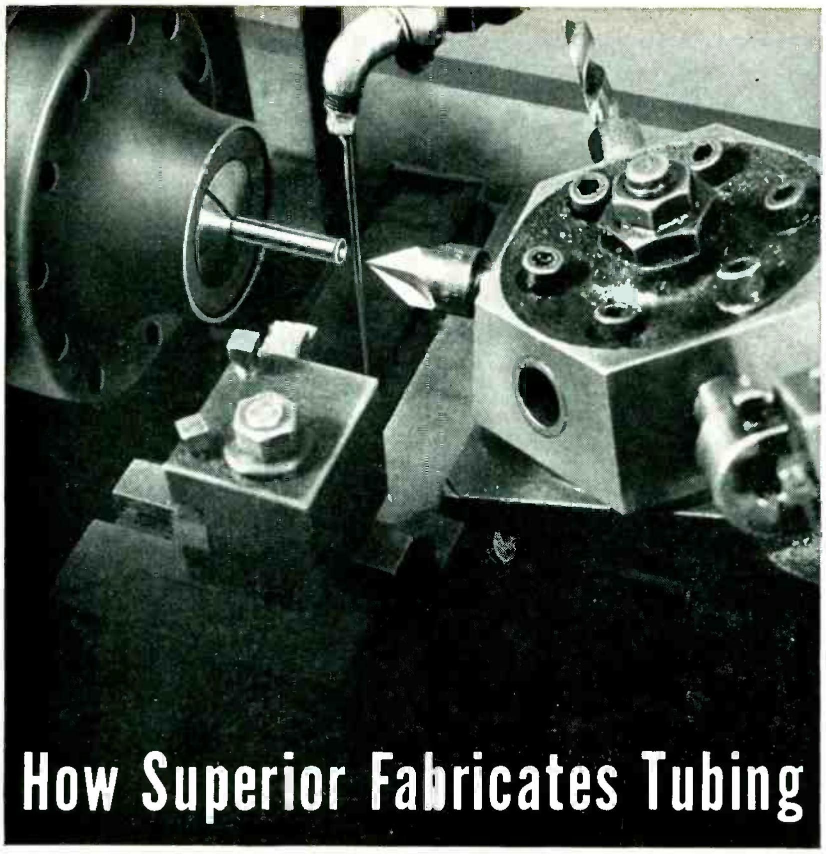
General Plate's Contact Department is completely equipped to produce blanked and formed parts of solid or composite metals, buttons, rivets, and brazed, welded or staked assemblies . . . fabricated to exact specifications. By letting General Plate fabricate your contacts, you eliminate costly fabrication problems, needless equipment costs and problems of scrap disposal . . . contacts and/or assemblies are shipped to you ready for installation.

Write for complete information and Catalog PR700 today.

Have You a Composite Metal Problem? General Plate can solve it for you

METALS & CONTROLS CORPORATION
GENERAL PLATE DIVISION
32 FOREST STREET, ATTLEBORO, MASS.

Want more information? Use post card on last page.



to give you the parts you need

Need a tubular part machined, inside or out, at one or both ends?

Like to have it drilled transversely at one or several points?

Want it to meet rigid dimensional and metallurgical specifications?

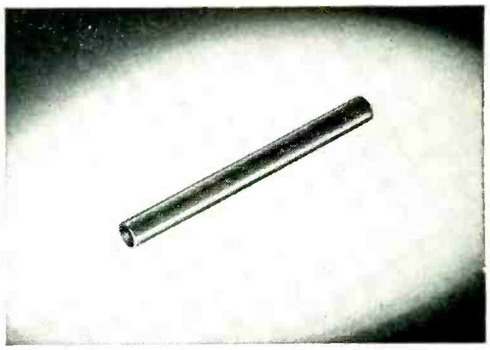
You're reading the right advertisement for all of these are Superior Specialties.

Superior has the experienced men, the specialized, highly developed equipment, the floor space, and the research facilities to produce quantities of drilled and machined tubular parts rapidly and economically.

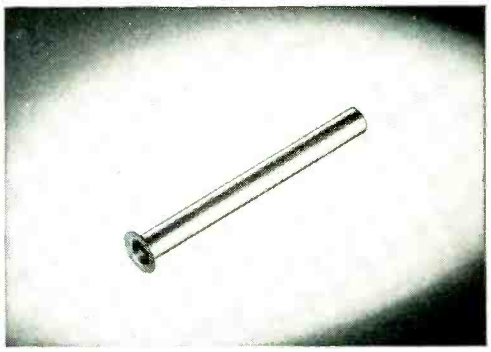
It's a job we like to do and know how to do. But there's more to the story than simple production of fabricated or semi-finished parts, or even top-quality tubing in any analysis and many sizes.

The rest of the story is our willingness, desire and ability to work closely with customers' development engineers and product designers. Frequently we are able to materially assist in design of parts, selection of analysis, and development of processes. Many times we have been able to suggest minor changes in shape or method to effect major economies in assembly time and product cost.

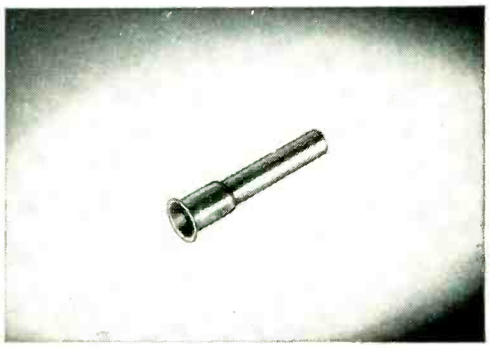
If you are a manufacturer or an experimenter in electronics and have a need for a tubular part of any kind, check with us. We can probably help by giving you quantity production of the parts you need. Write Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.



Cut and Annealed. Extensive cutting equipment, hand cutting jigs, electronically controlled annealers and other equipment, much of it developed within our own organization results in high speed, precision production of parts.



Flanging. Automatic flaring and flanging machines are combined in Superior's Electronics Division with carefully trained production and inspection personnel who know how to do a job right and take the time to be sure.



Expanded. Here is a part almost ready for delivery. Simple as it looks, it may well have been the subject of a score of operations and at every stage the prime consideration has been the *quality* of the finished part.

This Belongs in Your Reference File
. . . Send for It Today.

NICKEL ALLOYS FOR OXIDE-COATED CATHODES: This reprint describes the manufacturing of the cathode sleeve from the refining of the base metal. Includes the action of the small percentage impurities upon the vapor pressure, sublimation rate of the nickel base; also future trends of cathode materials are evaluated.

Superior
THE BIG NAME IN SMALL TUBING

All analyses .010" to ⅝" O.D.
Certain analyses (.035" max. wall) Up to 1⅛" O.D.

SUPERIOR TUBE COMPANY • Electronic products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800 internal inspection of the guides or insertion of attenuator wedges and other r-f components.

Time required for manufacture of circuits by this method is about one third of that required to make up a conventional waveguide assembly. The solid construction provided by the milled block technique allows the use of the block as a mount for other circuits. Amplifiers for r-f and i-f can be plugged directly into the block, eliminating the need for flexible leads.

Resistances for Symmetrical T and H Pads

CALCULATION OF RESISTANCES used in T or H pad attenuators for a given amount of attenuation can be simplified by the use of Table I. For a symetrical T pad, the values of R_1 and R_2 can be found by multiplying the impedance that the pad should have by the value in the table for the desired attenuation, according to the *Lenkurt Demodulator* for Nov. 1952.

For example, to construct a 600-ohm T pad with 10-db attenuation, the resistance values are as follows: R_1 is equal to 600 times 0.5193 or

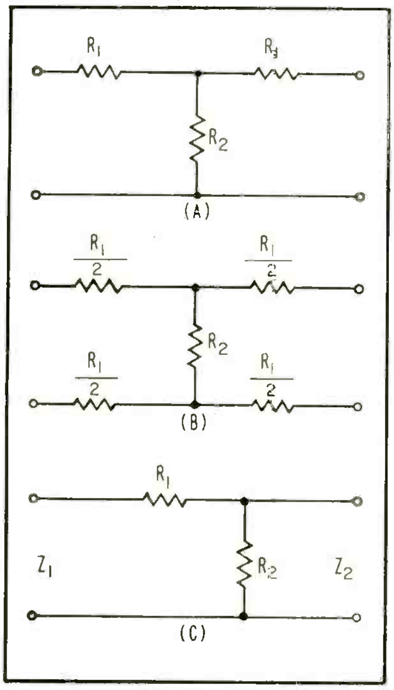


FIG. 1—Values of resistors for T-type (A), H-type (B) and low-loss L-type (C) pad attenuators can be determined from Table I

311.58 ohms; R_2 is equal to 600 times 0.7031 or 421.86 ohms. If an H pad were required, the values of the line resistors would be half the values of R_1 and R_2, as shown in Fig. 1.

Pi and O-type pads are equivalent electrically to T and H pads and are ordinarily used when the resistances required are more easily ob-

Table I—Resistance and Loss Values

db	Multiplier for R_1	Multiplier for R_2
0.5	0.0287	17.3775
1.0	0.0575	8.6680
1.5	0.0861	5.7620
2.0	0.1147	4.3037
2.5	0.1429	3.4270
3.0	0.1712	2.8357
3.5	0.1987	2.4168
4.0	0.2263	2.0963
4.5	0.2532	1.8483
5.0	0.2801	1.6453
5.5	0.3060	1.4808
6.0	0.3322	1.3389
6.5	0.3573	1.2206
7.0	0.3825	1.1158
7.5	0.4065	1.0267
8.0	0.4304	0.9466
8.5	0.4536	0.8756
9.0	0.4764	0.8112
9.5	0.4981	0.7547
10.0	0.5193	0.7031
10.5	0.5403	0.6552
11.0	0.5604	0.6119
11.5	0.5798	0.5724
12.0	0.5984	0.5364
12.5	0.6169	0.5021
13.0	0.6344	0.4710
13.5	0.6516	0.4416
14.0	0.6672	0.4158
14.5	0.6830	0.3905
15.0	0.6983	0.3668
15.5	0.7126	0.3453
16.0	0.7264	0.3251
16.5	0.7399	0.3058
17.0	0.7528	0.2878
17.5	0.7647	0.2715
18.0	0.7765	0.2556
18.5	0.7876	0.2411
19.0	0.7982	0.2273
19.5	0.8084	0.2143
20.0	0.8182	0.2020
20.5	0.8275	0.1905
21.0	0.8363	0.1797
21.5	0.8448	0.1683
22.0	0.8528	0.1599
22.5	0.8605	0.1508
23.0	0.8678	0.1423
23.5	0.8747	0.1343
24.0	0.8813	0.1267
24.5	0.8876	0.1195
25.0	0.8935	0.1128

$$R_1 = R_0\left(\frac{x-1}{x+1}\right)$$

$$R_2 = R_0\left(\frac{2x}{(x-1)(x+1)}\right)$$

$$x = 10^{db/20} = 10^{0.05db}$$

tained than those for a T or H pad. Most handbooks have formulas for conversions between the two types.

Resistance values for minimum-loss L pads can be obtained from the table by the use of the following formulas.

$$R_1 = Z_1 \sqrt{1 - \frac{Z_2}{Z_1}}$$

$$R_2 = \frac{Z_2}{\sqrt{1 - \frac{Z_2}{Z_1}}}$$

Echo Box Provides Target for Radar Training

By Lt. Robert A. Latimer

Connally AFB
Waco, Texas

Using an echo box to reflect radar waves, a target trainer in use at Connally Air Force Base, Texas, simulates airborne targets on radarscopes in ground school classrooms. The device allows students to become familiar with target tracking operations before making actual training flights.

The synthetic trainer is powered by two 28-volt motors mounted on a trolley that rides a curved track on a narrow table. One motor is geared to the drive wheels of the trolley and the other is used to move the echo box on a five-foot vertical rod. By varying the speed of the motors the position of the echo box

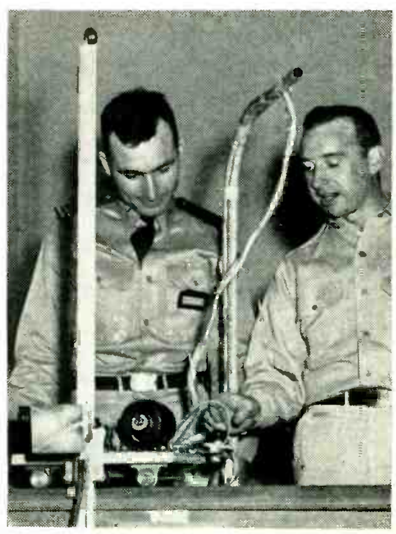


FIG. 1—Target simulator used in radar training. Echo box at lower left reflects radar waves to give same scope pattern as a plane in flight

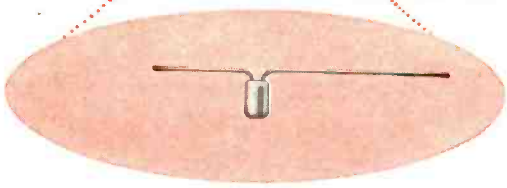
INTERNATIONAL RECTIFIER CORPORATION
EL SEGUNDO CALIFORNIA

Selenium Rectifiers

LARGEST TO SMALLEST

POWER RECTIFIERS

CELL SIZES: From 1″x 1″ to 6¼″x 7¼″
CURRENT RATINGS, per cell:
0.125 amperes to 7 amperes
VOLTAGE RATINGS, inverse per cell:
22 volts rms to 40 volts rms
Efficiency to 87%. Power factor 95%
Suitable for oil immersion.
Ratings to 250 KW. *Send for Bulletin C-349*



SELENIUM DIODES

DIAMETER: From 1/8″ to 13/32″
LENGTH: From 1/4″ to 1/2″
RMS applied voltage:
From 26 volts to 104 volts
RMS input current:
max. 500 microamperes
DC output voltage:
From 20 volts to 80 volts
DC output current: avg. from 200 microamperes to 5 milliamperes
Reverse Leakage at 10 volts RMS:
0.6 microamperes to 2.4 microamperes
Potted in thermosetting compound
Temperature Range:
From -60° C to 100° C
Available in 1, 2, 3 and 4 cell Diodes
Send for Bulletin SD-1

INTERNATIONAL RECTIFIER CORPORATION

General Offices: 1521 E. Grand Ave., El Segundo, Calif. • Phone: El Segundo 1890
Chicago Branch Office: 205 West Wacker Drive • Phone: Franklin 2-3889
New York Branch Office: 12 West 32nd Street, N. Y. 1 • Phone: Chickering 4-0017

can be changed to simulate climbs or dives in any direction.

Control of the unit is centralized at a desk alongside the radar set. By using electronic controls, range and speed variations, peel-offs, dives and similar evasive actions can be provided.

Negative Resistance Crystal Oscillators

By Sergio Bernstein

Government Division
Fada Radio and Electric Co. Inc.
Belleville, New Jersey

THE FREQUENCY stability of a crystal oscillator is affected essentially by variation of the quartz crystal properties, variations of the oscillator tube parameters, and Variation of the associated circuit parameters (R, L, C). Modern crystal cutting and mounting techniques have produced crystals whose frequency stability is very high. Thus changes occurring in the associated oscillator circuits are by far the greatest factors affecting the frequency stability.

A new circuit is presented here in which the circuit constants comprise only resistances. These resistances may have extremely small temperature coefficients by using special wire (such as manganin) and can be made noninductive by special winding methods.

Essentially the oscillator circuit comprises a piezoelectric crystal, driven by a vacuum tube connected so as to present a negative differential transconductance to the crystal terminals. Two possible meth-

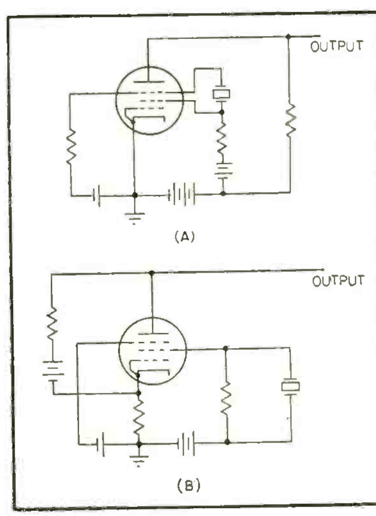


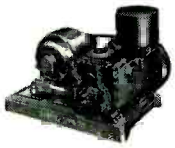
FIG. 1—Two crystal oscillators using only resistances as circuit components

VACUUM FACTS

It's a **FACT**...

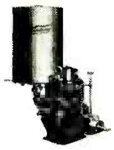
...Kinney originated the rotating plunger vacuum pump... universally acclaimed for fast pump down and quick recovery.

It's a **FACT**...



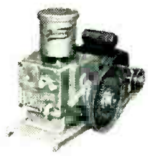
...Kinney pioneered the oil-sealed pumping system.

It's a **FACT**...



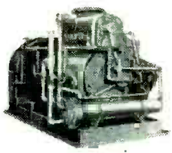
...Kinney is the BIG LINE of mechanical vacuum pumps... more models, more sizes, more capacities to choose from.

It's a **FACT**...



...Only Kinney offers in such a wide range both single stage and compound vacuum pumps — for creating and maintaining low absolute pressures alone or with diffusion pumps.

It's a **FACT**...



...More vacuum processes depend on Kinney Vacuum Pumps than on any other make or type of pump.

Find out for yourself how Kinney Vacuum Pumps can help in your low pressure processes — in laboratory, pilot plant, or production.

Send coupon or write for details.

Kinney

Kinney Manufacturing Co., Boston 30, Mass. Representatives in New York, Chicago, Detroit, Cleveland, Atlanta, Philadelphia, Pittsburgh, Johnstown (Pa.), Los Angeles, Charleston (W. Va.), Houston, New Orleans, San Francisco, Seattle and foreign countries.

KINNEY MANUFACTURING CO.
3565 Washington St., Boston 30, Mass.

Please send new Bulletin V-51B. Our vacuum problem involves:

- ☐ Vacuum drying
- ☐ Vacuum coating
- ☐ Vacuum metallurgy
- ☐ Vacuum impregnating
- ☐ Vacuum distillation
- ☐ Vacuum research

Name ....

Company ....

Address ....

City .... State ....

SUBSIDIARY OF THE NEW YORK AIR BRAKE CO.

ods of connection are shown in Fig. 1A and B. The first method of connection has a practical advantage over the second, since all the voltages can be derived from taps on a single power supply.

Another property of this type of crystal oscillator is that it is possible to make the frequency of oscillation of the system exactly coincident with the mechanical resonant frequency of the crystal. It is also possible to obtain small frequency changes by shunting very small capacitances across the crystal. To prevent appreciable changes in the figure of merit of the quartz crystal, these shunting capacitances should be on the order of 0.1 $\mu\mu$f.

Variation of tube parameters can be reduced to extremely small values by the proper choice of applied potentials. Moreover, if all the voltages are obtained from a common voltage divider, these variations will be practically nullified through a self compensating action.

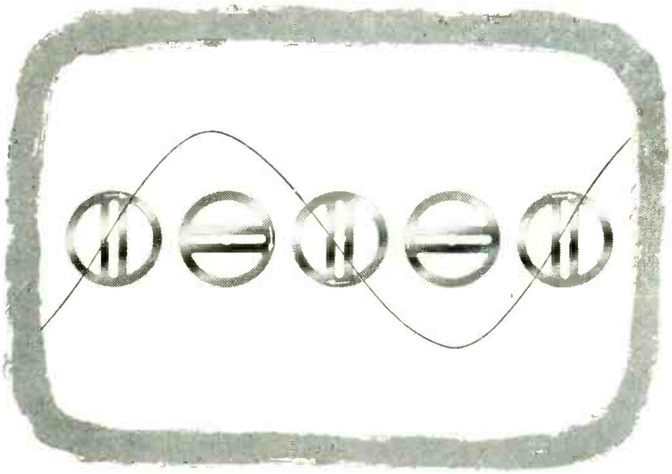
When extreme frequency stability is desired, it is important to insure that the operating point coincides with the point of inflection of the negative transconductance characteristic. This precaution has to be taken to obtain the best possible excitation voltage waveform, since any distortion in the exciting waveform will modify the oscillation frequency of the system.

Experimental results obtained with a 100-kc crystal oscillator has shown that it is possible to make the oscillator frequency coincide exactly with the mechanical resonant frequency of the quartz crystal. Variation of $\pm$ 5 percent of any or all of the applied voltages caused frequency variations of less than 1 part in 10^8.

Vehicular Communications Symposium

TECHNICAL PAPERS presented before 250 engineers at Washington, D. C. in early December outlined problems in the growth of mobile radio communications, particularly at vhf. Sponsored by the Professional Group on Vehicular Communications of the Institute of Radio Engineers, the meeting concentrated upon spectrum-conservation meas-

EVER RUN INTO THESE **FALSE IDEAS** ABOUT SYNCHRONOUS TIMING MOTORS?

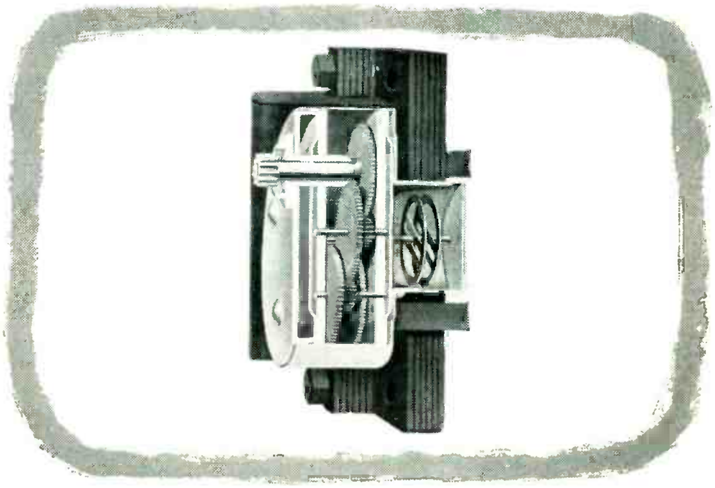


ALL SYNCHRONOUS TIMING MOTORS ARE FUNDAMENTALLY ALIKE

Not true. Telechron motors have the lightweight, low-inertia rotor that rotates once for every cycle of the alternating current. Thus Telechron motors are truly synchronous. They start instantly . . . reach full speed in less than a twentieth of a second . . . don't get out of "sync," even with severe fluctuations in line voltage.

ALL SYNCHRONOUS TIMING MOTORS GET NOISY AND FAIL AFTER A FEW YEARS

That hasn't been the experience of our customers. Of course, the rotor unit is entirely enclosed in Telechron motors . . . with a reservoir of special lubricant sealed in. Capillary action carries oil to all bearings. Dirt and dust can't get in. Many Telechron Synchronous Timing Motors are still giving dependable, accurate, quiet service after 20 years of continuous use.



IT'S EASY TO SPECIFY THE RIGHT MOTOR FOR A PARTICULAR JOB

Not unless you're an expert on timing problems. Because most of the time, only a timing motor specialist knows how to figure all the factors. And when you use Telechron Synchronous Timing Motors, you have the support of our experienced Application Engineering Service. We analyze the requirements of your application . . . and give an honest recommendation designed to assure you the longest motor life at the lowest unit cost.

WHAT'S YOUR APPLICATION?

Let us send you our complete catalog and application data sheet. Write Telechron Department, General Electric Company, 42 Homer Ave., Ashland, Mass.

Telechron®

MARK OF TIMING LEADERSHIP

ures. Emphasis was placed upon channel-splitting because the Federal Communications Commission in late 1951 had requested the Joint Technical Advisory Committee to study the feasibility of this technique, already demonstrated at 50 mc.

Field Experience

Early tests were described by W. M. Rust, Jr. of Humble Oil Co. and J. S. Stover, Communications Engineering Co. With a total of 20,000 petroleum stations now in operation and an increase of 5,000 a year predicted, tests were begun in 1951 using f-m receivers accepting a bandwidth of 20 kc and transmitters having a deviation of ±5 kc. Under conditions of normal noise, communications were good when an interfering station operated as close as 5 miles away. However, when receiver bandwidth was reduced to 17 kc, the interfering signal required displacement of 8 miles to re-establish comparable service. Interference from signals in adjacent bands is about the same using either wide-band or narrow-band techniques. Although the overall stability of the modified equipment has proved good, the narrow-band sets require careful maintenance.

Extensive field tests by RCA of mobile equipment having reduced receiver bandwidth and narrower transmitter deviation ratios were described by H. E. Strauss. For these tests, equipment stability was held to values such as ±0.0005 percent for receiver and transmitter oscillators. Three bandwidths were employed for systems of 60, 30 and 20 kc with transmitter deviation ratios of ±15, ±6 and ±3 kc respectively. In addition, other deviations were sometimes employed that just filled the receiver bandpass at the 6-db point. It was established that narrow-band equipment was more susceptible to noise than wide-band equipment, but that the amount of degradation caused by impulse noise had to be determined by field tests.

The JTAC tests conducted by a number of manufacturers at Syracuse, N. Y. during late October

Specify *Bliley*... For 22 Years The Foremost Name In Crystals

★ ★ ★

MILITARY

Military types CR15, CR16, CR18, CR19, CR23, CR24, CR27, CR32, CR36, CR47 are representative of current production by Bliley. Complete range of types and cross reference index is given in Bulletin 43.

SHIP-TO-SHORE

Types MC7, SR5 and SR8 are suggested for shipboard dependability. Price and details given in Bulletin 44.

BROADCAST

Types BC46T, MO3B, TC92 are first choice for automatic temperature control in AM, FM and TV transmitters. Consult Bulletin 43 for basic details.

SPECIAL PURPOSE

Types SR10 and MC9 provide wide range frequency choice for TV service, diathermy and citizens band. Request Bulletin 44 for price and description.

COMMUNICATIONS

Type BH6A is the predominant choice for land mobile and airborne applications. Consult Bulletin 43 for basic information.

STANDARD

Types KV3, MC9, SMC100 and MS433 cover reference frequencies from 100 kc through 10.7 mc. Price and "stock tolerances" given in Bulletin 44.

AMATEUR

Types AX2 and AX3 together with Bliley packaged oscillator Model CCO-2A were designed to bring precision and price together in the Ham Bands. Price and details are given in Bulletin 44.

ULTRASONIC DELAY LINES

Custom built fused quartz delay lines provide high stability and precision time intervals for manipulation of pulsed or pulse modulated signals. Consult Bulletin 45 for technical information.

FREQUENCY STANDARDS

Model BCS-1A is a high stability instrument for precision reference at 100 kc. Ideal choice for research and development laboratories. Descriptive information given in Bulletin 43.

Bliley CRYSTALS

BLILEY ELECTRIC COMPANY

UNION STATION BUILDING • ERIE, PENNSYLVANIA

Want more information? Use post card on last page.

were summarized by N. H. Shephard of GE who played back tape recordings showing comparisons of fringe-area signals employing a variety of systems characteristics. Receivers used were wide-nose (±15 kc), and narrow-nose (±5 kc) types, while the transmissions were characterized as wide-band (±15 kc), narrow-band (±5 kc) and narrow-band-filter types. In the latter, deviation was held to ±5 kc and the audio signal limited to 2,500 cycles.

Field tests included those of range comparison and adjacent-channel interference under varying proximity of the undesired signal. The latter tests bear importantly upon what changes will be necessary during the probable transition from present standards and older equipment to those employing narrow-band receivers and transmitters.

D. E. Noble described the operation of a year-old Miscellaneous Common Carrier serving about 100 mobile customers at Phoenix, Arizona. Standard ±15-kc deviation equipment modified for ±5 kc is used on a split-channel basis. The land station is located 30 miles from the city atop White Tanks Mountain. Included in the system is a two-way microwave link for control of car-to-car relaying. With this system, two mobile units a mile apart can be interconnected to communicate over a circuit that may be 120 miles long. In general, however, relaying is accomplished at the mountain and is seldom returned through the city operating room so the circuit is 60 miles. Mobile equipment is provided with selective calling that gives a busy signal to the car and locks out its transmitter.

Filters suitable for use in mobile channel selection were discussed by two engineers. L. J. Labrie of Bell Telephone Laboratories described a new AT-cut crystal with a single resonant response. The circular faces of this crystal are of lesser diameter than the maximum diameter of the quartz button, with a radius of curvature five times that of the face between each face and maximum diameter. Operating in a

Want more information? Use post card on last page.

thickness shear mode, the new crystal filter also requires special electrodes. Milton Dishal of Federal Telecommunication Laboratories, discussing the best filter with reference to a required i-f selectivity, analyzed L-C, mechanical and crystal devices. He showed that the coil-capacitor combination is not fundamentally inferior to newer types that are currently being recommended.

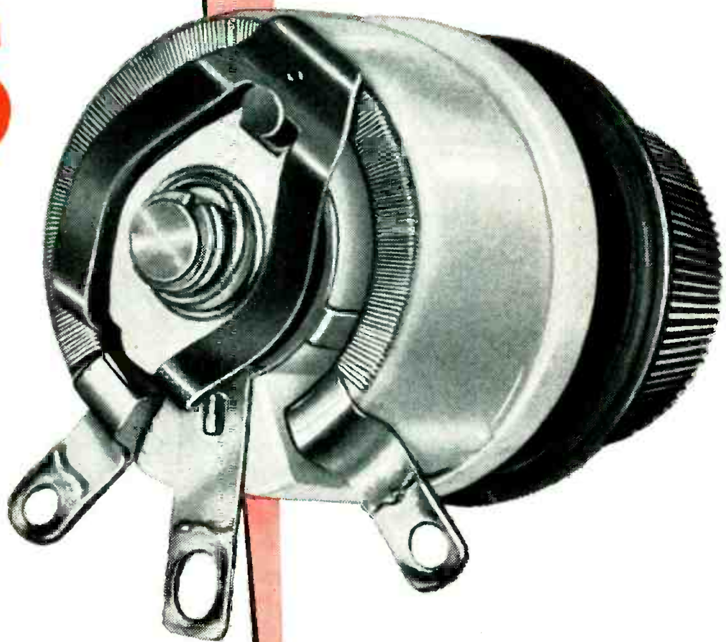
D. M. Heller of Bendix Radio and Kenneth Bullington of Bell Labs considered systems aspects of improved mobile communications. Mr. Heller showed that equipment using crystal control with an accuracy of 0.003 percent can be improved to 0.0006 percent by addition of simple temperature control. He suggested removing the residual i-f response error by improved mechanical design or temperature compensation indicating that characteristics of ± 1 kc per mc of mean frequency of the i-f over a range from -40 to $+60$ C is possible.

Mr. Bullington's paper covered in detail the necessary considerations of a coordinated system for a large metropolitan area wherein all high-power land stations would be located near a common point—within a mile of each other. By employing automatic gain control on the mobile receivers, all nearby signals could be fairly equally attenuated, whereas at a distance intermodulation effects of undesired signals will be too weak to cause interference. Base transmitters will require r-f filters for interference falling outside the bands employed in the coordinated system, but these can be installed easily at a base station.

Coordinated reception is not possible. Mobile power should therefore be cut to two or three watts (decreasing drain on the car battery) and multiple base receivers employed. While this has some disadvantages, it provides space diversity reception, which is good. In this system, guard bands will be needed at the system frequency extremities, but the sum total of spectrum required will be less because interchannel guard bands can be extremely narrow if not entirely eliminated. The alternative

The NEW rugged A-25

"Built to take it"



TYPE A-25 (25 WATT)

Tests show that our new A-25 rheostat is so rugged that it will stand up under the most adverse conditions!

It gives maximum wattage dissipation for its size; and the added safety factor made possible by our new high temperature blue-gray enamel.

The terminals, made of strong corrosion resistant alloy, are permanently welded to the winding form. The finest quality wire—made to our own specifications—is wound evenly on a toroidal ceramic form, and then securely bonded to eliminate troublesome connections.

The wound ring is made an integral part of the refractory base by vitreous enamel. The phosphor bronze actuating arm, to which is attached a graphite brush, gives perfectly smooth action, with excellent electrical control. And the shafts are insulated from all live parts by a strong shaft insulator.

Our A-25 units are equipped with three terminals to permit either potentiometer or rheostat use.

Send for new A-25 bulletin.

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 half a century to such system coordination appears to be a limit of ten or a dozen stations for each 10-mc slice of spectrum.

Comparison of mobile radio transmission at 150, 450, 900 and 3,700 mc was made in a paper by W. R. Young and read by his colleague, Walter Strack of Bell Labs. It was shown that 450 mc is a transmission medium superior in urban and suburban areas to the presently used 150-mc band. A broad optimum of performance falls in the region of 500 mc. While higher frequencies are less desirable, 900 mc is somewhat more effective than 150 mc if antennas with gain properties are employed. At 3,700 mc carrier-level fluctuations occur at an audible rate as the mobile unit progresses, impairing the use of this frequency. Frequencies above 1,000 mc can be used in this service but present difficulties.

E. N. Singer from the New York office of FCC pointed out the function of his group in running down complaints of adjacent and cochannel interference. To determine exactly the operation of mobile equipment a portable spectrum analyzer is being developed in the laboratories at Laurel, Md.

—A. A. MC K.

Suppressor Grid Control of Thyratrons

BY H. L. ARMSTRONG
National Research Council, Canada Ottawa, Canada

OFTEN THE SIMPLEST way to control the current supplied to a load is to provide d-c to the load by a thyratron used as a rectifier in series with an a-c supply, and to vary the conduction period by varying the time of firing of the thyratron. This

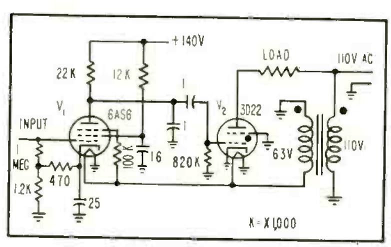
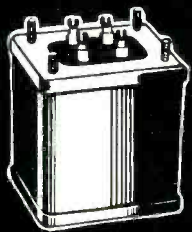


FIG. 1—Diagram of thyratron control circuit using out-of-phase suppressor grid voltage as trigger control

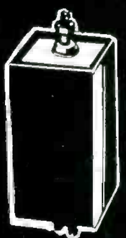
FREED *Instruments & Transformers*

Famous for

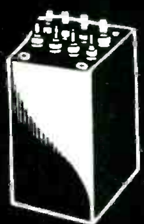
QUALITY • DEPENDABILITY • ACCURACY



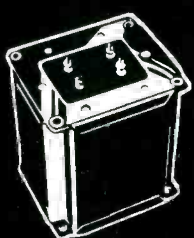
High Fidelity Transformers



Slug Tuned Components

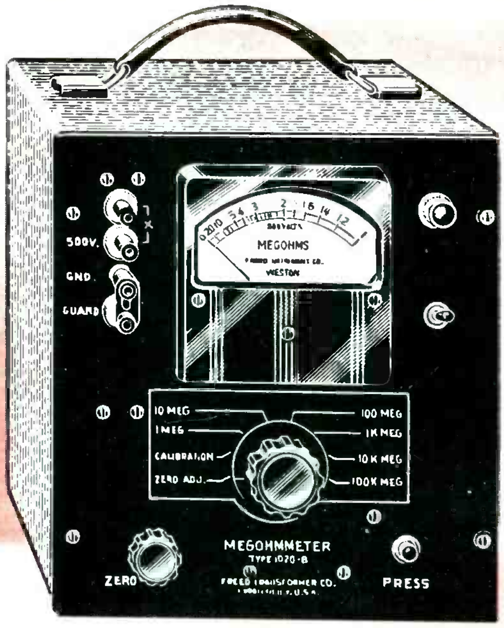


Hermetically Sealed Components to meet MIL-T-27 Specs



Commercial Components

FREED 1020-B MEGOHMMETER



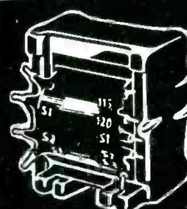
A precision electronic megohmmeter which for years has given satisfactory service in hundreds of laboratories and on production lines.

- **EASY TO READ**
  Direct reading on a 4" scale.
  Protected against overload.
- **RAPID & SAFE TO USE**
  Test voltage removed from terminals and capacitive components discharged to ground in all positions of multiplier switch.
- **ACCURATE**
  Within 3% up to 100,000 megohms, 5% from 100 000 to 2,000,000 megohms.

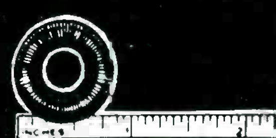
SPECIFICATIONS

Range: 1 megohm to 2,000,000 megohms in six overlapping ranges selected by a multiplier switch.
Voltages on Unknown: The voltage applied to the unknown terminals is 500 volts d-c and is independent (less than 1%) of the value of the unknown.
Stability: Line voltage variations from 105-125 volts will cause less than 2% variation in the meter reading.
Power Supply: 105-125 volts A.C. 50-60 cycles 30 watts.
Dimensions: 9½ x 10½ x 8 inches.
Net Weight: 18 pounds.

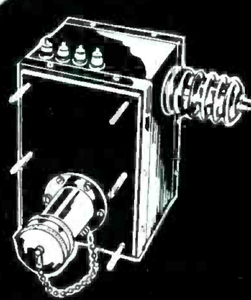
Sub-miniature hermetically sealed Toroidal Inductors



Freedseal Treatment ANE-19 Specs



Miniature Inductors



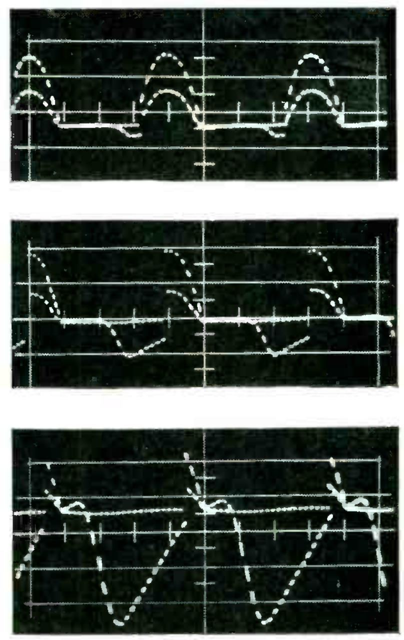
Pulse Modulators

FREED TRANSFORMER CO., INC.

1722C WEIRFIELD ST. (RIDGEWOOD) BROOKLYN 27, N. Y.

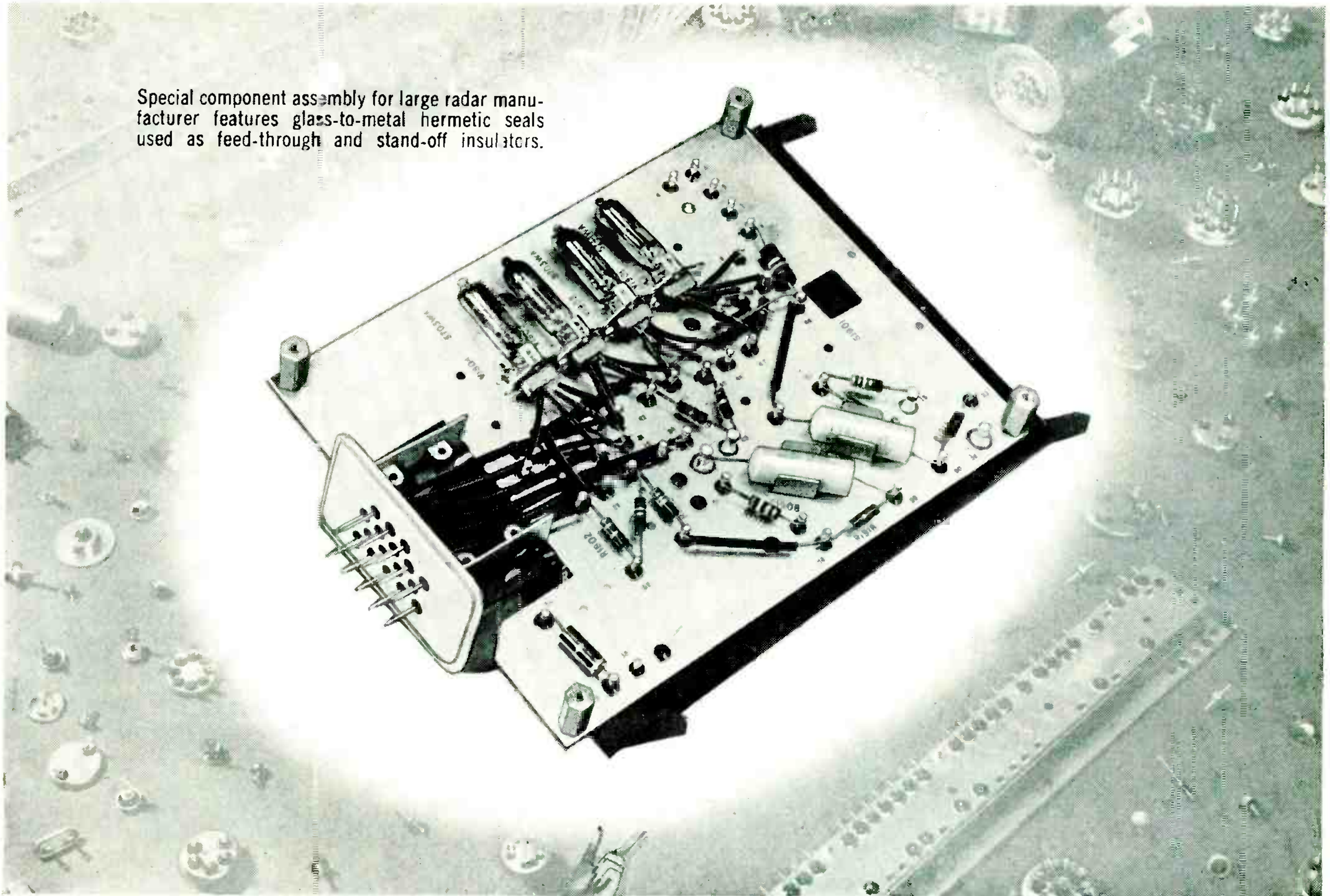
is accomplished usually by some combination of variable bias, and a-c 90 deg out of phase with the plate, applied to the grid of the thyratron. When the control must be accomplished by electronic means, variable bias can become difficult. The circuit described below and shown in Fig. 1 has been found to be simpler in some applications.

The idea is that the transformer is arranged so the voltage supplied to the plate of V_2 is 180 deg out of phase with that at the suppressor of V_1. Since the suppressor on a 6AS6 can cut off the plate current quite easily, V_1 draws current only during the negative peak of voltage



(A) The effects of negative grid swing (lower wave) on conduction period. (upper wave). As negative swing is increased conduction period is shortened

at the plate of V_2. The drop in voltage at the plate of V_1 is applied through the coupling circuit to the grid of V_2, driving it negative. Then the plate of V_1 is cut off by the suppressor, and the grid of V_2 rises exponentially to ground. When the plate of V_2 first goes positive, the grid will still be negative and conduction does not take place until the grid has risen to a certain voltage. The time required for this depends on how far negative it was driven originally. This depends on the plate current of V_1 which in turn depends on its grid bias. Thus a signal applied to the grid of V_1 con-



Special component assembly for large radar manufacturer features glass-to-metal hermetic seals used as feed-through and stand-off insulators.

Remember, Sealtron protects sensitive parts.

use this sub-assembly service to solve your design and production problems.

You can speed up development and production of electronic devices of all types . . . meet those tough delivery dates. Just call on SEALTRON to design and build hermetically-sealed plug-in assemblies *especially* for your products! Produced with SEALTRON's expert engineering, biggest selection of stock seals, miniaturization "know-how," these assemblies:

***1.** Provide compactness and miniaturization* ***2.** Streamline circuitry* ***3.** Insure conformity of production to design, reducing chances for stray "pick-ups," etc.* ***4.** Eliminate tedious sub-assembly operations* ***5.** Simplify final assembly, ease tough production schedules* ***6.** Release key personnel for other work*

Write us about your special sub-assembly needs. You will receive complete information by return mail.

Send for our new easy-to-use catalog-brochure today.

SEALTRON

Manufacturers of the world's most complete line of seals—over 1600 types

THE SEALTRON COMPANY

9701 READING ROAD • CINCINNATI 15, OHIO • TELEPHONE VALLEY 8500 trols the current flowing through V_2. In the application for which this circuit was devised, the input to V_1 was 60 cycle from a temperature sensitive bridge, giving the circuit the advantage of phase sensitivity. It was sensitive only to an input in phase with the suppressor of V_1. However, d-c input works as well. Also, the role of suppressor and control grids can be interchanged.

The waveform photographs show the grid voltage (lower wave) and plate current (upper wave) of V_2, superimposed with an electronic switch. It demonstrates how the grid goes negative during the negative half cycle, and then rises until the tube fires and current flows. Negative grid swing and decrease in signal applied to V_1 is also shown with the period of plate conduction increased in the same manner, as indicated in operating theory.

Measurement of Harmonic Distortion With A Filter

SINCE IT IS CUSTOMARY to operate a magnetic recording system at the highest possible recording level that does not exceed the allowable distortion limits, it is important to have an accurate means of measuring the amount of distortion present in a system. Because recording level is also dependent on such variable factors as the properties of the magnetic medium, the bias current, the recording heads and the gain characteristics of the recording amplifier, the method should be simple enough for periodical checking of professional

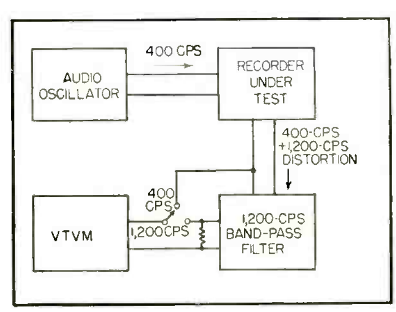
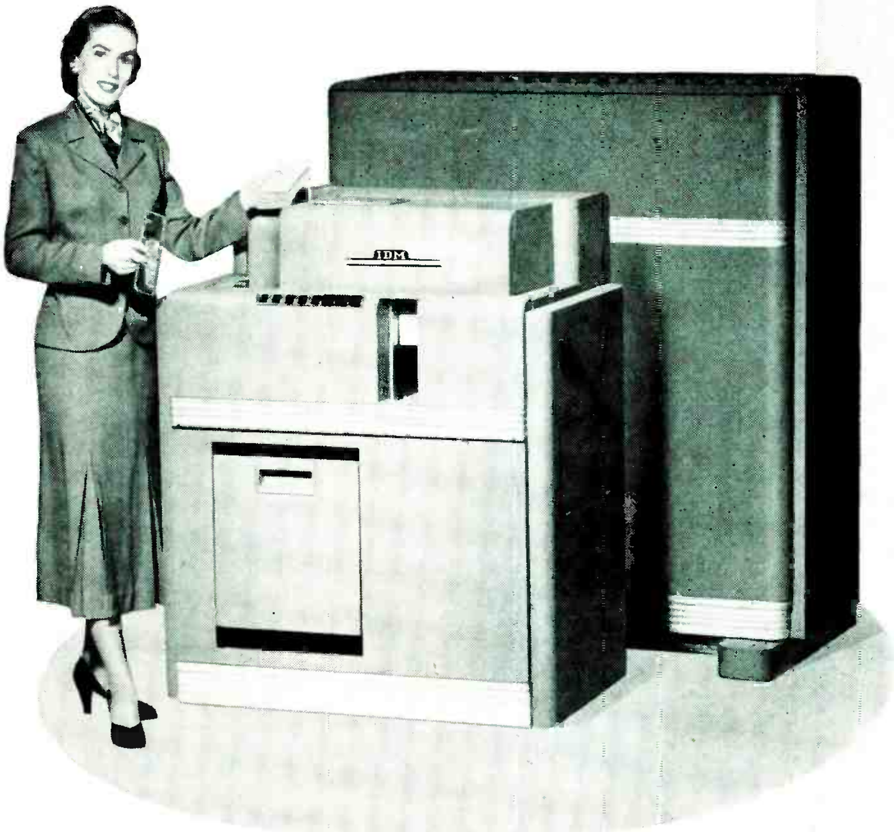


FIG. 1—Block diagram of distortion measuring system



OVER 10,000 BRADLEYUNITS in this Electronic Calculating Punch

The IBM Electronic Calculating Punch, shown above, will punch 6,000 cards per hour, performing up to 60 operating steps for each card.

The master key is the IBM Electronic Tube Assembly which comprises an electron tube and several resistors and capacitors. There are more than 1,200 of these pluggable units in each punch. With 8 or 9 Bradleyunits per assembly there are over 10,000 Bradleyunits per punch.

Bradleyunits are ideal resistors for such critical service, because they are rated at 70C . . . not 40C . . . which assures stability and permanence.

Made in all R.T.M.A. values, Bradleyunits are available from 10 ohms to 22 megohms in ½ and 2 watt sizes, and from 2.7 ohms to 22 megohms in the one-watt size. They need no wax impregnation to pass salt water immersion tests.

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

Allen-Bradley Fixed Resistors are rated at 70C for high safety factor

Above is shown the internal construction of the ½, 1, and 2 watt Bradleyunits, all encased in hard plastic shells. Both leads are differentially tempered to prevent sharp bends near the resistor body.

A·B Quality

ALLEN-BRADLEY
RESISTORS & CAPACITORS

Sold exclusively to manufacturers QUALITY of radio and electronic equipment recording machines in the field.

A method of measuring distortion with a band-pass filter developed by the Minnesota Mining & Manufacturing Co., greatly reduces the time and equipment needed for this operation. In a magnetic tape overload the principal distortion results from the third harmonic component. By recording a pure sine wave and then separating the third harmonic and measuring it with a vacuum tube voltmeter, it is possible to determine the third harmonic distortion. This set up is shown in Fig. 1. The only equipment required is an audio oscillator with good waveshape, a vacuum tube voltmeter with a fairly wide

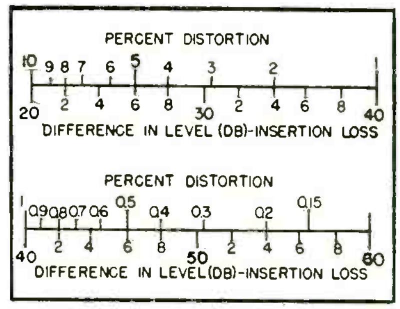


FIG. 2—Alignment chart for converting decibels to percent distortion

range, and a band-pass filter. A 1,200-cps filter is ideal for this purpose since it is customary to measure distortion at 400 cps. However, a more common 100 or 5,000-cps filter can be used if the test frequency is adjusted to a suitable value. For highest accuracy, a filter having a rejection of at least 60 db at the fundamental, should be used.

Before testing a recording system it is necessary to calibrate it for the insertion loss of the filter. Since the input termination affects this value, the filter should be calibrated on the recorder under test. First, the output level is measured at 400 and 1,200 cps, with the filter disconnected, to determine if the level is the same at both frequencies. If it is not, the input must be readjusted during the test to compensate for the difference.

With the filter connected to the recorder, readings are taken at the filter input at 400 cps and at the filter output at 1,200 cps adjusting the input level as previously determined. The insertion loss of the filter is the difference between these two readings.

To make the actual distortion test, the 400-cps signal is fed into the recorder and the level reading taken at both the input and output of the filter. The true ratio between the signal and the third harmonic component is the difference between these two readings minus the insertion loss of the filter. This value can be converted to percent by use of the alignment chart in Fig. 2.

Once the insertion loss calibration has been made for a particular system, it is not necessary to repeat this step on subsequent tests. It is only necessary to connect the oscillator, filter and voltmeter and take two readings.

High Sensitivity Tone Discriminator

By Sidney Wald

Use of sharply tuned parallel-T R-C networks in place of L-C filters results in sensitive, compact, and inexpensive tone localizer that is useful in guidance or navigation equipment or as a low-frequency discriminator in f-m subcarrier systems.

In the usual arrangement for these purposes, band-pass L-C type filters are used in a subtractive rectifying circuit. The size and weight of these filters becomes large if reasonably high sensitivity is to be realized.

The circuit shown in Fig. 1 was designed as a tone-localizer for 90 or 150 cycle input. When equal amplitudes of 90 and 150 cps are present in the input, the meter reads zero center. When one signal amplitude is larger than the other, the d-c microammeter deflects to

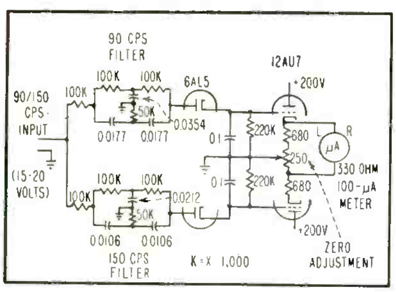


FIG. 1—Circuit diagram of the simplified tone indicator

Want more information? Use post card on last page.

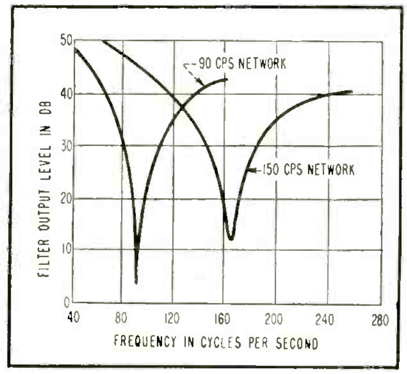


FIG. 2—Attenuation characteristics of the parallel-T filters

one side to indicate the relative magnitudes of the input frequencies. With the 100K-ohm input resistors in the circuit the output sensitivity is 50 μa deflection for 2 db difference between 90 and 150 cps signals into a 330-ohm microammeter. The input voltage is approximately 15 to 20 volts rms for this condition.

Figure 2 indicates the attenuation characteristics of the parallel-T filters.

Clutch Operates On Loudspeaker

A NEW CLUTCH that will find use in instruments and computers where fast response is required, uses the same moving-coil principle as an electrodynamic loudspeaker. Developed by the National Bureau of Standards, the clutch is actuated by the interaction of a magnetic field and current in a coil. The resulting force moves the coil causing the output disk to be pressed against the rotating input shaft. In an experimental model response time was less than a third of a millisecond.

The operating principle of the clutch makes it inherently capable of a faster response than is possible with most electric or magnetic friction clutches. In the loudspeaker type, the magnetic field is in existence before actuation, and the normally small induction of the coil is the only time factor involved. This coil inductance can be made

KELLOGG M W — PULLMAN INCORPORATED SUBSIDIARY OF

KEL-F*

*Reg. U. S. Pat. Off.

VOLUME-PRODUCTION PRICING NOW RADICALLY BROADENS SCOPE OF APPLICATIONS FOR THIS UNIQUE THERMOPLASTIC

Volume demand now measured in the hundreds of tons and improved production methods—have combined to radically reduce the per lb. cost of Kel-F. Further, experience has shown that potential applications require only small quantities of Kel-F per finished item, because of the plastic's superior properties. In view of these two facts, design engineers are currently reevaluating the use of Kel-F for all applications where the seven basic Kel-F properties meet design or performance specifications.

LEADING MOLDERS NOW OFFER KEL-F PARTS AND BASIC MATERIALS

Already, more than 50 leading molders in the country are prepared to deliver Kel-F tubing, rod, sheet, film and strip in a variety of sizes and types of material. Many of these are supplying not only these basic fabricating materials but are also producing finished parts by the standard methods such as compression, transfer, injection and extrusion molding.

TECHNICAL BULLETINS, SERVICES NOW AVAILABLE...

Detailed data—in bulletin form—on physical properties, molding techniques, dispersions and other Kel-F products are available. The Chemical Manufacturing Division's Technical Service Department has been augmented to offer additional help to design and materials engineers, as well as molders, in the use of this unique material.

Chemical Manufacturing Division
The M. W. KELLOGG Company
P. O. Box 469 • Jersey City 3, N. J.
In N. Y. WOrth 4-6775 — In N. J. DElaware 3-3100

BASIC KEL-F MATERIALS AVAILABLE
(Order direct from Kellogg)

Molding Powders	Unplasticized	#300 — for high temperature service
		#270 — for less severe temperatures
	Plasticized (In Grade #300)	P20 — Containing 20% plasticizer
		P25 — Containing 25% plasticizer
		P30 — Containing 30% plasticizer
Dispersions		NW-25 — Flows readily at fusion temperatures
		N-1 — High molecular weight
Oils, Waxes and Greases		Five grades — from Light Oil to Hard Wax — are available. Details on request.

USE KEL-F when applications require — Properties

CHEMICAL INERTNESS
No effect has been observed after prolonged exposure of Kel-F to concentrated sulfuric, hydrofluoric and hydrochloric acids; to strong caustic; to fuming nitric acid, aqua regia and other vigorous oxidizing materials. It is equally resistant to most organic solvents.

ELECTRICAL RESISTANCE
Kel-F has high resistance to electricity . . . is a poor conductor of heat . . . and its electrical properties are superior to most plastics. Dielectric constant is in the range of the best available materials.

ZERO MOISTURE ABSORPTION
In continuous tests, Kel-F exhibited zero water absorption. It is not wet by water . . . is unaffected by high humidity or tropical exposure.

WIDE TEMPERATURE RANGE
Kel-F performs satisfactorily over a temperature range of 710 fahrenheit degrees — from a low of —320° F (liquid nitrogen) to a high of 390° F.

MECHANICAL STRENGTH
Kel-F has high tensile strength on the order of 6000 psi at 77° F . . . excellent impact strength and abrasion resistance.

SUPERIOR MEMORY
Kel-F exhibits "cold-flow" characteristics superior to any other commercial fluoro-carbon. While it deforms slightly under pressure, it returns to original shape when pressure is released.

MOLDABILITY — MACHINABILITY
Kel-F is molded by all standard methods — compression, transfer, injection and extrusion. It is readily punched, drilled or otherwise machined to close tolerances.

WIDE VARIETY IN FORM
Kel-F is available in film, sheet, rod and tubes from recognized molders. As a dispersion for spray or dip application and in forms of oils, greases and waxes it is available direct from Kellogg.

PURCHASE KEL-F in any desired form — Products

FABRICATED PRODUCTS
- Gaskets
- Washers
- "O" Rings
- "U" Packing
- Valve Discs
- Valve Seats
- Valve Diaphragms
- Pump Diaphragms
- Resilient-Core "O" Rings
- Drum and Tank Liners
- Flexible Non-Corrosive Containers
- Machined Fittings
- Coated Wire
- Coated Hook-up Wire
- Coil Forms
- Transformer Terminals
- Multi-lead Terminals
- Rotary Switches
- Tube Socket Bases
- Aerial Supports
- Resistor Sleeves

FABRICATED MATERIALS

Molded Sheets
Thickness — 1/64" to 1/2"
Diameter — in disc form to 45"

Extruded Rod
Diameter — up to 1"
Length — to specification

Molded Rod
Diameter — up to 4"
Length — to 12"

Extruded Tubing
Diameter — up to 2"
Wall thickness — to specification
Length — to specification

Extruded Strip
Thickness — .010" to .125"
Width — 2" to 4"
Length — to specification

Thin Film
(EXTRUDED AS LAY-FLAT TUBING)
Thickness — .002" to .010"
Width — lay-flat up to 20" (total width to 40")

List of the molders, extruders, fabricators and coaters furnishing the above listed items available on request.

THE ONLY COMMERCIAL FLUORO-CHLORO-CARBON THERMOPLASTIC

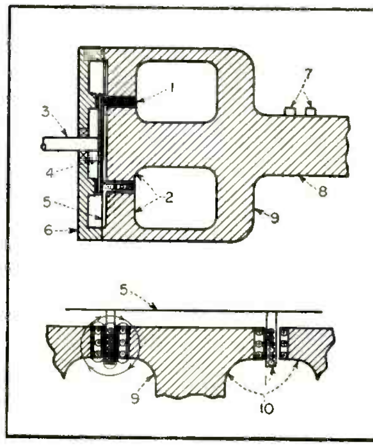


FIG. 1—Cross-sectional view of loudspeaker type clutch showing (1) actuating coil, (2) magnetic poles, (3) output shaft, (4) output disk, (5) flexible diaphragm, (6) backing disk, (7) slip rings for actuating current, (8) input shaft, (9) magnetic structure, (10) compensating coils. Lower diagram shows placement and action of compensating coils

negligible by the use of bucking or compensating coils, that have current flow in the opposite direction to that of the actuating coil. In the test model, the 1-kc inductance of the actuating coil was reduced from 2.4 mh to 0.15 mh.

In the experimental model, having an output torque of 10 ounce-inches, an electromagnet was used to provide the field. A permanent magnet could have been used, but the electromagnet allows shutting the field off to remove any magnetic particles that may have become attached to the pole pieces. The actuating assembly is mounted in the input member, and two sets of slip-rings carry the field and actuating currents to the rotating assembly. A thin flexible diaphragm attached to the actuating coil presses against the output disk when the coil is energized, holding the disk firmly against the backing disk.

An ordinary crystal phonograph pickup and an oscilloscope were used to test response time. The phonograph needle, resting in a small depression on the output shaft, gave an indication when motion started. Connecting the oscilloscope to the actuating switch and the phonograph pickup permitted observation of the time lapse between application of power and the

All Moloney HiperCore Electronic Cores, including over 1000 standard sizes, are manufactured under rigid quality controls. Electronic manufacturers will find this to be of great importance when performance specifications demand tranformer cores that have lower losses and greater flux carrying capacity. HiperCore Electronic Cores test well within industry standards. Typical test requirements for various types are listed in the panel at right. Special tests for specific operating conditions are also made when required. If your product demands better performance, smaller size and less weight, we can help you.

A booklet containing performance characteristics, sizes and weights, along with price information is available upon request. Write for it today.

ME53-2

STANDARD TESTS

All 12 mil cores are tested for core loss (true watts) and exciting volt-amperes (apparent watts) at 60 cycles. 4 mil cores are tested at 400 cycles. Following table gives maximum test values. Average values are approximately 20% less than maximum.

	12 Mil — 60 Cycle @ 15000 gauss	4 Mil — 400 Cycle @ 10000 gauss
Core Loss (TW)	0.95 x lbs.	3.75 x lbs.
Exciting Volt-Amps (AW)	1.85 x lbs. + 6.25A*	4.6 x lbs. + 16.6A*

* A = Gross Area of core face in Sq. In.

All 2 mil cores are tested for pulse permeability by using a 2 microsecond pulse width at 400 P. P. S. and maximum net flux density of 10000 gauss. The minimum permeability will be 550.

All 1 mil cores are tested for pulse permeability by using a 0.50 microsecond pulse width at 1000 P. P. S. and maximum net flux density of 3000 gauss. The minimum permeability will be 350.

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 start of motion in the output shaft.

Using 300 volts on both the field and actuating coils, the output shaft began to move within 200 microseconds and attained full speed in 300 microseconds. Using 100 volts on the field and 215 volts on the actuating coil, the time delays were 500 and 625 microseconds. The actuation voltages are required only momentarily and must be reduced promptly when the clutch reaches operating speed to avoid overheating and burnout.

When measuring response time, the effect of the compensating coils was also investigated. With the coil connections reversed so that the compensating coils aided rather than bucked the actuating coils, response time was increased to 900 microseconds. This indicates that the response time with the coils connected properly is limited by mechanical rather than electrical factors.

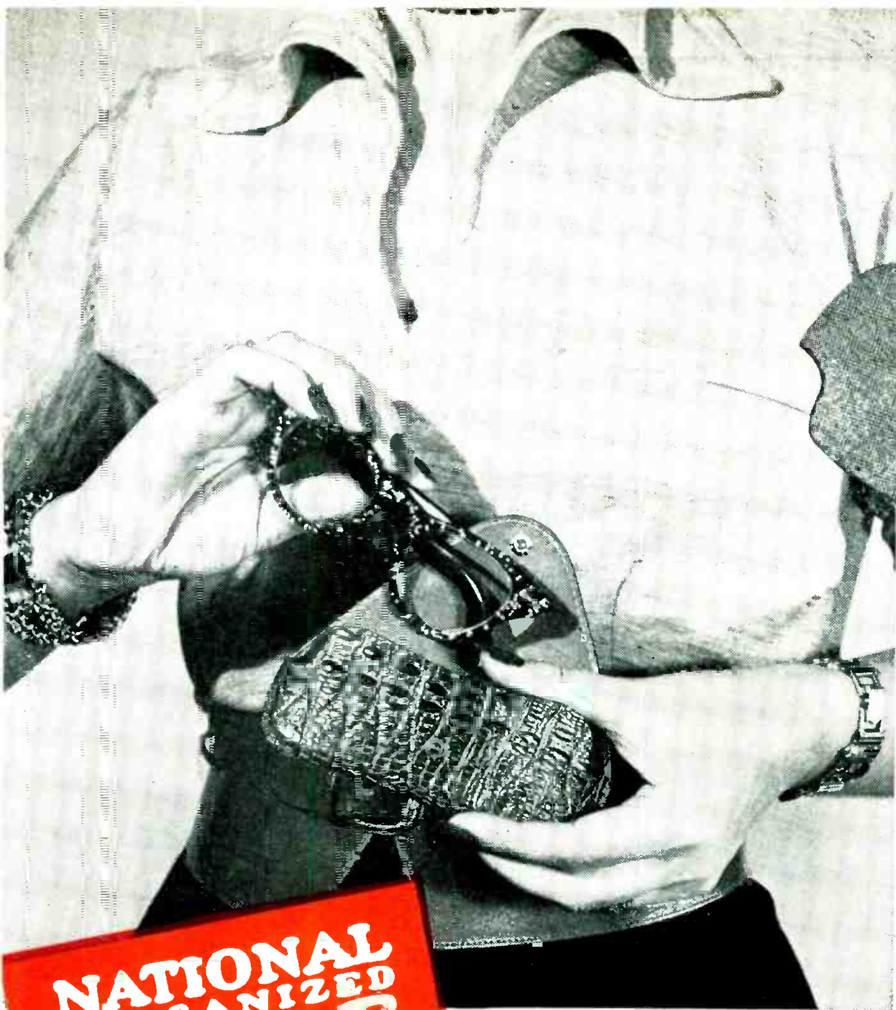
Deposited-Film G-M Counter Tubes

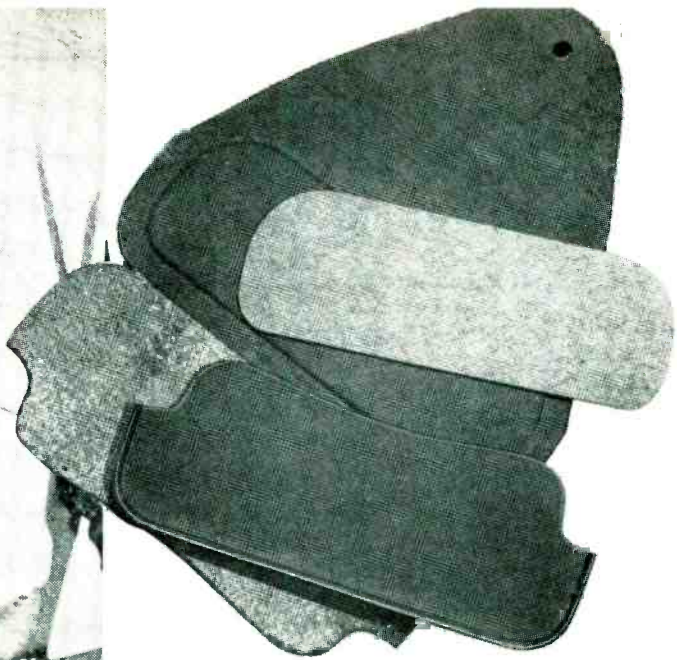
A NEW method for depositing a transparent, nonmetallic conducting film of constant thickness on the inside of a glass tube was announced recently by the Naval Research Laboratory, Washington, D. C. The new method has been used mainly, so far, for the production of halogen-quenched G-M counter tubes for laboratory research.

In the process, a nonmetallic film is deposited by condensation of a vapor on the inside of an electrically heated Pyrex glass envelope. A thin platinum-iridium wire is used for the anode, the tube is sealed off and mounted for a plug-in connection.

Various thicknesses of films have been deposited in this manner in areas up to 18 square inches. Although the films are actually colorless, they appear colored due to their light reflection-interference patterns.

The G-M tubes made by this process are nonsensitive to light, have an almost indefinite operating life, have uniform sensitivity response throughout their length and require no critical materials such as copper or stainless steel.





Punched and formed pieces of tough, resilient National Vulcanized Fibre reinforce spectacle case to provide lasting shape retention and serviceability.

NATIONAL VULCANIZED FIBRE

contributes to an improved product—

in spectacle cases for American Optical COMPANY

National Laminated Plastics nationally known—nationally accepted

This practical use of National Vulcanized Fibre by American Optical Company in their attractive spectacle cases is typical of the countless contributions National Vulcanized Fibre—*the material of a million uses*—makes to industry and business.

National Vulcanized Fibre applications, both mechanical and electrical, are varied and extensive. In mechanical applications it is desirable because it possesses exceptional tensile and crushing strength, toughness, density and resistance to wear—coupled with ease of fabrication. It actually improves with age; for many mechanical purposes it is better, more durable than metal.

In the electrical field National Vulcanized Fibre has been the standard insulation for years. It has high dielectric strength and, when subjected to hot electrical arcing, it evolves neutral gas which extinguishes arc without "tracking." Many electric appliances find National Vulcanized Fibre to be the *one best material* for one or more of their parts.

Available in various grades and colors; and in sheets, rods, tubes and special shapes. Write for detailed literature and engineering service information—

NATIONAL VULCANIZED FIBRE CO.

Wilmington Delaware

Offices in Principal Cities

Since 1873

Production Techniques

Edited by JOHN MARKUS

OTHER DEPARTMENTS featured in this issue:

Model of Television Plant Facilitates Rearrangement of Production Lines

A COMPLETE and accurate scale model showing locations of all partitions, shelves, benches, conveyors and offices in the 200,000-square-foot plant of Olympic Radio & Television was built for a total cost of only $100 and paid for itself in the first month of use. Light-weight steel angle iron was bolted together to represent the framework of the building. On one side the angle iron was partly cut out to permit sliding out the sheet of plywood used for each floor.

Floor plan blueprints, drawn to a scale of ⅛ inch to the foot, are cemented directly onto the plywood and serve as guides for showing positions of permanent columns or partitions when rearranging a floor.

In the drawers of the table that supports the model are sets of wood blocks representing movable equipment and Lucite sheets representing partitions. Blocks representing shelves are painted yellow; blocks for benches are green; blocks for conveyor runs are red.

When the need for this model first arose, the price quoted for its construction by an outside firm specializing in such work was $3,000. Instead of accepting this bid, an alert young man in the plant was assigned to the job full time for a week to see what he could do. The results were entirely satisfactory.

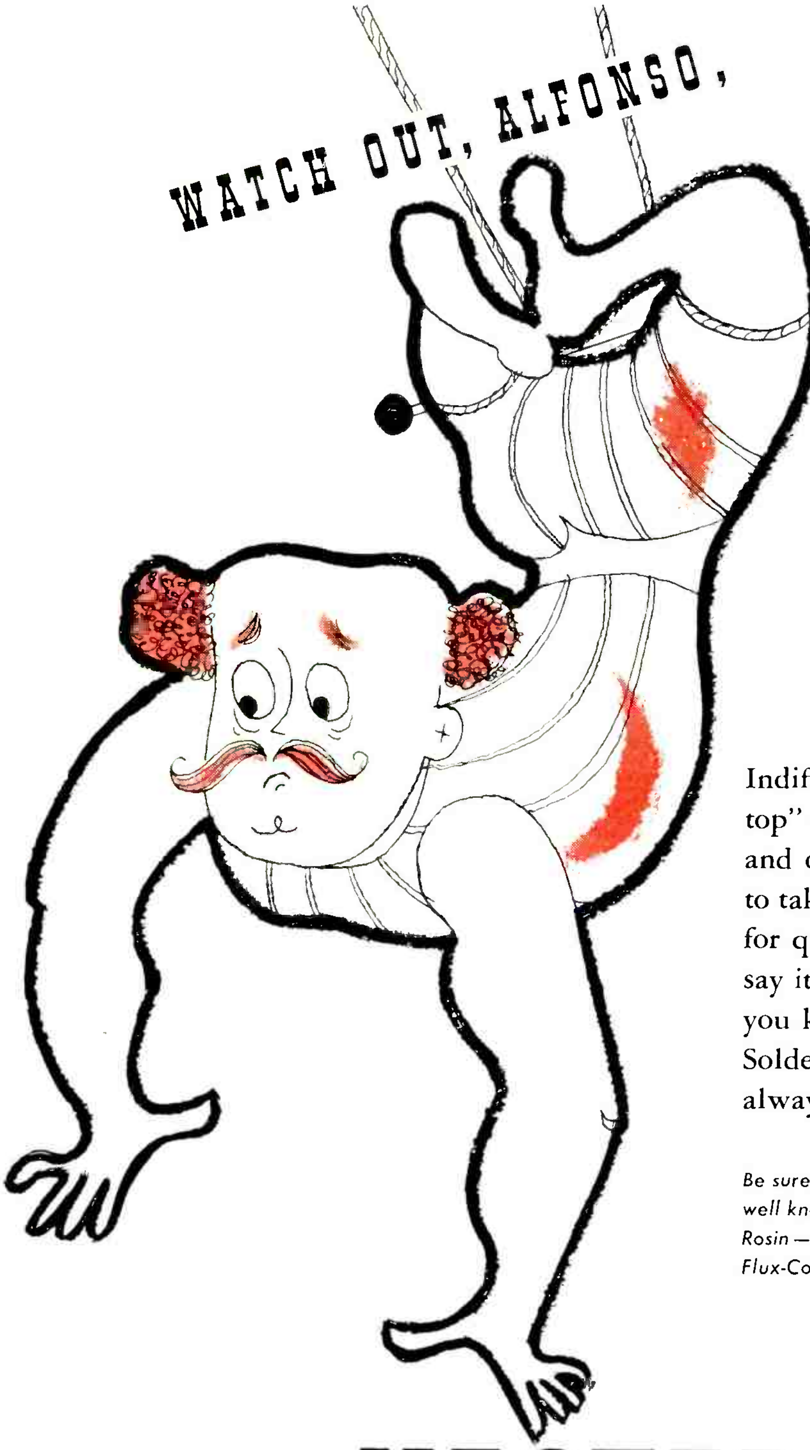
B. Bordiga, director of manufacturing at Olympic, tries out an idea for rearranging benches on second floor of his plant simply by sliding out plywood floor of model and shifting accurately scaled wood blocks. When the best setup for a new production problem is found, a draftsman is called in to take measurements and notes from which new floor plans can be drawn

Turntable for Pass-Along Assembly Line

THE PROBLEM of getting a television chassis around the bend of a U-shaped pass-along assembly line was solved in Olympic's plant with a free-spinning five-foot-diameter disc of one-inch plywood. When a chassis reaches the last position on one side of the long bench, the operator lifts it onto the plywood turntable. Here there are permanently mounted cleats and supports to hold each chassis, spaced equidistant to give six positions on the turntable.

Depending on the needs of the line, one or more workers are stationed around the turntable to perform assembly or inspection operations while the sets are going around the bend. One of the workers advances the turntable each time another chassis comes to it. On the other side of the bench, the first operator takes each chassis in turn off the turntable and starts it on its ride down the rails on

WATCH OUT, ALFONSO, ONE TUMBLE'S ALL IT TAKES...



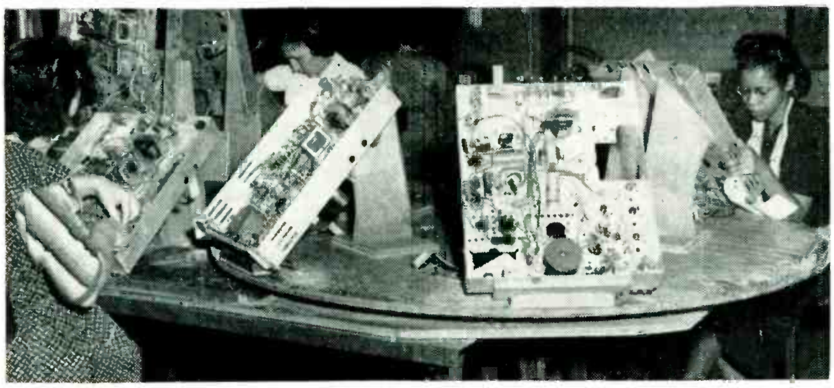
Indifference—whether it's under the "big top" or on the production line—is inexcusable and often fatal. You simply can't afford to take chances with a hard won reputation for quality performance. That's why we say it's a pretty good rule to stick to a solder you know and trust . . . time-proved Kester 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



Turntable on pass-along assembly line for television receivers

that side of the bench.

No pallets are used on the benches; instead, the chassis slides on two wood rails, one low on the bench near the front edge and the other high enough to support the chassis at the desired working angle. A plywood strip is clamped to the bottom edge of the chassis with bolts and wingnuts to serve as a sled runner that rides in the lowest rail, thereby protecting the antenna terminal strip and other chassis parts.

Cutting Resistor Leads

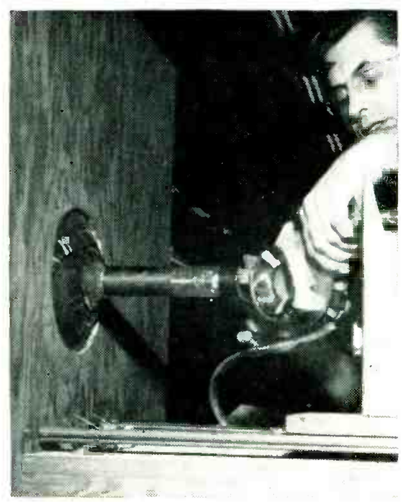
AN ORDINARY large hand-operated paper cutter is used at Olympic Radio & Television Inc. for cutting leads of resistors that come packaged in flat strips of corrugated cardboard. A group of a dozen or more resistors can thus be taken out of its shipping carton, placed on the cutting table and pushed against an adjustable stop. All leads on one side are cut to a desired shorter length in one downward movement of the cutting blade. The group of resistors is then turned over for cutting leads at the other ends.

In another manufacturers' plant, this same guillotine cutting action is used in an air-actuated two-blade automatic setup that cuts both leads simultaneously of each resistor in a flat-packaged group.

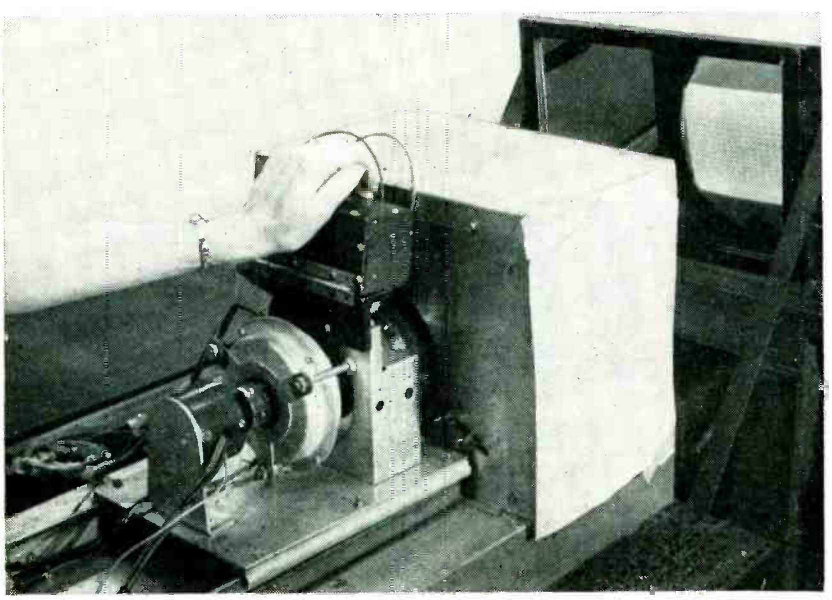
Defect-Indicating Diagrams for Deflection Yoke Test Set

IN THE FINAL performance of deflection yoke assemblies for Crosley television receivers, the picture-tube presentation associated with each type of yoke defect is shown on a chart attached to the side of the test set. When a defective yoke is encountered, the operator merely jots down the number of the observed diagram on the reject card. From this, troubleshooters can probe for the defect and clear it without need for further measurements.

The test set uses a 12-inch round picture tube of a type that does not require an ion trap. The tube is mounted rigidly in a protective metal box, with the neck projecting out the rear. Under the neck is a metal platform running on ball-bearing rails, on which are mounted the picture tube socket, focus coil and safety switch. This platform is pulled back on its rails so that a tested deflection yoke can be removed and the next one slipped onto the neck of the tube.



Placing 90-degree yoke over neck of 30-inch picture tube in DuMont test set



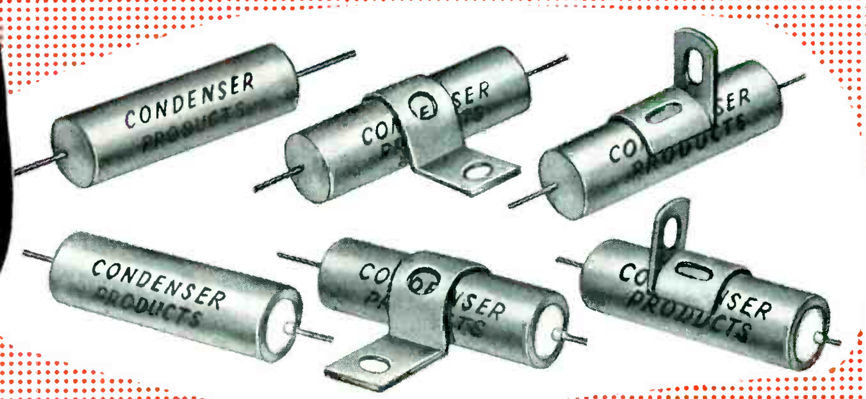
Crosley-developed test set for deflection yokes, with slant-line pattern for good yoke showing in mirror at upper right. Operator must press down cover of switch against spring action as shown in order to apply power for test

Test signals are obtained from a Raytheon-Belmont vertical and horizontal sync pulse generator, now manufactured by Supreme, Inc. A 630-kc oscillator generates dots, which appear on the screen as short slanting lines due to inten-

PLASTICON TYPE "M"*

Miniature Metal Tubular CAPACITORS utilizing the NEW Mylar Film**

*PLASTICONS ...the original type "M" capacitors (Mylar** Dielectric)*



Miniature Type M Capacitors

Part Number	Voltage	Capacitance	D	L
CM 102-4CA	400	.001	.235	11/16
CM 152-4CA	400	.0015	.235	11/16
CM 222-4CA	400	.0022	.235	11/16
CM 332-4CA	400	.0033	.235	11/16
CM 472-4CA	400	.0047	.235	11/16
CM 682-4CA	400	.0068	.235	11/16
CM 103-4CA	400	.01	.235	11/16
CM 153-4CA	400	.015	.312	13/16
CM 223-4CA	400	.022	.312	13/16
CM 333-4CA	400	.033	.312	13/16
CM 473-4CA	400	.047	.400	13/16
CM 683-4CA	400	.068	.400	1-1/16
CM 104-4CA	400	0.1	.400	1-5/16
CM 154-4CA	400	0.15	.562	1-1/16
CM 224-4CA	400	0.22	.562	1-5/16
CM 334-4CA	400	0.33	.562	1-13/16
CM 474-4CA	400	0.47	.670	1-13/16
CM 684-4CA	400	0.68	.750	2-1/16
CM 105-4CA	400	1.0	.750	2-7/16

Also available in 100, 400, 600 and 1000 volt ranges

The pioneer in the newest of synthetic materials for capacitor development provides another "first" with "M" film.

Plasticon Type "M" Capacitors are offered where high resistance, high temperature (−40° to +125°C), smaller size and lighter weight are required.

Plasticon Type "M" Capacitors are available with either or both ends insulated and with any selection of brackets.

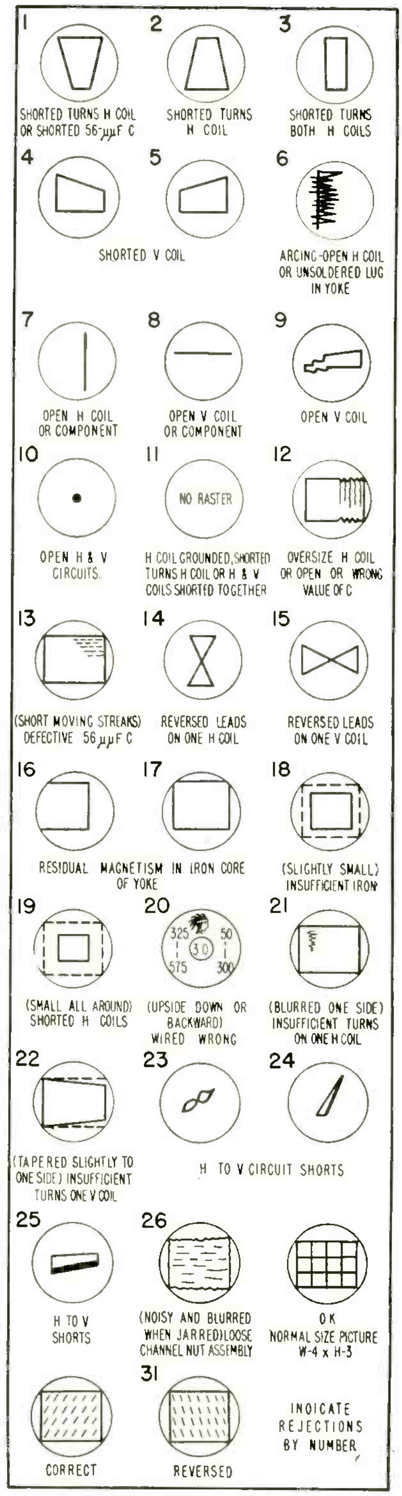
Engineered to your exact specifications.

MANUFACTURERS
Glassmike Capacitors
Plasticon Capacitors
HiVolt Power Supplies
Pulse Forming Networks

Condenser Products Company
Division of New Haven Clock & Watch Company

7517 North Clark Street • Chicago 26, Illinois

*For overall performance, PLASTICONS are incomparable. **Du Pont trade mark



Deflection yoke reject chart

tional misalignment of the test set. The direction in which the dots slant then indicates whether deflection yoke leads are correct or reversed.

A somewhat similar sliding platform is used for the same purpose in Final Test at the East Paterson, N. J. plant of Allen B. DuMont Labs. Inc. to test 90-degree yokes

There are hundreds of jobs open to engineers today!

but few opportunities like these

Westinghouse is in nuclear power to stay. We believe in the development of atomic energy as man's next great source of power. If you want to get in on a new era in industry, we want to talk to you.

Atomic power opportunities are waiting for electronic engineers with 4 to 10 years of this kind of experience...

ELECTRONIC COMPUTERS, employing pulse amplifying wide range linear amplifying and rate circuits.

NULL BALANCE DEVICES, employing both vacuum tube and magnetic amplifiers, SERVOMECHANISMS, PLANT CONTROL SYSTEMS.

LIAISON with customers, contractors, designers of component equipment.

SUPERVISION of drafting work.

REMEMBER! We are primarily interested in good *experienced* application and development engineers—lack of previous reactor development experience *is no handicap in this type of work.*

HOW TO APPLY! What Westinghouse wants to know is: Where and when you obtained your degree . . . how you did in school . . . where you have worked at your profession . . . what kind of work you have done.

In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

You will be in communication with men who are experienced in keeping secrets. All negotiations will be discreet, and your reply will be kept strictly confidential.

Address your application letter to: Manager, Industrial Relations Department, Westinghouse Electric Corporation, P. O. Box 1468, Pittsburgh 30, Pennsylvania.

What do you want?

MONEY? Good jobs are open here now—waiting for good men who want to make a permanent connection.

A PERMANENT JOB? Many of the engineers who joined Westinghouse 20 and 25 years ago are still with Westinghouse—and in key positions—and engineers who join us now will have the opportunity to make this work their lifetime careers. When many other industries may be going through slack times, atomic energy will still be in a stage of expansion.

SUBURBAN LIVING? It's here—within easy driving distance of your work. Within a few minutes of shopping centers . . . schools . . . metropolitan centers.

JOB EXTRAS? Westinghouse offers: Low cost life, sickness and accident insurance with hospital and surgical benefits. A *modern* pension plan. Westinghouse stock at favorable prices. Westinghouse appliances for your home at discount.

YOUR KIND OF ASSOCIATES? Every fourth person in the Division is an engineer or scientist. More than half the top Westinghouse executives are engineers.

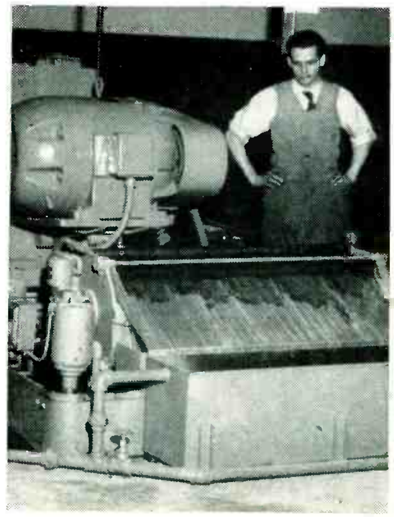
FASCINATING WORK? What other branch of science offers such exciting challenges? So many opportunities for discovery? So many chances to benefit mankind? So many opportunities for original work?

GROWTH OPPORTUNITIES? Never again in your lifetime will you be able to get into such a sure-to-expand industry so early in its development.

YOU CAN BE SURE.. IF IT'S Westinghouse

for 30-inch picture tubes. Here the actual 30-inch tube is used in the test set. Connections to the yoke terminals are made with a plastic cable clamp.

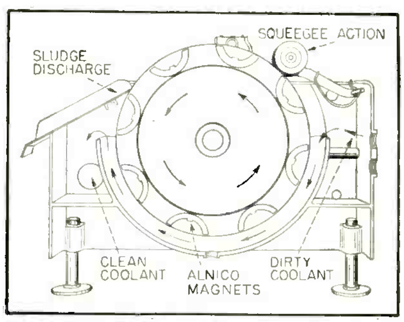
Magnetic Separator Recovers Alnico from Grinder



Alnico particles slide down metal incline to bin in foreground after being scraped off drum of magnetic separator, here installed on Besly No. 226 double-end grinder

VALUABLE particles of Alnico V are recovered and recast into magnets in the Peterboro, Ontario plant of General Electric Co., Ltd. by a magnetic automatic coolant separator made by Barnes Drill Co., Rockford, Ill. The separator is installed on a grinder that automatically trims Alnico castings to final size. The grinder is arranged to compensate for abrasive wear. Three pumps, each delivering 30 gallons per minute, bring the Alnico-bearing coolant water to the separator for recovery.

The separator itself uses Alnico magnets. These hold the desired



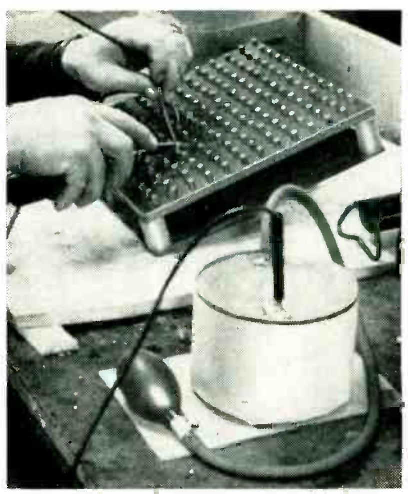
Cross-section of separator, showing how U-shaped Alnico magnets are mounted inside drum

metal particles against a rotating drum while the waste water flows over the drum, until particles are removed by a scraper blade for salvage. The cleaning action of the separator permits immediate reuse of the coolant, with further saving in operating cost.

Water Cooling for Resistance Soldering Tool

A BATTERY CLIP serves as a simple and convenient valve for a small rubber hose used for cooling metal cable plugs after they have been heated for soldering. The rubber hose is taped to the resistance soldering tool used for this operation, with the battery clip conveniently positioned under the normal position for the operator's thumb. After making a joint, the operator squeezes the clip to spread its jaws and allow water to flow. The hose is so positioned that the stream hits the plug automatically, cooling it sufficiently so the operator can remove her hand from the soldered wire without waiting for the solder to cool.

Water pressure for the operation is obtained with an ingenious combination of an empty coffee can and a blood pressure valve with rubber bulb. The bulb and valve are used to produce air pressure in the can,



Improvised water cooling system using one-pound coffee can in foreground as reservoir. Water hose goes to resistance soldering tool in operator's right hand. Jig for supporting the plugs during soldering is made from heat-resisting material and has drilled holes to take 168 plugs at a time. Surplus water runs down angle-mounted jig onto rubber-sponge mat on bench

Want more information? Use post card on last page.

so as to force out water when the battery-clip valve on the soldering tool is open.

Tubulations are soldered to the cover for the air and water hose lines. The cover is sweat-soldered to the can. Filling with water, required only about three times a day during continuous production, is done through a threaded plug in the bottom of the can.

When water pressure gets so low that the stream no longer hits the hot plug, the operator merely reaches over and gives the rubber bulb a few squeezes to build up pressure again. The technique was developed in the East Newark, N. J. plant of Utility Electronics.

Reject-Identifying Board

As a guide for sorting defective television receiver coils and transformers for return to vendors, a sample board containing one of each type and make of coil is maintained in Olympic's Long Island City plant. The products of twelve different vendors are represented. Coils are grouped by function and identified by number.

As an example, ten different units differing in only minor details are wired to the board over the heading

Using coil sample board to identify a defective unit. Vendors are identified on board by code letters, generally the first letter in the company name. Loops of wire pass through holes in board to hold each sample in position

"Pix I-F Coil"; here it is often necessary to compare an unknown coil carefully with each one on the board in turn to determine its manufacturer. This detailed comparison is only required a few times a day, as rejected coils usually come through in batches all from one vendor.

Spring Scale Checks Slip

INSPECTION of cavities for RCA pencil triodes involves checking the force required to move the plunger in the cavity. To check this in the Harrison, N. J. tube plant of the manufacturer, an ordinary spring scale is mounted upside down on a rack and gear arrangement operated by a hand wheel.

The operator places a finished cavity on the anvil, then turns the hand wheel to lower a cylinder which is mounted on a rod that goes inside the scale to its weighing point. With the left hand re-

Upside-down scale operated by rack and gear measures downward testing pressure being applied to plunger in pencil triode cavity. New printed numbers have been placed on scale so operator does not have to read upside-down values


LAPP GAS-FILLED CONDENSERS
For duty at high voltage and high current, Lapp Gas-filled Condensers offer the advantages of extreme compactness . . . low loss . . . high safety factors . . . puncture-proof design . . . constant capacitance under temperature variation . . . grounded tuning shaft . . . complete reliability—electrically and mechanically. Models for capacitances up to 60,000 mmf; current ratings to 525 amps at 1 mc; voltages to 100 kv peak.
Write for description and specifications. Radio Specialties Division, Lapp Insulator Co., Inc., Le Roy, N. Y.
Lapp

maining on the cavity in order to feel for any slip, the operator turns the wheel to apply pressure while watching the pointer on the scale. Loose plungers are set aside for repair or replacement.

Tube Aging and Testing Techniques

PRODUCTION of miniature and subminiature tubes is expedited through use of a large variety of test sets and aging racks in Sylvania's Emporium plant. Most of these are applied 100 percent to the entire production to meet the requirements for premium tubes.

Tubes are aged on vertically mounted sliding drawers each having 100 sockets. Plugs at the rear of each drawer mate automatically with jacks at the rear of the rack when the drawer is pushed in, to apply the required voltages for aging. Miniature tubes plug directly into the sockets. Subminiatures are mounted in octal adapters that in turn plug into drawers having octal sockets.

The pull-out drawers are supported by roller suspensions at the top. Power supplies are below the drawers, in sections having a similar pull-out construction.

At the front of each drawer are two lamps with jewels. One indicates application of normal d-c plate voltage, and the other indicates a

Pull-out drawers for aging tubes. Each drawer has 100 sockets. Operator is here loading one with type 6095's, which are the ruggedized equivalents of 6AQ5 pentodes

At last! A tubing that's TAILOR-MADE FOR TV ANTENNAE

REYNOLDS ALUMINUM ANTENNA TUBING

HIGH STRENGTH ALUMINUM ALLOY CORE FOR *INCREASED DURABILITY*

HIGH PURITY ALUMINUM *RESISTS CORROSION . . . GIVES BRIGHTER FINISH*

Diligent research by the industry's electronics engineers have brought forth wonderful improvements in today's television receivers . . . and antenna designs that insure better performance. Now, Reynolds—pioneer producer of antenna tubing—offers a vastly superior *aluminum antenna tubing* to help *you* produce a superior antenna! The new Reynolds Aluminum Antenna Tubing is precision roll-formed . . . tailor-made for TV antenna manufacturers. It is extra-sturdy, lightweight, and its gleaming, corrosion-resistant finish *invites* sales.

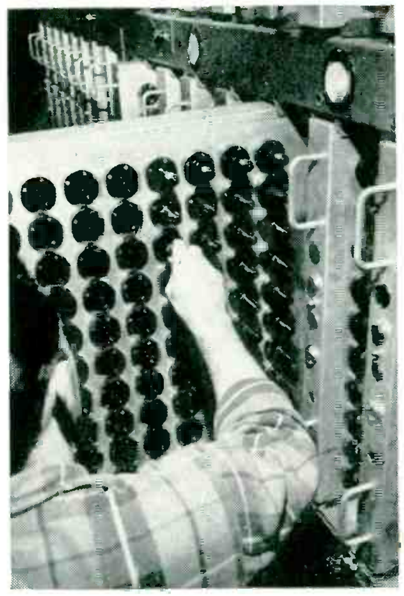
Reynolds Antenna Tubing 31—a maximum strength tubing; and Reynolds Antenna Tubing 41—designed with ample strength for most demands. Available in either butt seam or lock seam tubing, Reynolds Aluminum Antenna Tubing is offered in a complete range of sizes and in lengths to meet your specifications. For additional information and sample sections, call your nearest Reynolds Sales Office listed under "Aluminum" in the classified telephone directory.

INCREASE YOUR CAPACITY AND YOUR PROFITS . . . USE

REYNOLDS ALUMINUM FABRICATING SERVICE

REYNOLDS METALS COMPANY • 2000 SOUTH NINTH STREET • LOUISVILLE 1, KENTUCKY

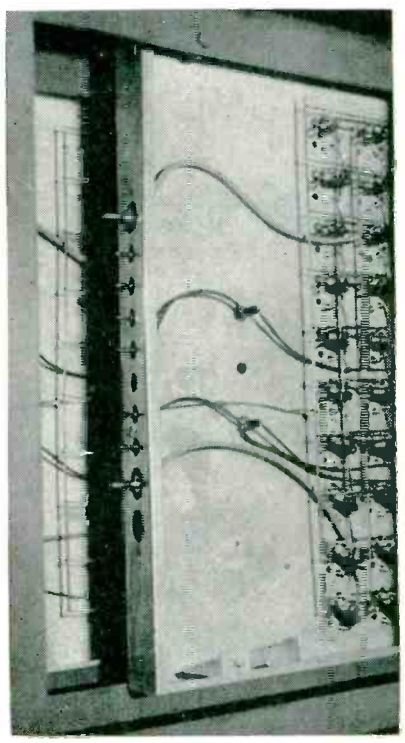
Want more information? Use post card on last page.



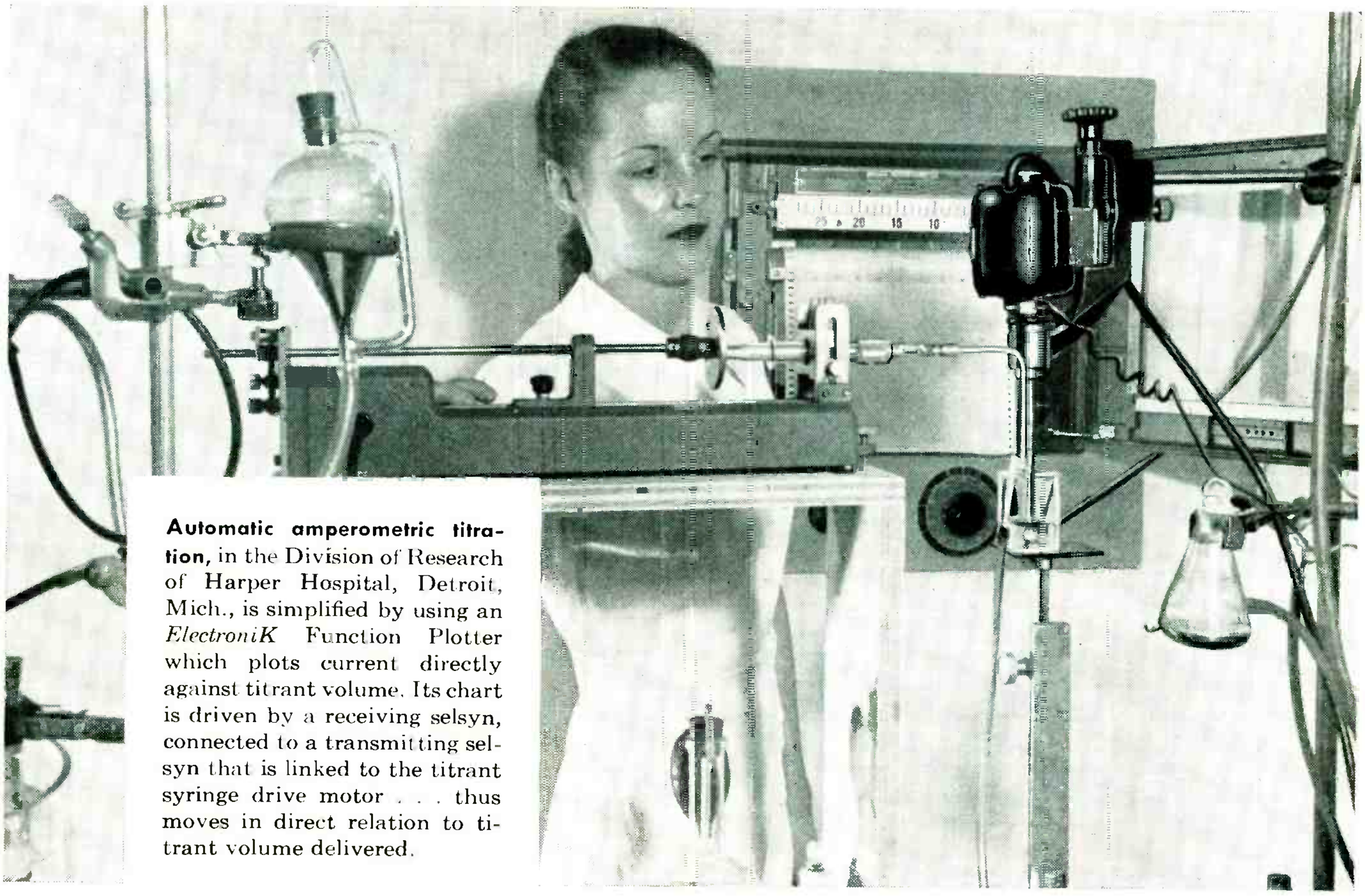
Drawer for octal sockets, used with octal adapters for subminiature tubes

heater-cathode short in one of the tubes. In the event of a short, which is rare, the tubes must be pulled out one by one while power is being applied, until the shorted tube is removed. The bad tube is indicated by darkening of the short-indicating lamp.

High-temperature life runs of subminiature tubes are carried out



Rear view of slide-out aging drawer, showing jacks that make connections to mating jacks at rear of rack. Supporting rollers are at top of drawer and locking latch is at bottom



Automatic amperometric titration, in the Division of Research of Harper Hospital, Detroit, Mich., is simplified by using an *ElectroniK* Function Plotter which plots current directly against titrant volume. Its chart is driven by a receiving selsyn, connected to a transmitting selsyn that is linked to the titrant syringe drive motor . . . thus moves in direct relation to titrant volume delivered.

Speed your data recording with these *ElectroniK* instruments

For recording y = f (x)—the Function Plotter. One of the best time-savers for any laboratory, this instrument automatically records a continuous curve such as stress vs. strain, speed vs. torque, temperature vs. pressure. It eliminates hours of hand logging and point-by-point plotting. It has two independent measuring systems; one moves the pen, the other moves the chart. Optional selsyn drive for the chart can also be supplied. Either can measure any variable that can be converted to a d-c signal. The chart moves 11 inches, at only 4 seconds for full travel. Pen movement is 11 inches; pen traverse time 2 seconds.

For recording two variables—the Duplex Recorder. This two-in-one instrument combines continuous records of any two independent variables on a single chart . . . where they can be conveniently compared without tedious cross-reference. Each of the two recording pens has its own independent "Continuous Balance" measuring system. Each pen can traverse the full 11 inches of chart width. Different calibrations can be supplied for each pen.

Your local Honeywell engineering representative will be glad to discuss ways that these instruments can save time in your research work. Call him today . . . he is as near as your phone.

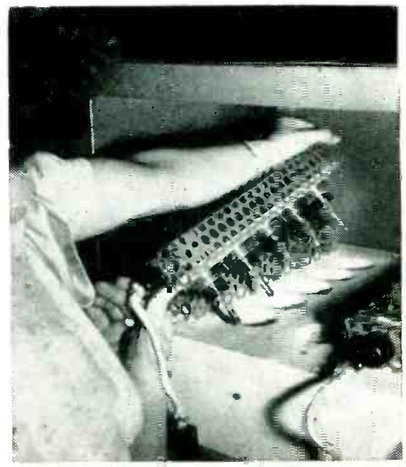
MINNEAPOLIS-HONEYWELL REGULATOR CO.
Industrial Division
4428 Wayne Avenue
Philadelphia 44, Penna.

● **REFERENCE DATA:** Write for Data Sheet No. 10.0-5 on the Function Plotter . . . and Data Sheet No. 10.0-6 on the Duplex Recorder.

H
HONEYWELL

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

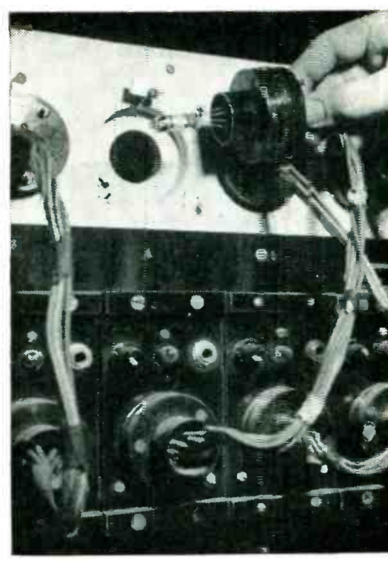
Want more information? Use post card on last page.



Rack for holding five subminiature tubes at a time inside high-temperature oven

with small panels holding five tubes each and with individual single-tube panels that mount over holes in the ceramic lining of an oven. The tubes project inside where they are subjected to a temperature of 175 F for accelerated life runs of 500 hours, 1,000 hours and even up to 5,000 hours in some cases. Normal operating voltages are applied. All important characteristics of each tube are measured every 500 hours or less.

High-temperature tests are conducted on a sampling basis, to show how tubes hold up in equipment that runs at high temperatures. This is important in the special applications for which a large number of these subminia-



Method of supporting subminiature tube in life test oven. Swinging metal tab above hole in oven locks socket in position. Neon lamp on panel below indicates shorts, and jack permits monitoring of tube current at 500-hour intervals during the run

Revlon's Treasurer and General Manager, Joseph Revson, with "Fire and Ice" girl Dorian Leigh

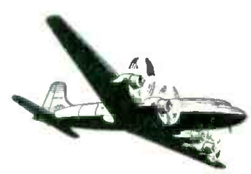
He kept 7,235 dates with this girl!

Five months ago she was just an idea. Today, as the temptress who sells Revlon's new "Fire and Ice" Lipstick and Nail Enamel, she's America's most talked-about glamour girl!

"She created the greatest shipping problem we ever had," says Joseph Revson. "7,235 stores wanted 'Fire and Ice' merchandise and displays — to be delivered *before* the promotion date of November 1.

"There was only one way to keep all those dates! And as heavy re-orders flooded in, we continued to fill them via Air Express. Volume is now the heaviest in our history! In maintaining that momentum—and keeping the good-will of the stores—Air Express service has been invaluable.

"We don't overlook costs, either. Air Express rates are the lowest in the field on practically every shipment we make. With a volume like ours, those savings add up to a very substantial figure!"

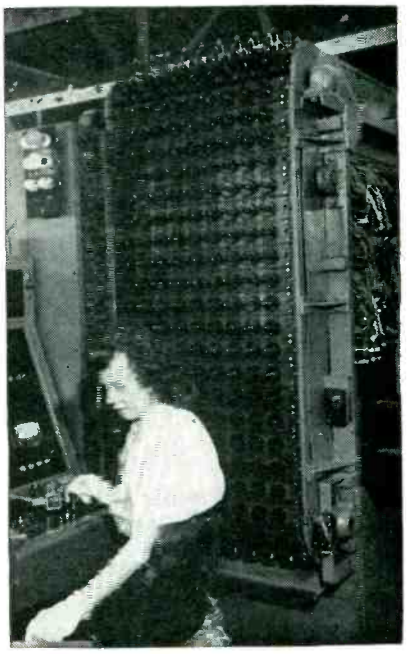


AIR EXPRESS

GETS THERE FIRST

Division of Railway Express Agency

Want more information? Use post card on last page.

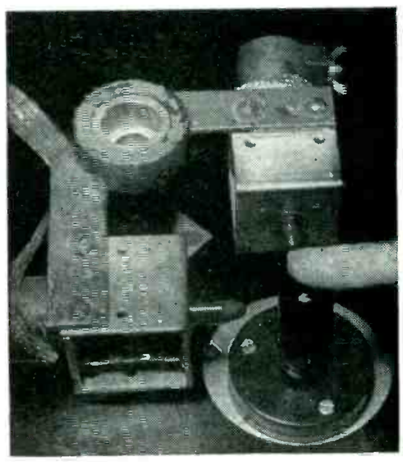


Aging and preheating conveyor used to transport tubes from Sealex machine (off picture at right) to operator at first test position

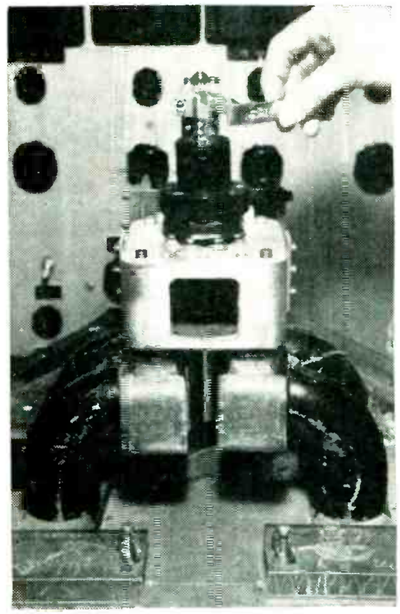
ture tubes are intended. Temperature in the oven is automatically controlled.

Initial aging of all tubes is accomplished automatically by the moving conveyor that transfers tubes from the automatic tube machine to the first test position. This short-period aging also serves to preheat the tubes, thereby speeding up the electrical test.

Each slat on the conveyor contains nine tube sockets, to which the required voltages are fed through a



Closeup view of socket on test set, showing solenoids that drive plungers against tube in sequence when pressure is applied to socket. A snap-action switch, located under the socket, initiates the tapping action

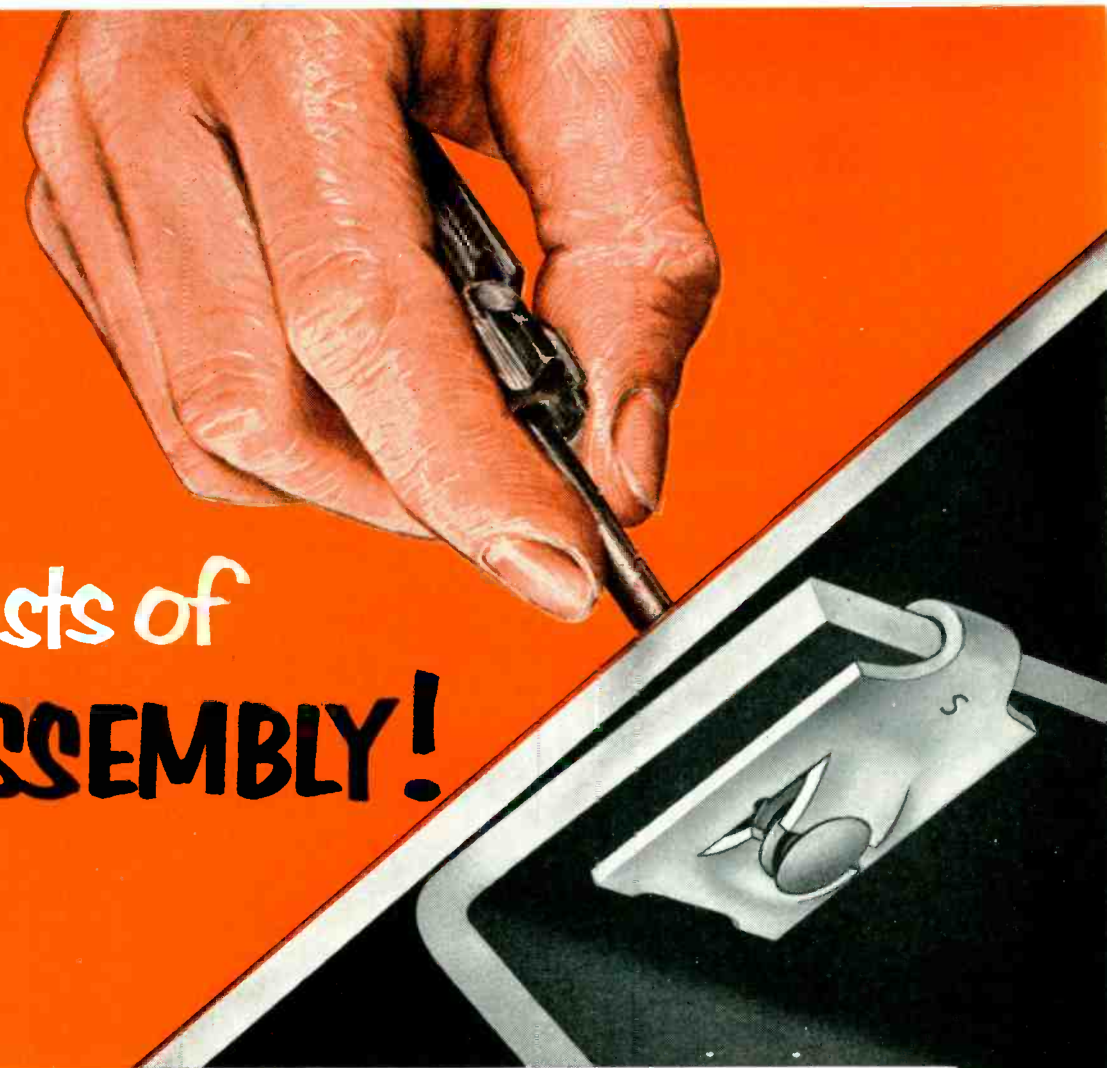


Method of locking subminiature tube in position, and construction details of exciter

system of brushes and wiping contacts. As tubes are taken out of the Sealex machine, they are inserted in sockets on the conveyor for a ride over the top. The tubes come down alongside the operator at the test position, within easy reach for transfer to the socket in front of her.

Insertion of a tube in the test socket automatically energizes two solenoids in sequence to drive fiber rods sharply against the tube from directions 90 degrees apart. This

Vibration test set using magnetron magnets for 100-percent production testing of subminiature tubes



Cut costs of BLIND ASSEMBLY!

SHAKEPROOF® "SPEED NUTS*"

SELF-RETAINING FEATURE ELIMINATES RIVETING, STAKING OR WELDING

They're easy to install without special tools . . . can't clog with paint . . . make screw driving faster . . . lock tight with unique thread gripping action and assure a strong, shock resistant fastening.

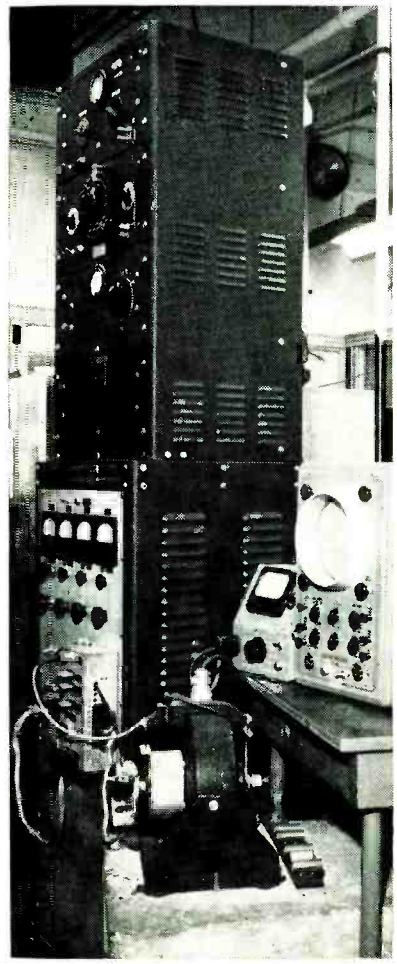
SHAKEPROOF®
"Fastening Headquarters"
DIVISION OF ILLINOIS TOOL WORKS
St. Charles Road, Elgin, Illinois • Offices in principal cities

America's Great Resources Plus A Free Economy Made This Business Possible!

*T.M. Reg. U. S. Pat. Off. by Tinnerman Products, Inc.

FREE...TESTING SAMPLE KIT

. . . contains all three self-retaining types of SHAKEPROOF "SPEED NUTS", "U", "J" and "Latching", in a selection of sizes. Make your own test and prove the savings. Send for your kit today!

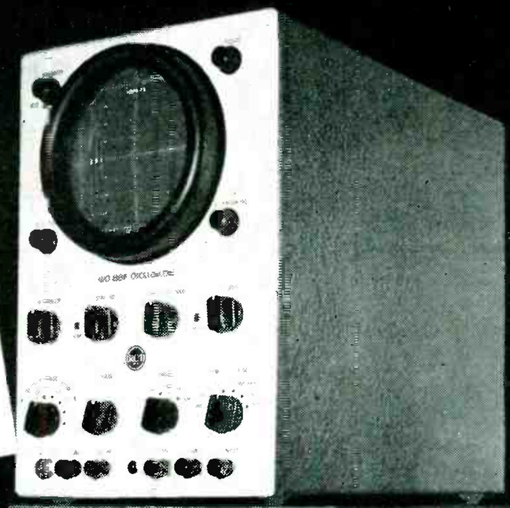


Laboratory-type vibration test setup used for sampling inspection of tubes. Exciter is mounted on concrete block to minimize extraneous vibrations

test reveals loose elements by noise heard from the loudspeaker behind the sloping panel of the test set. Pushbuttons are then operated to make remaining tests in quick succession on tubes that pass the vibration test.

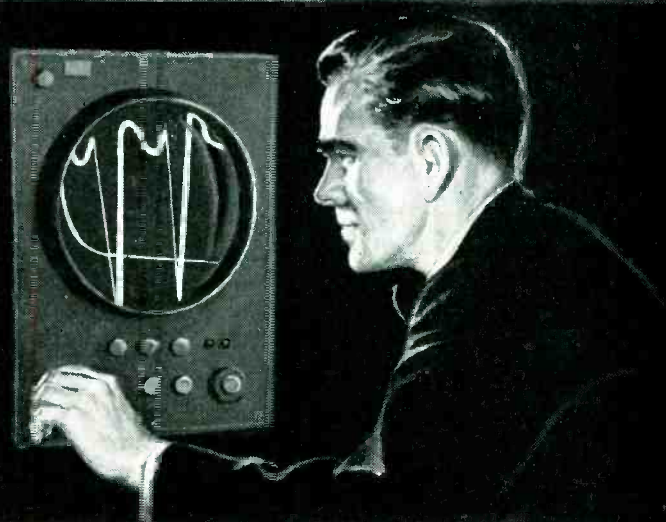
Conveyor speed is governed by the rate at which the operator can remove tubes for tests. If any tubes are left in long enough to reach a wire stretched across the conveyor near the floor, they trigger a snap-action switch that stops the conveyor. Cord sets equipped with Jones plugs are used to change conveyor aging voltages whenever a different type of tube is placed in production.

Premium subminiature tubes are given a 100-percent test for ability to withstand 15g vibration at 40 cycles. The exact magnitude of vibration is calculated from the measured displacement of the tube



5"
RCA WO-88A
159^{50}
Suggested User Price

You can *believe* what you see with an RCA oscilloscope



7"
RCA WO-56A
217^{50}
Suggested User Price

The RCA WO-88A 5-inch and WO-56A 7-inch oscilloscopes have the facilities you need for precise *qualitative analysis* and accurate *quantitative measurements* . . . thanks to advanced engineering design.

For instance, one of the outstanding features of these instruments is their *remarkably true square wave* response . . . obtained by adequate band width, negligible phase shift, fast rise time, frequency-compensated attenuators, and a complete absence of peaking circuits.

Equally important are the peak-to-peak *voltage-measurement features*—obtained through the use of voltage-calibrated attenuators, front-panel calibrating-voltage terminals, calibrated graph screens, and good amplifier linearity.

Other quality features common to both designs include . . . push-pull direct-coupled amplifiers . . . extra fast retrace . . . shielded CRT gun . . . plus and minus sync . . . line-frequency sweep with phasing . . . and a set of matched probes and cables including a high impedance probe having an input resistance of 10 megohms and an input capacitance of less than 10 uuf!

Before selecting a 'scope for your special needs, be sure to get the full details on the WO-88A and WO-56A from your *RCA Test Equipment Distributor* . . . or write RCA, Commercial Engineering, Section 42BX, Harrison, New Jersey.

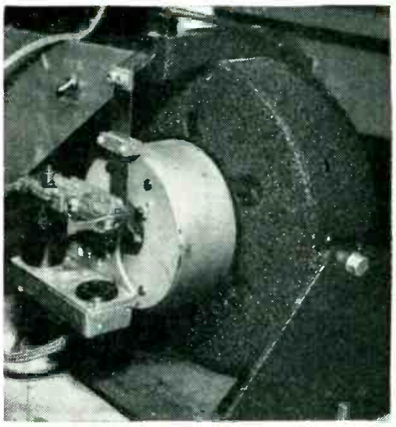
RADIO CORPORATION of AMERICA
TEST EQUIPMENT **HARRISON, N. J.**

Want more information? Use post card on last page.

at the known frequency. The vibrator developed for the purpose utilizes two pairs of large magnetron magnets, with coils surrounding their poles. These coils are energized by a 30-watt audio oscillator and amplifier set.

Rated operating voltages are applied during the test, with a 10,000-ohm resistor in the plate circuit. The a-c voltage drop across this resistor is measured with a vtvm as an indication of the extent to which the tube is reacting to the 40-cycle vibration frequency. At the right of the operator on the vibration test set is a 16-socket rack for preheating the tubes, to speed up the actual test.

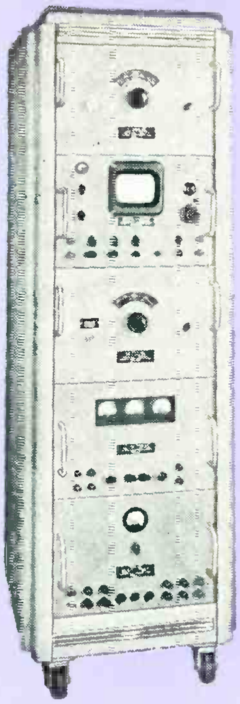
In a more elaborate vibration test



Closeup of electromagnetic-type vibration exciter. Use of two sockets permits vibrating tubes in two planes 90 degrees apart. Direction of motion is in and out of the field coil, just as in a loudspeaker voice coil

set used to measure any change in plate current during either 2.5 g or 15 g under complete normal operating conditions, a standard vibration exciter made by MB Mfg. Co., New Haven, Connecticut, is mounted on a large concrete block. The exciter employs a voice coil and field construction similar to that of an electrodynamic loudspeaker. Direct current for the field coil is obtained from a power supply in an adjacent rack, and variable-frequency audio power for the voice coil is obtained from a Hewlett Packard 202D audio oscillator feeding a 500-watt amplifier. Most tests are conducted at either 25 or 40 cps.

This test setup is used for



All Band, Direct Reading

SPECTRUM ANALYZER

10 MC to 21,000 MC

The Model LSA is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an rf signal.

Outstanding Features:

- Continuous tuning.
- One tuning control.
- 5 KC resolution at all frequencies.
- 250 KC to 25 MC display at all frequencies.
- Tuning dial frequency accuracy 1 percent.
- No Klystron modes to set.
- Broadband attenuators supplied from 1 to 12 KMC.
- Frequency marker for measuring differences 0-25 MC.
- Only four tuning units required to cover entire range.
- Microwave components use latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Model LSA

The instrument consists of the following units:

Model LTU-1 RF Tuning Unit—10 to 1000 MC.

Model LTU-2 RF Tuning Unit—940 to 4500 MC.

Model LTU-3 RF Tuning Unit—4460 to 16,520 MC.

Model LTU-4 RF Tuning Unit—15,000 to 21,000 MC.

Model LDU-1 Spectrum Display Unit.

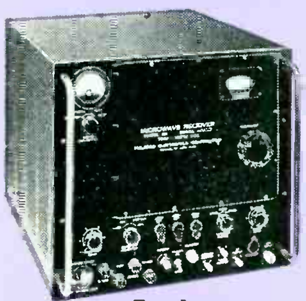
Model LPU-1 Power Unit.

Model LKU-1 Klystron Power Unit.

Polarad PRECISION LABORATORY INSTRUMENTS

MICROWAVE RECEIVERS

1000—10,750 mc



Four microwave receivers of high sensitivity, wide tuning range and selectivity. Image rejection is greater than 60 db. Gain stability better than ±2 db, permits application as a field intensity meter. Extra large dials enable frequency to be clearly read to an accuracy of 2%. Video bandwidth is 3.0 mc. Input power required is 105-125 v, 50/1000 cps.

Features:

- Single Dial Tuning
- Low Noise Figure
- Tracked R. F. Preselection, Triple-Tuned
- Linear Db Output Indication
- AM-FM Reception
- Video Output — 10 v Pulse across 100 ohms
- Audio — BFO
- Recorder Output
- Provisions for Using External Attenuators in I.F. Channel
- Frequency Calibration Accuracy — 2%
- Separate Audio & Video Channels
- AFC
- Calibrated Tuning Meter

WIDE BAND VIDEO AMPLIFIER

Model VT 10 CPS to 20 MC

Designed for use as an oscilloscope deflection amplifier for the measurement and viewing of pulses of short duration and rise time. Excellent for TV, both black and white and color applications.

Model VT

Features:

- Flat frequency response from 10 cps to 20 mc ±1.5 db.
- Uniform time delay of .02 microseconds.
- Gain of 50 db.
- Frequency compensated high impedance attenuator calibrated in 10 db steps from 0-50.
- Fine attenuator covers a 10 db range.
- Phase linear with frequency over entire band.

MICROWAVE SIGNAL SOURCES

Models SSR, SSL, SSS, SSM, SSX
634 MC to 10,750 MC

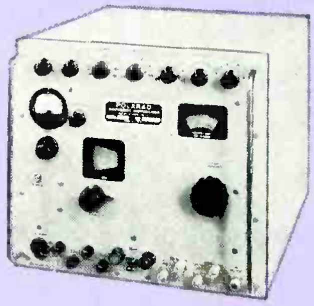
For use as a reliable source of microwave energy in transmission loss measurements, standing wave determination, etc. Unidial Control for accuracy and ease of operation. Direct reading (no mode charts to consult). Frequency determination accurate to 1% through use of present calibration and temperature compensated klystrons.

Five Microwave Signal Sources are available to cover the frequency range from 634 MC to 10,750 MC. Units ruggedly constructed, mounted on aluminum castings to insure mechanical stability. Klystron reflector voltage automatically tracked with tuning of the klystron cavity to provide unidial control. Signal sources supplied complete with klystron.

MICROWAVE SIGNAL GENERATOR

Model MSG-4

7,000 mc — 10,750 mc



Polarad's Microwave Signal Generator, Model MSG-4, is an ideal source of an accurately known signal voltage, precisely modulated. Sensitivity, frequency and performance of radio and radar equipments in the frequency range from 7 to 10.75 kmc can be readily measured on this continuously variable, direct reading signal generator.

Features:

- Continuous tuning
- One tuning control
- Tuning dial accuracy — 1%
- No Klystron modes to set
- Accurate stable power measurement
- Non-contacting shorts guarantee long life
- Modulation — Internal Pulse, FM and external
- Sync output — delayed and undelayed.

Polarad *Electronics Corporation*

100 METROPOLITAN AVE., BROOKLYN 11, N. Y. • STagg 2-3464

See us at Booth 2-511 Radio Engineering Show

sampling inspection only, being too costly and delicate for production purposes. Two sockets are provided, oriented 90 degrees to check vibration in two planes.

Wire-Stripping Machine

CONTINUOUS uniform movement of wire and accurate timing of operations are features of a new wire-stripping machine constructed by Jeffers Electronics Inc.

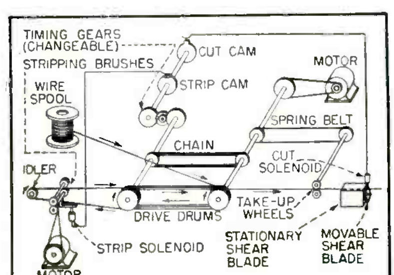
The machine was designed to handle wire from B&S No. 20 to B&S No. 32, in lengths from 2 to 48 inches. The length of the stripped end is adjustable from zero to the whole length of the cut wire.

The change in length of the cut wire is made by changing the gears, which changes the speed and the time for the cam shaft to make one complete turn. The cam that controls the cutting of the wire is a simple one-point cam which can be located in any angular position.

The cam which controls the stripping is a double cam that can be adjusted to control the time or the distance the wire is stripped. Special cut cams can be used which will permit stripping of the wire at one or more points between the cut ends.

The wire is pulled from the supply spool and makes one loop around two driving drums, then goes around the idler wheel and between the two stripping brushes.

The stripping brushes are small, round brushes that are driven at high speed and are in contact on their outside diameter. A solenoid is connected to the lower brush



Operating principle of high-speed continuous wire stripping and cutting machine, in which gear-driven cams control operation of the stripping and cutting solenoids

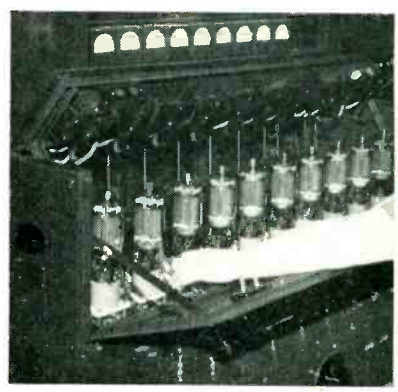
bearing so that the lower brush can be pulled away from the upper brush, permitting the wire to pass between them without being stripped.

After passing between the two stripping brushes, the wire makes three loops around the two driving drums. These two driving drums are connected by a chain and are driven at a constant speed by a drive motor.

The wire, after leaving the driving drums, is pulled to the cutoff part of the machine by two take-up wheels that are driven by a spring belt which keeps tension on the wire at all times. Here the wire goes through a cutting arrangement which consists of a stationary shear block and a movable shear blade which is round and has a series of holes about the outside diameter. The wire passes through the hole in the stationary shear block and through one of the holes in the movable shear blade. In operation, the power solenoid advances the shearing disc the spacing of one hole, which cuts the wire off and allows the new wire to push out through the next hole in the shearing disc. The length of cut is adjusted by rotating the cam that controls the cut solenoid.

Testing High-Voltage Tubes

A TEST console developed for power tubes makes plate voltage connections automatically to the top caps of ten tubes at a time when the top cover is lowered, and applies voltage automatically only when the operator has pushed the front



Safety-first console developed for testing ten large tubes at a time without risk of electrical shock to the operator

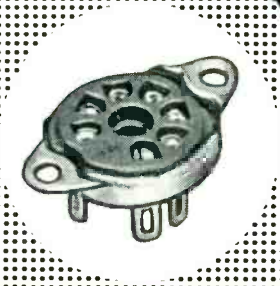
MINIATURE TUBE SOCKETS FOR

UHF Applications

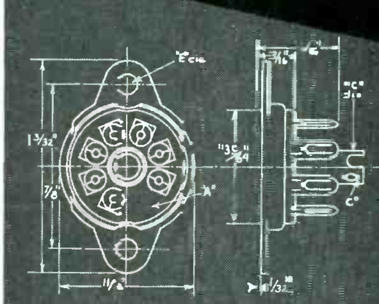
Methode design and tooling, completed well in advance of the thaw in commercial ultra-high frequency station allocations, makes available miniature sockets especially designed to minimize inductance and capacity in tuner and converter tube applications. Miniaturization of contacts and insulator permits 50% reduction in distance between lead terminations and tube seal.

Available with several types of standard mountings, superior performance in these precision products is assured by METHODE'S high production experience in their manufacture.

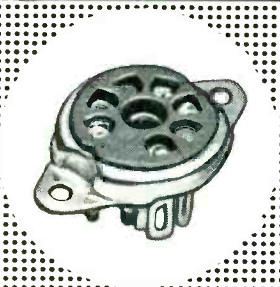
Sub-Panel Saddle



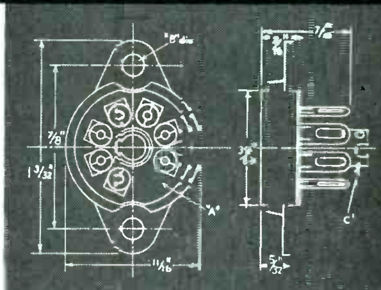
PART NO.	"A" INSULATOR MATERIAL	"B" MOUNTING HOLES	"C" CENTER SHIELD
SMU-153-093	Mica Phenolic	3/32"	
SMA-153-093	Alkyd	3/32"	
SMU-153-125	Mica Phenolic	1/8"	
SMA-153-125	Alkyd	1/8"	
SMU-154-093S	Mica Phenolic	3/32"	1/8" D x 3/8" L
SMA-154-093S	Alkyd	3/32"	1/8" D x 3/8" L
SMU-154-125S	Mica Phenolic	1/8"	1/8" D x 3/8" L
SMA-154-125S	Alkyd	1/8"	1/8" D x 3/8" L



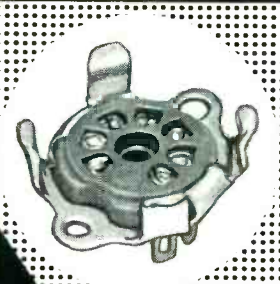
Top Panel Saddle



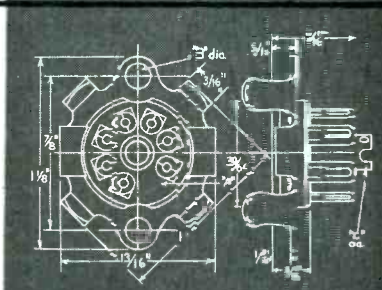
PART NO.	"A" INSULATOR MATERIAL	"B" MOUNTING HOLES	"C" CENTER SHIELD
SMU-155-093	Mica Phenolic	3/32"	
SMA-155-093	Alkyd	3/32"	
SMU-155-125	Mica Phenolic	1/8"	
SMA-155-125	Alkyd	1/8"	
SMU-156-093	Mica Phenolic	3/32"	1/8" D x 3/8" L
SMA-156-093	Alkyd	3/32"	1/8" D x 3/8" L
SMU-156-125S	Mica Phenolic	1/8"	1/8" D x 3/8" L
SMA-156-125S	Alkyd	1/8"	1/8" D x 3/8" L



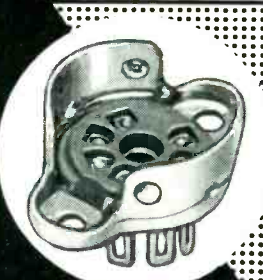
Top Panel Mount "Snap-In" Shield Base



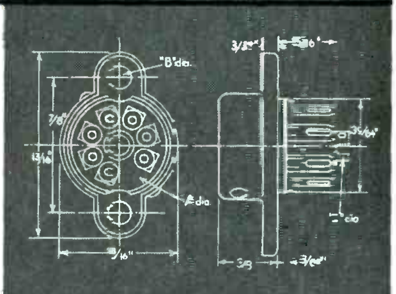
PART NO.	"A" INSULATOR MATERIAL	"B" MOUNTING HOLES	"C" CENTER SHIELD
SMU-185-093	Mica Phenolic	3/32"	
SMA-185-093	Alkyd	3/32"	
SMU-185-125	Mica Phenolic	1/8"	
SMA-185-125	Alkyd	1/8"	
SMU-186-093S	Mica Phenolic	3/32"	1/8" D x 3/8" L
SMA-186-093S	Alkyd	3/32"	1/8" D x 3/8" L
SMU-186-125S	Mica Phenolic	1/8"	1/8" D x 3/8" L
SMA-186-125S	Alkyd	1/8"	1/8" D x 3/8" L



Top Panel Mount "Twist-On" Shield Base



PART NO.	"A" INSULATOR MATERIAL	"B" MOUNTING HOLES	"C" CENTER SHIELD
SMU-175-093	Mica Phenolic	3/32"	
SMA-175-093	Alkyd	3/32"	
SMU-175-125	Mica Phenolic	1/8"	
SMA-175-125	Alkyd	1/8"	
SMU-176-093S	Mica Phenolic	3/32"	1/8" D x 3/8" L
SMA-176-093S	Alkyd	3/32"	1/8" D x 3/8" L
SMU-176-125S	Mica Phenolic	1/8"	1/8" D x 3/8" L
SMA-176-125S	Alkyd	1/8"	1/8" D x 3/8" L



Material Specifications

Insulators are available in mica-filled phenolic (type MFE) or Alkyd #420 production capacity material. Contacts are low resistance copper base alloy with cadmium finish (silver if specified). Mounting saddles and bases are cadmium plated steel.

NOVAL SOCKETS SIMILAR TO THE ABOVE ALSO AVAILABLE.

METHODE Manufacturing Co.
2021 West Churchill St. Chicago 47, Illinois

Production capacity on this new product is being rapidly increased to meet industry demand

Want more information? Use post card on last page.

safety cover all the way up. Pairs of shorting plugs on the front screen mate into jacks on the top cover to complete the circuit for testing the tubes in this arrangement, developed by Westinghouse.

Phosphor bronze strips mounted on an insulating sheet under the top cover make contact with the top caps of the tubes. Each strip is double-ended, to take care of an additional ten tubes for which a second row of ten sockets is provided. This permits using the test set for tubes requiring another type of socket.

Selection of Casting Resins

THE THREE principal applications for casting resin in connection with the production of electronic equipment are for circuit and component immobilization, for high-voltage insulation and for moisture protection. The five most important properties used as criteria when choosing a resin for one of these applications are dissipation factor, dielectric constant, dielectric strength, heat-distortion temperature and moisture absorption. Tables I and II show at a glance the best resin for each requirement and give pertinent properties.

The general casting procedure for encapsulating electronic circuits or components is diagrammed in Fig. 1. Some resins will require heat during mixing, as specified in manufacturer's instructions. Various techniques are used for releas-

Table I—Selection of Casting Resins

For Circuit and Component Immobilization:
- High Temperature—GRX-71
- High Dielectric Strength—AN-5; R-1433
- Low Loss—NBS; Stycast
- Low Dielectric Constant—Stycast; AN-5; NBS
- Low Moisture Absorption—NBS

For High-Voltage Insulation:
- Stycast; AN-5; Kriston; NEL-177; RLS-3869; EC 10C-10CM; R-1433

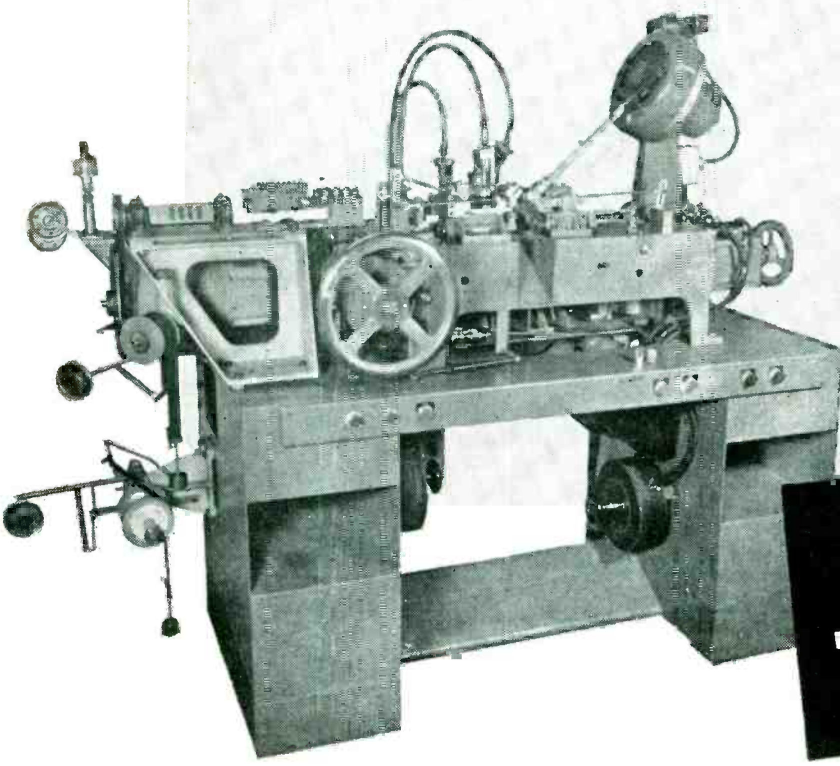
For Moisture Protection:
- Stycast; Epon RN-34;AN-5; NBS

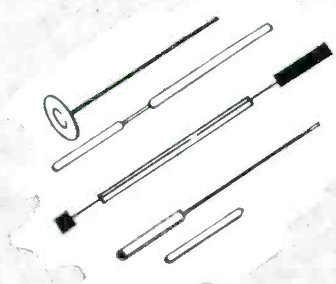
Here's how to get production quantities of precision components for TRANSISTORS • RADIO TUBES HERMETIC SEALS • LAMPS

Now it is possible for progressive manufacturers to produce their own precision electronic components. For example, the Automatic Lead Wire Welding Machine, shown below, was recently designed and built by Kahle to produce 12,000 3-piece leads per hour for miniature receiving tubes. Although this machine, Model 2148, is designed to make standard welds, it is but one step from a machine to produce leads for electronics' latest wonder . . . the transistor. In addition, Kahle has produced a fully automatic Filament Making and Tabbing Machine, Model 2036, that produces from 1,200 to 3,000 filaments per hour depending upon wire diameter.

These machines reflect Kahle's ability to design and build special-purpose machinery to meet any given specifications. Regardless of your current production problems, learn . . . without obligation . . . how Kahle's more than 40 years of practical experience can benefit you.

For specific information, write Kahle . . . now.





Kahle
ENGINEERING COMPANY
1310 SEVENTH STREET
NORTH BERGEN, N. J.

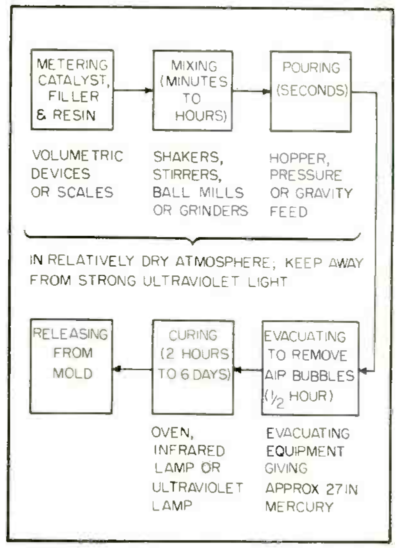


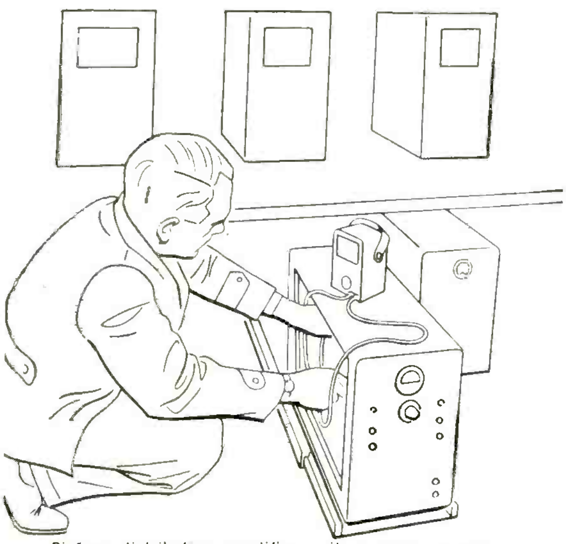
FIG. 1—General casting process for circuit and component embedment

ing the cured product from the mold. When expendable molds, made of wax or some similar material, are used it may be necessary to add additional operations such as melting away the mold after the casting is cured.

Curing times vary greatly with choice of resin and curing conditions, hence examples of recommended cure conditions are given below for typical casting resins. These cure conditions are taken

Table II—Properties of Resins

Resin, Mfr, Temp Range & Max Freq:
Araldite Resin B (Ciba Co.); 30 C to 140 C; freq unknown.
Bakelite C-8 with Inert Filler (Bakelite Corp.); −64 C to +80 C; 400 cps.
Hysol 6000 PR, 6020, 6500 and 6501 (Houghton Labs.); −55 C to +150 C; 3,000 mc.
Laminac 4116 (American Cyanamid Co.); −45 C to +100 C; 50 mc.
N. E. L. No. 177 (U. S. Navy Electronics Lab.); −54 C to +100 C; 200 mc.
Paraplex P-13 (Rohm and Haas); −40 C to 100 C; freq unknown.
Paraplex P-43 (Rohm and Haas); −45 C to +100 C; 50 mc.
Polystyrene (Emerson and Cuming); up to 80 C; 1,000 cps.
Selectron 5003 (Pittsburg Plate Glass Co.); −65 C to +125 C; 30 mc.
Selectron 5016, 5081, 5208 (Pittsburg Plate Glass Co.); −55 C to +71 C; 30 mc.
Selectron 5209 (Pittsburg Plate Glass Co.); −65 C to +120 C; D-C.
Stypol 503 (H. H. Robertson Co.); −55 C to +100 C; freq unknown.



Picture distribution amplifier unit as well as synchronizing generator and power supply units are mounted on Grant Industrial Slides. Units are normally retracted but roll out for servicing.

Grant Slides... Smooth, Fast and Efficient!

DuMont's problem was space

Compactness was the prime requirement for the DuMont Telecruiser — a mobile unit which had to duplicate actual studio operating conditions in every respect.

It was absolutely necessary to confine the servicing operations of various units to a limited area. Consultation with Grant representatives resulted in the selection of the proper (Electronic Equipment) Slides for the DuMont Telecruiser.

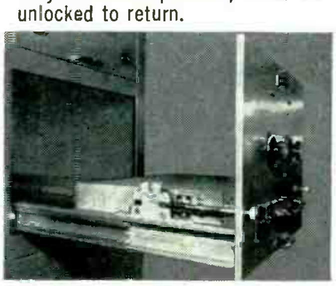
Do you have a servicing and maintenance problem?

Grant Research and Development facilities are at your service. Let us assist you in the choice and application of Grant Slides to your equipment. Engineering liaison is available from the planning stage through the production processes.

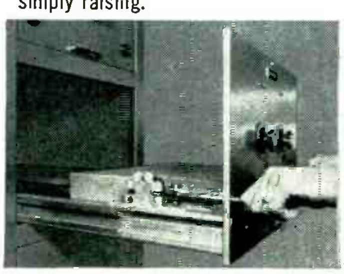
GRANT INDUSTRIAL SLIDES

a product of the engineering design department of
Grant Pulley and Hardware Company
31-73 Whitestone Parkway, Flushing, New York.
Write for information . . . consult on any problem

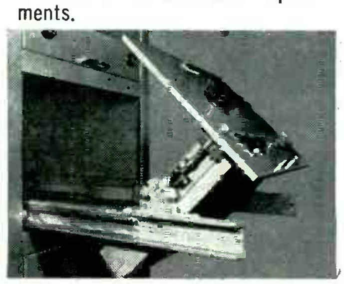
1. FULL EXTENSION — Continous ball bearing action permits smooth, non-jar chassis removal. Locks in fully extended position, must be unlocked to return.



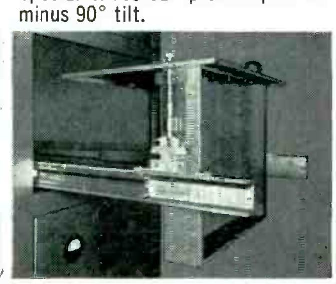
2. PIVOT RELEASE — Withdrawing release rods disengages them from quadrant mechanism, enables perfectly balanced unit to be tilted by simply raising.



3. 45° PIVOT — Unit locks in 45 degree or 90 degree position. Special pivoted positions can be obtained to fit individual requirements.



4. FULL TILT — Maintenance and repairs easily made. Access to component is gained in a few seconds. Special slides can provide plus or minus 90° tilt.



from manufacturer's data; faster cures may be obtained at higher temperatures, but size and shape of the casting should be considered before attempting an accelerated cure. The resins listed here are only representative of those available, hence this is by no means a complete listing.

Curing Times and Catalysts

Stycast (Emerson & Cuming Co.)—5 days at room temperature, then 24 hours at 60 C followed by 4 hours at 85 C. Catalyst—benzoyl peroxide.

Epon RN-34 (Shell Development Co.)—24 hours at 60 C, then 2 to 3 hours at 100 C. Catalyst—pipiridine.

AN-5 (developed by National Bureau of Standards)—1 day at 50 C. Catalyst—1. benzoyl peroxide; 2. cobalt dryer; 3. Pro-A.

NBS (developed by National Bureau of Standards) — Room temperature for gelation period, followed by 8 to 10 hours at 50 C to 60 C. Catalyst—1. Uniperox 60; 2. benzoyl peroxide.

NEL (Rohm & Haas Co.; developed by Naval Electronics Lab, San Diego, Calif.)—8 hours refrigerated, then 2 hours at room temperature and 10 hours at 45 C. Catalyst—Uniperox 60.

Selectron 5000–5200 (Pittsburgh Plate Glass Co.)—6 hours gelation at room temperature, then 15 to 30 minutes at 250 F to 260 F. Catalyst—1. Uniperox 60; 2. benzoyl peroxide.

Resin 40 (Emerson & Cuming Co.)—36 hours at room temperature, then 4 hours at 85 C. Catalyst—benzoyl peroxide.

R-1433 (Minnesota Mining & Mfg. Co.)—Gelation cure 2 to 4 hours at 250 F to 275 F, then final cure 2 to 4 hours at 300 F to 325 F. Catalyst— phthalic anhydride.

RLS-3869 (Minnesota Mining & Mfg. Co.)—2 to 4 hours at 250 F to 275 F, then 1 to 2 hours at 300 F to 325 F. Catalyst—diallyl phthalate.

EC 10C-10CM (Emerson & Cuming Co.)—Cure time. not given Catalyst—Emerson & Cuming Catalyst No. 6.

It should be noted that P-43, the Selectron resins and EC 10C-10CM are air-inhibited, hence the surface of the casting exposed to air will

COLLINS AIR-NAVIGATION RECEIVERS USE G-E 5-STAR TUBES FOR DEPENDABILITY!

GENERAL ELECTRIC is a large supplier of high-reliability tubes to Collins Radio Company, who use G-E 5-Star types widely in the 51R-series receivers for air navigation and communications.

25 tubes, or practically the entire complement of the chassis, are high-reliability types. "Every 51R component has to do its job under the toughest flight conditions," says J. H. Hamilton, Manager, Aviation Sales. "So we specify high-reliability tubes all along the line. The result is equipment with maximum dependability."

G-E 5-Star Tubes have an extensive record of dependable tube service to airlines and to the armed forces. The Collins application is further evidence of the ability of these tubes to solve your electronic equipment problems.

Courtesy American Airlines, Inc.

AND NOW--G-E 5-STAR SUBMINIATURES!

As the largest supplier of high-reliability tubes—manufacturing the most types, and with outstanding production facilities—General Electric now offers to designers a complete line of ten 5-Star subminiatures.

In all respects, these subminiatures match the premium performance of regular 5-Star types. They are uniformly operable when installed. They are shock-proof . . . extra-dependable . . . long-lived . . . with fewer shorts, fewer heater failures than standard tubes.

Select the right types for *your* new miniaturized equipment from the listing at right! For detailed application facts about 5-Star Tubes—both regular and subminiature—wire or write for new Booklet ETD-548A. *Tube Department, General Electric Company, Schenectady 5, New York.*

SPECIFY THESE 5-STAR SUBMINIATURES!

GL-5718	Medium-mu triode
GL-5719	High-mu triode
GL-5797	Semi-remote-cutoff pentode
GL-5798	Medium-mu twin triode
GL-5840	Sharp-cutoff r-f pentode
GL-5896	Twin diode
GL-5899	Semi-remote-cutoff pentode
GL-5902	Beam power amplifier
GL-6111	Medium-mu twin triode
GL-6112	High-mu twin triode

1878 75 1953
YEARS OF ELECTRICAL PROGRESS
Diamond Anniversary

GENERAL ELECTRIC

163-1A2

remain tacky after cure.

Recommended fillers that may be used with all resins are powder glass, micronized silica, aluminum powder, calcium carbonate, powdered slate, talc, asbestos, glass beads and powdered mica.

Casting Problems and Examples of Corrective Measures

Cracking of Resin Castings. (1) Amount of promoter was reduced; this lowered temperature during curing and increased setting time; (2) fillers were added, such as asbestos, talc, mica, slate flower or powdered glass; (3) casting resin was modified; (4) casting was cured in temperature-controlled oven; (5) sharp edges or projections were eliminated from articles to be embedded; (6) flexible resins made from epoxides were used; (7) article to be embedded was coated with flexible material such as Silastic 181; (8) curing technique was modified with respect to activation and temperature.

Cracking of Fragile Components. (1) Filler was added to resin; (2) parts were coated with an elastomer before encapsulating.

Excessive Shrinkage of Castings. (1) Filler was added; (2) a maximum amount of rigid resin was used; (3) epoxy resins were used instead of polyesters; (4) materials and curing procedure changed. Maximum shrinkage of Houghton Labs resins is specified to be 2.3 percent.

Casting Adheres to Mold. (1) Use mold release agents, such as silicone grease, Hi-Glo parting lacquer or mineral oil; (2) use molds made of teflon or nylon.

Poor Adherence to Embedded Parts. (1) Prepare metal surfaces more thoroughly; (2) match thermal coefficient of expansion of resin to that of metal by adding fillers; (3) omit insulating tubing from components, as Selectron resin would not adhere to the tubing.

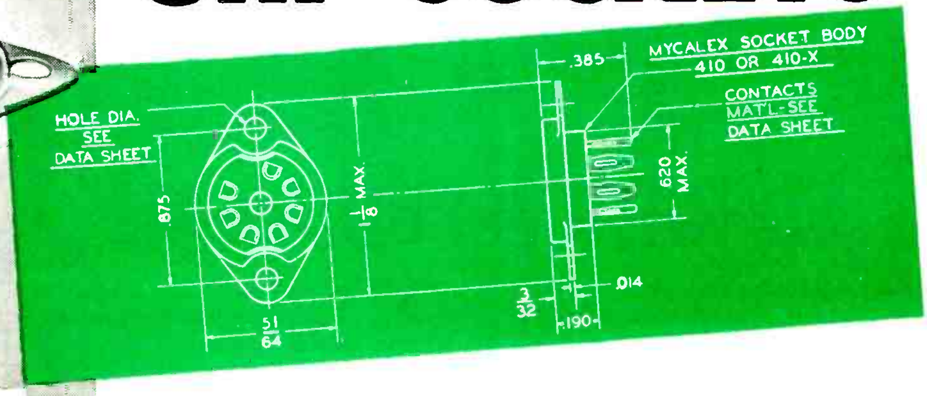
Poor Heat Transfer. (1) Add fillers to improve heat transfer from components to outside of casting; (2) change circuit configuration, so that high-temperature components were near radiating

 Want more information? Use post card on last page.

THE *complete answer* TO *uhf* SOCKET PROBLEMS—

"MYCALEX 410"

7- AND 9-PIN
UHF SOCKETS



... ELECTRICALLY EFFICIENT!

... MECHANICALLY PERFECT!

- LOW INTER-ELECTRODE CAPACITANCE
- VERY LOW DIELECTRIC LOSS
- HIGH DIELECTRIC STRENGTH
- PERMANENT DIMENSIONAL STABILITY
- NON-HYGROSCOPIC, NON-WARPING

INFORMATIVE DATA SHEETS AVAILABLE!

Write for your complete set, together with loose-leaf binder for instant, easy reference. Your request will automatically assure prompt forwarding of all subsequent Mycalex data sheets and catalog material. Write on company letterhead please.

MYCALEX engineers designed these sockets to provide a complete, yet economical, solution to UHF tube mounting problems. Exhaustive tests have proven their mechanical excellence and high electrical efficiency. The use of "MYCALEX 410" (injection molded glass-bonded mica) with its great dimensional stability permits a minimum amount of dielectric to be used in the body structure. This plus other unique design features results in extremely low inter-electrode capacitance. In addition to its other advantages—high arc resistance, high dielectric strength, non-porosity, etc., "MYCALEX 410" has very low dielectric loss at all frequencies including UHF and thereby offers great advantage over phenolic materials. "MYCALEX 410" operates continuously in temperatures up to 650°F with practically no change in electrical properties or mechanical structure. Soldering operations will not cause body distortion.

MYCALEX TUBE SOCKET CORPORATION
Under exclusive License of Mycalex Corporation of America • 30 ROCKEFELLER PLAZA, N. Y. 20

TROUBLE-FREE CONTACT TERMINALS!

Contact terminals on these sockets are so designed that the effective inductance from soldered connection to the tube base is no greater than if the connection was made directly to the tube pin. Special design results in high contact area pressure that effectively reduces contact resistance. Contact terminals are secured in the body in a manner that permits 90° bending of the tab without weakening.

ALL TYPES OF MOUNTING HARDWARE!

"MYCALEX 410" UHF Sockets, 7 or 9 pin, can be furnished mounted in various standard saddle hardware—regular saddles (top or bottom mounted), saddles with ground lugs, snap or JAN types, permitting the use of radio tube shields.

SINCE 1919
MYCALEX
THE INSULATOR
TRADE MARK REG. U.S. PAT. OFF.

MYCALEX CORPORATION OF AMERICA
Owners of 'MYCALEX' Patents and Trade-Marks
Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 • Plant & General Offices: CLIFTON, N. J.

Want more information? Use post card on last page.

surfaces; (3) use heat radiators.

Fume Hazards. (1) Use convection heating equipment, because of danger of fire when curing with heat lamp because catalyst and promoter are inflammable; (2) install proper ventilation to carry off fumes while mixing, pouring and setting as the fumes are toxic to some operators.

These corrective measures are presented as things to try one after another when a particular problem is encountered. As a rule, not all the corrective measures are necessary; sometimes only one is sufficient to solve the problem.

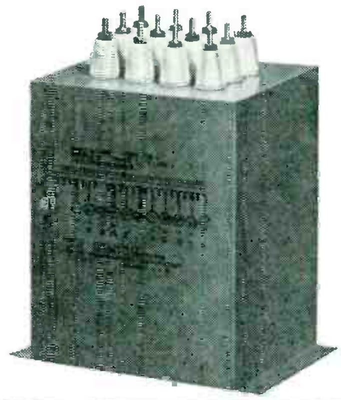
The foregoing information was abstracted from a technical report, "Development and Application of Automatic Assembly Techniques for Miniaturized Electronic Equipment", prepared by Stanford Research Institute for the Wright Air Development Center.

Induction Sealing of Pencil Triodes

IN THE envelope-assembling machine used for pencil triodes at RCA's Harrison, N. J. plant, induction heating is used exclusively for making the required vacuum-tight glass-to-metal seals. The parts making up the assembly are supported on a Nichrome jig which aligns and spaces the parts. Six separate high-frequency generators

Electronic heating generators here speed production of pencil triodes, appearing here as tiny vertical white rods under the work coils

MERIT TRANSFORMERS

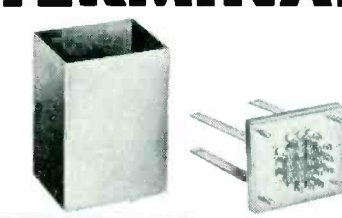


BE A LEADER . . .

manufactured with

Heldor

CANS & TERMINALS



Heldor Transformer Cans and Bushings are standard components of Merit Transformer Corporation's products. They demand better quality and uniform production—Heldor gives it to them.

More and more of the leading electronic parts manufacturers are now using Heldor's complete "package" — cans with compression-type hermetic-seal terminals ASSEMBLED in can covers. —If you want to cut production costs, save time and eliminate inventory problems, send us specifications for a quotation today.

FREE! New Can Catalog! Write today for your copy!

HELDOR MANUFACTURING CORPORATION

Heldor

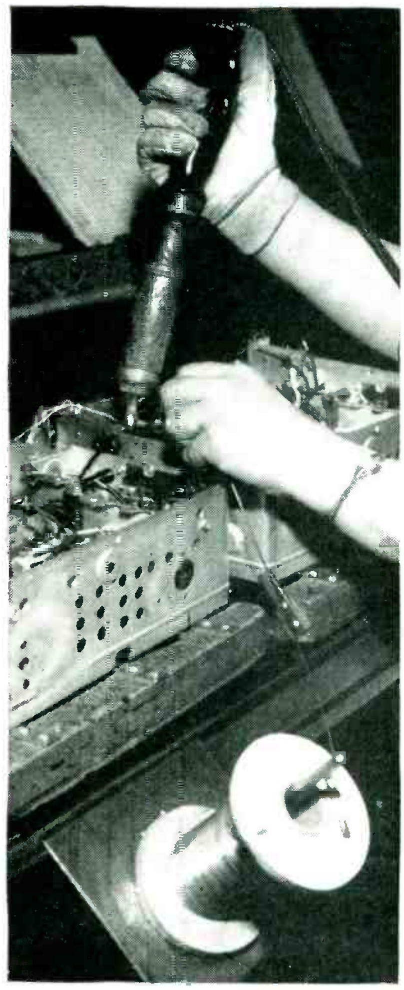
HELDOR BUSHING & TERMINAL CO., INC.

225 Belleville Avenue, Bloomfield, New Jersey

are required, one for each of the six heating positions. The water-cooled work coils are connected to the generators by multiple layers of flexible bonding braid and rubber hose sections are used as water lines, to permit vertical movement of the heating coils. As each tube in turn is indexed to a heating position, the work coil is lowered and automatically energized. Fluorescent lamps fastened overhead with tape glow to indicate that power is on. The electric field is sufficiently strong so that no connections are needed for the lamps.

Brackets on Pallet Hold Auto Radios

SIMPLE angle brackets and straight metal pieces are fastened to plain wood pallets with screws to provide non-slip positioning of the wrap-



Use of inexpensive angle brackets on pallets to position auto radios, and simple support for solder reel. The solder holder can be slid along the bench readily, and may be lifted off when no longer needed

A Guide for MAGNET WIRE Insulation Removal

TYPES OF WIRE AND STRIPPING METHODS

Type of Winding	DCC	Glass	EC	Formvar-Cotton	PE	HF	HNC	Method of Stripping
Motor Stators	x	x	x	x	x	x	x	Brushing
			x	x	x	x	x	Brushing & Burning
	x		x	x	x	x	x	Welding
						x	x	Chemicals
	x	x	x	x	x	x	x	Scraping
Wound Armatures Wire sizes 8-20 AWG	x	x	x	x		x	x	Brushing
				x		x	x	Burning & Brushing
						x	x	Chemicals
						x	x	Scraping
Wound Armatures Wire sizes 21-30 AWG					x	x	x	Brushing
						x	x	Burning
						x	x	Hot Solder
					x	x	x	Chemicals
Wound Armatures Wire sizes 31-40 AWG					x	x	x	Brushing
						x	x	Burning
						x	x	Chemicals
					x			Sanding

Type of Winding	Paper DCC	Glass	°HNC Form. Cotton	PE	°HNC HF	•Nylen •Celen	Nylon Celanese Over •Nylen •Celen	Nylon Celanese Over HF-°HNC	Silk Over HF-°HNC	Silk Over PE	Method of Stripping
Transformers (large) & Solenoids (large)	x	x	x	x	x						1. Brushing
			x		x						2. Burning & Brushing
	x		x		x						3. Welding
					x						4. Hot Solder
				x	x						5. Chemicals
				x	x						6. Scraping
Transformers (small) & Solenoids (small)				x	x			x	x	x	1. Brushing
					x						2. Burning & Brushing
					x			x			3. Hot Solder
						x	x				4. Soldering Iron
				x	x						5. Chemicals
				x	x						6. Scraping or Sanding

•Nylen = Nylenamel
EC = Enamel Cotton
•Celen = Celenamel
HF = Formvar
° HNC = Nylclad a Formvar-Nylon coated wire
PE = Plain Enameled Wire, Beldenamel

Hot Solder:—This method is well adapted in many applications for removing Nylclad or Formvar films with or without nylon or celanese textile covering. The leads are tinned and ready to solder after this operation. Sizes 21 to 30 AWG represent a range that is best adapted for this method. The high surface tension and temperature of the hot solder, the tendency for the solder to amalgamate and reduce the size or embrittle fine wire leads usually limits the usefulness of this method to the intermediate wire sizes shown.

A 50-50 lead-tin solder bath is used generally, at a temperature of approximately 500°C or higher. The tin percentage, after the bath has been used for sometime, will decrease. Tin additions must be made therefore from time to time as dictated by experience.

Some formulations of Formvar films are not uniformly removed by the hot solder method and erratic results sometimes are encountered. Formvar nylon combination coatings such as Nylclad can be removed consistently.

Brushing:—For large wire sizes with insulations such as cotton glass (with or without plain enamel, Formvar, Nylclad), Formvar, Nylclad, plain enamel, revolving steel wire brushes are in general use for stripping apparatus leads.

For finer film coated wire, glass fibre brushes are being increasingly used. In the case of fine wires, steel wire brushes tend to scratch the copper and embrittle the leads whereas glass fibre brushes remove the insulation with a burnishing action and have practically no injurious effect on the copper itself.

Burning:—Equipment has been developed and is being used especially for stripping wound motor armature leads that first removed the insulation by burning. Copper oxide thus formed is next removed by brushing.

Welding:—Lead wires and coil leads frequently are welded. A small high-temperature gas flame is applied to heat the spliced lead to a temperature that just melts the copper. This method is used extensively for medium and large motor stator coils. In this operation, of course, all the film coating and textile is burned off.

Chemicals:—There are many proprietary compounds in general use for stripping film-coated magnet wire. They have one property in common. All are evil smelling and injurious to the skin. Care must be exercised therefore in handling these materials, and for some the use of a ventilated enclosure or hood is mandatory.

Soldering Iron and low-temperature solder pots:—Celenamel and nylon film-coated wires are in general use, particularly in the radio and television industry. Both materials being thermoplastic can be removed by using a rosin alcohol flux and the application of a soldering iron, or dipping in 650°F lead-tin solder.

Reprints of this table for shop use available on request.

Belden MAGNET WIRE

BELDEN MANUFACTURING CO.
4625 West Van Buren Street, Chicago 44, Illinois

Want more information? Use post card on last page.

around housing of an auto radio as it moves down the assembly line on a moving conveyor belt in Sylvania's Buffalo plant. Positions of the brackets are easily changed to accommodate a new housing design. Two brackets project inside the housing and one on the outside at the front edge to give rigid positioning.

The spool of solder is mounted on the bench directly under the left hand of the operator. This keeps the length of unrolled solder at a minimum and thereby prevents tangling. The solder holder is a piece of sheet metal that hooks over the metal front edge of the work bench. The stud for the spool is welded or bolted to the center of the projecting sheet.

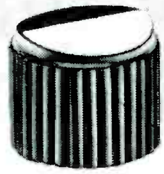
Automatic Coil Dipper

A SPECIAL Crosley-designed automatic dipping machine applies a plastic protective coating to television receiver peaking coils at a production rate of 650 coils an hour. On the motor-driven face plate of the machine are six coil-holding arbors, each driven by gears inside the face plate.

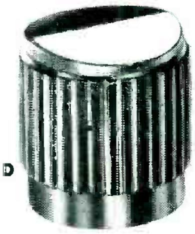
The operator pushes the lead of a coil into the hole in the end of an

Automatic dipping machine set up for applying plastic coating to peaking coils. The same machine is also used for adding a plastic corona bead to flyback coils

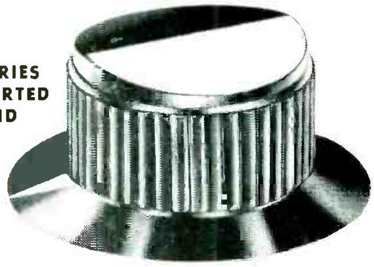
To Guarantee QUALITY BEYOND QUESTION in RAYTHEON®



70 SERIES ROUND



90 SERIES SKIRTED ROUND



125 SERIES DIAL SKIRTED ROUND

90 SERIES POINTER

90 SERIES SKIRTED POINTER

175 SERIES CRANK

Standard Control Knobs

So that you may specify them with confidence for the finest electronic and electrical equipment, Raytheon Standard Control Knobs must pass these quality control tests:

HUMIDITY — 48 hours of 95% relative humidity at 65°C.

SALT SPRAY — 50 hour fog test in accordance with Specification QQ-M-151.

VIBRATION — tested in 3 planes from 10 CPS to 33 CPS at an amplitude of .072″ for 3 minutes each way in accordance with Specification 40T9

IMPACT — blows of 400, 800 and 1200 foot pounds through each of 3 axes in accordance with Specification 40T9.

HIGH TEMPERATURE — 4 hours at 85°C combined with torque test.

TORQUE — 25 to 50 pound-inches applied in one direction, then opposite while under high temperature test.

ROTATION — crank knobs rotated 200,000 times with 1½ pound load applied intermittently to handle during each rotation.

EXTREME TEMPERATURE — knobs subjected for 2 hours to 95% relative humidity at plus 65°C, then minus 40°C for 2¼ hours, then quickly back to room temperature.

RAYTHEON STANDARD CONTROL KNOBS are made in five basic sizes and six functional styles of tough, durable "Tenite II" (cellulose acetate butyrate), injection molded with anodized aluminum inserts and dual setscrews. Black knobs available in "matte" or "mirror" finish.

BRAILLE KNOBS

Based on Navy Drawing RE10F651A and styled to match our Standard Control Knob line. Available in two size ranges with symbol caps molded in the required colors.

Write for complete information

RAYTHEON

MANUFACTURING COMPANY

EQUIPMENT SALES DIVISION

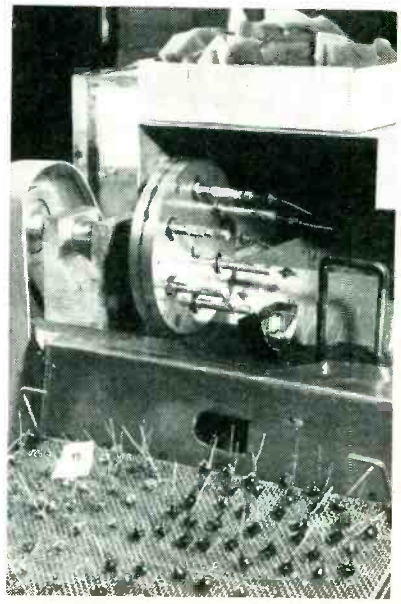
DEPT. 6270-KA, WALTHAM 54, MASSACHUSETTS

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.

Want more information? Use post card on last page.



Machine with container of hot wax raised to dunking position. U-shaped metal bar comes up with pot, to serve as guard, because the wax is hot enough to burn fingers

arbor. A spring clip on the arbor holds the lead there. When the undipped coil reaches the lowest point on its orbital route, the operator pushes a foot pedal that controls an air-operated cylinder. This brings a pan of hot high-melting point wax up to the rotating coil. It is held there long enough for the coil to make several revolutions and get thoroughly coated with wax. Release of the foot pedal lowers the semicircular pan into the larger wax pot without splashing.

By the time that the dipped coil has completed its single revolution of travel around the face plate, the wax has cooled and hardened sufficiently to permit removal by the operator. Gloves are not needed. The completed coil is placed in a screen-type tray for further hardening, transporting and storage. A rack supports this tray directly in front of the operator.

The wax is heated by a Sta-Warm automatic electric heater having a range of 260 F to 550 F in seven steps.

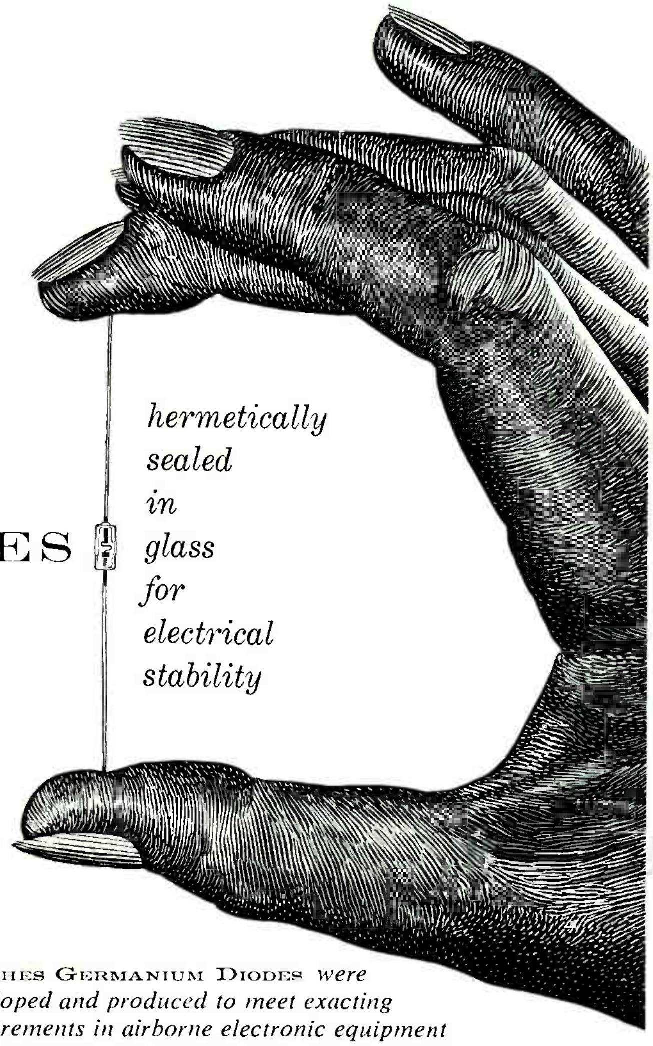
Masking Tape Holds Meters

WHEN RUNNING performance and life tests of experimental magnetic amplifiers, engineers at Bogue Electric use miniature multimeters

STABILITY SEALED IN

HUGHES

GERMANIUM DIODES



hermetically sealed in glass for electrical stability

HUGHES GERMANIUM DIODES *were developed and produced to meet exacting requirements in airborne electronic equipment for navigation, fire control, and guided missiles. In addition to the advantages of germanium diodes over vacuum tubes,* HUGHES GERMANIUM DIODES *exhibit these outstanding characteristics:*

1 MOISTURE-PROOF

Each hermetically sealed HUGHES DIODE is humidity cycled in saturated water vapor from +90°C. to −78°C., and then oscilloscope-tested for humidity penetration.

2 DEPENDABLE

Each HUGHES DIODE is subjected to JAN shock tests and then inspected under vibration for the familiar electrical instabilities—hysteresis, drift, and flutter. *Each* diode is aged and then reinspected for stability of electrical characteristics.

3 THERMALLY STABLE

The HUGHES DIODE is designed to reduce differential expansion which would cause instability of electrical characteristics with fluctuations in temperature. *Each* diode is temperature cycled and then tested to assure that the operating temperature range is limited only by inherent characteristics of germanium itself.

4 SUBMINIATURIZED

The HUGHES DIODE is designed for maximum space economy.

ELECTRICAL SPECIFICATIONS AT 25° C.

RTMA Type	Peak Inverse Voltage*	Minimum Forward Current at +1 volt—ma.	Maximum Back Current ma. (volts)
1N55B	190	5.0	0.5 (−150)
1N70A	130	3.0	0.01 (−10); 0.41 (−50)
1N67A	100	4.0	0.005 (−5); 0.05 (−50)
1N81A	50	3.0	0.01 (−10)
1N89	100	3.5	0.008 (−5); 0.1 (−50)
1N68A	130	3.0	0.625 (−100)
1N69A	75	5.0	0.05 (−10); 0.85 (−50)
1N90	60	3.0	0.8 (−50)

*NOTE: It has been found that Hughes Diodes will support 80% of this inverse voltage applied continuously at 25° C.

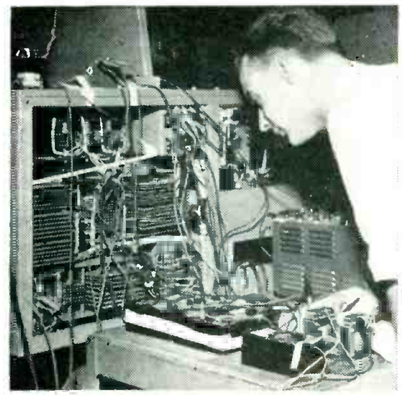
Because of expanded production capacity, HUGHES DIODES *are now available for commercial sale. Moderate quantities can be delivered from stock.* HUGHES DIODES *are classified in accordance with RTMA specifications, and also are supplied to special customer specifications, including high temperature electrical requirements.*

Address inquiries to: SEMICONDUCTOR DEPARTMENT

HUGHES

Aircraft Company, Culver City, California

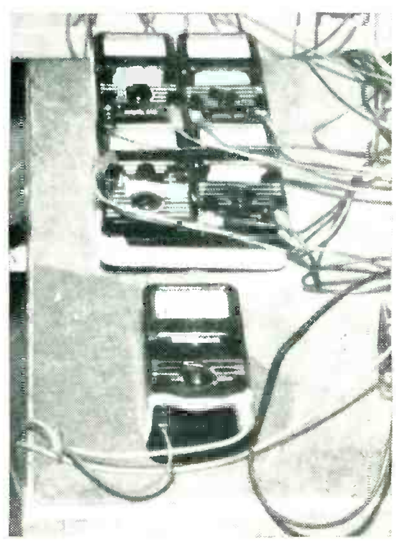
Want more information? Use post card on last page.



Magnetic amplifier test setup, showing use of masking tape for anchoring additional selenium rectifier on top of cabinet and for supporting glass thermometer

rather than individual voltmeters and ammeters for measuring circuit values. To minimize chances of having the multimeters pulled off the bench by their test leads, the instruments are grouped together with masking tape. The tape can readily be removed when the test is completed, for returning the individual meters to the stock room or rearranging them for other tests.

To avoid mistakes in reading meters, a piece of masking tape is placed on the face of each instrument and the characteristic being measured is lettered on the tape. These notes are in abbreviated forms; thus, SENSING identifies the Simpson multimeter which is set



Use of masking tape to fasten four multimeters together temporarily, and method of using the tape to identify the function of each instrument. Tape across test lead plugs of lone multimeter in foreground is safety precaution when measuring 440-volt line voltage

to a milliampere range for measuring the sensing current.

When a multimeter is used on a high-voltage range, such as 440 volts, masking tape is placed across the instrument ends of the test leads after they are plugged in. This strip of tape serves as a high-voltage warning and minimizes chances of accidentally or carelessly pulling out the test leads and thus exposing the high-voltage pins.

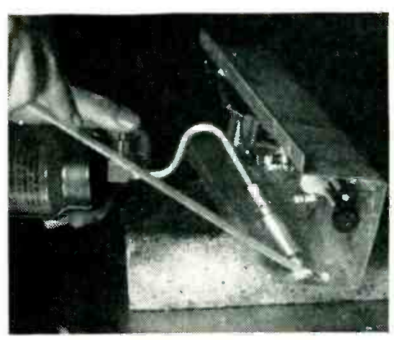
When measuring the temperature rise of selenium rectifiers during heat runs of magnetic amplifiers, masking tape is used to hold the bulb end of the glass thermometer against a rectifier plate. A longer strip of tape is used to support the other end of the thermometer in a position for easy reading.

During experimental work with magnetic amplifiers it is often necessary to hook in additional components temporarily. Instead of drilling holes in a chassis or cabinet for mounting these, the parts are set on top of the cabinet and held in position with masking tape. Leads with test clips can then be used for making connections, without risk that the part will fall off and dislodge all leads.

Aluminum Soldering Alloy

A NEW METAL alloy called Chemalloy facilities soldering to aluminum sheet or wire. The aluminum is merely heated beyond 800 F and the alloy rod rubbed on. After this tinning operation, conventional soft soldering is possible.

During shortages of copper wire in Crosley's radio plant, the new alloy was used to tin aluminum wire after cutting and stripping. The wire could then be soldered conven-

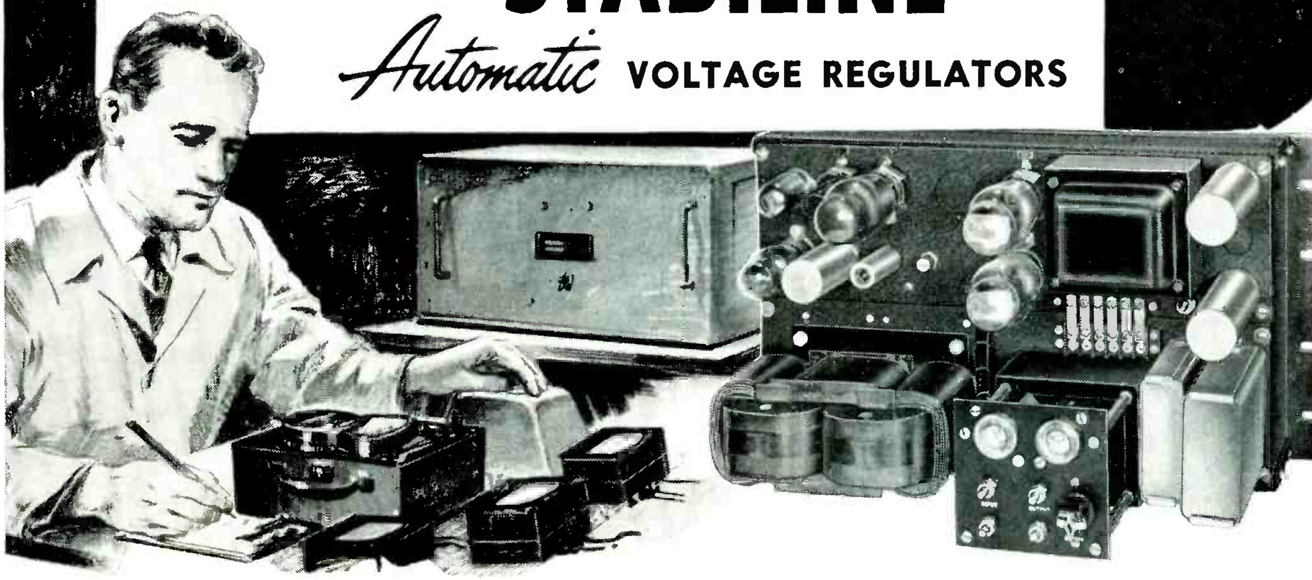


Tinning an aluminum radio chassis by heating with a gas torch and rubbing the heated area with a rod of the new alloy sci'ence (si'ens), n.(OF., fr. L. scire to know)

--and knowing the advantages of automatic voltage regulation, this man depends on

STABILINE

Automatic VOLTAGE REGULATORS



Scientific developments are based on EXACT knowledge. To obtain exact data in tests involving electrical circuitry, input voltages must remain constant. To insure dependable, accurate results . . . to eliminate the need for rerunning experiments because a change in input voltage has invalidated the first run . . . depend on a STABILINE Automatic Voltage Regulator to maintain constant voltage regardless of line or load changes.

Offering the finest in automatic voltage regulation equipment, The Superior Electric Company offers two types of STABILINE Automatic Voltage Regulators. Type IE (Instantaneous Electronic) is completely electronic with no moving parts. Correction — when compared with other types — may be considered instantaneous. Regulation and stabilization are excellent; maximum change in output voltage will not exceed ¼ of 1% for any or all variations in operating conditions. Waveform distortion never exceeds 3%.

Type EM (Electro Mechanical) is an electro-mechanical device with inherent characteristics of zero waveform distortion, high efficiency and faster correction than most types of automatic voltage regulators. It is ideal for controlling large industrial loads. Both types are available in numerous capacities and ratings.

SPECIAL MODELS of STABILINE Automatic Voltage Regulators can be supplied to meet individual requirements. Specializing exclusively in the design, development and manufacture of voltage control equipment, The Superior Electric Company is thoroughly experienced to help you in studying your exact needs and recommending the right equipment to serve you best.

FOR ENGINEERING INFORMATION and CATALOG, WRITE TO 202 MAE AVENUE

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

- POWERSTAT LIGHT DIMMING EQUIPMENT
- STABILINE AUTOMATIC VOLTAGE REGULATORS
- 5-WAY BINDING POSTS
- VOLTBOX A-C POWER SUPPLIES
- POWERSTAT VARIABLE TRANSFORMERS
- VARICELL D-C POWER SUPPLIES

tionally on the production lines.

In Lear's radio plant, ingots of the alloy were melted in large solder pots, and aluminum cans inserted therein to facilitate making hermetic seals. A similar setup was used by the Navy to coat aluminum transducers so they could be immersed in sea water.

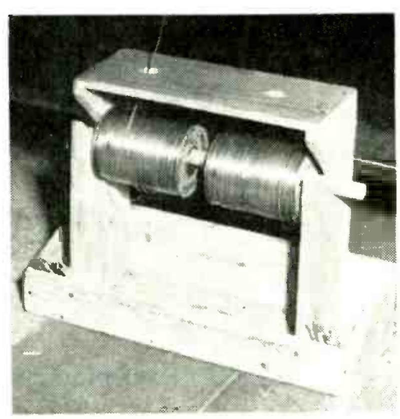
At the melting point of the alloy, it acts as a simple solder. Above the melting point, the action is that of welding, and capillary action starts under the skin of the parent metal. This spreading of the alloy in every direction away from concentrated heat makes it ideal for use on thin-gage aluminum or screen wire that would normally disintegrate or burn through.

The alloy was developed by Chemally Associates, Santee, California, while seeking an improved method of fabricating aluminum waveguides and attaching flanges. Even where one sheet of aluminum stands on edge against the full surface of another sheet, a weld made with the alloy and a small propane gas torch is sufficiently strong that the aluminum breaks before the weld.

Two-Spool Solder Holder

A PORTABLE on-the-floor holder for spools of solder gives flexibility for rearranging soldering positions on an assembly line, provides storage space for discarded and newly cleaned soldering iron tips, and makes a supply of solder last twice as long before replenishing from the stock room.

The holders are constructed from



Simple holder for two spools of solder. Compartments at ends hold soldering iron tips

plywood and assembled entirely with box nails, hence can be built at minimum cost. Slots are cut in the uprights for a half-inch hardwood dowel rod that serves as a shaft for the two spools of solder. This holder is used in the plant of Olympic Radio & Television.

Vacuum Bakeout Ovens

THOROUGH CLEANING of precision parts for mass spectrometers is achieved with a carefully planned sequence of cleaning operations associated with a 2,500-watt oven providing vacuum bakeout, in a Pasadena plant of Consolidated Engineering Corp.

The oven is mounted directly over the vacuum pump, with its controls on an adjacent table. The Pyrex bell jar and the metal shield surrounding the insulation are counterbalanced for ease in lifting. Nichrome ribbon is wound around the outside of the bell jar to serve as the heating element for the oven.

Preliminary cleaning of the parts before vacuum bakeout is accomplished by washing in Dreft deter-

Bakeout equipment with bell jar and oven lifted to show basket in which parts are placed for final degasification. Large part on bench is an analyzer tube for a mass spectrometer, one of the largest parts customarily baked out

Short cut to loss.........

8:30 on a hectic night — and bids for the Cohansey Run Bridge had to be in the night's mail. It was after 5 when the estimators finished the roughs — everything was supposed to be automatic from that point on. Miss Exton was at the new electric calculating machine literally steaming along— when suddenly it stopped. Seems it wasn't steam — it was smoke — the machine had shorted through failure of the electrical insulation. Too late to get a serviceman — and it took 'til 4 A.M. to finish the calculations by hand — all because some manufacturer tried to save pennies by using an electrical insulation that cracked.

Electrical equipment is wonderful when it works. But let the insulation short out and failure is complete.

BH "649", pioneer in the field of vinyl-coated fiberglas tubings, provides extra protection for your equipment against costly rejections and failures. It is permanently flexible, and offers high dielectric strength at continuous operating temperatures of 110°C., with "spot" resistance up to 220°C., without regard to aging and abuse.

Made of continuous Fiberglas yarns, coated with a vinyl compound, BH "649" can be twisted and knotted without damage. It withstands "push-back" during installation, without loss of physical or dielectric properties. It will not fail on a bend — even when bent back upon itself. It is absolutely fray and ravel proof. An imposing list of users testifies to its superiority — specific applications cited on request.

BH "649" is one of a family of BH electrical insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements, product, operating temperatures, voltages. We will furnish production samples for testing purposes.

Address Dept. E-2

Bentley, Harris Manufacturing Co.
Conshohocken, Pa.

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.

Method of handling baked-out parts with a lint-free cloth. Glass container is used for storage before baking, and container at right is used after bake out

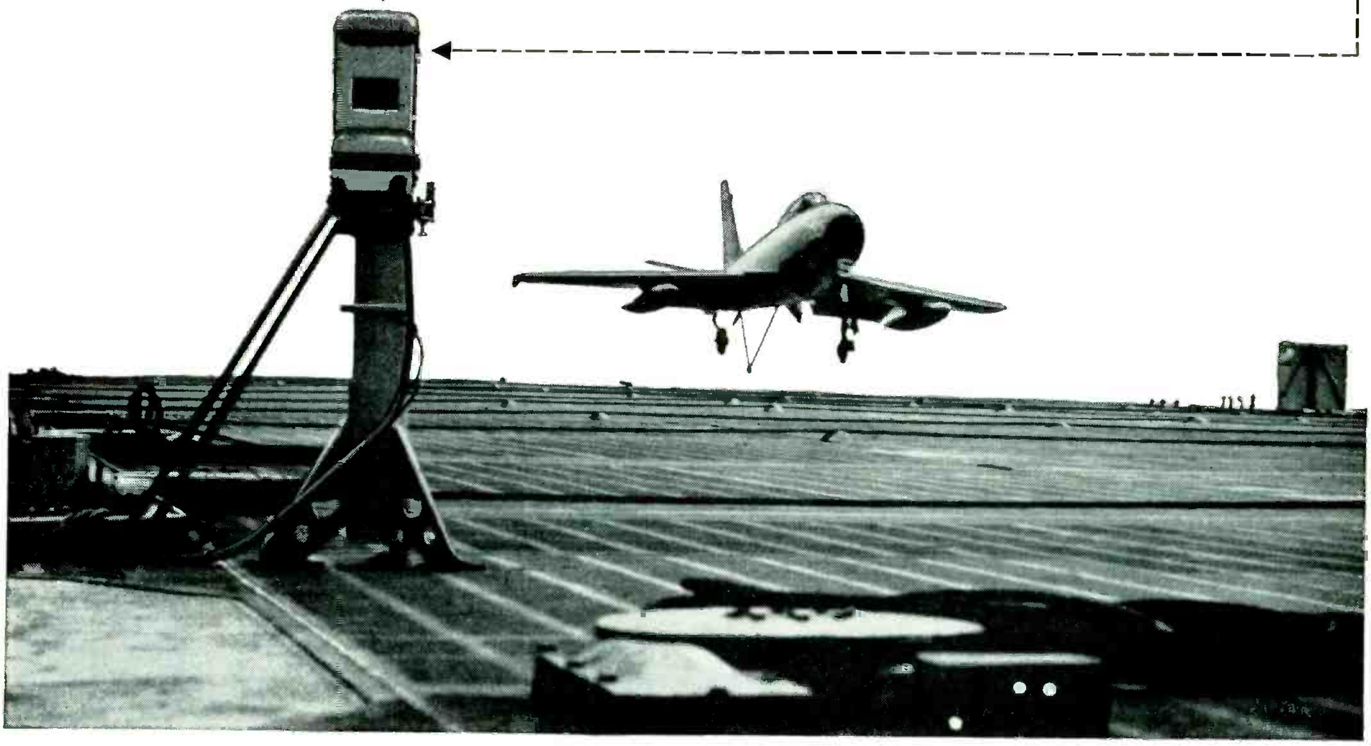
gent and warm water, followed by a series of rinses in tap water, distilled water, alcohol, benzine and ether, and drying under a heat lamp. After the dunking in Dreft, the parts are handled with clean tweezers to prevent further contamination.

After this cleaning, the parts are placed in the work basket inside the bell jar. Small parts may be placed around larger parts to utilize the full capacity of the basket. Pressure in the bakeout oven is approximately 2 x 10^{-6} mm Hg, and temperature of baking is about 400 C. A typical baking cycle requires three hours, with the exact time depending upon the load in the oven. The gasses driven off from the surfaces and the microscopic pores and fissures of the parts include nitrogen, oxygen, hydrogen, carbon dioxide and carbon monoxide.

Without the bakeout procedure, parts installed in highly sensitive mass spectrometers and mass spectrometer-type leak detectors would require a lengthy period of bakeout after assembly in the machine.

When parts are to be stored between cleaning and bakeout, they are placed in stoppered glass containers. For storage and shipment after bakeout, the parts are placed in special metal containers that can be evacuated and filled with helium to prevent corrosion or contamination. Baked-out parts are handled only through special lint-free cloths.

BRIGHT MINDS CONJURE UP ELECTRONIC MENTAL GIANTS



AT NORTH AMERICAN AVIATION

An airplane's rate of descent used to be painstakingly computed from photographs which took several days to evaluate. Then North American's electro-mechanical engineers developed TRODI (above) for the Navy for carrier suitability tests.

TRODI is an electro-optical Touchdown Rate of Descent Indicator that watches the airplane descend, measures its rate, and electronically readies its information so it's available the minute the pilot lands. TRODI's electronic brain saves untold time, men and money for the Navy.

TRODI is just one ingenious example of the challenging electronic and electro-mechanical work being pioneered at North American by some of the nation's best scientific minds, using the most advanced facilities.

If you like theory, you may find an exciting and secure future at North American in the field of operations analysis, advanced dynamics, kinematics, noise, error or information theory, systems engineering, statistical quality control or servo analysis.

If research and development are your specialty, you'll find attractive opportunities in radar and communications systems, analogue and digital computers, automatic guidance systems or optics.

Write today, including a summary of your education and experience, to:

NORTH AMERICAN AVIATION, INC.

Engineering Personnel, Missile and Control Equipment Department

12214 Lakewood Boulevard, Dept. 93-E, Downey, California

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

Want more information? Use post card on last page.

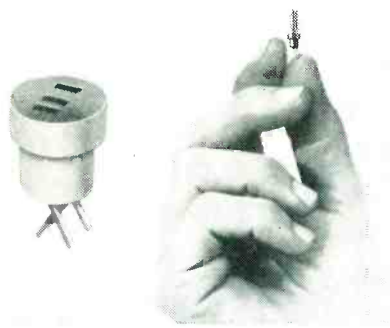
NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

Recently Developed Test Instruments, New Materials and Components and Several of the Latest Tubes Are Included . . . Forty-Six Trade Bulletins Reviewed Under *Literature* (p 328)

OTHER DEPARTMENTS

featured in this issue:



Transistor Sockets

MYCALEX TUBE SOCKET CORP., 60 Clifton Blvd., Clifton, N. J. The body of these transistor sockets is precision-molded of Mycalex 410, glass-bonded mica insulation for lasting dimensional stability, low dielectric loss, immunity to high temperature and humidity exposure combined with maximum mechanical strength. The loss factor is only 0.014 at 1 mc and dielectric strength is 400 v per mil. Contacts can be supplied in brass or beryllium copper. The sockets are readily solderable. Socket bodies will not warp or crack when subjected to high soldering temperatures. They function in ambient temperatures to 700 F.

F-M Monitor

BROWNING LABORATORIES, INC., 750 Main St., Winchester, Mass., announces the MD-33 frequency-modulation monitor designed to check the modulation swing of f-m transmitters operating in the police, fire and special service bands from 25 to 174 mc. This continuous coverage is accomplished in two bands without the use of plug-in units of any kind. Modulation swing is indicated directly on a 4-in. panel meter with a 20-kc full scale linear calibration. A dual range flasher circuit permits checking overmodulation by the shortest of voice peaks at either of two preset amounts of swing. The unit is 9 in. high x 20½ in. wide x 12 in. deep. Weight is 35 lb.

Miniature Power Supply

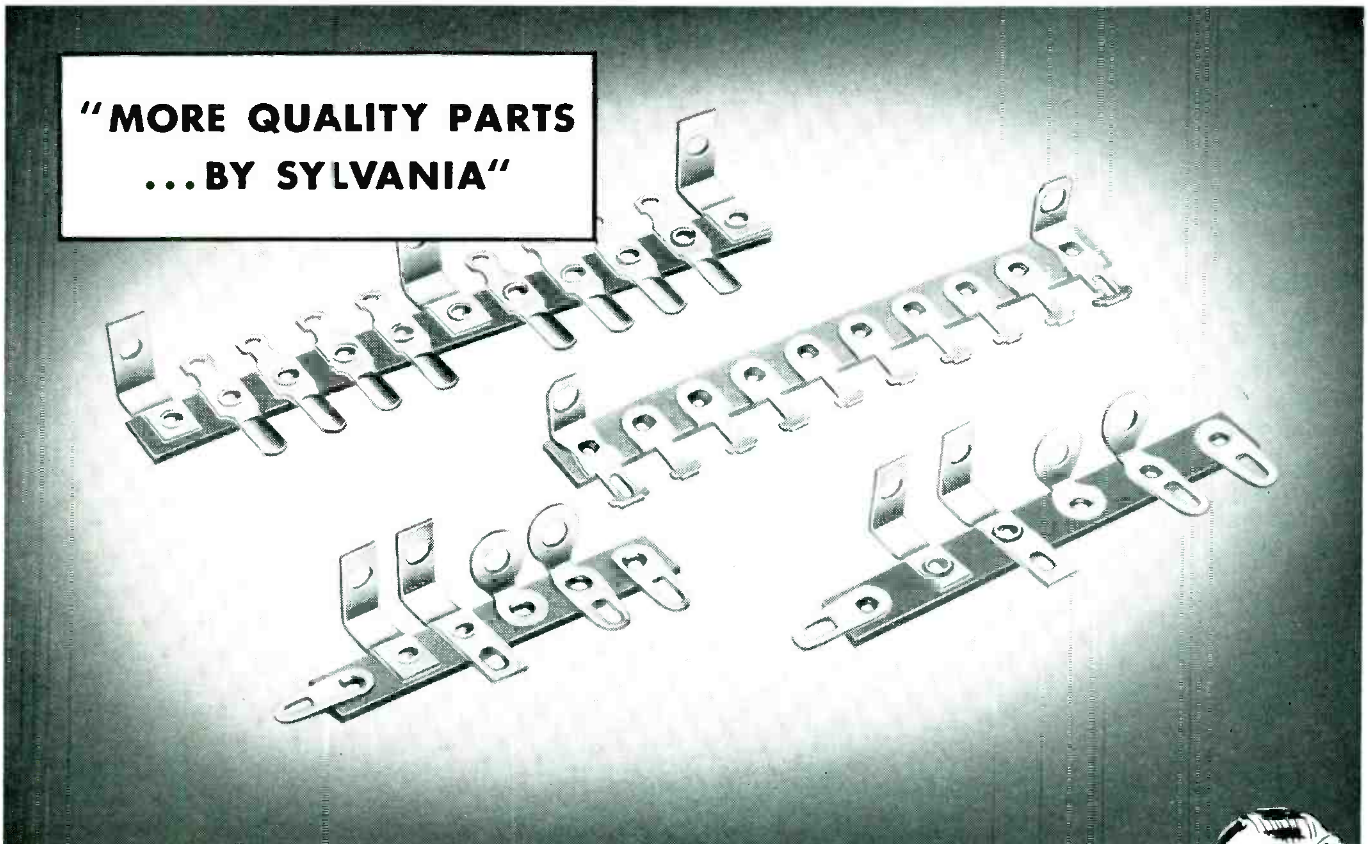
AIRPAX PRODUCTS CO., Middle River, Baltimore 20, Md., has released model A-1220, the first of a series of miniaturized d-c to d-c power supplies using a 450-cycle vibrator. Total weight is only 1 lb. 14 oz. Vibrator and power supply are hermetically sealed. The vibrator attaches with snap fasteners. Output is 150 v at 100 ma; peak ripple, 1.0 percent. Three standard units of 6, 12 and 26.5 v d-c input are offered. On special order output power up to 20 w, output voltages up to 300 v, and input voltage between 4 and 110 v d-c can be furnished. The unit is designed to meet severe military standards of vibration, shock, temperature range, humidity and altitude.

Tiny Transmitter

MOTOROLA, INC., 4545 W. Augusta Blvd., Chicago 51, Ill., has announced mass production of a hand sized Handie Micro-Talkie transmitter designed to operate in the 152 to 174-mc frequency bands. The compact unit, weighing only 1 lb 13 oz, has a power output of 20 to 40 mw and a tested optimum range up to 5 miles. Overall case dimensions are only 7⅜ in. x 2½ in. x 1¾ in. A rigid, chrome plated loop antenna doubles as the carrying handle. The unit uses 8 subminiature tube stages with printed associated circuitry. With the transmitter operated on the practical duty cycle of 15 seconds out of each 5 minutes, A battery life is one work week with the B batteries lasting 2½ weeks. The unit is especially useful for patrolmen on foot, firemen at the scene of a fire, or for on-the-spot news reporting. Indus-

MAKE BETTER CONNECTIONS

with Sylvania's improved terminal strips



Sylvania now offers you a wide variety of highest quality terminal strips . . . equipped with from 2 to 14 lugs . . . suitable for many different applications.

Insulators are made from laminated phenolic. Contacts are brass or cadmium-plated steel. Sylvania Terminal Strips can be supplied to your specifications.

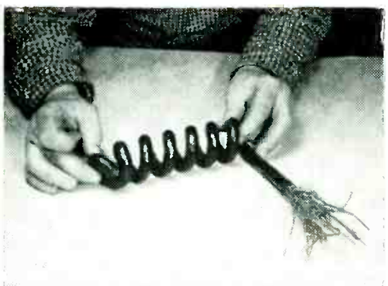
Today, with enlarged, modern plastic molding equipment and metal stamping facilities, Sylvania offers you precision-built components of highest quality at lowest possible cost. For new illustrated catalog showing the long line of Sylvania Terminal Strips and other radio and electronics components now available, write to: Sylvania Electric Products Inc., Dept. 3A-1002, 1740 Broadway, N. Y. 19, N. Y

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

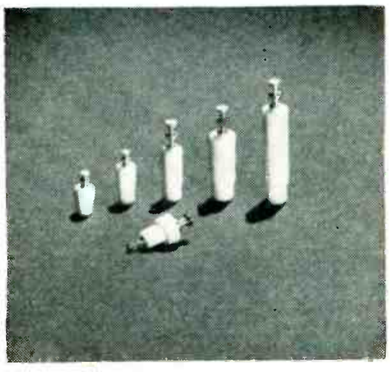
Want more information? Use post card on last page.

trial uses include railroad car checking, inventory control and materials handling.



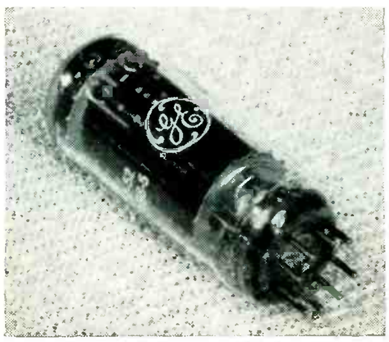
Multiconductor Cable

KOILED KORDS, INC., 1565 Dixwell Ave., New Haven, Conn., has developed a 19-conductor retractile cord for use with movable relay rack mountings for electronic equipment. The retractile feature of the cord permits the equipment to remain operative when the mounting shelves are pulled out and then rotated for inspection or servicing. This shielded cable answers the need for a cord that would extend to the desired length but would not become fouled in the mechanism when relaxed. Conductors are No. 23 AWG tinned Hi-Tenso bronze insulated with synthetic rubber. A wound shield of tinsel is applied over the core of seven conductors. The remaining 12 conductors are cabled about this core and covered with another tinsel shield and an overall rubber jacket to an outside diameter of 0.540 in. The cord is then vulcanized in the coiled shape and terminated as required.



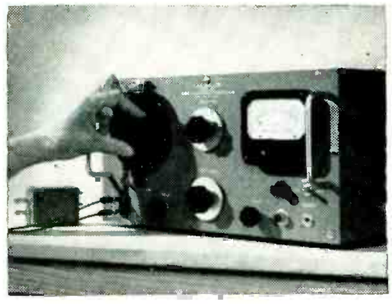
Insulated Terminals

SEALECTRO CORP., 186 Union Ave., New Rochelle, N. Y., has introduced a line of DuPont Teflon insulated standoff and feed-through terminals. These Press-Fit terminals are one complete unit ready for assembly, eliminating the use of any and all hardware for installation. A simple press fit with an inexpensive hand tool or drill press, into a chassis drilled with a predetermined diameter hole fastens the terminal securely. Teflon's excellent electrical properties are unaffected by thermal change. Its dielectric constant is lower than almost any other engineering material and in combination with the extremely low power factor results in a loss factor lower than for any other material. The losses are also constant into the microwave region. It is unaffected by sparking over its surface and sheds moisture. Additionally, it will not support the growth of fungus and is therefore useful in equipment to be used in the tropics.



Power Pentode

GENERAL ELECTRIC CO., Schenectady, N. Y., has announced type 6CL6 power pentode for use in the video output stage of television receivers. Using this tube it is possible to obtain a voltage gain of from 40 to 45 in wide band video circuits. The tube features high transconductance, low capacitances and high output current capability. It provides a high plate current at low plate voltages and can supply enough peak-to-peak output voltage to drive large picture tubes with high efficiency and low amplitude distortion. It is capable of supplying 132 v peak-to-peak output across a load resistor of 3,900 ohms. In addition to its use in video output service, the new 9-pin miniature may also be used as a wide-band amplifier in industrial and laboratory equipment.

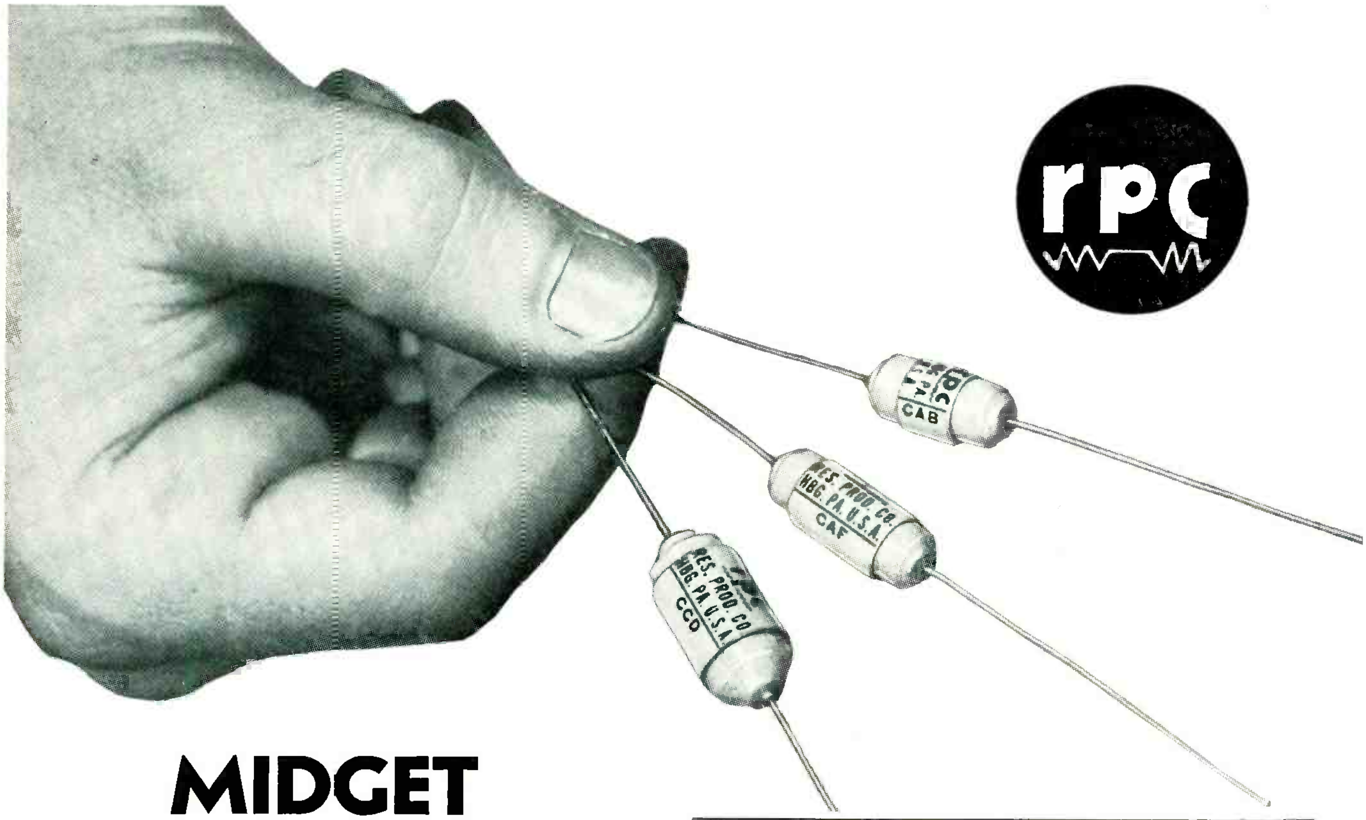


Wave Analyzer

SIERRA ELECTRONIC CORP., 810 Brittan Ave., San Carlos, Calif. Analysis of the frequencies and amplitudes of signal components in a complex waveform is accomplished in a simple and direct way with the model 121 wave analyzer. A novel two attenuator design permits a wide range of measuring amplitudes without the introduction of instrument distortion. Signal components are read directly on a 4-in. indicating instrument calibrated in db. Voltage calibration is accomplished with an internal 100-kc injection oscillator, and a listening jack is provided for monitoring the signal being measured. The instrument has an input level range from +42 dbm to −70 dbm at a 600-ohm impedance level. Input impedance is 10,000 ohms in the pass band. Selectivity is such that 100 cps off resonance the response is 3 db down; 200 cps off resonance, 10 db down; 500 cps, 30 db; and 1,000 cps, 45 db. Measuring accuracy is ±2 db and spurious components are at least 50 db below signal fundamental.

High Speed Trigger

THE WALKIRT CO., 145 W. Hazel St., Inglewood, Calif., announces the type M1563 high speed trigger. It is a Schmitt type circuit designed to meet the wide need for a fast pulse suitable for driving many types of counting or scaling equipment from a sine wave input. The unit can also be driven from a square wave input, in which case it acts as an amplifier and will pro-



MIDGET
Precision Wire Wound
RESISTORS

TYPE	DIMENSIONS		Jan-R-93	POWER RATING (WATTS)		RESISTANCE	
	Leng.	Diam.		Jan.	Comm'l.	Min. (ohms)	Max. (meg.)
CAB	1/2	9/32	——	——	1/4	2.0	0.15
CAF	3/4	9/32	RB51B	1/4	1/2	1.0	0.40
CCD	3/4	3/8	RB51B	1/4	1/2	0.5	1.0

Successfully used in Armed Forces' most critical applications

Scores of results have established the superiority and outstanding quality of RPC's new TYPE C PRECISION WIRE WOUND RESISTORS. These high quality units are designed to meet the stringent requirements of JAN-R-93.

Completely insulated precision resistors which may be soldered directly into circuits. Their small size and light weight make them self supporting. Ideal for aircraft applications where reduction in size and weight are vital.

Completely enclosed in rugged plastic of high insulation value. Windings are impregnated in special compound and protected against dust, salt spray, humidity and mechanical damage.

Winding form is of low loss steatite having extremely high insulating quality with low coefficient of expansion. Impervious to moisture.

Type C resistors are wound with specially tested low temperature coefficient alloys. RPC's Type C resistors are being used by many of America's outstanding manufacturers. They are available in any amount with prompt delivery. Write for complete information.

RESISTANCE PRODUCTS CO.

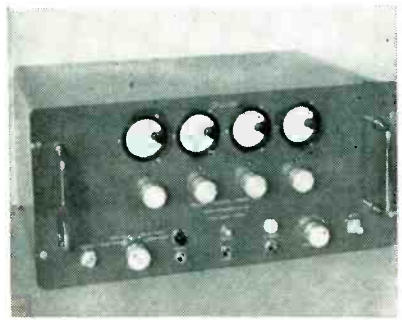
714 RACE ST. **HARRISBURG, PENNA.**

SPECIALIZING IN THE MANUFACTURE OF QUALITY RESISTORS IN ANY AMOUNT

HIGH MEGOHM, HIGH VOLTAGE, HIGH FREQUENCY, WIRE WOUND PRECISION

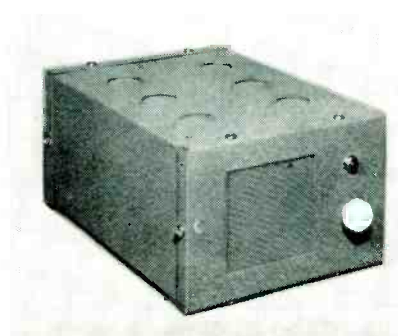
Want more information? Use post card on last page.

duce pulses of either positive or negative polarity. The 150-v peak-to-peak output has a rise of 0.2 μsec and a fall time of 0.45 μsec, measured to 90-percent amplitude. Nominal plate to ground voltage on the type 5670 tube employed is 100 v when conducting, and 250 v when nonconducting. The type 5670 tube is used meeting new military reliable tube requirements. The unit is packaged in a resin encapsulated plug-in form with a versatile 11-prong octal-style base.



Digital Preset Counter

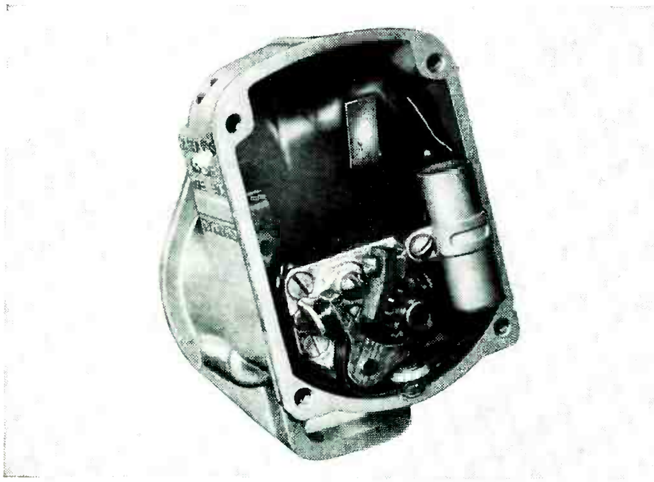
DIGITAL INSTRUMENT CO., INC., P. O. Box 1246, Coral Gables, Florida, has introduced two high-speed presetting types of counters. In the model 333 any number may be set from 0 to 999 and in model 334, any number from 0 to 9,999. Recycling can be obtained at speeds as high as 20,000 per second and the counter will operate as a standard counter at speeds up to 100,000 counts per second. Relay contacts are available for control functions. Direct-coupled output is available for electronic control and gating.



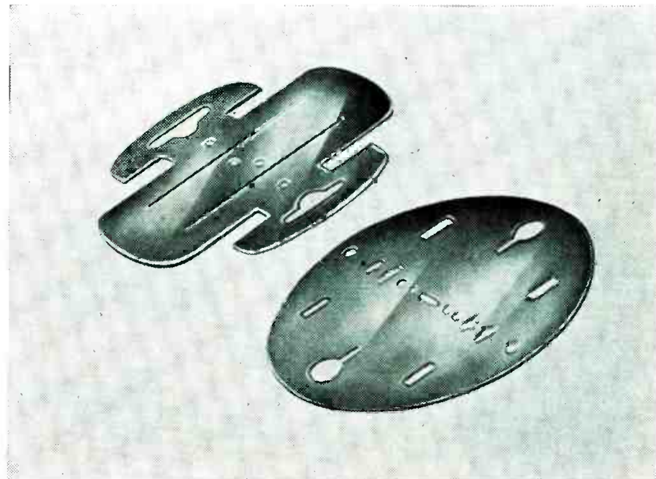
Mobile Wireless Receiver

RADIO APPARATUS CORP., Indianapolis, Ind., now has available the

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

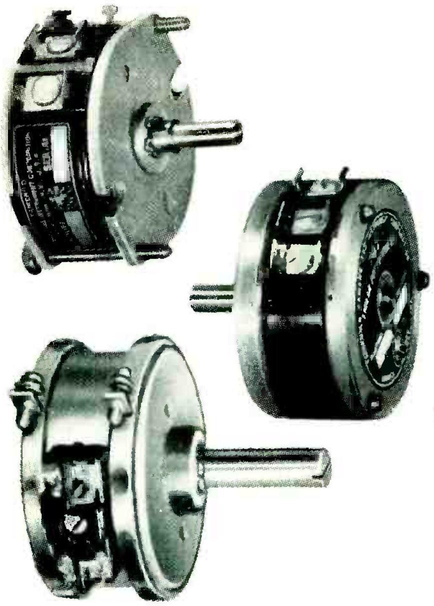
MICA *Insulator* COMPANY

Schenectady 1, New York

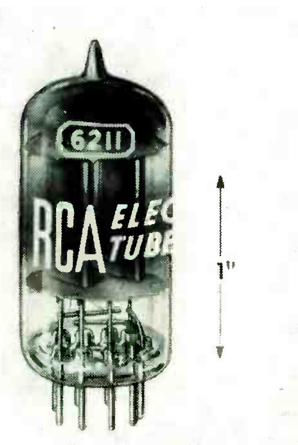
Offices in Principal Cities

LAMICOID® (Laminated Plastic) • MICANITE® (Built-up Mica) • EMPIRE® (Varnished Fabrics and Paper) • FABRICATED MICA • ISOMICA*

Want more information? Use post card on last page.



Monitoradio Pager—model AmC-1—which is a radio paging receiver for use in motor cars as a supplement to the pocket receiver utilized by most paging systems. Thoroughly field tested in conjunction with one of the paging systems now in operation, this unit is the only demonstrated receiver available for this type of operation. The receiver is expected to be used in many fields within a short time.



Medium-Mu Twin Triode

RADIO CORP. OF AMERICA, Harrison, N. J. The 6211 is a new medium-mu twin triode of the 9-pin miniature type designed especially for frequency-divider circuits in electronic computers and other on-off control applications involving long periods of operation under cutoff conditions. It has separate terminals for each cathode to facilitate flexibility of circuit arrangement, and a midtapped heater to permit operation from either a 6.3-v or 12.6-v supply. The heater is made of pure tungsten to give long life under conditions of frequent on-off switching.

Transformer Cans

TRIAD TRANSFORMER MFG. CO., 4055 Redwood Ave., Venice, Calif., announces the introduction of a line of deep drawn transformer cans. These cans are seamless and are drawn from cold rolled steel to meet the dimensional specifications of MIL-T-27. The lids are internal and require no stops since they fit the can snugly. Cans are available only

SAVE POWER

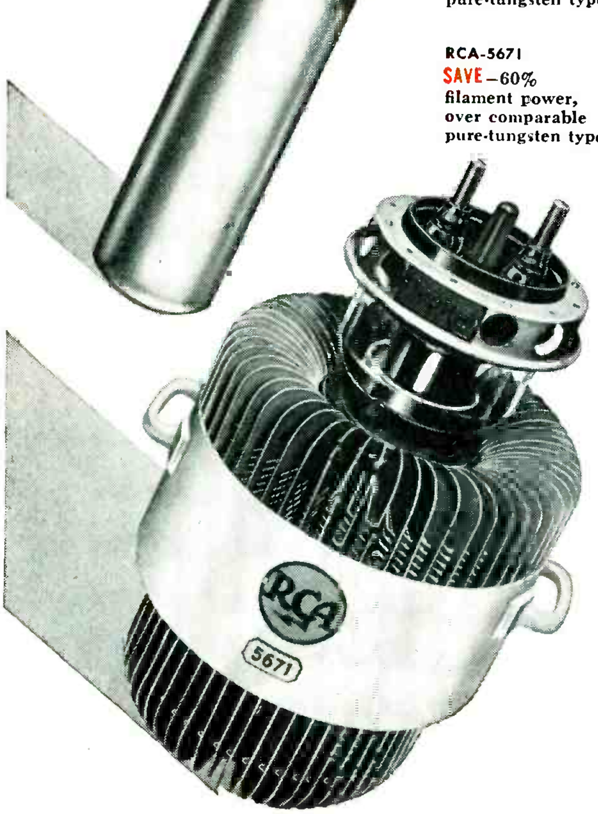
...with RCA *thoriated-tungsten filament* tubes

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!*

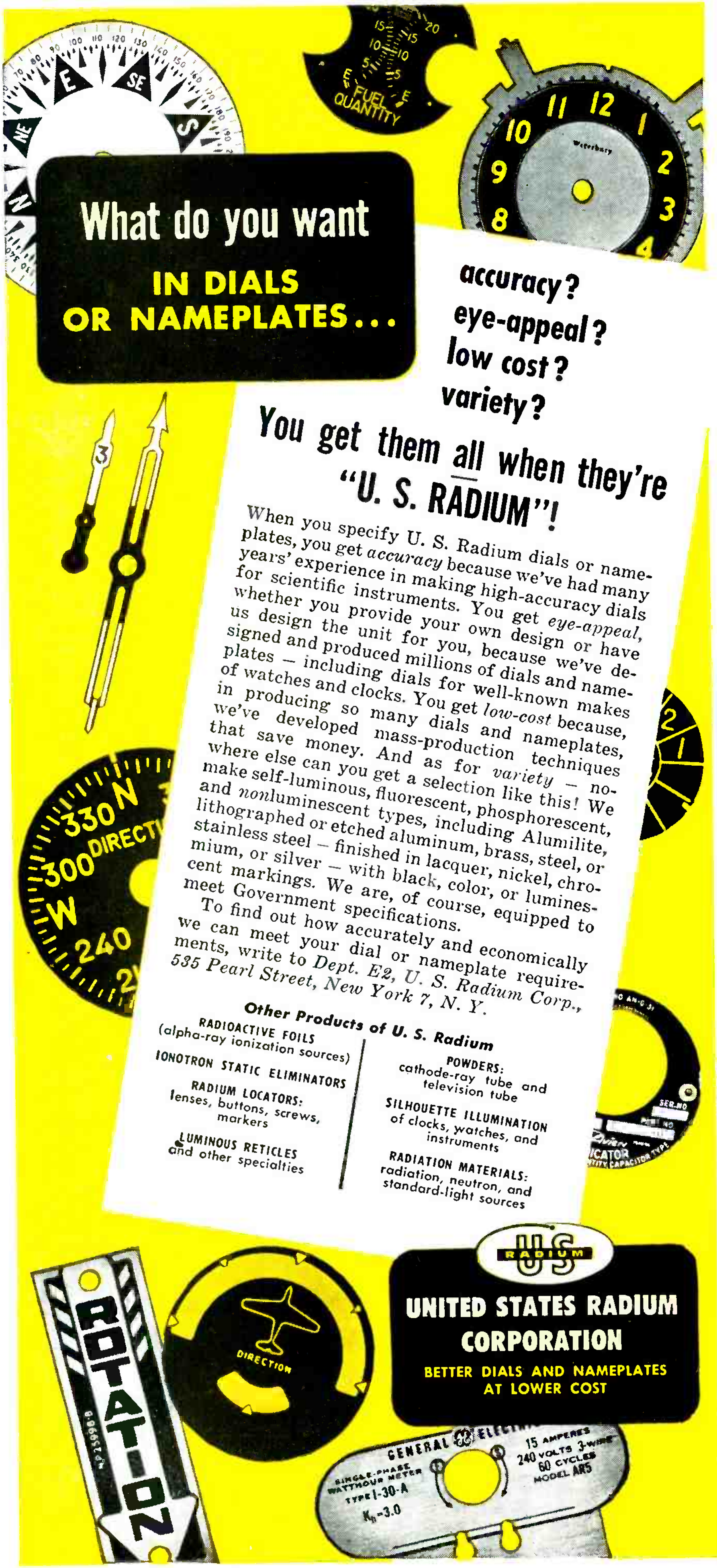
Consider these important features for the equipment you design. For additional technical information write RCA, Commercial Engineering, Section 42BR, Harrison, New Jersey. For application assistance, simply call your nearest RCA Field Office:

(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.**

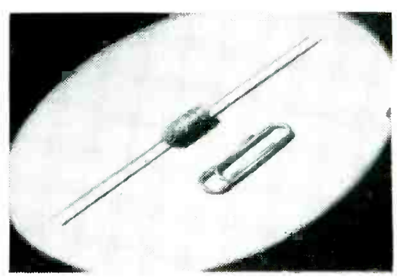
Want more information? Use post card on last page.



for military contracts. Specifications and prices are available from the company.

Direct-Drive Yokes

HALLDORSON TRANSFORMER CO., 4500 N. Ravenswood Ave., Chicago 40, Ill., is currently supplying their new 6,000-v test deflection yokes, DR603 and DF604, extra-heavily insulated to stand up under the rigors of direct-drive tv service. Both deflection yokes have 30-mh horizontal inductance, but to cover all direct-drive applications, the vertical inductance of DF603 is 3.5 mh, while DF604 is 50 mh. Both yokes are supplied with 20-in. color-coded leads and networks. Bulletin 109 fully describes the deflection yokes discussed.



Tiny Capacitor

SPRAGUE ELECTRIC CO., 35 Marshall St., North Adams, Mass., has developed a very tiny molded paper capacitor for continuous operation at temperatures up to 125 C. Designated type 85P, these capacitors are impregnated with Prokar, an exclusive high-temperature organic material which is polymerized to a

Magnetic Amplifiers

Keystone is one of the nation's foremost suppliers of magnetic amplifiers. Effective immediately we have available for prompt delivery the first of five "stock" magnetic amplifiers. Engineers may now design units around these "pre-designed" magnetic amplifiers. Inquiries are invited on the

"MotoMag"

Registered Trademark of Keystone Products Co.

In place of the conventional output transformer and power amplifier tubes, the KP 10-400 utilizes a phase sensitive vacuum tube demodulator and magnetic amplifier output stage which eliminates the need of rectifiers, thus assuring greater reliability. Each unit built in accordance with MIL specifications. KP 10-400 operates from an input voltage of 115 volts, 400 cycles single phase. Output is 10 watts, reversible phase. KP 10-400 operates from a minus 55° to plus 70° C with minimum variation. An input signal of 2 volts AC or DC working into a high impedance is required for a maximum of 110 volts, 10 watts, 400 cycles. The unit is 4 inches high, 3½ inches wide and 2½ inches deep. Weight—only 1 lb., 13 ounces.

Your inquiry will have our prompt attention.

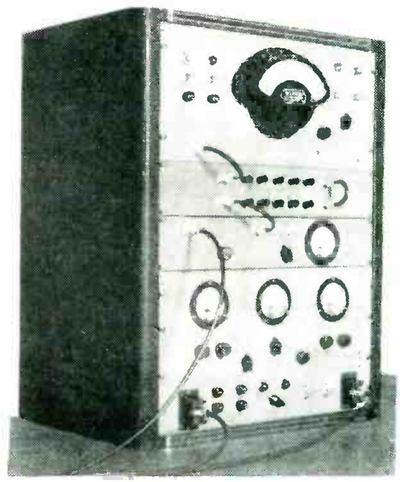
KEYSTONE PRODUCTS CO.

904-6 TWENTY-THIRD ST., UNION CITY 2, NEW JERSEY

UNion 6-5400

Want more information? Use post card on last page.

solid resin. The resulting dielectric is completely solid and permits considerable size reduction with extreme stability under all operating conditions. The impregnated sections are then molded in a mineral-filled, high temperature plastic. Originally developed for military use, these miniatures are now available for precision electronic equipment requiring high-quality components such as electronic computers and geophysical amplifiers. Type 85P units are available in 2 molded sizes—0.175 in. diameter x $\frac{3}{8}$ in. long and 0.200 in. diameter x $\frac{5}{8}$ in. long. Standard RTMA 20-percent and 10-percent capacitance decade values are available as well as 5-percent values.



Microwave Gain Set

KAY ELECTRIC CO., 14 Maple Ave., Pine Brook, N. J. The microwave gain set illustrated is a complete equipment for making precision measurements of gain or loss in microwave components or systems, and it can also be adapted for use down to the vhf range. Unusually high precision is attainable, since the gain set, which is readable to 0.025 db, is capable of measurement accuracy within 0.1 db of the attenuator calibration. Measurements can be made where available power is as low as −80 dbm. In order to measure the gain, loss, standing-wave ratio, or other properties of a microwave system or component, energy of the desired frequency is sent through the component under test and then received by a microwave receiver. The microwave gain

KLIXON

TRADE MARK REG. U.S. PAT. OFF.

C6360 MOTOR STARTING RELAY LEADS

Since these KLIXON starting relays are used as standard equipment by a great many leading manufacturers of refrigerating units, insulation must be able to withstand both high and low ambient temperatures. Natvar 400 tubing has excellent flexibility and resistance to oil and moisture over a very wide temperature range.

ARE INSULATED AND PROTECTED

with

NATVAR 400

EXTRUDED PLASTIC TUBING

The KLIXON C6360 is a current type relay which means that the entire motor current flows through it. Therefore the wire in the coil winding is heavy enough to be used for leads, eliminating screw terminals. And since sleeves of Natvar 400 are reasonably low in cost, and are easily slid over the leads, assembly is quicker and less expensive. Also, leads can be color coded, because Natvar 400 is furnished in bright, distinctive colors.

KLIXON Protective devices and controls, manufactured by Spencer Thermostat Division of Metals & Controls Corporation, are used by foremost makers of refrigerating and other electrical equipment to assure safe, continuous operation under all service conditions.

Since reliability of KLIXON devices is essential, only the best materials are used. Natvar 400 extruded plastic tubing has been selected as the most suitable lead insulation for the starting relay shown above because of its excellent physical and electrical properties and its dependable uniformity.

Natvar 400 and other Natvar flexible insulating materials are available either from your wholesalers stock or direct from our own.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubing and sleeving
- Varnished identification markers
- Lacquered tubing and sleeving
- Extruded plastic tubing and tape
- Extruded plastic identification markers

Ask for Catalog No. 22

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

201

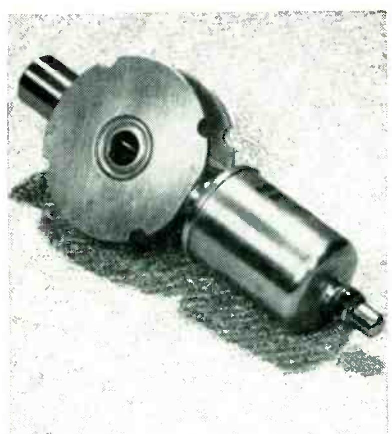
TELEPHONE RAHWAY 7-8800

CABLE ADDRESS NATVAR: RAHWAY, N. J.

RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY set is available with or without r-f heads, and it may be used in conjunction with a klystron signal source and a local oscillator for any frequency range.

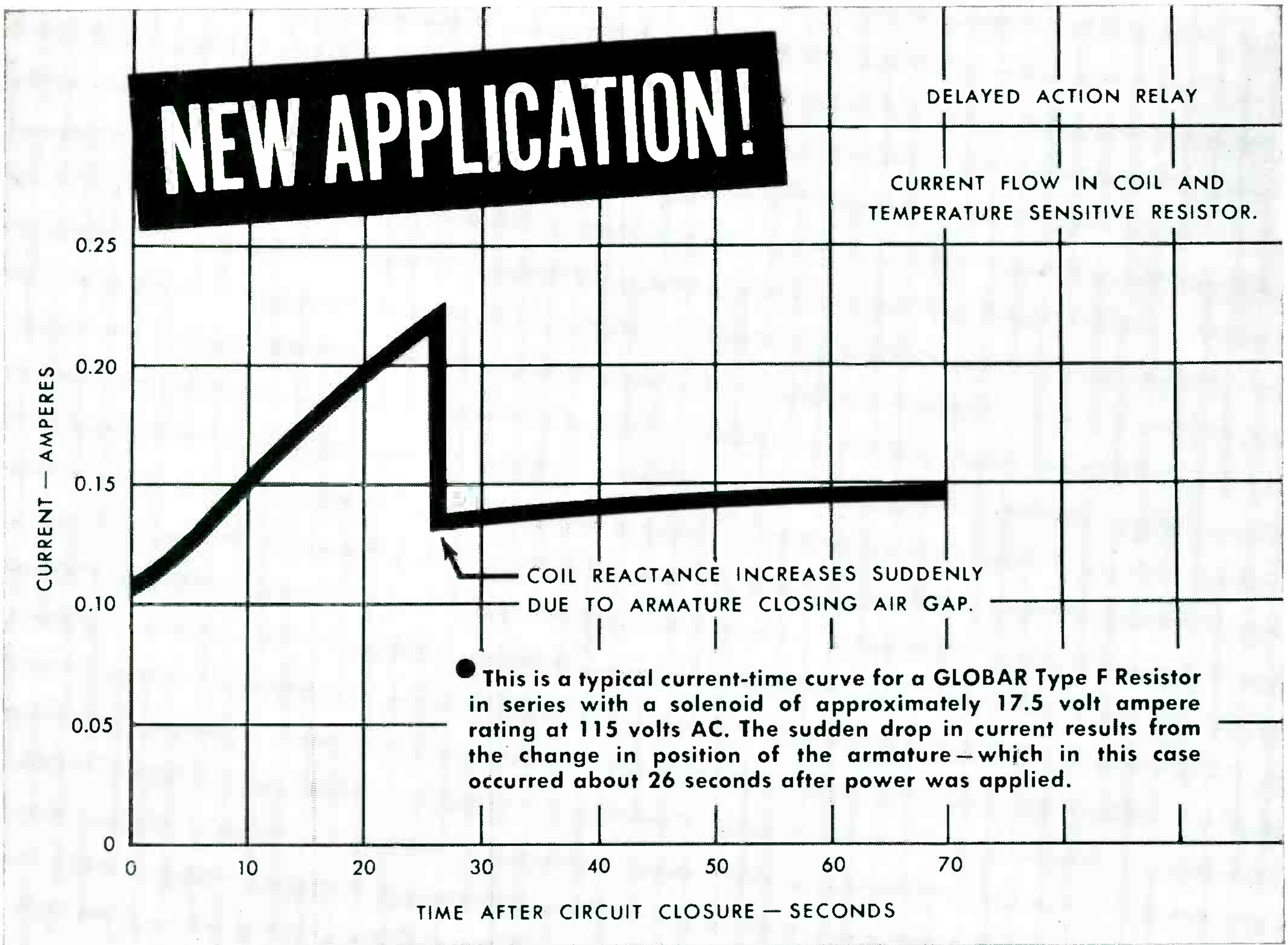
L-F Time Calibrator

OWEN LABORATORIES, 9130 Orion Ave., San Fernando, Calif. The type 190 low-frequency time calibrator is a synchronous-motor driven device furnishing pulses at intervals of 0.01, 0.1, or 1.0 second. It is intended for use with oscilloscopes and various types of recording equipment in electrical, mechanical biological investigations. Pulse amplitude is about 1.5 v. Size is $5\frac{1}{4} \times 3\frac{1}{4} \times 3$ in.



Gas-Switching Tube

GENERAL ELECTRIC CO., 1 River Road, Schenectady 5, N. Y. Type GL-1B24-A gas switching tube for airborne radar is an integral-cavity tunable type designed for use in simple duplexers in pulsed microwave circuits which do not require that the short circuit in the tube have a fixed electrical position. The tube is designed for use in an operation band of from 8,490 to 9,600



Simple, maintenance-free TIME DELAYS with GLOBAR Type F Resistors

Now time delays in many relay and solenoid circuits are being obtained inexpensively by simply connecting a GLOBAR Type F Ceramic Resistor in series with the actuating coil. Delays range from a few seconds up to two minutes, depending upon the values and sizes of the resistors used.

When power is applied in the circuit, the current through the resistor causes it to heat. As it heats, its resistance decreases and the current increases until the tripping value of coil current is reached.

It's simple, inexpensive, and maintenance-free—and requires less space than dash-pots or other more complicated delay devices. It is useful in single delay applications—as in the starting of critical electron tubes; or in multiple delay applications where fixed timing of a series of events is necessary—as in the starting of oil burners.

If you have a time delay problem—or any circuit problem where long-life GLOBAR Ceramic Resistors might provide the answer—let our engineers help you. Just send complete circuit information to Dept. E 87-31.

GLOBAR Ceramic Resistors

TRADE MARK

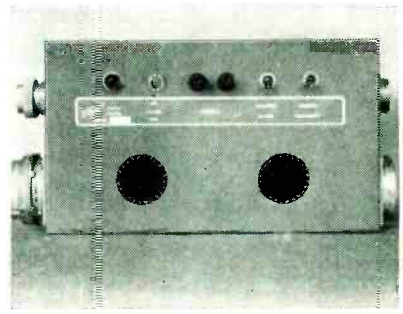
by CARBORUNDUM

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

87-31

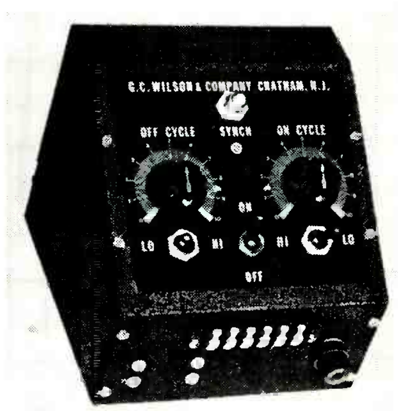
Want more information? Use post card on last page.

mc. It operates to decouple the receiver effectively from a common transmitting and receiving antenna during a transmission period. The GL-1B24-A has a recovery time of 4 μsec at 10 kw peak, 3 db down. It has a leakage power of 30 mw. Transmitter peak power is 100 kw.



Cable Tester

LLOYD'S ENTERPRISES, Box 313, Altadena, Calif., has available a cable tester for testing multiconductor cables for opens, shorts between any other conductor or shorts to ground. The model LK24-7 tests the TV24 conductor camera cable (three conductors are coax) and the RCA field sync generator 7 conductor cables. Any combination with standard fittings can be supplied upon request. The buzzer is normally used to indicate continuity or shorts, but binding posts are supplied so that an external ohmeter can be used if desired.



Repeat Cycle Timer

G. C. WILSON & Co., 2 North Passaic Ave., Chatham, N. J. Model No. 1 electronic repeat cycle timer is suitable for regulation of automatic machinery, sampling, valve pacing and heat sealing as well as

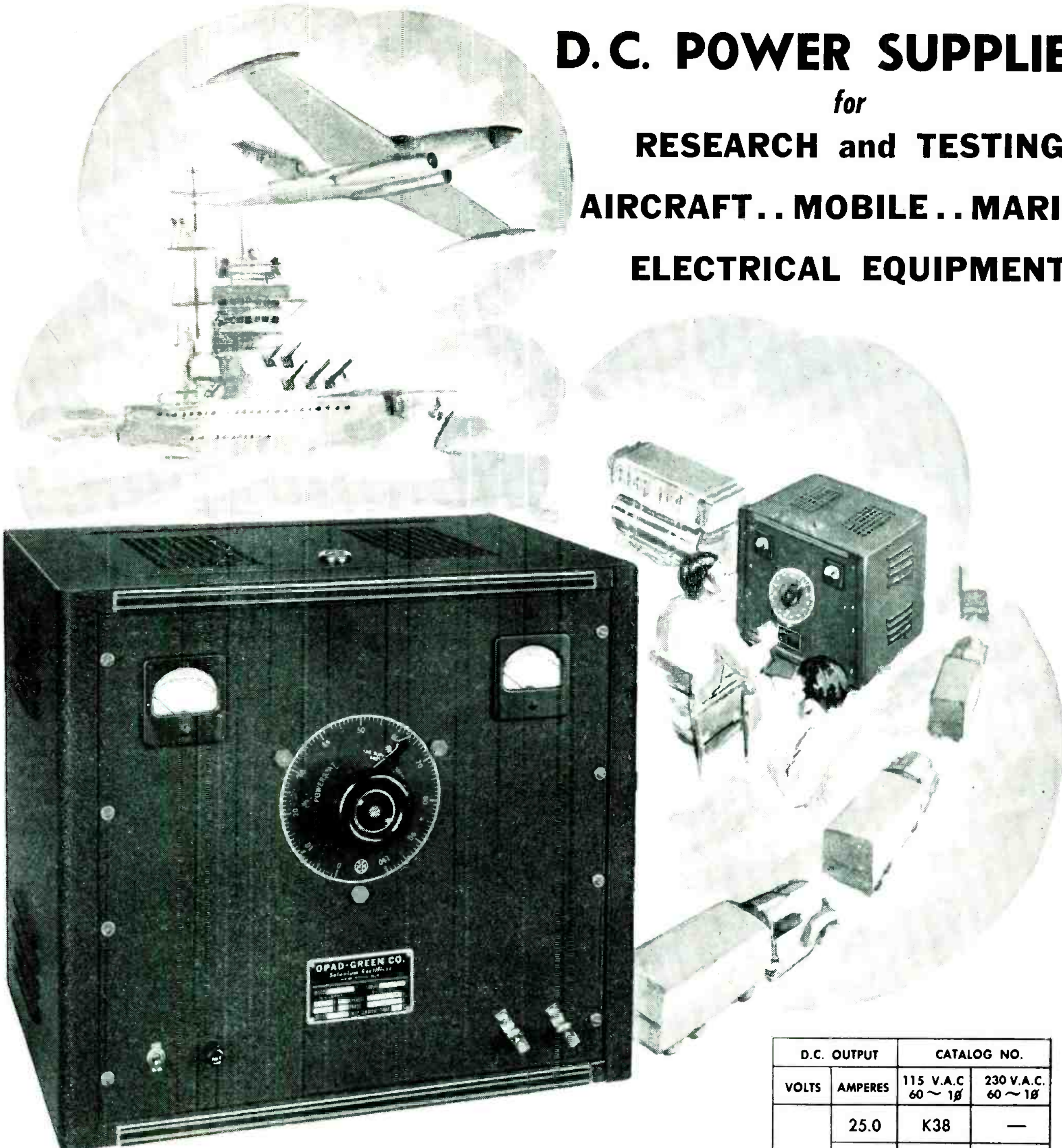
D.C. POWER SUPPLIES

for

RESEARCH and TESTING

AIRCRAFT . . MOBILE . . MARINE

ELECTRICAL EQUIPMENT



The OPAD-GREEN General Purpose Power Supplies are designed to furnish an adjustable source of unfiltered direct current from single phase 50 or 60 cycle A.C. power lines. A unique feature is their stepless control of the D.C. output voltage which permits them to serve as power sources for a wide variety of electrical equipment and electro-chemical processes. *For additional information write for Bulletin No. 147*

D.C. OUTPUT		CATALOG NO.	
VOLTS	AMPERES	115 V.A.C 60 ~ 1Ø	230 V.A.C. 60 ~ 1Ø
O-6	25.0	K38	—
	50.0	K47	K48
	100.0	K56	K57
O-12	12.5	K65	—
	25.0	K74	K75
	50.0	K83	K84
O-28	10.0	K92	—
	20.0	K101	K102
	40.0	K110	K111

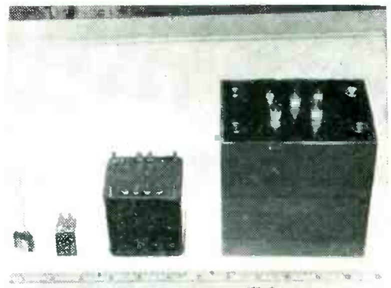
Opad-Green COMPANY

71-2 WARREN STREET, NEW YORK 7, N. Y.

laboratory testing such as heat cycling and refluxing. The timer uses a single electron tube to charge a resistance-capacitance network so that on cycles are adjustable from 0.2 to 200 seconds and off cycles range from 0.1 second to 1 minute. The unit is supplied in a 6 × 6 × 6-in. cabinet for operation on 105 to 120-v, 60-cycle a-c. Output is supplied to a dpdt relay for noninductive loads up to 10 amperes at 115 v or 2 amperes at 460 v. Relay contacts are wired to a plug or a terminal strip to facilitate installation.

Frequency Standard

American Time Products, Inc., 580 Fifth Ave., New York 36, N. Y. Type 2007 hermetically sealed frequency standard contains a shock-mounted miniature high-Q tuning fork, a subminiature double triode tube and all circuitry. Output frequencies available are 400 or 500 cycles with an accuracy of ±1 part in 50,000 from 15 to 35 deg C and ±1 part in 5,000 from −65 to +85 deg C. It is sealed in an octal base container, 1½ in. in diameter and 4½ in. high. It weighs less than 10 oz. Power required is 75 to 200 v d-c at 1 to 5 ma, and 6.3 v at 300 ma. It is designed to withstand MIL environment.



Transformers

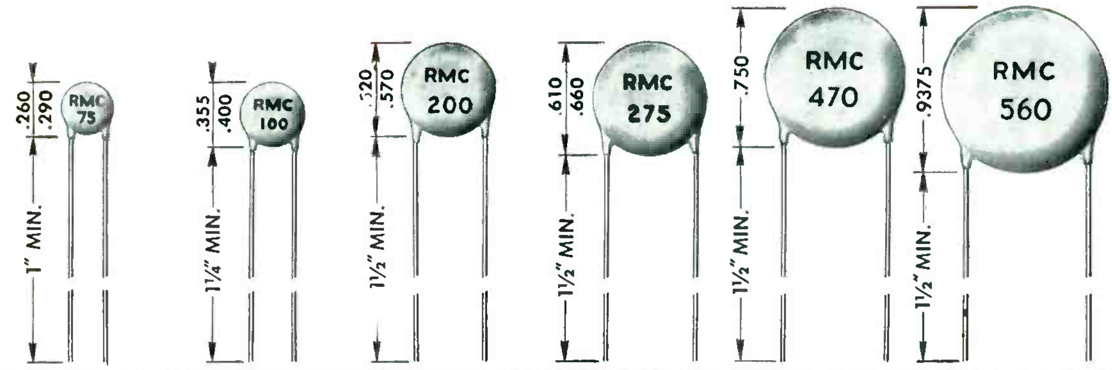
A.J.F. Industries, Inc., 852 Monroe St., Brooklyn 21, N. Y., is now

RMC

Temperature Compensating as well as By-Pass

DISCAPS®

are Rated at 1000 Working Volts!



TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	—	2– 9 MMF	10– 30 MMF	—	—	—
NPO	2– 12 MMF	13– 27	28– 60	61– 75 MMF	76–110 MMF	111–150 MMF
N– 33	2– 15	16– 27	28– 60	61– 75	76–110	111–150
N– 80	2– 15	16– 27	28– 60	61– 75	76–110	111–150
N– 150	2– 15	16– 30	31– 60	61– 75	76–110	111–150
N– 220	2– 15	16– 30	31– 75	76–100	101–140	141–190
N– 330	2– 15	16– 30	31– 75	76–100	101–140	141–190
N– 470	2– 20	21– 40	41– 80	80–120	121–170	171–240
N– 750	5– 25	26– 50	51–150	151–200	201–290	291–350
N–1400	15– 50	51–100	101–200	200–250	251–470	480–560
N–2200	47– 75	76–100	101–200	201–275	276–470	471–560

If the samples you need are not here — send for them.

SPECIFICATIONS

POWER FACTOR: LESS THAN .1% AT 1 MEGACYCLE

WORKING VOLTAGE: 1000 VDC TEST VOLTAGE: 2000 VDC

DIELECTRIC CONSTANT: P-100 14K N-750 88K N-2200 265K NPO 35K N1400 165K

CODING: CAPACITY, TOLERANCE AND TC STAMPED ON DISC

INSULATION: DUREZ PHENOLIC—VACUUM WAXED

LEAKAGE RESISTANCE: INITIAL 7500 MEG OHMS AFTER HUMIDITY 1000 MEG OHMS

LEADS: # 22 TINNED COPPER (.026 DIA.)

LEAD LENGTH: ¼" BODY 1", 5/16" BODY 1¼", ½" AND LARGER BODY 1½"

TOLERANCES: ±5%, ±10%, ±20%

RMC DISCAPS are Designed to Replace Tubular Ceramic and Mica Condensers at LOWER COST

SEND FOR SAMPLES AND TECHNICAL DATA

DISCAP CERAMIC CONDENSERS

RMC

RADIO MATERIALS CORPORATION

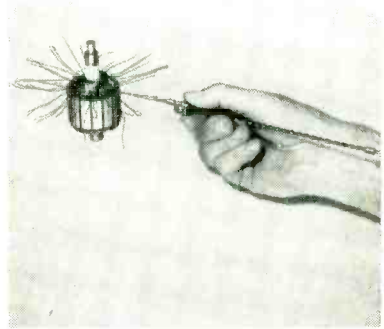
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

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

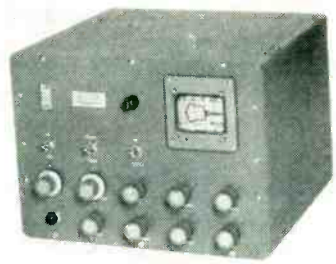
Want more information? Use post card on last page.

producing hermetically sealed transformers per MIL-T-27 specifications in quantity. Sizes range from the sub-subminiature (less than ¼ oz) to 1 kva for the audio, power, plate and filament for temperature rise of 40C at 65C ambient and are made grade 1 with can and also encapsulated without the can. They are manufacturing high temperature 200C transformers which are made hermetically sealed; and pulse transformers ranging in size from trigger and blocking oscillator units of 300 v peak secondary to pulse units of 80 kw peak power and 10 kv peak volts.



Wire Twister

THE ERASER CO., INC., RUSH WIRE STRIPPER DIV., 114 S. State St., Syracuse 2, N. Y. Designed for uniform, low-cost wire twisting, this new wire twister consists of a spiral rod with hooks on both ends and a follower shaped to fit the thumb and forefinger. With the followers at one end, the wire is attached to the hook on that end and the follower drawn the full length of the spiral rod. Then the unit is turned end for end and the operation repeated. The No. G-3 is designed for 6 turns; the No. G-4, for 12 turns.



Servo Tester

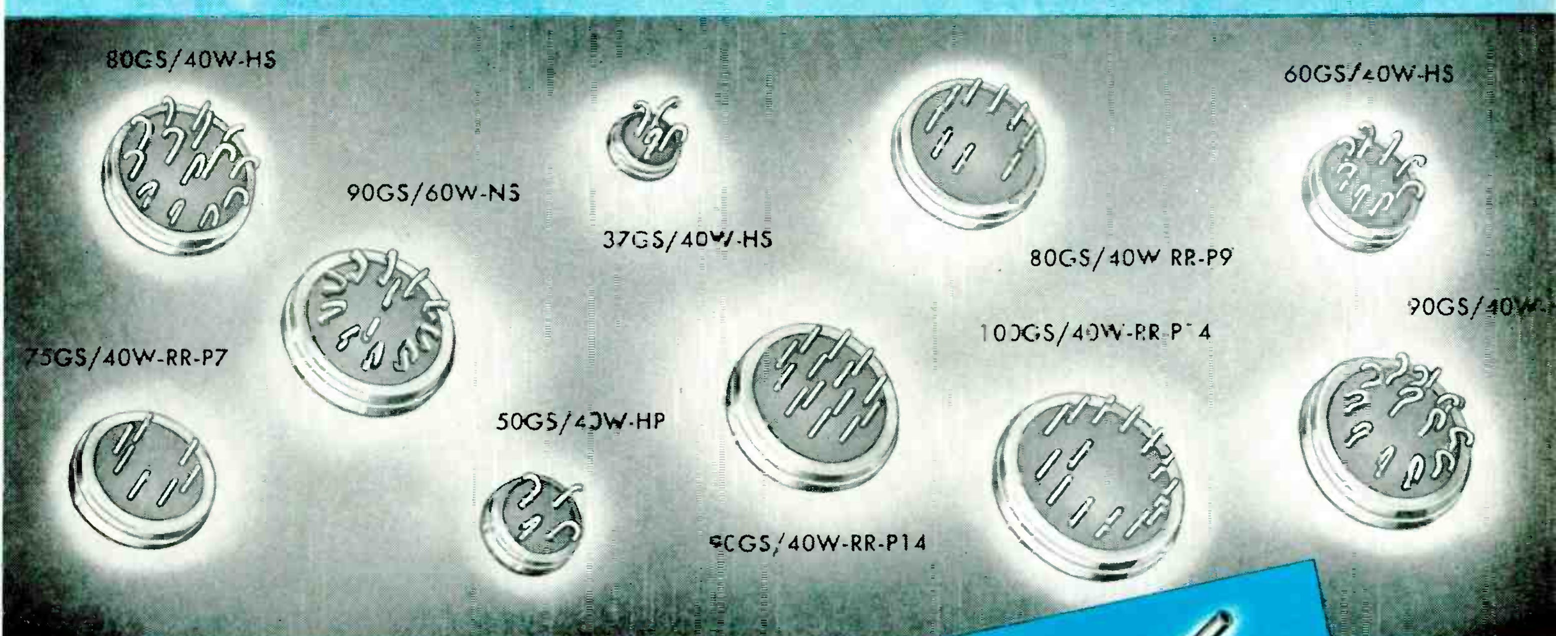
INDUSTRIAL CONTROL CO., Wyandanch, Long Island, N. Y. The

Introducing the new E-I

GS SERIES MULTIPLE HEADERS

...specially designed for relay closures and similar applications

New GS Series multiple headers are another step forward in standardization by E-I engineers. They offer engineers in electronic and electrical design a selection of economical standard components that solve most, if not all, problems of hermetically sealed terminals for relay closures and similar applications. Over 200 standard headers are now available for this type of service. For complete information on other types, consult the bulletin described below.



- RUGGEDLY DESIGNED FOR EXTRA DEPENDABILITY
- MANY TYPES AVAILABLE WITH EXHAUST TUBES
- WIDE RANGE OF SIZES FOR ALL REQUIREMENTS
- STANDARD TYPES FOR MAXIMUM ECONOMY

E-I . . . your Headquarters for Hermetically-Sealed Multiple Headers, Octal Plug-Ins, Terminals, Color Coded Terminals, End Seals, etc.

WRITE FOR NEW E-I MULTIPLE HEADER BULLETIN 950-B!

Includes the complete line of E-I Standard Multiple Headers which offer an economical solution to practically any problem of design involving hermetically sealed terminals.

DIVISION OF AMPEREX ELECTRONIC CORP.

ELECTRICAL INDUSTRIES

44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

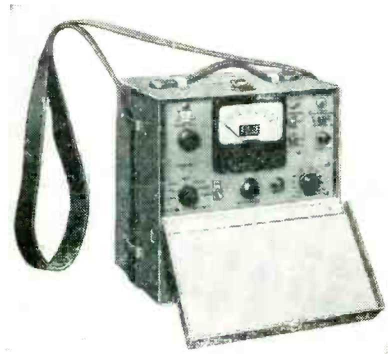
101-A servo tester is designed for the rapid field maintenance and production testing of servo systems by technical personnel using no additional instrumentation. The transient response of the loop under test is shown on a 3-in. c-r screen, and viewed through a mask onto which has been previously drawn the response specified by the manufacturer. The operator adjusts the servo loop to match the two traces; if this is not possible, the loop is declared inoperative and returned to a laboratory area or maintenance depot for repairs. A standard servo test receptacle is installed on the equipment to be checked, and wired into the data system. A single cable connects this plug to the 101-A. The tester can be used with d-c and carrier frequency servos, and operates from the 117 v 60 or 400-cycle line.

Power Resistor

INTERNATIONAL RESISTANCE Co., 401 N. Broad St., Philadelphia 8, Pa., has added to its line a new power resistor, type PW4, rated at four watts. Completely insulated with an inorganic core material molded in a high temperature plastic, this unit will not support combustion. The wire element is uniformly and tightly wound on glass fibre core with axial leads $1\frac{1}{2}$ in. long and 0.036 in. in diameter. Body dimensions are $1\frac{3}{4}$ in. long x $\frac{3}{4}$ in. in diameter. The resistor is available from 1 ohm to 8,200 ohms in ± 5.0 percent and ± 10.0 percent tolerance. It is particularly recommended for tv circuits requiring 2 to 3 w actual dissipation at high ambient temperature, as resistance element of resistance—capacitance filter in automobile receiving sets where operation is at high ambient

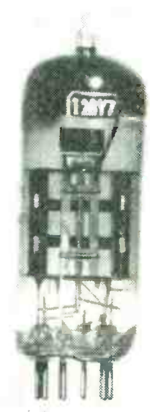
Want more information? Use post card on last page.

temperature, and all other circuits where a stable resistor is required, with wattage dissipation of 4 watts and less.



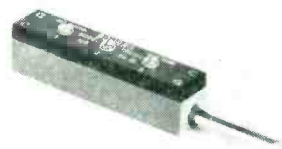
Field Strength Meter

JERROLD ELECTRONICS CORP., N. E. Cor. 26th & Dickinson Sts., Philadelphia 46, Pa., has developed the model 704 field strength meter that is designed to bridge the gap between ultra-expensive laboratory models and the simple-type field meters which provide only a relative indication of signal strength. It is a direct-reading meter for tv and f-m and will read in microvolts. The unit is accurate to ±0.8 db and has a continuous tuning range from 50 to 220 mc. Model 704 separates and measures video, audio and adjacent channel carriers, and locates r-f interference.



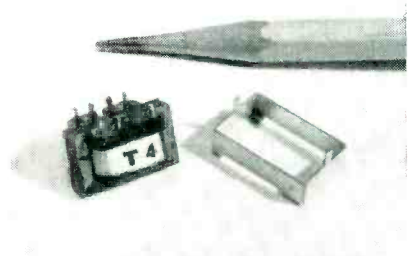
Television Pentode

SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa., has in production a new television pentode, the 12BY7. It is a high-transconductance, sharp-cutoff video amplifier designed for service in tv receivers. The tube features miniature T-6½ construction, and will furnish large output voltages across low values of load resistance and supply voltage. The separate suppressor grid connection allows the 12BY7 to be used for more diversified applications. The heater may be operated from either 6.3 or 12.6 v.



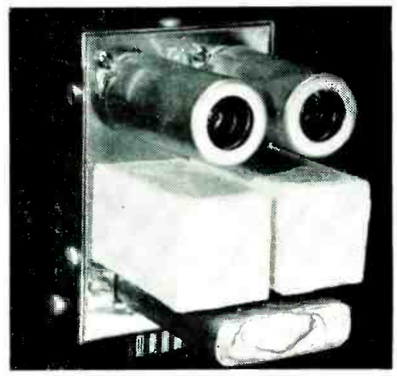
Linear Motion Potentiometer

Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif. The new linear motion potentiometer with precision wire-wound resistance elements was designed for airborne and industrial electronic systems. Linearity, tested by the continuous calibration method is ±0.5 percent or better. A resolution of 0.001 in. is attainable with standard shaft travels of 1 $\frac{1}{16}$ (model illustrated), 2¼, 4 and 6 in. The potentiometer will withstand sustained acceleration of 100 g's and vibration of more than 1,000 cps. Standard resistances range from 1,000 to 50,000 ohms. An output of at least 26 v is attainable from the unit. Size is ⅝ in. x ½ in. x 2½ in. Weight is 1¼ oz.



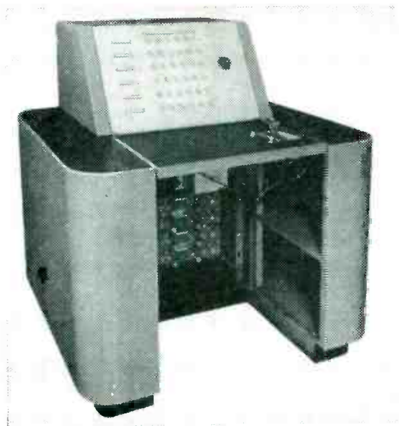
Miniature Transformer

Fortiphone Ltd., 247 Regent St., London, W.1, England. Type T.4 miniature transformer has been designed for use as an output transformer in hearing aids and similar miniature equipment. The windings of the transformer are brought out to terminals molded into the robust thermosetting plastic material of the bobbin. A laminated core of high permeability magnetic alloy is used. All coils are tested to insure that there are no short circuited turns and each completed transformer is checked for efficiency at three frequencies under typical operating conditions. Insulation resistance between primary and secondary at 500 v d-c is better than 100 megohms. Ratio of primary turns to secondary turns is normally 31.6 to 1 although other ratios are available on request.



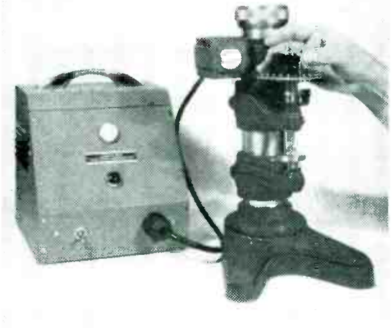
Isolation Amplifier

SEAY INSTRUMENT CO., 6521 N. Lamar Blvd., Austin 5, Texas, announces a new amplifier designed primarily for use in driving resolvers and computing potentiometers. Virtually universal application has been achieved through a novel circuit design that has been tried and proven in several large scale computors. A very high input resistance has been obtained through elimination of the conventional input summing resistors normally used. Up to 66 db of negative feedback provides almost complete independence from tube, power supply and frequency variations. The networks for controlling the frequency response of the amplifier are molded in a thermosetting material for stability and simplified packaging. Their broad band design permits use of the amplifier at any carrier frequency from 30 cps to 1 kc. Detailed information on performance, circuit applications and dimensions are published in technical bulletin No. 1.



TV Master Switchboard

FEDERAL TELECOMMUNICATION LABORATORIES, INC., Nutley, N. J., has developed a television master switchboard for increased operating control and flexibility. Completely self-contained, the unit permits channeling six separate inputs to six destinations by means of indirect relay switching. These relays may be located in the operating console or at a remote rack. A larger automatic clearing, and automatic termination and automatic holding features have been incorporated, as well as adjustment of the gap or lap switching interval. The built-in fader employs a two-channel video amplifier through which any two incoming signals may be routed. The output signal may then be reinserted as an additional signal source.

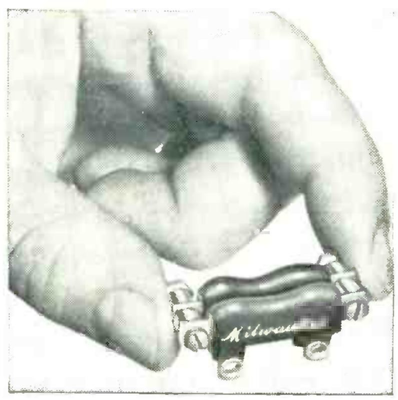


Electronic Micrometer

J. W. DICE CO., 1 Engle St., Englewood, N. J. Model W electronic

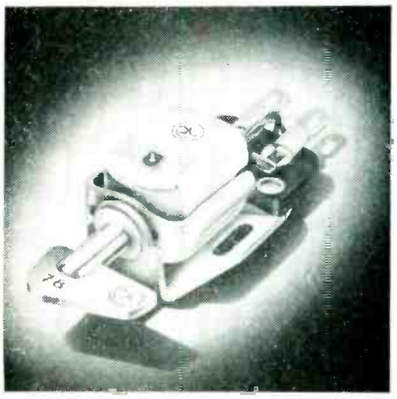
Want more information? Use post card on last page.

micrometer permits direct measurements to 0.00002 in. without any measuring pressure being exerted on the work. The measuring head consists of an extremely accurate micrometer screw. An electronic circuit, sensitive to five millionths of an inch displacement at the micrometer tip, gives a visual indication at the moment of contact but before pressure is exerted. Model W is especially designed for use in research, development and performance testing of diaphragms and bellows used in flight instruments, temperature, refrigerator and other types of controls where a pressureless means of testing is required. This new model is an addition to the other models now widely used for measuring thin paper, fine wire, foil, machined parts, springs, radio tube grids and cathodes and other items requiring the highest possible accuracy in a direct measurement.



Miniature Oval Resistors

MILWAUKEE RESISTOR CO., 700 W. Virginia St., Milwaukee 4., Wisc., is manufacturing oval type wire wound resistors designed to give higher wattage ratings within small space limitations. These small resistors are equipped with an aluminum mounting strip to provide cooler operating temperatures and greater dissipation of heat caused by intimate contact with the ceramic core. Spacers attached to the ends of the aluminum strip permit easy stack mounting and better heat conduction to the mounting surface. The resistors are available in 10 watts ($\frac{3}{8}$ x $\frac{3}{4}$ in.) and 15 watts ($\frac{3}{8}$ x 1 in.) sizes. They are wound on oval steatite cores with silver soldered connections and coated with vitreous enamel. Samples are available on request.



Turnover Pickup

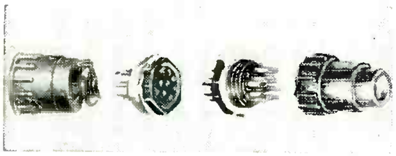
PICKERING & Co., Oceanside, N. Y., has developed a new contribution to the technique of recreating recorded music. Model 260 turnover pickup has an output of 30 mv at 10 cm per second; and it mounts easily in any type arm. Detailed literature is available for the writing.

Small Variable Transformer

PACIFIC TRANSDUCER CORP., 11921 W. Pico Blvd., Los Angeles 64, Calif., announces model 226 small variable transformer for portable use in factory and laboratory. With a primary of 117 v a-c, 50 watts, the secondary is from 7 to 13 v a-c continuously variable and 4 amperes continuous duty. It can be used for 6 to 12-v lamps, small motors, heater elements and for operation of a-c relays and solenoids. The unit weighs 3 lb. Its dimensions

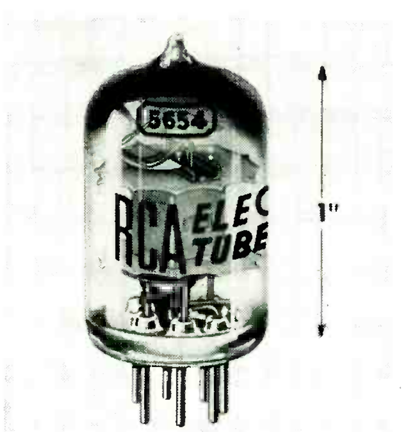
Want more information? Use post card on last page.

are $3\frac{1}{2}$ in. $\times$ 4 in. $\times$ $3\frac{1}{2}$ in. high. Each unit is supplied with a 6-ft a-c cord.



Miniature Connector Hood

DEJUR-AMSCO CORP., 45-01 Northern Blvd., Long Island City, N. Y., announces the addition of a new hood to the series 20 miniature hexagonal connector line of Continental precision connectors, terminal boards and stand-off terminals. The type C38-C hood, molded from melamine with aluminum anodized cable clamp is now an added feature to the C5, 7, and 9 contact hexagonal connectors. It provides for strain relief on cable assemblies when disengaging connectors in hard-to-get-at places.



Sharp-Cutoff Pentode

RADIO CORP. OF AMERICA, Harrison, N. J. The 5654 is a "premium" version of the miniature sharp-cutoff pentode 6AK5 for use as a broadband r-f or i-f amplifier in mobile and aircraft receivers. Compact structure provides increased mount strength against shock and vibration. A pure-tungsten heater gives long life under conditions of on-off switching. The tube also features high transconductance, low interelectrode capacitances, high input resistance and high signal-to-noise ratio. A recent data sheet gives a complete technical description, in-

Want more information? Use post card on last page.

cluding characteristics charts and dimensional diagram.

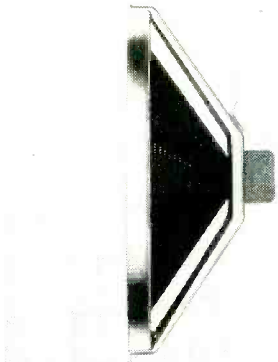
Magnetic Signal

FEDERAL TELEPHONE AND RADIO CORP., Clifton, N. J., has developed a new magnetic switchboard signal capable of providing both visual and audible indication. Designed for fast indication, long life and dependable performance under rugged conditions, this sturdy, compact magnetic unit supplants the mechanical operation commcn to the old-type drop signal. It is only ¾ in. sq x 3½ in. long, and operates on 8 ma d-c or 8 ma a-c in series with selenium rectifier equipment or its equivalent. The unit is equipped with a contact for an audible signal when required. The new signal is dust and moisture proof, nonpositional and constructed to withstand severe vibration. It has high sensitivity, a luminous face indicator that is clearly visible day or night, and the signal is mechanically restored.

L-V Power Supply

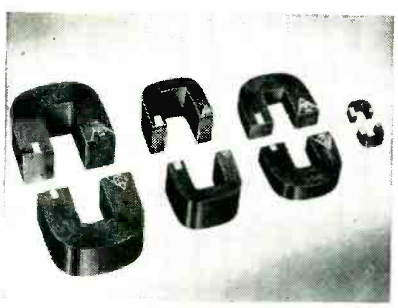
OWEN LABORATORIES, 9130 Orion Ave., San Fernando, Calif. The type 200 low-voltage power supply is a highly regulated unit for use with resistance strain-gage elements, and for similar exacting applications. Output is one ampere maxi-

mum, at from 0 to 15 v d-c Where absolute freedom from drift is required a small chopper-amplifier provides precise stabilization against an external reference. The supply may be rack mounted.



Streamlined Speaker

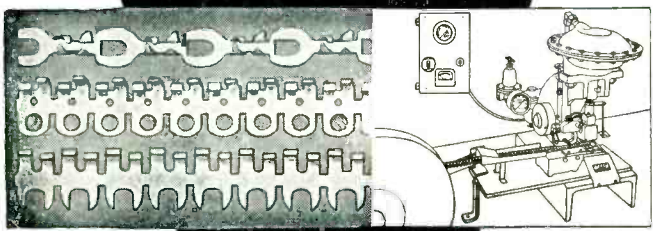
CARBONNEAU INDUSTRIES, 21 Ionia N. W., Grand Rapids, Mich. The Gold Cup speaker features the ultimate in simplicity of design, thus eliminating costly bulk and weight. Ten-inch Gold Cups are now available with 2.15 oz magnet, 1-in. voice coil, and 1.00 oz magnets with 1-in. voice coil, both supplying flux in the air gap equivalent to speakers using up to 50 percent more magnet.



Strip-Wound Transformer Cores

PERMOFLUX CORP., 4900 West Grand Ave., Chicago 39, Ill., announces the availability of its new Cee-Cor strip-wound transformer cores, manufactured from grain-oriented silicon steel strip to exacting mechanical and electrical tolerances. These units give the transformer engineer cores of extremely high efficiency and permeability and are particularly suited to designs where space and weight are critical fact-

TANDEM TERMINALS
Attached and Soldered



at rates up to
1200 Per Hour

Costs are reduced, production increased and more efficient terminations consistently result when P-M Pre-Soldered Tandem Terminals are machine attached and soldered! Produced in continuous form, and supplied on reels, P-M Tandem Terminals are applied in our machine that cuts off, clinches and solders terminals to wires in one instantaneous operation. This method has replaced slow, costly hand attachment in many leading plants. Handling of loose terminals, solder and flux are eliminated to cut costs and boost production on long runs. Standard types available. Send for detailed information, and enclose sample of terminal and wire now used. Address Dept. E.

For ordinary runs in moderate quantities we continue to produce

SEPARATE TERMINALS for ELECTRIC WIRES

We are also large producers of SMALL METAL STAMPINGS. Modern plant with complete equipment for large volume production of stamped metal parts in accordance with customers' prints. Moderate die charges. Precision work. Prompt service.

PATTON·MacGUYER COMPANY

201 CHAPMAN ST., PROVIDENCE 5, R. I.

MICROWAVE RESISTORS TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE

(Ideal for Miniaturization)

TYPICAL APPLICATIONS

- Power measurement at any frequency
- Matched terminations for waveguides 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.

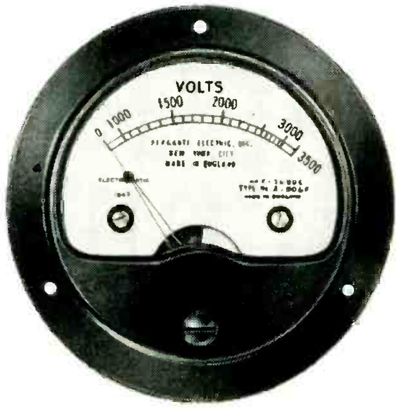
SPECIFICATIONS

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

A TRUE ELECTROSTATIC VOLTMETER

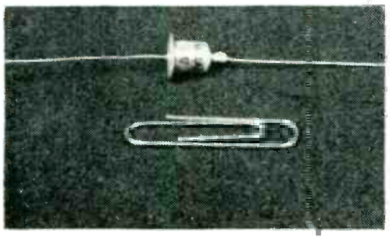


This instrument permits voltage readings on AC or DC circuits of very high resistance. The only current drawn is the very small leakage current and a very low capacitance current on AC circuits. Very useful for the many high voltage—low current circuits employed in nuclear research. Available with full scale voltages ranging between 300 and 3500 volts. Special laboratory instrument available with full scale reading of 150 volts. Full scale capacitance ranges from 8 mmfds for the 3500 volt model to 100 mmfds for the 150 volt instrument. Magnetic damping. 2½" dial. Write for complete specifications.

FERRANTI

FERRANTI ELECTRIC, INC.
30 Rockefeller Plaza • New York 20, N. Y.
FERRANTI, LTD., Hollinwood, England
FERRANTI ELECTRIC, LTD., Toronto, Canada

ors. Cee-Cor's, wound from 1, 2, 4 and 12-mil material, are available in a wide variety of standard window sizes and build-ups. Facilities also make possible the winding of special cores for unusual applications.



Germanium Rectifiers

GENERAL ELECTRIC CO., Syracuse, N. Y., has announced new diffused junction germanium rectifiers for use in computers, magnetic amplifiers, tv receivers and telephone switchboards. The four models in the new series are hermetically sealed and extremely small in size. Forward resistance of the new units is very low, less than 2 ohms at rated load. Back resistance and peak inverse voltages are high. Peak inverse voltages range from 100 to 400 v. The d-c output currents into a resistive load range from 75 to 500 ma. Full load voltage drop is 0.5 in three models and 0.7 in the fourth. All ratings are at ambient temperature up to 55 C.

Audio Amplifier

SUMMIT ELECTRONICS, INC., 7 Industrial Place, Summit, N. J. A new precision audio amplifier combines unusually low signal-to-noise and distortion factors with high power output. The equipment is available in several models for vary-

Want more information? Use post card on last page.

TUBE COST DATA
you've always wanted!

Most comprehensive and accurate purchasing and cost-analysis tool in tube history! Product of over 2 years' research. Covers *every* tube type and crystal manufactured in U.S.—from tiniest crystal to largest transmitting tube—including . . .

Amperex • Bomac • Chatham • Cetron Du Mont • Eimac • Federal • General Electric Hytron • Industro • Lewis & Kaufman Machlett • National • National Union North American Philips • Philco • Raytheon RCA • Sperry • Sylvania • Taylor • Tung-Sol • United • Western Electric • Westinghouse

Tells list prices and your current costs for over 4,000 tube types! Kept up-to-date by State Labs' famous Weekly Market Guides mailed free to all owners of the Tube Buyers' Guide. In loose-leaf form, alphabetically and numerically indexed for quick, easy reference.

PRAISED BY INDUSTRY LEADERS

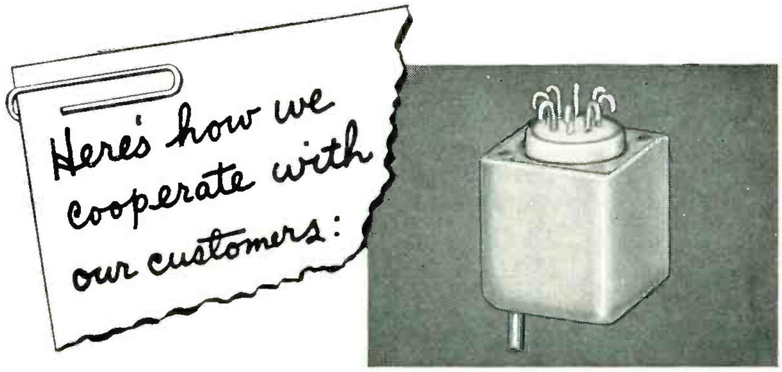
Says W. L. Urquhart, President, W. L. Urquhart, Inc. one of America's leading electronic tube exporters: "Without doubt your new 1953 U.S. Electronic Tube Buyers' Guide contains the most extensive tube cost information ever to hit the tube markets of this country. It's invaluable to me — I wouldn't be without it for a day."

for YOUR copy-USE the COUPON!

Note: This Tube Buyers' Guide is necessarily restricted to Purchasing Agents, Manufacturers, Industrials, Government Agencies, Distributors, Exporters. Please fill out the coupon in full and attach to your letterhead.

STATE LABS, INC. Dept. E
37 East 28th St., New York 16, N. Y.
Send me your FREE 1953 U.S. Electronic Tube Buyers' Guide.
NAME__________
TITLE__________
COMPANY NAME__________
ADDRESS__________
CITY__________ STATE__________
NATURE OF COMPANY BUSINESS__________

State Labs, Inc., 37 E. 28 St., N.Y.C.
MUrray Hill 3-9802

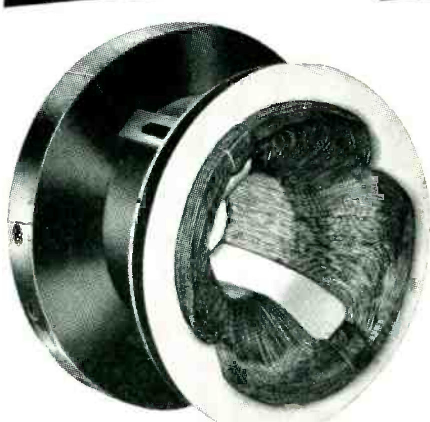


EXAMPLE: Working with the North Electric Manufacturing Co., Galion, Ohio, we developed a new miniature hermetically sealed relay to meet exacting military requirements. Features include an 8-terminal sealed header .600" O.D. and a new design balanced armature relay, sealed in a $\frac{7}{8}$" x $\frac{7}{8}$" x $\frac{7}{8}$" drawn aluminum can. The entire unit may be panel mounted from either the top or bottom. The unit can be furnished either with a dry air fill or vacuum-pumped and pressure filled with dry nitrogen.

HAVING HEADER TROUBLES? We make all types of Sealed Headers, ranging from simple 2- and 3-electrode, crystal holder bases, and standard octal headers, to 14- and 16-terminal headers for sealed Transformer and Relay applications. (Also a variety of special-design headers and terminals.) Write for catalog and quotes.

Hermaseal **THE HERMASEAL COMPANY, Inc.**
Elkhart 10, Indiana

DX *Announces*
a NEW 90° YOKE for 27" TUBES



It's Engineered for TOP PERFORMANCE ... in Production *NOW!*

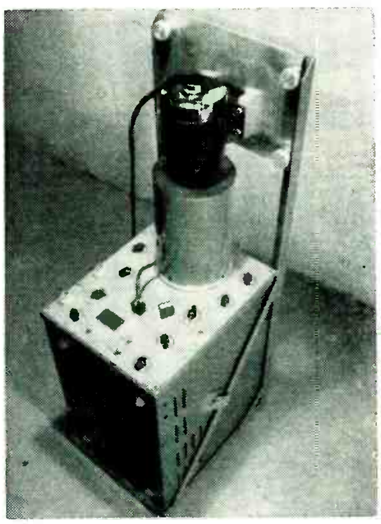
This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

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.

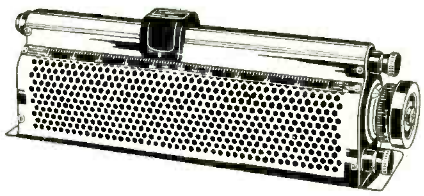
ing input impedance requirements, while output impedance is switch controlled from 4 to 600 ohms in all models. Employing negative feedback on all stages, the new amplifier offers extremely stable characteristics. Distortion is less than 1.0 percent at the full rated output of 30 w while frequency response is exceptionally flat over a 30-cps to 15-kc range; with a high impedance input the response is flat ±0.2 db over the entire range, and similarly low variances are encountered when low bridging or terminating impedances are used. All components have been carefully chosen to assure fulfillment of the flat frequency response, low distortion and noise characteristics for which the amplifier was designed.



Bandwidth Compressor

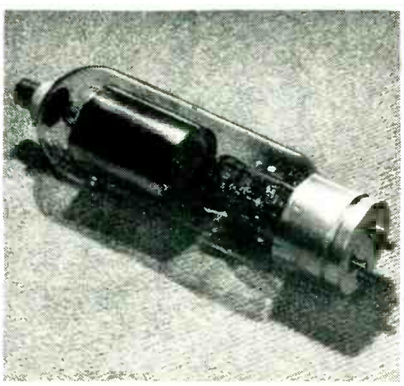
HALLER, RAYMOND AND BROWN, INC., State College, Pa. The Rafax bandwidth compressor is a device for laboratory use in connection with testing radar relay equipment and processes. It accepts radar video signals from a search type radar. These signals usually have a bandwidth of from 1 to 5 mc. Its output is a compressed video signal whose bandwidth is of the order of 1 to 5 kc. The device takes advantage of the inherent redundancy in radar signals and of the fact that the usual ppi type radar picture can be reproduced at a bandwidth of only a few kc. Since the Rafax unit should be matched to the parent radar, each application calls for a

tailor-made model in which the motor scan rate and integrator storage time are optimized.



Combination Rheostat

REX RHEOSTAT Co., 3 Foxhurst Road, Baldwin, L. I., N. Y., has introduced a new vernier rheostat for extremely fine control of current and voltage. It consists of a combination of a standard tubular rheostat with a turnable vernier rheostat in series or in parallel connection. Each step on the vernier has about $\frac{1}{10}$th of the ohmic value of one winding of the main rheostat. Each rheostat is provided with a dial, making exact settings of the slider positions possible. Ask for catalog No. 5.



Half-Wave Rectifier

GENERAL ELECTRIC Co., 1 River Road, Schenectady 5, N. Y., has added to its industrial tube line a half-wave rectifier designed for use in h-v rectifier circuits. The type GL-4B32 is designed particularly for use as a rectifier in radio and tv transmitters, industrial heating oscillators, and other applications where high-voltage d-c is required. The tube is an inert-gas-filled tube that will operate over a wide temperature range, from —55 to +70 C. Use of an inert gas instead of mercury permits mounting it in any position. Maximum ratings for

Want more information? Use post card on last page.

NEW

the AUTOGRAF

a general purpose, wide range, portable, universal X=(f)Y graphic recorder

Now you can expedite your research, development, and test programs with the AUTOGRAF —a precision recorder that automatically plots curves showing relationship between a dependent and an independent variable. Through two rebalancing, servo-actuated recording axes, the AUTOGRAF draws cartesian coordinate graphs from any data that can be reduced to electrical form. You save the time it would ordinarily take to read meters, collate data, transfer data to grid, draw in curves...The AUTOGRAF does all this work for you, plotting the data simultaneously with occurrence of the phenomenon being studied. Too, the AUTOGRAF draws related curves in families as fast as input information can be altered. Without any additional steps, once a test is run, you have in hand a complete, accurate, pen-and-ink graph, drawn on a standard 8½"x11" sheet of paper, ready for study, file, notebook, or reproduction.

TYPICAL PLOTTING APPLICATIONS:

- Current/Voltage
- Lift/Drag
- Speed/Torque
- Magnetization
- Frequency response
- Analog computer output curves
- Temperature/Pressure
- Stress/Strain
- Transistor and Diode characteristics
- Magnetic amplifier, input/output
- Temperature/Activity
- X=(f)Y

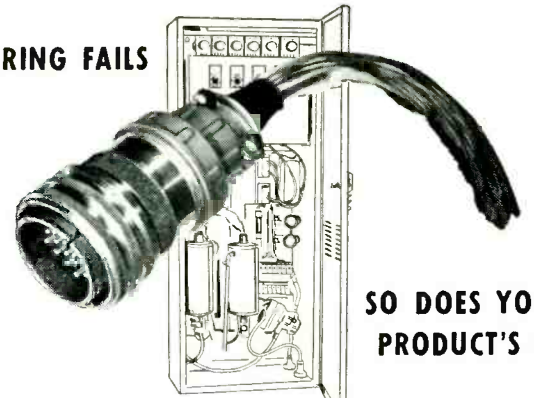
SPECIFICATIONS: — Two independent servo-actuated recording axes; input free of ground. • Recording speed, both axes, 1 second for full scale travel. • Scales: from 0-5 millivolts up to 0-100 volts, both axes. • Full-range zero set on either axis — plots data in any desired quadrant. • Sensitivity — 200,000 ohms per volt, 5 microamperes drain for full scale. • Size and weight: 13" x 13" x 10"; 35 lbs. • Self-contained; operates from 115 volt 60 cycle line, 85 watts.

WRITE for complete details

MOSELEY

FRANCIS L. MOSELEY
1325 N. FAIR OAKS
PASADENA 3, CALIFORNIA

IF THE WIRING FAILS



SO DOES YOUR PRODUCT'S REPUTATION

FOR DEPENDABLE PRODUCT WIRING USE

UNILECTRIC WIRING SYSTEMS

TRADE-MARK

Year after year — for over ten years — UNILECTRIC has produced millions of wiring systems, for more than 150 leading manufacturers of electric and electronic products. From controls to complex armed forces equipment, these wiring systems have consistently met the most exacting requirements and provided substantial savings to each customer.

To assure utmost dependability plus cost saving engineering assistance, low cost production and "on-schedule delivery" investigate UNILECTRIC today.

UNILECTRIC WIRING SYSTEMS
TRADE-MARK
Manufactured by
UNITED MANUFACTURING & SERVICE COMPANY
409 SOUTH 6th STREET • MILWAUKEE 4, WISCONSIN

WHEN you need a quick answer to

WHO MAKES IT...

Just look it up in

the electronics BUYERS' GUIDE

•

There are ...

23,367 ANSWERS

to

1,445 PROBLEMS

covering every ...

COMPONENT EQUIPMENT and MATERIAL

used in every phase of electronics

•

GET IN THE HABIT OF LOOKING IT UP IN the electronics BUYERS' GUIDE

A McGRAW-HILL PUBLICATION
330 West 42nd Street
NEW YORK 36, N. Y.

Experienced Electronics
Production Test Equipment
ENGINEERS
Needed

to
apply
techniques
to

GUIDED MISSILES

Inquire:
MGR., ENGR. PERSONNEL

BELL Aircraft CORPORATION

P. O. BOX 1, BUFFALO, N. Y.

2 ELECTRIC PRODUCTIMETERS

"CS" and "Y"
ELECTRIC PRODUCTIMETERS
The answer to all electric counting requirements

Two Companion Counters . . . Two Sizes . . .
Hi-Speed . . . Accurate . . . Long Life . . . Totally Enclosed

Speeds of 1000 counts per minute. Both counters give maximum readability. Design fits all mounting conditions . . . panel mounting or base mounting. Hardened steel working parts for long life and dependability.

New type case for compactness, rigidity, and protection against dust and moisture conditions. Operate accurately over wide current fluctuations.

DURANT MANUFACTURING CO.
1912 N. Buffum St., Milwaukee 1, Wis.
112 Orange St., Providence 3, R. I.
Representatives in Principal Cities

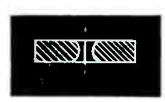
Write for "New Electrics" Bulletin

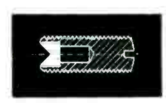
PRODUCTIMETERS SINCE 1879 *Count Everything*

Sapphire... Glass...
PRECISION Jewel Bearings by *Bird*

At your service, for all small bearing problems, the Bird Company engineering staff designs accurate sapphire and glass jewel bearings used in the world's most famous aircraft, electrical and timing instruments; weather and all types of recorders; and fine indicating apparatus.

Close tolerances, accuracy, and long life qualify Bird Jewel Bearings to insure quality in your finest instruments. Quotations on request for jewels made to specifications for your individual requirements.



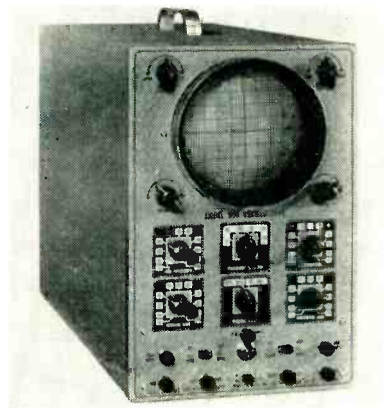


The engineering staff of the Bird Company is at your service for all small-bearing problems.

Serving industry with fine jewels since 1913

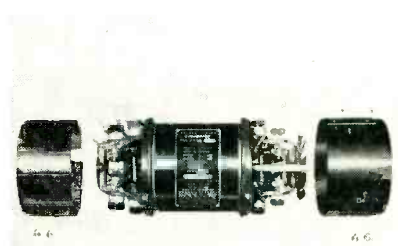
Richard H. Bird & Co., Inc.
Sapphire and glass jewels ● Precision glass grinding
Ferrite precision products ● Sapphire stylii
7 Spruce Street, Waltham 54, Mass.

the GL-4B32 include a peak maximum cathode current of 5 amperes, an average maximum cathode current of 1.25 amperes, and a maximum peak inverse anode voltage of 10,000 v. The tube is recommended for use with a filament voltage of 5 v and a filament current of 7.5 amperes.



Oscilloscope

ELECTRONIC MEASUREMENTS CORP., New York, N. Y. Model 600 oscilloscope features the use of a 5VPI new 5-in. scope tube. The vertical amplifier has a wide band and can be used up to 5 mc. A two step attenuator input is available. Synchronization is available on either positive or negative phase of input voltage through the vertical amplifier or from an external source. A multivibrator type of sweep from 15 cycles to 75 kc is incorporated.



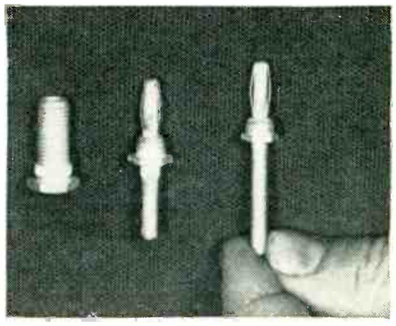
Dynamotor

ELECTRO ENGINEERING PRODUCTS Co., 609 W. Lake St., Chicago, Ill. Model ES-129 dynamotor is a 4-commutator unit that will operate with equally efficient performance from 6, 12 or 24-v power supply. Output is 500 v at 0.100

ampere. Length of the unit is 10¼ in. and diameter is 4½ in. Total weight is 11½ lb. The dynamotor is intended for continuous service, with a rated temperature rise of 50 C. It is ideal for heavy-duty or standard use in communications, laboratory applications, and wherever power supply is variable.

Deflection Yoke

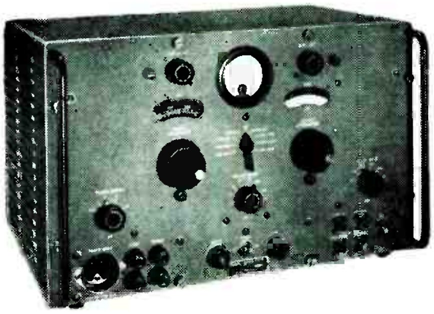
DX RADIO PRODUCTS CO., 2300 West Armitage Ave., Chicago 47, Ill., announces that it is in production on a newly designed 90-deg deflection yoke for 27-in. television tubes. The yoke provides a sharp focus across the entire picture tube screen. The horizontal inductance is 11.2 millihenries and the vertical inductance is 45 millihenries.



Banana Plugs and Jacks

INSULINE CORP. OF AMERICA, 3602 35th Ave., Long Island City 1, N. Y., has announced a new line of silver-plated banana plugs and jacks, intended for use in military, industrial and commercial equipment requiring very low contact resistance. The No. 428 plug has a straight threaded shank 1⅛ in. long. The No. 429 has a combina-

Accurate • Portable • AVAILABLE



the Type H-12 UHF SIGNAL GENERATOR

900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0 to —120 dbm, continuously adjustable by a directly calibrated control accurate to ± 2 dbm. The frequency range is controlled by a single dial directly calibrated to ± 1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of silicone-treated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

Built to Navy specifications for research and production testing, the unit is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator

(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

Price: $942.00 net, f.o.b. Boonton, N. J.

WRITE TODAY for descriptive literature on A.R.C. Signal Generators or airborne LF and VHF communication and navigation equipments, CAA Type Certificated for transport or private use. Dept. 5

ARC

Dependable Electronic Equipment Since 1928

Aircraft Radio Corporation
Boonton, New Jersey

Special TO SPECIFICATIONS — IN ANY QUANTITY

COILS
TRANSFORMERS
PRECISION WIRE WOUND RESISTORS

We offer a complete *Engineering and Manufacturing Service* with emphasis on *Special Applications.* Small pilot runs, or full scale production executed economically and on schedule. Consult us for these products:—

COILS:	TRANSFORMERS:
High Freq. Air Core	Audio • Power
Multi-Layer Solenoids	Elevator
Peaking	High Voltage
Synchro Windings	Pulse Applications
Television RF, IF, etc.	Synchros, etc.

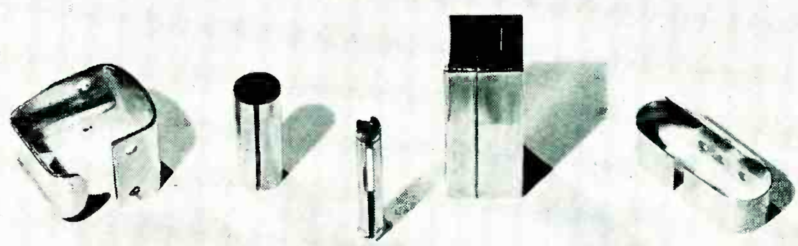
Experimental Samples promptly submitted, usually without charge. Write to:

COMPONENTS MFG. DIV., Dept. E23

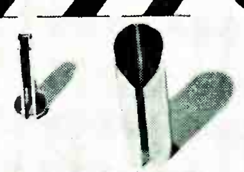
TRANSVISION, INC.

NEW ROCHELLE, N. Y. NE 6-6000

YOUR PRODUCTION RESERVE!



THOMAS

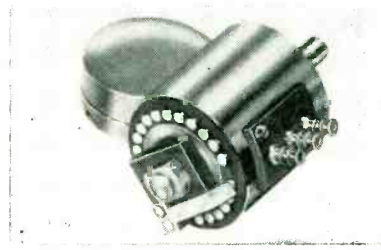


is standing by to quickly tool up for your metal parts requirements. Specializing in large volume production of quality parts at competitive prices. Facilities for all secondary operations, automatic assemblies and finishing. 4-slide equipment available for multi-forming operations.

WILLIAM THOMAS & SONS
91 Pearl St., Brooklyn 1, N. Y., TRiangle 5-5626

FOUR GENERATIONS OF EXPERIENCE...

tion shank ¾ in. long with a knurled collar for force-fit in a panel hole and a threaded section in addition. Both plugs have contact springs of beryllium copper. The No. 431 banana jack is machined of solid brass, also heavily silver-plated. It has a knurled shoulder and a threaded body. The hex head is 7/16 in. across flats, and the shank is 3.4 in. long.



Miniature Attenuator

THE DAVEN CO., 191 Central Ave., Newark 4, N. J., has available the series 120 miniature attenuator that is 1⅜ in. in diameter x 1 29/32 in. deep. The unit was developed primarily for government and commercial applications requiring a smaller step-type attenuator. Its reduced size and weight make it particularly suitable for use in portable equipment as well as stationary equipment where space is at a premium. This miniature attenuator is available in 20 steps having a ladder or potentiometer network. All standard decibel steps and various impedances up to 500,000 ohms are available. Resistor accuracy is ±5.0 percent and power dissipation is 0.6 watt.

ULF Oscillator

KROHN-HITE INSTRUMENT CO., 580 Massachusetts Ave., Cambridge 39, Mass., announces a new ultra-low-

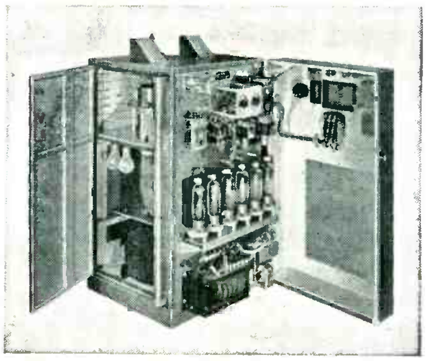
Want more information? Use post card on last page.

(Advertisement)

PANELS, LIDS, DOORS MADE RF-TIGHT BY LOW COST METHOD

Electronic Weatherstripping, made of knitted wire mesh compressed to required sizes and shapes, effectively "shields" these openings against RF leakage just as weatherstrips seal doors and windows.

Openings such as these are necessary for operating and servicing the electronic equipment housed in the metal cabinet. Yet these same openings destroy the full shielding efficiency which an "unbroken" metal container would otherwise provide. Careful machining of mating surfaces at



"Thermatron built by Radio Receptor Co., Inc."

these openings is an obvious answer. But such work is expensive, and the initial close fit is often destroyed by repeated openings and closings, by warping of the lid or door and by corrosion of the mating surfaces. Numerous latches, screws, bolts and other fasteners, closely spaced, will help keep these joints RF tight, but they are a time consuming nuisance whenever the cabinet must be opened and closed, and they are expensive to purchase and install.

Metex Electronic strips and gaskets eliminate these objections. Being made of metal, they are conductive; and being knitted they are resilient and conform to normal surface irregularities. They actually "block" the otherwise leaky openings with a gasket of flexible metal, and make the cabinet as effective a conductive shield as if the openings had never been made.

Metex electronic strips and gaskets are easy to install. Not only are they inexpensive, but their use may well save more than their cost by eliminating many operations that would otherwise be necessary. They are available in different shapes, dimensions and resiliencies to meet the varied requirements of specific electronic applications and can be made of metals or alloys selected to meet actual or anticipated corrosive conditions.

A bulletin giving detailed information is available on request from the manufacturer, Metal Textile Corporation, 641 East First Avenue, Roselle, N. J.

FOR MARKING...

PLASTIC • METAL GLASS • PAPER RUBBER • CERAMIC CARDBOARD

***in such products as* Resistors, capacitors, valves, tubes, labels, sleeves, spark plugs, cartons, etc., etc.**

THESE PRODUCTS AND MANY OTHERS OF ALMOST ANY MATERIAL AND SHAPE CAN BE IMPRINTED

ON THE

REJAFIX

MARKING MACHINE

***Why not send us samples* of your products? They will be test-printed and returned to you for your examination!**

- **REJAFIX HAND-OPERATED MODELS FOR SMALL RUNS. FULLY AUTOMATIC MODELS FOR MASS PRODUCTION.**

EST. 1922

POPPER & SONS INC. 300 FOURTH AVENUE NEW YORK 10, N. Y.

CONTINUOUSLY

VARIABLE FILTERS

MODEL 302

VARIABLE ELECTRONIC FILTER

Fast, Accurate, Reliable

The — SKL — Model 302 includes two independent filter sections, each having a continuously variable cut-off range of 20 cps to 200 KC. Providing a choice of filter types each section has 18 db per octave attenuation. When cascaded 36 db is obtained in the high and low pass setting and 18 db in the band pass position. With low noise level and 0 insertion loss this versatile filter can be used as an analyzer in industry and the research laboratory or to control sound in the communications laboratory, radio broadcasting, recording and moving picture industries.

SPECIFICATIONS

- CUT-OFF RANGE 20 cps to 200 KC
- SECTIONS 2—can be high, low and band pass
- ATTENUATIONS 36 db/octave maximum
- INSERTION LOSS . 0 db
- NOISE LEVEL 80 db below 1 volt
- FREQUENCY RESPONSE 2 cps to 4 MC

SKL SPENCER-KENNEDY LABORATORIES, INC.
181 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

Want more information? Use post card on last page.

frequency oscillator, model 400 C, with standard rack panel construction. It simultaneously provides both sine and square-wave voltages at any frequency between 0.009 and 1,100 cps. The sine wave output may be used either balanced or single ended. Maximum output is 30 v peak-to-peak across a 1,000-ohm load. Special circuitry to eliminate tuning and band-switching transients has been incorporated. Other features are low hum and distortion, excellent amplitude constancy over the entire frequency range, a single scale logarithmic dial with a vernier tuning control, and low input power. The unit is especially useful for the designing and testing of servomechanisms for geophysical and seismological instruments and feedback amplifiers, for vibration checks and medical research and in conjunction with timing and production controls. Dimensions of the unit are 19 x $8\frac{3}{4}$ x $7\frac{1}{2}$ in.

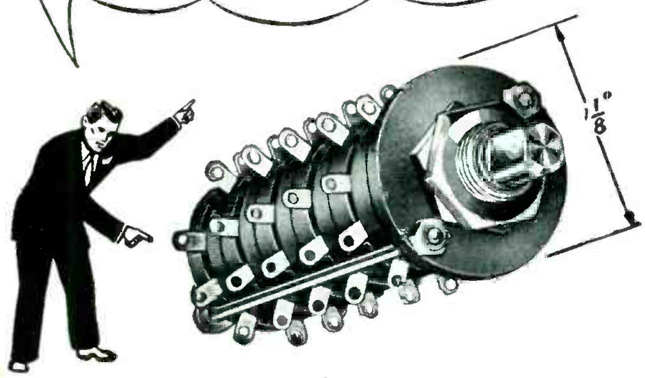
Literature

Permanent-Magnet Motors. Barber-Colman Co., Rockford, Ill., has available p-m motors with electrically balanced armature that insures low radio noise level, higher efficiency, and longer brush life. Ask for bulletin F4344.

Metalized - Power Capacitors. Aerovox Corp., New Bedford, Mass. Concise, yet highly informative, is the "High-Temperature Metallized-Paper Capacitors" bulletin now available. It deals with the performance characteristics of such capacitors, including facts, figures and graphs on rated voltages, temperature range, insulation resistance, nominal capacitance, power factor, vibration, humidity and life test. It also gives available types and listings.

Gas Tubes in Industry. Electrons, Inc., 127 Sussex Ave., Newark 4, N. J. A treatise on the history, development and application of hot cathode gas-filled rectifier and thyratron tubes has just been pub-

THE GRAYHILL SERIES 5000 MINIATURE TAP SWITCH IS DESIGNED TO MEET SPACE FACTORS INVOLVED IN THE MINIATURIZATION TREND. THE POSSIBLE CONTACT ARRANGEMENTS RUN FROM A SINGLE DECK UP TO 10, WITH FROM 2 TO 10 TAPS PER DECK. EITHER SHORTING OR NON-SHORTING CONTACTS. RATED TO BREAK 1 AMP., 115 V. A C, NON-INDUCTIVE.

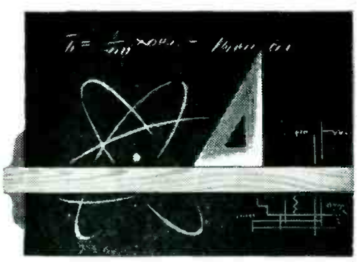


Grayhill

GET DETAILS—Write for the Grayhill Catalog now.

4522 West Madison St., Chicago 24, Illinois

"Back home in Indiana"



I.D.E.A., Inc., is looking for a design engineer. Someone who would like to make Indianapolis his permanent home—who would like to work for a young, forward looking company that is already the leader in its field. If you are that man, address full information about yourself to: R. A. Morris, Chief Engineer, I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26.

Makers of the Regency VHF Booster, UHF Converter and other electronic devices.

Regency

INDIANAPOLIS, INDIANA

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. 2102, 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. 2102, 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________

lished. Entitled "Gas Tubes in Industry," the treatise is concisely written, but comprehensive in its coverage of the subject. It will give the reader a well-rounded introduction to the many useful purposes of the EL rectifier and grid control (thyratron) tube.

Parts Catalog. Newark Electric Co., 223 W. Madison St., Chicago 6, Ill., has published a 196-page comprehensive parts catalog containing thousands of items for industry, laboratories, high fidelity, radio and television. Whole sections are devoted to test equipment, industrial equipment and supplies, high-fidelity systems and components, tv chassis, accessories and antennas, including the latest vhf antennas and converters, tape, wire and disk recorders, phonos and changers, p-a and intercom systems, books, tools and the latest in amateur equipment. Wherever possible the complete lines of all nationally-known manufacturers are listed.

Printed Circuits. Electralab, Inc., 105 First St., Cambridge 41, Mass. A recent 8-page catalog contains a picture story showing the company's facilities for engineering and designing printed circuits in addition to the large scale production of this type of assembly. Included is a list of 17 of the many electronic applications that have been engineered by the company utilizing printed circuits and unitization techniques.

Research Laboratories. Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill., has published bulletin R10, a 47-page book containing information on the latest facilities and services of its new Research Laboratories. The book will be of interest to anyone engaged in research, development and instrumentation in the fields of nuclear physics, servomechanisms, upper air research, weather reconnaissance, radar, sonar, guided missiles and general electronics.

Transmission Systems. Fischer & Porter Co., 7250 Jacksonville Road, Hatboro, Pa. Catalog T-50 de-

S.S.White MOLDED 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

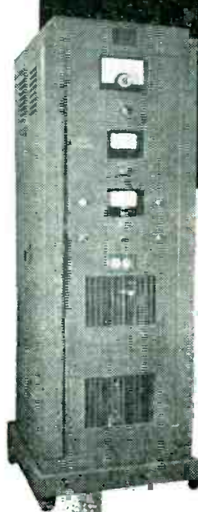
It gives details of Standard and High Value Resistors, including construction, characteristics, dimensions, etc. Also described are S. S. White 80X Resistors, designed for extremely high voltage equipment. Copy with Price List sent on request.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. R, 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.

---

variable frequency POWER SUPPLY



Model VS-500

Model VS-500. 50 to 3000 Cycles. INPUT: Volts—115v 2 wire or 230v 3 wire single phase; Frequency—60 cycles/sec.; Power—1600 V.A. OUTPUT: Volts—115v or 230v, regulated; Frequency—50—3000 cycles/sec.; Power-500 watts. WAVE FORM: Standard—sine wave; Optional—variable waveform with amplitude factor variation of 1.16 to 1.65. Square wave through sine wave to peaked wave. REGULATION OF OUTPUT VOLTAGE: Better than 3% from no load to full load.
SIZE: 75" H. 26" W. 27" D.
Weight Net: 535 lbs.
Furnished with caster base to provide an easy means of moving equipment to desired location.

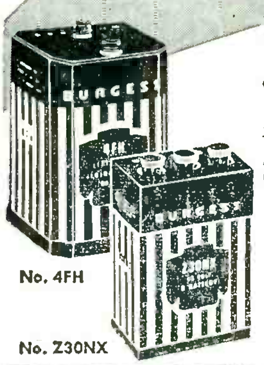
Write for descriptive literature now.

TRAD TELEVISION CORPORATION
1001 FIRST AVENUE
ASBURY PARK, N. J.

Independent Research Proves:

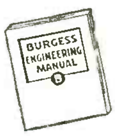
2 out of 3 Engineers Prefer BURGESS BATTERIES!

NO WONDER Burgess is *the* first source for industrial dry batteries. Burgess long-life dependability and uniform, high-level performance are backed by more years of engineering "know-how" than any other batteries. The maintenance of highest quality always is the reason why 2 out of 3 engineers prefer Burgess . . . by independent survey. Check for your local source of supply or write now!



No. 4FH

No. Z30NX



WRITE FOR ENGINEERING MANUAL AND CHECK SHEET—No obligation. By return mail you will receive the FREE Engineering Manual listing the complete line of Burgess Batteries together with detailed specifications; also the Burgess "Check Sheet" on which you may outline your battery requirements in the event that the battery you need has not already been developed. Address:

BURGESS BATTERY COMPANY
(DEPT. E-2) FREEPORT, ILLINOIS

scribes completely the pneumatic, magnetic, electric, electronic and electronic-follower transmission systems for use in measurement and control of flow, pressure, liquid level, viscosity and specific gravity. The booklet is profusely illustrated containing performance characteristics and schematic diagrams of the various systems.

UHF Booklet. The Brach Mfg. Corp., 200 Central Ave., Newark 4, N. J., has available a booklet entitled "How to Select UHF TV Antennas". The introduction to the booklet outlines the major differences between vhf and uhf and also the different problems that may arise. Example 1 takes into account the primary signal area where there are no reflections. Example 2 describes the primary area with reflections and interference. Example 3 discusses primary areas with both uhf and vhf. Examples 4, 5 and 6 discuss respectively the problems of installation that arise in primary uhf areas with medium vhf signals, fringe areas for uhf only, and indoor reception with uhf. Example 7 outlines the new Mul-Tels designed primarily for uhf multiple installation systems.

General Catalog. Thordarson-Meissner, Mt. Carmel, Ill. The No. 53-A general catalog includes such new products as a novice transmitter kit and a new high-fidelity 10-w amplifier. The catalog is packed full of information and specifications on the company's line of a-m/f-m tuners, receivers and amplifiers. Included also is a section on receiver and amplifier kits, for those who like to build their own. Many new items have been added to the regular list of coils, chokes and traps.

X-Ray Spectrograph Chart. North American Philips Co., Inc., 750 S. Fulton Ave., Mt. Vernon, N. Y., has available a new $17\frac{1}{2}$ x $22\frac{1}{2}$ in. x-ray spectrograph chart showing characteristic secondary x-ray beams for elements from sodium (Atomic No. 11) to uranium (Atomic No. 92). The new chart is suitable for wall display and will greatly assist scientific personnel in understand-

Want more information? Use post card on last page.

ing the theory and principles of x-ray spectrography and will be useful in handling actual problems. It shows K Alpha and K Beta lines for mica analyzing crystal, for quarts analyzing crystal, for lithium fluoride analyzing crystal and rock salt analyzing crystal. It also shows L Alpha$_1$ and L Beta$_1$ lines, 1st and 2nd orders, for rock salt analyzing crystal. The horizontal scale on the chart shows 2 Theta Angle in degrees, as well as wavelengths in Angstroms for all elements under various conditions.

Antennas & Accessories. United Catalog Publishers, 110 Lafayette St., New York 13, N. Y., has available a 76-page booklet cataloging radio and tv antenna systems, antennas and accessories, and giving detailed specifications, illustrations, descriptions and prices. It covers the products of the 32 leading manufacturers and includes f-m, a-m and uhf antennas, tv towers, masts, tv boosters, insulators, wire and mounting hardware, among other items.

Germanium Diodes. Amperex Electronic Corp., 230 Duffy Ave., Hicksville, Long Island, N. Y. A single-sheet bulletin announces the addition of a line of seven germanium diodes of the hermetically sealed glass variety which are not affected by atmospheric conditions of humidity, altitude and extremely low temperature. Four of the diodes described are electrically interchangeable with well-known standard types, and the others are new. All are highly resistant to shock and vibration. Characteristics, ratings and curves are included.

Electrometer. Special Instruments Laboratory, Inc., Knoxville, Tenn., has published a single-sheet bulletin illustrating and describing the model 145 electrometer, an a-c operated sensitive d-c amplifier of very high input impedance and excellent stability. The instrument discussed measure voltages of 0 to 150 mv directly on a panel meter, and it may be used to measure currents from 10^{-8} to 10^{-16} amperes either directly or by the slide-back voltage method. The unit described

Want more information? Use post card on last page.

also measures resistances from 10^8 to 10^{13} ohms. Circuit and operation specifications are included.

TV Replacement Guide. Thordarson-Meissner, Seventh and Bellmont, Mt. Carmel, Ill., has released a new tv replacement guide handbook for the service industry. Complete up-to-the-minute information is arranged alphabetically by manufacturers and their model numbers, for over 2,500 tv models. Manufacturers' parts numbers and the Thordarson-Meissner replacement types are listed for power and filament transformers, filter chokes, audio, vertical and horizontal output transformers, focus coils, booster transformers, horizontal and vertical blocking transformers and deflection yokes. In addition, the guide contains much other information, such as color codes on all kinds of transformers, resistors, capacitors and coils.

Analog Computer. Computer Corp. of America, New York, N. Y., has released a 12-page catalog that gives full product description and specifications of IDA (Integro-Differential Analyzer). The catalog discusses the general theory of analog computers and describes the method of setting up problems for solution. Three pages of typical examples in various fields of dynamics furnish graphical illustration of these principles. Also described is the new NLU-2 function simulator, which makes possible the addition of backlash, dead-zone and limit stops to IDA or any other analog computer.

Cords, Tapes & Sleevings. Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6, Ill. Cotton, glass and asbestos woven tapes, braided sleevings, and cords for electrical insulating purposes are fully described in a new 28-page catalog. Information on applications, properties, technical data, sizes, types and packaging is included. Products described are used in motors, coils, tv sets, transformers and other electrical units in a variety of ways. As well as covering the Imcor, Electra, Fiberglas, R/M and Asbeston brands of

Want more information? Use post card on last page.

cords, tapes and sleevings, the catalog explains characteristics of the basic cotton, glass and asbestos fibers.

Audio Facilities for Schools. Radio - Television Manufacturers Association 777-14th St. N.W., Washington 5, D. C. The Association's School Equipment Committee has available a new booklet on audio facilities for school use. This booklet, the title of which is "Teaching with Radio, Audio, Recording and Television Equipment," combines and brings up to date material contained in the three former Committee publications and also includes information on the use of tv in public schools. It was prepared with the assistance of a group of educators appointed by the U. S. Office of Education.

Strip Chart Potentiometer. Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44 Pa. Specification sheet 179 illustrates and gives full details of the new Brown ElectroniK strip chart potentiometer with two-second full scale pen travel for 60-cycle operation. The instrument described has a calibrated accuracy within $\pm\frac{1}{8}$ of 1.0 percent of scale span for spans in excess of 12 mv; within ± 0.045 mv for spans less than 12 mv.

Sound-Powered Communications Equipment. The Wheeler Insulated Wire Co., Division of The Sperry Corp., Waterbury 20, Conn., offers a new file-size comprehensive catalog bulletin covering sound-powered communications equipment for industrial and commercial use. Designated as bulletin SA-25, it includes installation information, wiring and dimension diagrams and description of special instruments.

Microwave Products. Microwave Associates, Inc., 22 Cummington St., Boston 15, Mass., announces the availability of the 8-page catalog 52A. Over eighty products are described, including magnetrons, radar gas-switching tubes, silicon diodes, waveguide components and test equipment for the millimeter

and centimeter wavelengths. The research and production facilities are also described with numerous illustrations.

Snap Nut Fasteners. Prestole Corp., Toledo, Ohio. Bulletin 8000-A gives complete engineering and application data on snap nut fasteners that have been popular with production personnel as a means of securing front mounting, and/or blind assembly applications with metal screws or studs. The fasteners described allow high speed assembly and prevent "dead-tight" fastening that might craze enameled or painted surfaces.

Small High-Reliability Tubes. General Electric Co., 1 River Road, Schenectady 5, N. Y., has published a new booklet describing the essential characteristics of 17 Five Star miniature and 8 subminiature high reliability tubes. Publication ETD-548A covers tubes designed for use in critical applications, both industrial and military, in which operational dependability is essential to protect life, customer's investment or product reputation. Included in the data are the specific differences between individual Five Star Tubes and their standard-tube prototypes, heater ratings, maximum design center ratings and operating characteristics.

Digital Recorder. Berkeley Scientific, Division of Beckman Instruments Inc., Richmond, Calif., has available a single-sheet, loose-leaf perforated bulletin dealing with the series 1550 digital recorder that provides a simple, reliable and inexpensive means of converting electronic count information into printed form. Illustrations, description, basic design information, operation data and specifications are included.

High-Current Test Unit. Multi-Corp., Harrison, N. J. Bulletin 1005-111 announces the development of a portable high-current test unit designed primarily for use by electrical utilities and larger industrials. Principal uses of the unit described include testing and calibrating oil circuit reclosers,

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**

DIPPING BASKETS • LEKTROMESH • RESISTANCE WIRE • FILTERS • STRAINERS • WIRE CLOTH • PARTS • WIRE MESH

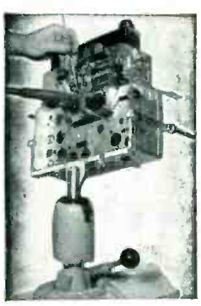
THE C. O. **JELLIFF** MANUFACTURING CORPORATION SOUTHPORT, CONN.

WIRE PRODUCTS SINCE 1880

Detailed Enquiries Welcomed. Address Dept. 17.

Cut Your Costs, Too, With POWRARM WORK POSITIONERS

HERE'S HOW OTHERS DO IT



POWRARM cuts costs by increasing every worker's productivity. It gives the worker a powerful *third hand* to hold work while two hands produce. That's why POWRARM works on the most efficient assembly lines in America today, and *belongs on yours.* Write us about your production "headache" . . . we'll show you how POWRARM can cure it.

Holds work at any angle in Horizontal, Vertical or Co-axial Plane.

Three sizes of Powrarm—24 to 150 lbs. capacity.

Write For Catalog 101E
32 informative pages, FREE

WILTON TOOL MFG. CO.
Precision Built Bench Vises, "C" Clamps and Work Positioners
925-T Wrightwood Avenue • Chicago 14, Illinois

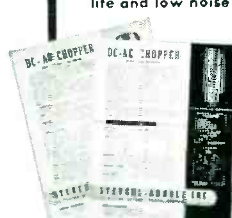
DC-AC CHOPPERS

A model for every use.
10—500 cycles
Single pole

60 cycles
Single pole and double pole
Make-before-break contacts

These Choppers convert low level DC into pulsating DC or AC so that servo-mechanism error voltages and the output of thermocouples and strain gauges, may be amplified by means of an AC rather than a DC amplifier.

They are hermetically sealed, precision vibrators having special features which contribute to long life and low noise level.



WRITE FOR THESE CATALOGS . . .
#280A 10-500 cycles
#246C 60 cycles

STEVENS ARNOLD INCORPORATED

22 ELKINS STREET
SOUTH BOSTON 27, MASS.

SA-5

Want more information? Use post card on last page.

CSP transformer breakers, sectionalizers, circuit breakers, motor overload relays, current transformers, fuse links and overcurrent relays of all types. Also available with the bulletin is a partial list of Multi-Amp users.

Magnetic Amplifiers. Karl-Douglas Associates, 3160 W. El Segundo Blvd., Hawthorne, Calif., have released a brochure describing their line of magnetic amplifiers. The publication describes the six important advantages of magnetic amplifiers over other power control amplifier designs; lists typical performance specifications for 60-cycle and 400-cycle units; and lists the various applications where they can be used.

Printed Circuits. Electralab, Inc., 105 First St., Cambridge 41, Mass. A recent 8-page catalog contains a picture story showing the company's facilities for engineering and designing printed circuits in addition to the large scale production of this type of assembly. Included is a list of 17 of the many electronic applications that have been engineered by the company utilizing printed circuits and unitization techniques.

Servo Amplifiers. Industrial Control Co., Wyandanch, L. I., N. Y., has available a booklet dealing with a line of standard servo amplifiers that lead the way to the quick and facile use of servo systems, and obsolete the development delays and expense otherwise necessary. Truly versatile, with adjustable parameters, the instruments discussed mate with a broad range of gear ratios and load constants. Illustrations, specifications and applications are given for the model 410-A and 423-A servo amplifiers, model 100-A dynamic analyzer, model 204-A null detector, model 200-A d-c millivoltmeter and model 302-A motor control. Also included is a servo data sheet that will enable one to define all his servo performance requirements.

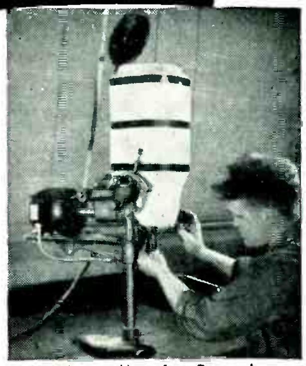
Resistors and Controls. Clarostat Mfg. Co., Inc., Dover, N. H. An exceptionally wide choice of resistors, controls and resistance de-

EDWARD E. ROBINSON

METERING PUMP for HOT WAXES and CEMENTS

- Filling
- Sealing
- Potting
- Insulating
- Cementing
- Impregnating
- Weather Proofing

Transformers	Sockets
Condensers	Switches
Rectifiers	Wiring Devices



Robinson Metering Pump being used to forcibly eject metered amounts of cement into wire brush handle. Reservoir temperature 350° F.

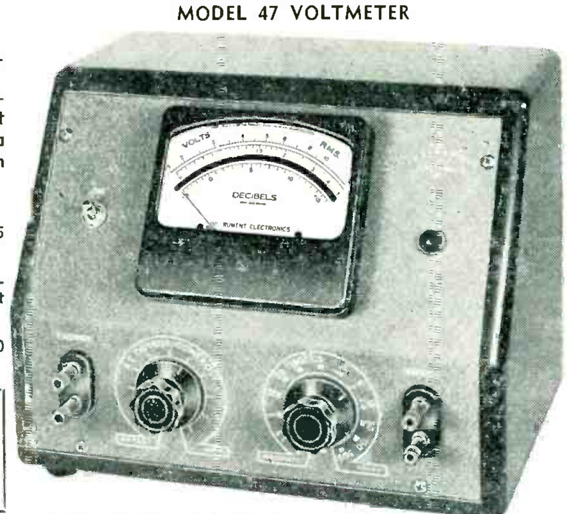
Not a gravity dispenser — Forcibly ejects hot waxes and cements.
Thermostatically controlled heat — Variable with a maximum reservoir temperature of 450° F.
Motor driven, clutch actuated — 2/3 second per ejection.
Variable discharge — Ejections changed in 2 seconds, *without tools.*
Reduces unit costs—No skilled operator required. Saves material — reduces rejects.
Easily installed — Adaptable to any production set-up.

For complete information on this modern production tool and its possible application to your requirements, write for Bulletin No. 1A-R.

EDWARD E. ROBINSON
INCORPORATED
95 PARK AVENUE · NUTLEY 10, N. J.

High Sensitivity . . Logarithmic
AC VOLTMETER
50 MICRO VOLTS TO 500 VOLTS

MODEL 47 VOLTMETER



SELF-CONTAINED
ALL AC OPERATED UNIT

An extremely sensitive amplifier type instrument that serves simultaneously as a voltmeter and high gain amplifier.

- Accuracy ±2% from 15 cycles to 30 kc.
- Input impedance 1 megohm plus 15 uuf. shunt capacity.
- Amplifier Gain 23000

Also MODEL 45
WIDE BAND
VOLTMETER
.0005 to 500 Volts!
5 Cycles 1600 kc

A few of the many uses:

- Output indicator for microphones of all types.
- Low level phonograph pickups.
- Acceleration and other vibration measuring pickups.
- Sound level measurements.
- Gain and frequency measurements for all types of audio equipment.
- Densitometric measurements in photography and film production.
- Light flux measurements in conjunction with photo cells.

Write for Complete Information

Instrument Electronics Corp. 90 MAIN STREET
PORT WASHINGTON, N. Y.

Now . . .

a new group of TERMINALS especially designed for use in the U.H.F. region . . . available in both feed-thru and stand-off types . . . for hermetic or non-hermetic applications.

•

Design engineers . . . for further information, write to . . .

Lundey Associates
694 Main Street
Waltham 54,
Massachusetts

Want more information? Use post card on last page.

vices is presented in the latest catalog, No. 52. The catalog features expanded listings of carbon and wire-wound controls, including Pick-A-Shaft or field-inserted-shaft controls taking any one of 12 different shaft types, plus the nonmetallic shaft and the high-voltage coupler. For the first time the aircraft-type metal-cased power rheostats are offered, together with miniaturized carbon and wire-wound controls, and the outdoor-theatre L-pad.

Electrical Embedment Resin. Minnesota Mining and Mfg. Co., 900 Fauquier St., St. Paul 6, Minn. A new industrial technique—embedding electrical components in "Scotchcast" brand electrical insulating resins—is described in an 8-page, illustrated booklet. Applications for both "Scotchcast" resin No. 1 (hot pouring) and "Scotchcast" resin No. 2 (cold pouring) are given, the use of fillers to obtain special characteristics is discussed, and casting techniques are outlined briefly. The outstanding properties of these epoxy "Scotchcast" resins—moisture resistance, dielectric strength, adhesion, low shrinkage and stability over a wide range of temperatures—are presented in detail on a technical data page.

Two-Way Radio. General Electric Co., Syracuse, N. Y. A new 8-page illustrated booklet discusses the use of two-way radio for better coordination of men, materials and machines. The booklet, titled "Instant Communication," is slanted to those businesses using materials handling and emergency service equipments, and others who have plant protection problems. It outlines the use of two-way radio in numerous industries, and shows equipment now available for a wide variety of applications. The new publication also carries a list of 27 GE offices throughout the U. S., from which advisory service is now available on communications problems.

Flexible Cords. Whitney Blake Co., New Haven 14, Conn., has available an illustrated 24-page bulletin that includes all of the new Underwriters' classifications for its flexi-

ble cords. Featuring catalog data on Dynaprene and rubber-jacketed cords as well as braid-covered types, the bulletin also gives information on cord selection, how to order specialties and technical data of interest to users of wire and cable. It includes illustrations of factory operations and laboratory facilities.

Transformer Catalog. Thordarson-Meissner, Mt. Carmel, Ill., has announced its new No. 400-K transformer catalog. It contains unusually complete listings of replacement types of power, filament and audio transformers for the service industry, as well as standard types. A special section is devoted to various types of transformers used in the tv service field. Many special transformers, such as vibrator, isolation and band-pass speech filter types are also listed in the catalog.

C-R Tube Reflectance Meter. Gardner Laboratory, Inc., 4723 Elm St., Bethesda 14, Md. Bulletin 120 covers the portable Glossmeter for television tube face plates. The instrument discussed is highly versatile and convenient for measuring reflectance from any type of tube face with a radius of curvature greater than 12 in. An illustration, descriptive of the instrument and method of operation, is included.

Embedded Selenium Rectifiers. Sarkes Tarzian, Inc., 415 N. College Ave., Bloomington, Ind., has published a new 4-page folder dealing with embedded selenum rectifiers. (Embedments are designed principally for use where because of environmental conditions or extreme altitudes, standard convection cooled painted rectifiers are not suitable.) Designated as Number B-1, this catalog gives detailed information on the various types of embedments made by the firm. Illustrations and dimensional diagrams are included.

Audio Catalog. Terminal Radio Corp., 85 Cortlandt St., New York 7, N. Y., has published a 132-page audio equipment catalog. Besides fifty pages of high-fidelity home music system components, the book

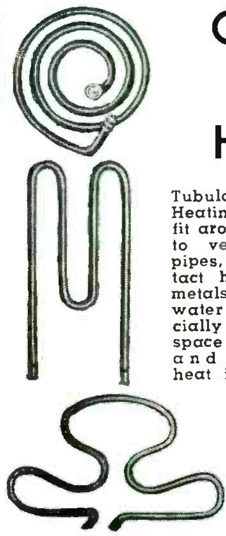
illustrates and describes seventy-six pages full of public address, institutional, recording and broadcast equipment as well as audio test instruments and similar specialized equipment.

Shaded Pole Motors. Barber-Colman Co., Rockford, Ill. Motor sheet F 4271-2 describes a complete line of unidirectional, reversible and synchronous shaded pole motors for servomechanisms, communication equipment, industrial instruments and other uses. The publication is available on request.

Retaining Rings. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y. The new 52-page retaining ring catalog is packed with engineering specifications, data and other useful information covering 17 different types of Truarc rings and more than 600 different sizes. Designed to help engineers properly select and use the rings to best advantage, the catalog devotes 28 pages to data and charts giving ring dimensions, groove dimensions, clearance, allowable thrust loads, safety rpm limits and countless other valuable data. Six pages graphically illustrate typical cost-cutting applications and at-random field applications covering self-locking ring types, basic ring types, rings for taking up end-play and rings applied radially. Assembly and acessory tools designed to handle retaining rings on a speedy production line basis are illustrated and described in detail.

Wiring and Insulation. The William Brand and Co., Inc., North and Valley Sts., Willimantic, Conn., has released a new wiring and insulation manual entitled "Here's How Turbonics Will Assist You in Solving your Complicated Wiring System and Insulation Problems." The manual explains how to obtain pertinent information required to permit uninterrupted operation of any electrical unit or component from a wiring and insulation point of view. It is intended particularly for all aircraft, design, development engineers who are continuously faced with the trend toward lighter weight, smaller space factor, better

VULCAN
ELECTRIC HEATING UNITS



Coils of Heat

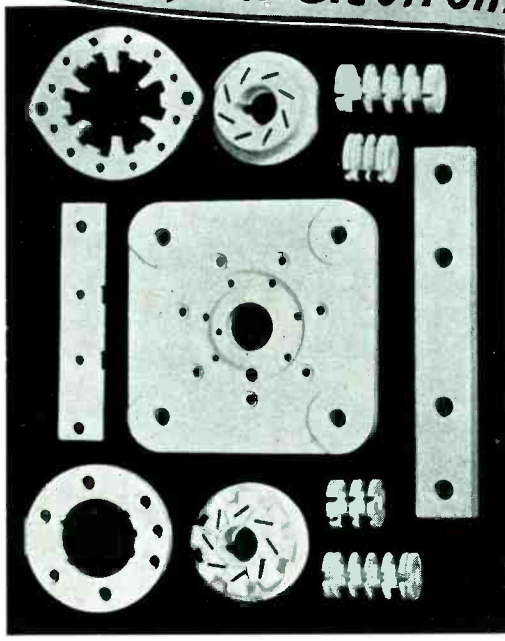
Tubular Electric Heating Units that fit around or clamp to vessels, tanks, pipes, etc. for contact heating of metals, oils, air and water . . . . especially where little space is available and considerable heat is needed.

Can be bent into almost any shape.

STANDARD SIZES or made to your requirements.

VULCAN
ELECTRIC COMPANY
DANVERS 10, MASS

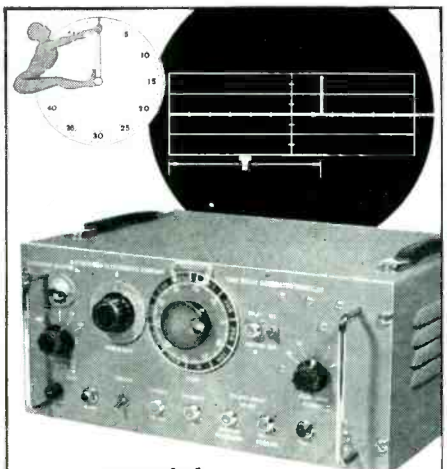
STAR STEATITE
for Your Electronic Needs



STAR low-loss STEATITE has proved an ideal insulation for electronic applications. It is a strong, dense material with excellent dielectric and mechanical strength.

Every STAR STEATITE part is engineered for your specific job and precision made to meet demands for dimensional accuracy. And STAR'S facilities for volume output assure you a steady flow of material to maintain your production schedules.

The STAR PORCELAIN COMPANY
49 Muirhead Avenue — Trenton, N. J.



MODEL A-4
TIME DELAY GENERATOR

- A precision device for the generation of accurate and variable time intervals from .00001 to 10 seconds.

Also available:
Model A-2 — .8 to 100,000 μs.

Write for complete data:
Our bulletins E-A-4 and E-A-2

Rutherford
ELECTRONICS CO.
3707 S. ROBERTSON BLVD., CULVER CITY, CALIF.

PRIMARY BATTERIES
for your Specialized Needs

DRY TYPES

78 Standard Industrial, Laboratory and Government Types.

LAB-BILT BATTERIES

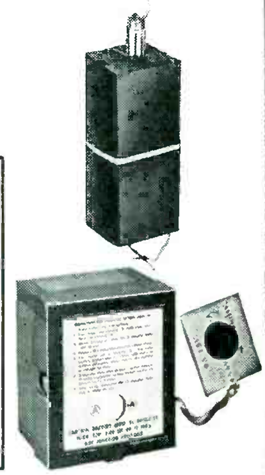
Our engineers will design and create to your requirements. Send us your specifications.

HI-DRIVE MINIATURE MOTOR

Precision-built, low-cost, battery-operated — available for delivery now.

RESERVE TYPES

Water activated "One Shot" Batteries.



Send for FREE Catalogs

SPECIALTY BATTERY COMPANY
A Subsidiary of the RAY-O-VAC *Ray-O-Vac Company*
MADISON 10, WISCONSIN

electrical properties and greater temperature extremes problems.

Setting & Adjustment of Adapters. Kinetix Instrument Co., Inc., 902 Broadway, New York 10, N. Y., has announced a 2-page catalog sheet illustrating and describing tools for setting and adjustment of adapters on synchros, resolvers and servo motors. The purpose is described. Also included are diagrammatic methods of recommended mounting.

Synchro Electrical Transformer. Kinetix Instrument Co., Inc., 902 Broadway, New York 10, N. Y. For an illustrated description of receiving electrically the angular position of synchro transmitter rotor and inducing a voltage in the transformer rotor which falls to a null when matched to the angular position of the transmitter, see a recent 2-page perforated catalog. Average electrical characteristics are included.

Microwave Transmission Line. Product Development Co., Inc., 307 Bergen Ave., Kearny, N. J. Technical bulletin No. 28, entitled "Microwave Transmission Line Measured Technical Data" is available upon written request. Complete technical data concerning frequency in mc, peak volts, approximate weight per 20-ft section and nominal characteristic impedance are included.

Potentiometers and Noise. Technology Instrument Corp., 531 Main St., Acton, Mass., has available on request Laboratory Report No. 6. It contains an article entitled "Precision Potentiometers and Noise" by Joseph R. Atieri. Application of the Ponogometer production noise tester is also included as a feature of this report. Causes of potentiometer noise, definition of noise and advantages of the Ponogometer are detailed.

Retractile Cords. Koiled Kords Inc., Box K, New Haven 14, Conn., has available an 8-page bulletin on retractile cords for general communication and power applications. Containing catalog data and in-

to the

ELECTRICAL

ENGINEER

or

PHYSICIST

with experience in

RADAR

or

ELECTRONICS

Hughes Research and Development Laboratories, one of the nation's leading electronics organizations, are now creating a number of new openings in an important phase of their operations.

Here is what one of these positions offers you:

THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, are presently engaged in the development and production of advanced radar systems, electronic computers and guided missiles.

THE NEW OPENINGS

The positions are for men who will serve as technical advisors to government agencies and companies purchasing Hughes equipment—also as technical consultants with engineers of other companies working on associated equipment. Your specific job would be essentially to help insure successful operation of Hughes equipment in the field.

THE TRAINING

On joining our organization, you will work in the Laboratories for several months to become thoroughly familiar with the equipment which you will later help users to understand and properly employ. If you have already had radar or electronics experience, you will find this knowledge helpful in your new work.

WHERE YOU WORK

After your period of training—at full pay—you may (1) remain with the Laboratories in Southern California in an instructive or administrative capacity, (2) become the Hughes representative at a company where our equipment is being installed, or (3) be the Hughes representative at a military base in this country or overseas (single men only). Compensation is made for traveling and moving household effects, and married men keep their families with them at all times.

YOUR FUTURE

In one of these positions you will gain all-around experience that will increase your value to our organization as it further expands in the field of electronics. The next few years are certain to see large-scale commercial employment of electronic systems. Your training in and familiarity with the most advanced electronic techniques now will qualify you for even more important future positions.

How to apply:

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Engineering Personnel Department
Culver City,
Los Angeles County, California

If you are under thirty-five years of age, and if you have an E.E. or Physics degree, write to the Laboratories, giving resumé of your experience.

Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

formation helpful in ordering as well as photographs of actual applications, the bulletin explains how the cords are made, where they are used and the specific features which make their use advantageous.

Metal & Contacts. Metals & Controls Corp., Attleboro, Mass., has an illustrated, 12-page catalog that describes the various composite metals, precious metals, electrical contacts and Truflex metals manufactured by the company. Contents cover some of the unusual composite metals recently developed; information on the platinum-group metals and manganese age-hardening alloys; and two sections dealing with thin-gage rolling and mirror-finish rolling.

Temperature - Humidity Test Chambers. Tenny Engineering, Inc., 26 Avenue B, Newark 5, N. J., announces a new two-color four-page bulletin on its standard line of temperature-humidity test chambers. Chambers covered can simulate temperatures from −100 F to +200 F and relative humidities from 20 to 95 percent. Specifications give data on heaters, humidification, dehumidification, temperature and humidity controllers, compressor equipment, insulation, exterior construction, access door, air circulation, standard equipment and optional equipment. Chamber construction information, performance characteristics and typical applications are given. Interior dimensions and temperature ranges for eight different standard model types are tabularized in a specification section. Included also are 5 pictures showing typical chambers and chamber applications. Ask for bulletin TR.

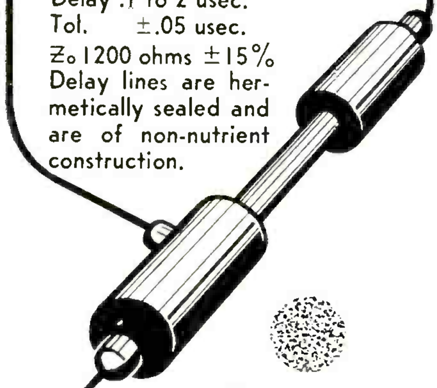
Direct-Writing Recorders. Sanborn Co., 38 Osborne St., Cambridge 39, Mass. A new booklet that explains the advantages of using the company's equipment for the study and recording of a wide variety of electrical and mechanical phenomena has been released. It contains 16 pages of pert illustration and pertinent text that describes direct-recording equipment for industrial users.

FLEXIBLE

DELAY LINES

to meet military specifications

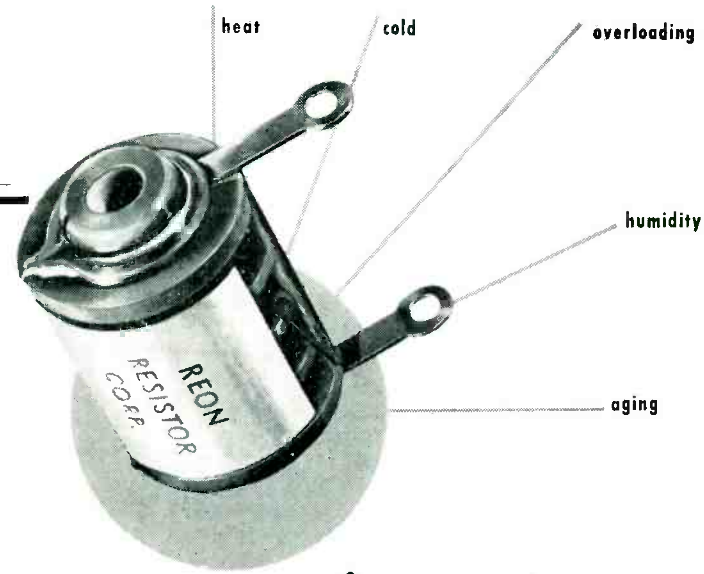
Delay .1 to 2 usec.
Tol. ±.05 usec.
Z_0 1200 ohms ±15%
Delay lines are hermetically sealed and are of non-nutrient construction.



We invite your inquiries.

BREW

RICHARD D. BREW and CO., INC.
106 CONCORD AVE., BELMONT 78, MASS.



any way you look at it....

REON PRECISION WIRE WOUND RESISTORS stay dependable under the most adverse conditions. The resistance changes less than .05% after completion of the MIL-R-93A tests.

The resistor is the heart of your electronic equipment. No other type of resistor has the inherent stability and accuracy of a REON PRECISION WIRE WOUND RESISTOR.

Specification brochure on request.
For delivery information, call YOnkers 5-9850.

REON RESISTOR CORPORATION 117 Stanley Avenue, Yonkers, N.Y.

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

FINNFLEX AIRBORNE MOUNTING BASES

Conform to JAN-C-172A SPECIFICATIONS
... but are actually made to *exceed* AN-E-19 Drop Test requirements

TYPE SR MOUNTING BASE

TYPE TPM VIBRATION ISOLATOR

RUGGED PROTECTION for VITAL EQUIPMENT: 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. Wide range of sizes and load ratings available.

SHOCK MOUNTS for Signal Corps Mobile Equipment and for Naval Fire Control Units.

SPECIAL PROBLEMS: Complete facilities for designing and fabricating Shock and Vibration Mounts to order — *regardless* of size or weight of equipment mounted.

Specify FINNFLEX—for Ruggedness, Efficiency, and Economy.

Write for Catalog MB-110

VIBRATION ISOLATORS and SHOCK MOUNTS

To JAN-C-172A SPECIFICATIONS and TO ORDER

T. R. FINN & COMPANY, Inc.
Specialists in Vibration Control
333 JACKSON AVENUE, NEW YORK 54, N. Y.
Phone: CYpress 2-4192-3-4

PLANTS AND PEOPLE

Edited by WILLIAM G. ARNOLD

RAC TO Build Manufacturing Plant In Spain

PLANS of RCA to build a factory in Spain for the production of 45-rpm phonograph records, record players and eventually tv home receivers were recently announced by F. M. Folsom, president of RCA. The proposed plant is expected to be completed in mid-1953. It is to be erected at a 322,000 sq ft site overlooking Madrid, on the main highway to Barajas Airport and the city of Barcelona. Estimated cost of the new plant is $0.5 million. When in full operation it will employ about 1,000 people.

According to RCA's president, a favorable economic climate for electronic development exists in Spain and the country offers a good ground for investment. He noted that a large amount of building was being done in Spain, largely with Spanish capital and not with U. S. ECA funds.

Arrangements for the project were made in cooperation with Gabriel Soria, president and managing director of Industria Electronica S.A., associate RCA company in Spain. Industria Electronica will share the cost of the plant with RCA. Chairman of the board of the new company is Demetrio Carceller, former Spanish Minister of Industry and Commerce. Another former Spanish cabinet minister, Jose Luis de Arreseo, also is a member of the board. He is at present a ranking counselor to the Government of Spain.

Mr. Soria, president of the new company, said that when the opportunity arises, Spanish workers would be sent to the U. S. for further training in RCA factories. Although no tv stations now exist in Spain, plans are in progress that will be developed rapidly.

BENDIX PLANS COMPUTER DIVISION

FORMATION of the Bendix Computer Division of the Bendix Aviation Corp. with headquarters in Hawthorne, California was announced recently by E. Palmer Nicholls (left), vice-president of the Bendix Pacific Division. Maurice W. Horrell (right), former executive engineer of the Bendix Research Laboratories in Detroit, Mich., will head the computer division staff. They are discussing one of the parts used in computers. The new division is being formed for the perfection and manufacture of digital computers designed to provide immediate answers to scientific and industrial problems. Horrell is now organizing a staff of top engineers and scientists for the new division

OTHER DEPARTMENTS

featured for this issue:

Zworykin Awarded Edison Medal

V. K. ZWORYKIN, pioneer researcher in electronics, has been awarded the 1952 Edison Medal by the AIEE "for outstanding contribution to the concept and design of electronic components and systems". The medal was presented at the opening session of the Winter General Meeting of the Institute at the Hotel Statler.

This honor is the latest of many won by Dr. Zworykin, who is vice-president and technical consultant of the RCA Laboratories Division, RCA, Princeton, N. J. He has been associated with RCA since 1929. Others include the Morris Liebmann Memorial Prize of the IRE for pioneer work in television, the Howard N. Potts Medal of the Franklin Institute for contributions to commercial television, the AIEE Lamme Medal for outstanding contribution to the concept and design

World's most successful Autochanger

Radio set makers everywhere have acclaimed the Monarch automatic record changer—the brilliant new changer with the exclusive 'Magidisk' auto-selector ★ Now 7", 10" and 12" records may be intermixed and played at 33⅓, 45 or 78 r.p.m. with a realism and a purity of tone hitherto impossible ★ Simple centralised control provides easy selection of record speed and 'On,' 'Off,' 'Reject' ★ New extended frequency range dual stylus crystal pick-up faithfully reproduces the most fragile overtones ★ Fine engineering guarantees a lifetime of trouble-free service ★ The price is competitive—send for details.

BSR

Birmingham Sound Reproducers Ltd., Old Hill, Staffs. England . Grams: 'Electronic Old Hill, Cradley Heath.'

of electronic apparatus basic to modern television, the Poor Richard Club Gold Medal for Achievement, and the Chevalier Cross of the French Legion of Honor in recognition of his contribution to victory in World War II.

The Edison Medal, first awarded in 1909, has been won by such outstanding scientists as Alexander Graham Bell, George Westinghouse, Frank B. Jewett, and Vannevar Bush. The medal was founded by associates and friends of Edison.

MIT Appoints Electronics Lab Research Heads

GEORGE G. HARVEY, associate professor of physics, and Henry J. Zimmermann, associate professor of electrical engineering, have been appointed associate directors of the Research Laboratory of Electronics at MIT.

Frank White Elected President of NBC

FRANK WHITE, vice-president and general manager of the radio and television networks of NBC, has been elected president and a director of NBC to succeed Joseph H. McConnell.

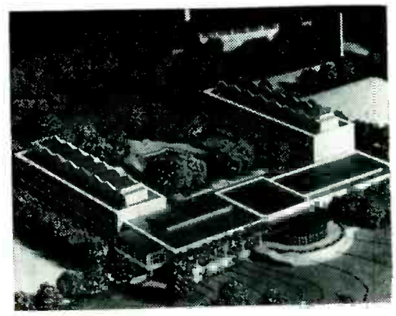
Mr. McConnell has resigned from NBC to join a company in another industry, and his new position will be announced by that company. It is reported that he will become president of the Colgate-Palmolive-Peet-Co.

Sylvester L. Weaver, Jr., vice-president in charge of the radio and television networks of NBC, was elected vice-chairman of the NBC board of directors, a new position.

John K. Herbert, vice-president in charge of network sales, has been appointed to succeed Mr. Weaver as vice-president in charge of the radio and television networks.

CAPTAIN ROUND RECEIVES ARMSTRONG MEDAL

Capt. Henry J. Round of England (right) received the prized Armstrong Medal from John Bose, president of the Radio Club of America, at the Club's 43rd annual banquet. The Medal was awarded to Capt. Round in recognition of his pioneering work in radio, especially in the fields of radio direction and position finding and the amplification of short-wave signals. During World War I the direction-finding apparatus he designed and operated made it possible to trace the movements of the German Fleet, making possible interception by the British Fleet in the Battle of Jutland



IBM To Build New Electronics Center

INTERNATIONAL business machines Corp. has announced plans to begin construction of a research center near its Poughkeepsie, N. Y., plant early next spring, to be completed before the end of 1954. The plant, a model of which is shown above, will add 179,000 square feet of floor space to the company's existing laboratory facilities. An estimated 750 employees will work in the building. The research center will provide centralized facilities for the company's widespread electronics research program.

Honeywell Elects Seidel V-P

GLENN E. SEIDEL has been elected a vice-president of Minneapolis-Honeywell Regulator Company in charge of engineering in the company's Minneapolis plants, Harold W. Sweatt, president, announced recently.

Seidel, a member of Honeywell's engineering organization since 1943, has been director of the company's expanding ordnance division for the past year and a half. Before that he served for a number of years as assistant to W. J. McGoldrick who, as part of his duties as vice-president, has been handling the engineering activities that Seidel will take over.

Outstanding Engineers Honored

THE ETA KAPPA NU plaque designating the most outstanding young electrical engineer for 1952 was awarded to John V. N. Granger, 34, of the Stanford Research Institute, Stanford, California. In addition Edward O. Johnson, 33, of RCA Laboratories, Princeton, New Jersey and Gustave W. Staats, 33, of the Allis Chalmers Mfg. Co., Mil-

NOW!

smallest coax assemblies

1/4 BNC size to do a bigger job

MICRODOT, pioneer of micro-miniaturization, has completed development of Coaxial Assemblies one-quarter BNC size with savings in weight of 87% to a comparable BNC* assembly...and designed to do a BIGGER job on top of these outstanding size and weight advantages.

COMPARE these characteristics for instrument hook-ups, transistor packaging, computer and airborne components, etc. Here's how big a job a Microdot Coax Assembly can do for you.

MICRODOT® ELECTRICAL ADVANTAGES

Characteristic impedance	50 or 70 ohms
Capacity	30 mmf/ft or 21mmf/ft
Low VSWR	1.3
Low insertion loss (400 mc)	0.3 DB/ft
High voltage breakdown	2500 DC
High temperature stability	— 65° to + 300° F.

Special MININOISE treatment reduces self-generated cable noise by 95% compared to standard cable.

IMMEDIATE DELIVERIES!

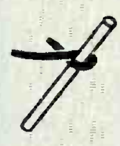
Single and double-ended assemblies, feed-throughs and couplings—immediately available for delivery. Write today. Ordering information and data will reach you promptly.

Patents Pending

VIBRATION RESISTANCE

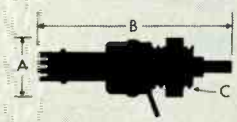
Microdot Assemblies resist 5 to 55 cps at 25 G's. Mininoise treated cable makes high termination impedances practical.

FLEXIBLE



The MININOISE Cable (0.10" diameter) can be wrapped around a 0.5" mandrel without change.

SMALL SIZE



A– the male and female joined diameter is 0.22".
B– the male and female joined length is 0.85".
C– the thread size is 10/32.

*Compared to BNC Connectors and RG59U cable.

—the pioneer of micro-miniature components

Scale 1:1

MICRODOT DIVISION
FELTS CORPORATION
1826 FREMONT AVENUE • SOUTH PASADENA, CALIFORNIA

waukee, Wisconsin received honorable mention citations.

Citations presented to the men were as follows:

John V. N. Granger

"By virtue of his noteworthy researches on aircraft radio antennas, his organization and direction of a large radiation systems laboratory, and his unusual interest in cultural and professional activities, Eta Kappa Nu recognizes John Van Nuys Granger as an outstanding young American engineer."

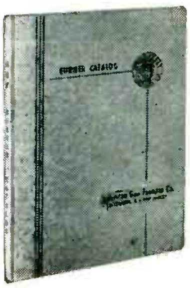
Edward O. Johnson

"By virtue of his notable contributions to the field of gaseous electronics, his invention of the plasmatron, and his special interests in art and professional activities, Eta Kappa Nu recognizes with

free! NEW AGF BURNER CATALOG

The first complete catalog of never before available technical data.

Gives hole sizes, flame patterns, gas consumption on various gases and complete information with illustrations of —



- BURNERS
- BLOW PIPES
- GLASS FIRES
- MIXERS
- INSERTS
- BALL JOINTS
- MANIFOLDS
- CROSSFIRES
- MACHLET TIPS
- GOVERNORS
- TUNNELS
- OXYGEN—GAS BURNERS

Write for your copy today on your company letterhead.

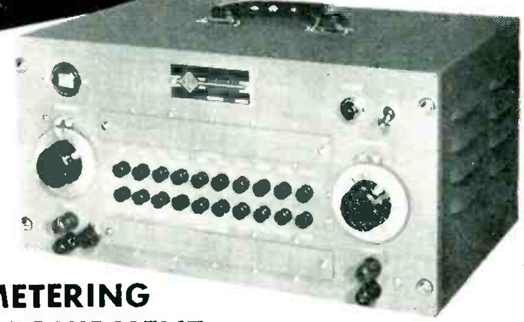
AGF

AMERICAN GAS FURNACE Co

130 SPRING ST., ELIZABETH 4, N. J.

PUSH-BUTTON AUDIO OSCILLATOR

MODEL TO-100



NEW ACCURATE STABLE

FOR CHECKING

FM/FM TELEMETERING SUB-CARRIER EQUIPMENT

- 20 accurate, fixed centre-frequencies
- Calibrated control for ± 10% adjustment
- Indicator for beating external signal
- Low distortion and excellent stability
- Constant voltage low impedance output
- Continuously variable calibrated level
- Standard FM/FM frequencies furnished
- Other frequencies available to order

FOR RAPID PRODUCTION CONTROL TESTS

TELETRONICS LABORATORY INC.

WESTBURY, L. I., N. Y.

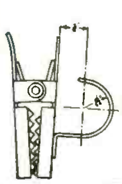
MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND PRODUCTION TEST EQUIPMENT

Roanwell

Style No. 2906

CLOTHES CLIP

Sturdily constructed for maximum life. Finished in semi-gloss black enamel. Ribbed, firm-gripping clamping pads made of hard neoprene. Mounting plate enables clip to be attached to hard surface, such as a switch case. Hard drawn steel spring wire insures optimum spring action.



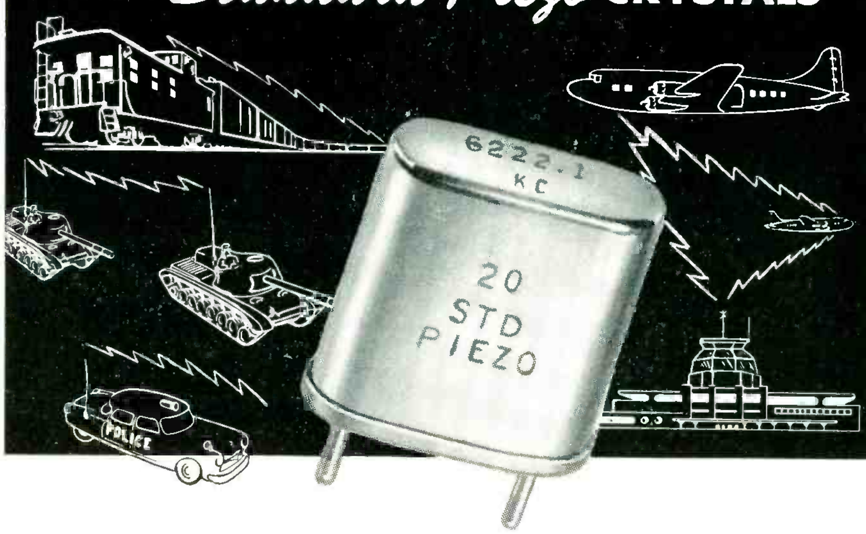
WITH MOUNTING HOOK FOR USE ON CORDSETS . . . This model utilizes a steel mounting hook which can be hooked directly on a cordset molded for this purpose.

DATA SHEETS ON REQUEST.

ROANWELL CORPORATION

27 SIXTH AVENUE, BROOKLYN 17, NEW YORK

ALWAYS . . . "on the beam" with *Standard Piezo* CRYSTALS



If it is important for your transmitting and receiving equipment to stay "on the beam"—always, regardless of atmospheric extremes and rough handling—be sure to specify Standard Piezo Crystals. They're built to take it. Send for our completely illustrated catalog or submit your problems to our engineers for recommendations.

Standard Piezo Co.

CARLISLE, PENNA

honorable mention, Edward O. Johnson."

"By virtue of his outstanding contributions to the design and construction of supercharged hydrogen cooled turbine generators, and his extraordinary participation in the life of his community, Eta Kappa Nu recognizes with honorable mention Gustav W. Staats."

Motorola To Expand Plant

MOTOROLA president Paul V. Galvin announced that his company plans to spend $3 million for a plant expansion program in 1953. A major new plant will be built in Franklin Park, Illinois which will nearly double the production capacity of the electronics firm's television manufacturing facilities. Some 27½ acres of land have been acquired to accommodate the single large structure measuring 833 feet by 325 feet, embracing 278,000 square feet of usable factory space.

Paul V. Galvin

The new facilities will constitute a bulk assembly plant for final assembly, packing, storing and shipping of tv units. The completion of the new plant, with all installations necessary for operation, is anticipated by mid-year.

GE Elects Vice-Presidents

PRESIDENT Ralph J. Cordiner of the General Electric Company announced that general managers of eight operating divisions of the company have been elected vice-

presidents by the board of directors. Mr. Cordiner said that the promotions were made in furtherance of the company's announced plan of decentralization.

Those elected were: James M. Crawford, general manager of the Motor and Generator Division, Schenectady, N. Y.; Francis E. Fairman, general manager of the Transformer and Allied Products Division, Pittsfield, Mass.; Cramer W. LaPierre, general manager of the Aircraft Gas Turbine Division, Evendale, Ohio; Clarence H. Linder, general manger of the Major Appliance Division, Louisville, Ky.; Harold A. MacKinnon, general manager of the Component Products Division, Fort Wayne, Ind.; Charles K. Rieger, general manager of the Small Appliance Division, Bridgeport, Conn.; Glenn B. Warren, general manager of the Turbine Division, Schenectady; and William C. Wichman, general manager of the Industrial Power Components Division, Plainville, Conn.

Warde B. Stringham of Washington, D. C. has been elected a commercial vice-president of GE.

Zenith Plans Expansion

DIRECTORS of Zenith Radio Corporation have authorized new construction that will add more than 300,000 square feet of floor space to the company's main plant at 6001 Dickens Avenue, Chicago, it was announced by Hugh Robertson, executive vice-president.

The new space will be used chiefly to provide additional packing and shipping facilities required for the steadily increasing volume of Zenith's production.

Construction will begin as soon as final drawings are completed, and is scheduled for completion within a year. With this new addition Zenith and subsidiary companies will have total floor space exceeding 1.8 million square feet. Estimated cost of the new addition is $3 million.

Bendix Names Chief Engineers

ALBERT E. NAMEY has been promoted to the position of chief engineer of the Test Equipment Design

Want more information? Use post card on last page.

Department at the Towson Plant of Bendix Radio, Division of Bendix Aviation Corporation, it was announced recently by A. C. Omberg, Director of Engineering and Research. He will be responsible for the design, production and purchase of all test equipment used by Bendix Radio and also maintain custody of all primary standard equipment and climatic and environmental test equipment.

Norman Caplan has been named to the position of Chief Engineer of the Military Communication and Navigation Engineering Department of the Bendix Radio Division. He will be responsible for the administration of the design and developmental work currently being undertaken in connection with military communication and navigation equipment programs. Prior to this appointment, he occupied the position of Chief Engineer of the Test Equipment Design Department.

Sparks-Withington Names Fisk Chief Engineer

SPARKS-WITHINGTON COMPANY, Jackson, Michigan, announced the appointment of Harry Fisk as chief electronics engineer of the company's Sparton Radio-tv division. He replaces H. H. Knubbe who served Sparton in that capacity for five years.

Harry Fisk

Formerly Sparton assistant chief electronics engineer, Fisk has been a major factor in Sparton engineering and research for 26 years. In his new post, Fisk will be responsible for all engineering research at

SINCE 1931
ULANET
ELECTRIC HEAT CONTROL ENGINEERS

THE ULANET ORGANIZATION SPECIALIZES IN THE DESIGN AND MANUFACTURE OF

THERMAL UNITS

FOR ALL TYPES OF

TIMING & THERMOSTATIC CONTROLS

It will pay you to compare our units — contact us and you'll save time & money by using engineered Ulanet Controls.

★ ★ ★ ★ ★ ★

It's "TREATMENT" that makes DANO your Best Bet for Coils

DANO's battery of vacuum impregnating tanks and heat controlled ovens for curing varnish impregnations is always at your service. Yes, Dano coils and Dano customers are always *treated* in the manner that makes your production pay dividends.

Send us samples or specifications with quantity requirements for our recommendations. No obligation!

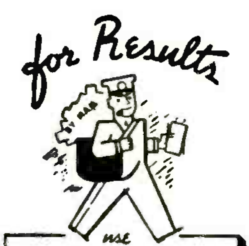
Also, Transformers Made To Order

- Form Wound
- Paper Section
- Acetate Bobbin
- Molded Coils
- Bakelite Bobbin
- Cotton Interweave
- Coils for High Temperature Application

DANO

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

DOUBLE BARREL ADVERTISING



use
McGRAW-HILL
DIRECT MAIL LIST SERVICE

Advertising men agree — to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your Display Advertising. It pin-points your message right to the executive you want to reach — the person who buys or influences the purchases.

Ask for more detail information today. You'll be surprised at the low overall cost and the tested effectiveness of those hand-picked selections.

McGraw-Hill Publishing Co., Inc.

330 West 42nd Street New York 36, New York

---

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.

Want more information? Use post card on last page.

Sparton as well as engineering supervision of the company's radio, television and government projects.

Admiral Works On Color TV

ADMIRAL CORP. announced an established research laboratory for color television at Palo Alto, Calif., near the campus of Stanford University. The company has more than 20 engineers working on various phases of color television and other electronic developments. Robert M. Jones is director of research at Palo Alto.

Sylvania Names McClintock

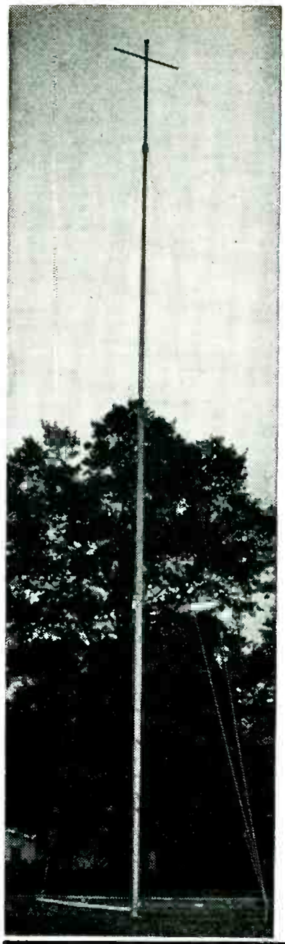
APPOINTMENT of Raymond K. McClintock to the newly created post of manager of new product promotion of Sylvania Electric Products Inc. was announced by B. K. Wickstrum, vice-president and director

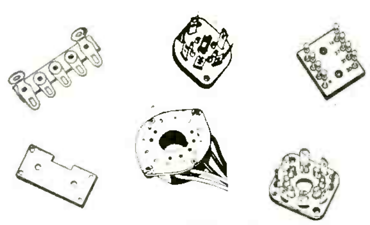
New Sylvania product promotion manager

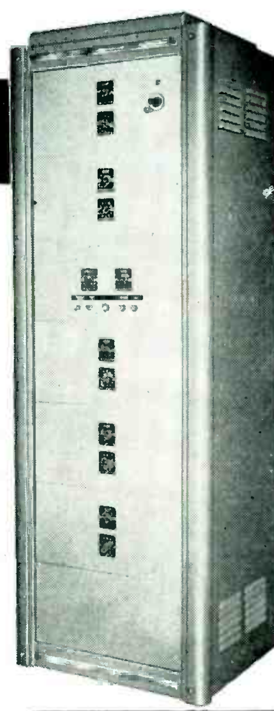
of sales. From company headquarters in New York City, he will be responsible for fostering the promotion and sale of new products and for exploratory work leading to the consideration of new lines of products by Sylvania.

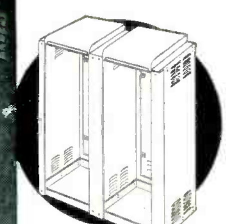
Magnecord Sets Expansion

ARRANGEMENTS for $300,000 additional capitalization have been completed by Magnecord, Inc., Chicago, manufacturer of professional magnetic tape recording equipment. The funds are to come from Ameri-









can Research and Development Corporation, Boston, Mass.

In announcing the increased capitalization, A. P. Buetow, executive vice-president of Magnecord, outlined a broad program of general expansion. Plans call for immediate extension of manufacturing facilities.

R. J. Sullivan Joins Fairchild

ROBERT J. Sullivan has joined the Potentiometer Division of the Fairchild Camera and Instrument Corporation at its Hicksville, N. Y. plant, to act as head of research and development. He was formerly chief of the Potentiometer Research Unit of the Air Force Cambridge Research Center, Cambridge, Mass.

New research head

At Fairchild, he will guide a new effort towards continual improvement in potentiometer design to meet the stringent requirements of both the military and industrial markets.

Hallicrafters Names Graver and Wilson

RICHARD A. GRAVER, formerly vice-president and general manager of the Capehart-Farnsworth Corp., Ft. Wayne, Ind., has been appointed vice-president and director of marketing of the Hallicrafters Co.

Mr. Graver's position at Hallicrafters is a new one with more comprehensive duties than those of the former vice-president in charge of sales, Roland J. Sherwood, who recently resigned to form an auto

Want more information? Use post card on last page.

parts manufacturing business of his own.

At Hallicrafters, Mr. Graver will be in complete supervision of all merchandising, marketing and advertising activities of the company.

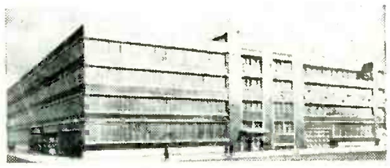
M. Robert Wilson, prominent major appliance sales executive, has been appointed vice-president in charge of sales for Hallicrafters Co.

IRC Elects Officers

THE board of directors of the International Resistance Company, Philadelphia, elected Ernest Searing chairman of the board of directors. Charles Weyl, formerly executive vice-president, was elected president.

JFD Completes Plant

JFD MANUFACTURING COMPANY, INC., has just announced the completion of a new plant that will expand the company's factory space to a total of more than 200,000



JFD factory

square feet. In addition, a 32,000 square foot area recently purchased will be eventually utilized for another factory, according to Julius Finkel, president of JFD.

Barthel Board Chairman of NEC

CHRISTOPHER E. BARTHEL, JR., was elected chairman of the board of directors of the National Electronics Conference. Starting his fourth year as a member of the NEC board, Dr. Barthel succeeds Kipling Adams of General Radio Company. During the current year, he was chairman of the publications committee which prepared the proceedings for the organization's eighth annual conference and exhibition in Chicago.

Ransom Joins Karl-Douglas As Chief Engineer

DAVID H. RANSOM, formerly director of research at Bogue Electric

Want more information? Use post card on last page.

Manufacturing Co., Paterson, N. J. has been appointed chief engineer of the Electronic Division of Karl-Douglas Associates, Hawthorne, California. In his new duties he will direct the design and production of various electronic and electrical products, including a new line of magnetic amplifiers.

Randall Named RDB Electronics Head

WALTER G. WHITMAN, chairman of the Research and Development Board of the Department of Defense, announced the appointment of Henry Randall as executive director of the RDB Committee on Electronics.

Randall has been associated with RDB since March, 1948, having served successively with the Planning Division, the Committee Coordination Division in the Office of the Vice-Chairman, and as acting executive director of the Committee on Electronics.

Canadian Radio Board Re-elects Officers

R. A. HACKBUSCH of Toronto, president and managing director of Stromberg-Carlson Co. Ltd., was re-elected president of the Canadian Radio Technical Planning Board at the eighth annual meeting of the Board.

C. W. Boadway, communications engineer, Ontario Hydro Electric Power Commissioner was re-elected vice-president and Stuart D. Brownlee of Toronto was re-elected Secretary-Treasurer.

Mr. Hackbusch in his annual report pointed out that 160 of the top-ranking engineers, scientists and specialists of all kinds in the electronic fields have been devoting a considerable portion of their time and effort to planning the future of electronics in Canada.

LaPointe-Plascomold Appoints Damerel

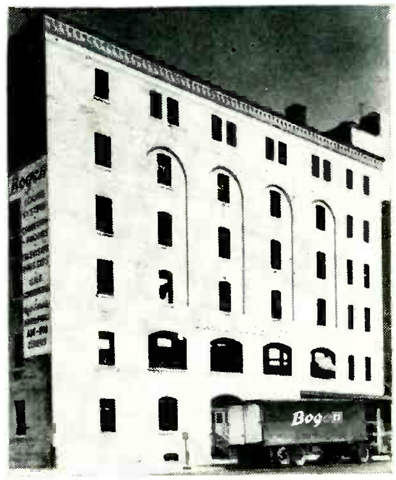
WILLIAM A. DAMEREL has been appointed to the position of assistant to the president, it was announced by J. E. Respess, president of the LaPointe-Plascomold Corporation. Damerel, who was with the Maxim

Want more information? Use post card on last page.

Silencer Company, Hartford, Connecticut, will coordinate all phases of administration. He will aid Mr. Respess in the formulation of overall company planning and policies.

Bogen In New Quarters

THE DAVID BOGEN COMPANY, INC., has completed the removal of its complete plant facilities to new quarters at 29 Ninth Avenue in New York City. The building, which contains a total of 70,000



New Bogen plant

square feet of area on six floors and basement, will permit expansion of all departments, especially engineering laboratories and production facilities for the company's new products.

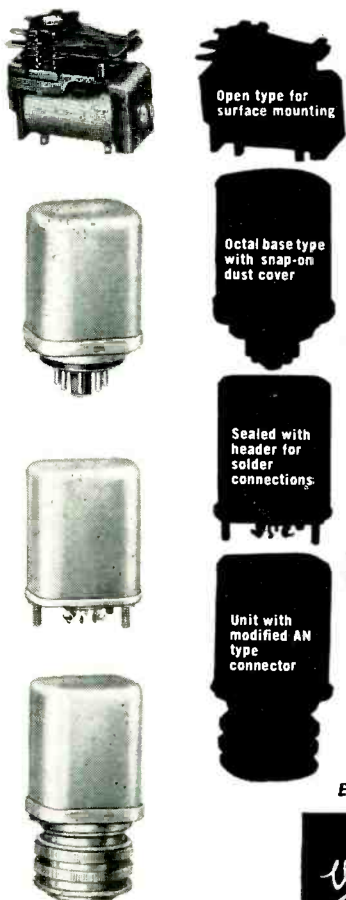
MASCO Appoints Two Executives

RALPH AASEN has been appointed chief engineer and G. L. Werner has been appointed director of sales engineering of Mark Simpson Mfg. Co., Inc. of Long Island City, New York, it was announced by John A. Van Auken, general manager.

Stackpole Promotes Five

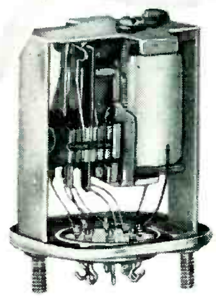
DR. E. J. SHOBERT has been appointed manager of carbon research and engineering for the Stackpole Carbon Co., St. Marys, Pa., and Henry M. Dressel will serve as director of research and engineering for the firm's electronic components division.

Other Stackpole appointments also announced by H. S. Conrad,



a rugged little space saver . . .

MIDGET TELEPHONE TYPE RELAYS SERIES (80)—OPEN TYPE FOR SURFACE MOUNTING, OR IN HERMETICALLY SEALED CONTAINERS.



This vibration and shock-proof Midget Type Relay is the answer to numerous applications where unfailing operation is necessary. In fact, it is built to meet rigid Army and Navy specifications. This "rugged little space saver" is a compact, multiple contact relay which has been developed over years of specialized engineering in the field by Signal Engineering and Mfg. Co., manufacturers of a comprehensive line of relays and signals of various designs and sizes.

Write for Bulletin MTR-6

Engineering Representatives in Principal Cities.

Wheelock RELAYS
SIGNAL
ENGINEERING & MFG. CO.
154 WEST 14TH ST NEW YORK 11 NY

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.

leads in the field of

TRANSILLUMINATED PLASTIC LIGHTING PLATES

BECAUSE OF *Quality • Uniformity • Performance*
Design & Layout "Know-How Service"
Quantity Production Promptly

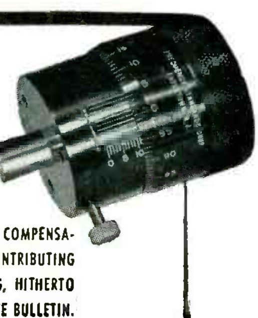
NEW YORK —19 Railroad Ave., New Rochelle (Home Office)
TEXAS —Jefferson Tower Building, Dallas
CALIFORNIA—11056 Cumpston St., N. Hollywood
CANADA —313 Montreal Trust Bldg., 67 Yonge St., Toronto

DEMONSTRATION PANEL MIL-P-7788 (AN-P-89) Sent on Letterhead Request

---

FS MICROMETER HEAD

for the Electronics Industry



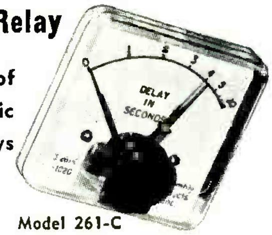
ENGINEERS USING FS MICROMETER HEADS FOR VARIOUS APPLICATIONS FIND THE TEMPERATURE COMPENSATION CONSTRUCTION AND AUTOMATIC COMPENSATION FOR WEAR OF SPINDLE AND NUT THREAD CONTRIBUTING FACTORS TO THE INSTRUMENT'S PRECISE ACCURACY . . . A DEGREE OF ACCURACY IN READING, HITHERTO UNATTAINABLE IN ANY MICROMETER HEAD. SEND TODAY FOR YOUR COPY OF THE NEW DESCRIPTIVE BULLETIN.

FREQUENCY STANDARDS
P. O. BOX 66, EATONTOWN, N. J. • TELEPHONE ASBURY PARK 1-1018

ADVERTISEMENT

Time Delay Relay

Retard action of coil in magnetic field for delays to 10 seconds.



Model 261-C

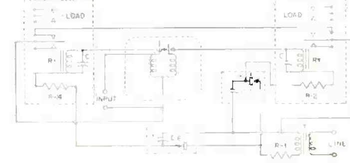
This moving coil, permanent magnet relay gives adjustable delays in ranges of volts and current, AC and DC. Delay results from the magnetic drag inherent in sensitive microammeters. All contact meter ranges listed in Bulletin CMR-79 can be furnished with time delay.

The dial can indicate current, volts or temperature, or it can show delay in seconds. Timing is little affected by temperature or pressure. The relay uses no condensers, dash pots nor motors so size and weight are small.

SPST or SPDT contacts are self locking, rated five milliamperes DC for one million operations—ratings to 500 milliamperes for reduced number of operations. Contacts are locked by an extra coil in meter—released by braking circuit to that coil. Non-locking contacts can be supplied for special applications.

Normal reset time is about the same as operate time. Special adaptions provide fast operate, slow release or slow operate, fast release. Delay is adjusted by setting index pointer. Or, relays may have fixed setting. They are adaptable to hermetic seal.

Here are typical specifications:
Cat. No. 306-7000, range 0-10 seconds, 0-1 DCMA, 100 ohms $30.00
Cat. No. 306-7002, range 0-5 seconds, 0-50 DCUa, 2800 ohms $45.00
Cat. No. 705-7003, range 0-10 seconds, 0-150 AC volts $47.00



Simplytrol Double CMR Improved Self-Releasing Circuit

There are so many possible variations for these relays it is suggested that engineers submit descriptions of proposed use. Include diagrams of associated circuits. Write Bradley Thompson, Assembly Products, Inc., Chagrin Falls 16, Ohio. Phone 7374.

vice-president and general manager, include: L. D. Andrews, director of research and engineering on magnetic materials; E. F. Kiefer, director of research and engineering on carbon products; and F. X. Sorg, director of research and engineering on fixed resistors.

Packard-Bell Enlarges Plant

PACKARD-BELL CO., Los Angeles radio-tv manufacturer, is now constructing a new 92,460 sq ft addition to its Los Angeles main plant. Building and equipment together will represent an investment exceeding $750,000.

The addition will have two units, one housing a division for milling and assembling tv cabinets and the other housing the electronics division for government contracts. When this addition is completed, the total facility will contain 250,000 sq ft.

Capehart Names Manufacturing V-P

L. G. HAGGERTY was elected vice-president in charge of manufacturing of the Capehart-Farnsworth Corporation, associate of IT&T, at a meeting of the firm's directors in Chicago.

Arma Advances Walz

ALLEN W. (SKIP) WALZ has been advanced by Arma Corporation, subsidiary of American Bosch Corporation, to executive staff assistant to Clifton T. Foss, Arma's vice-president for engineering. His executive position is a newly created one made necessary by the tremendous blacklog of orders, now on Arma's books, requiring engineering and development work. The Engineering Division of Arma Corporation now has some 1,700 employees.

Allied Radio Builds $2 Million Building

RAPID progress is being made on a new $2 million building of Allied Radio Corporation, Chicago, national distributor of electronics

WHEN you need a quick answer to WHO MAKES IT...

Just look it up in

the electronics BUYERS' GUIDE

•

There are . . .

23,367 ANSWERS

to

1,445 PROBLEMS

covering every . . .

COMPONENT
EQUIPMENT
and MATERIAL

used in every phase of electronics

•

GET IN THE HABIT OF LOOKING IT UP IN

the

electronics BUYERS' GUIDE

A McGRAW-HILL PUBLICATION
330 West 42nd Street
NEW YORK 36, N. Y.

WESGO ALUMINA CERAMIC INSULATORS

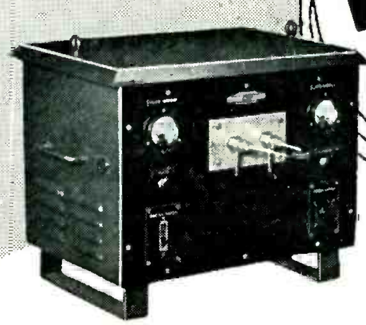
- High purity . . . free of all impurities such as Iron, Titania, Alkali group elements.
- Made to various formulations with Alumina content from 94% to a pure sintered Alumina with 99.85% minimum Al_2O_3.
- Available in porosities ranging from 20% to an impervious, vacuum tight body.
- Formed to dimensional tolerances of plus or minus ½%, minimum of plus or minus .001".
- Completely homogeneous structure.

Our Engineering Department will gladly answer all inquiries relative to your particular problems.

WESTERN GOLD & PLATINUM WORKS
Ceramic Division
589 BRYANT ST., SAN FRANCISCO, CALIF.

2KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT

only $650



Simple . . Easy to Operate . . Economical Standardization of Unit Makes This New Low Price Possible

Never before a value like this new 2-KW bench model "Bomborder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

This compact induction heater saves space, performs with high efficiency Operates from 220-volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. Specify time cycle required for your particular job. We will quote on proper size unit for your requirements. Immediate delivery.

Scientific Electric Electronic Heaters are made in the following ranges of power: 1—2—3½—5—7½—10—12½—15—18—25 40—60—80—100—250KW.

Scientific Electric
DIVISION OF "S" CORRUGATED QUENCHED GAP CO.
107-119 MONROE STREET GARFIELD, NEW JERSEY

Want more information? Use post card on last page.

parts and equipment. With a total floor space of 150,000 square feet, the new center is expected to be ready for occupancy this summer.

A. D. Davis, president of Allied, points out that the firm's rapidly expanding sales have been keeping pace with the phenomenal growth of the electronics industry. The firm now stocks 19,000 items, with an increase to 25,000 anticipated within a few years. Processing of 7,500 shipments daily instead of the current peak of 4,000 daily will be possible in the new building. Allied maintains a \$2.5 million inventory to meet everyday demands for electronic products.

New NBS Lab Under Way

CONSTRUCTION has begun on a major laboratory of the National Bureau of Standards at Boulder, Colorado. The new building will house the Bureau's Central Radio Propagation Laboratory on a 210-acre site directly south of the city. Complete and modern facilities are to be provided for research on the propagation of radio waves and on the expanded utilization of the radio spectrum now being used for f-m, television, facsimile and radar.

The new building is scheduled for completion in early 1954. By mid-1954 a staff of about 500 will be employed there.

OTHER NEWS

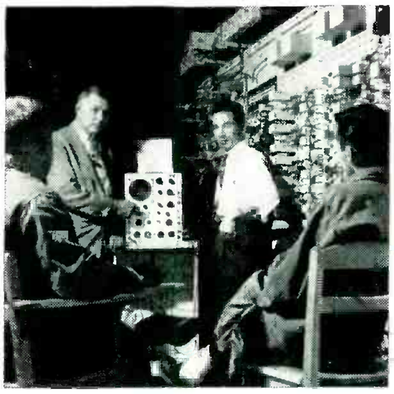
Westinghouse Readies Round-The-World Sub

THREE nuclear power plants of major size are under construction or design at Westinghouse. One, known as Mark II, will be used on the submarine Nautilus for which the keel was laid last July. It will be the first submarine to receive this revolutionary new type of power plant. In the ship, nuclear energy will be put to use for large-scale power utilization for the first time, resulting in an around-the-world submarine.

The second plant is a full-size

working model of a submarine atomic plant, while the third is another nuclear power plant many times larger than those mentioned above. It is planned that this power plant shall be suitable to power major naval vessels such as aircraft carriers.

GE INSTRUCTS SIGNAL CORPS MEN



SERIES of month-long classes is conducted by General Electric to instruct Signal Corps technicians on the installation, operation and maintenance of microwave relay communications equipment. The company is producing the equipment for the Signal Corps at its Syracuse, N. Y. plant. Assisting instructor Gus Kandaris (right rear) is J. N. Craver (left rear), chief radio engineer for the Signal Corps plant engineering agency, who attended the class to further familiarize himself with the equipment

RTMA Launches Serviceman Program

A PROGRAM designed to improve the technical proficiency and business technique of radio-tv service technicians is being launched by RTMA with the institution of a pilot course in the New York Trade School.

The vocational training program, developed by the RTMA Service Committee under Chairman R. J. Yeranko of The Magnavox Co., has as its immediate objective the upgrading of television service technicians through existing vocational and trade schools. This is to be accomplished through the development and publication of manuals and teaching aids for schools and instructors which would reflect the recommendations of the radio-tv

Want more information? Use post card on last page.

industry and be consistent with the rapidly changing designs and products of the industry.

It is estimated that the radio-tv training program will require an industry subsidy of $80,000 for the first two years. After this period the program is expected to be self-supporting.

Cincinnati IRE Sets All-TV Conference

SEVENTH Annual Spring Technical Conference of the Cincinnati Section of IRE will be entirely devoted to television. It will be held in Cincinnati on April 18, 1953.

Following is the list of speakers and papers to be delivered: Television and the Bell System, by (speaker undetermined); A High Powered UHF-TV Broadcast System, by F. J. Bias of GE; The Design of TV Receivers Utilizing Non-Synchronous Power, by G. D. Hulst of DuMont; Approach to Mechanized Assembly of Electronic Equipment Applicable to TV Receivers, by L. K. Lee of Stanford Research Institute; The Selection and Amplification of UHF TV signals, by W. Boothroyd and J. Waring of Philco; Transient Considerations in the NTSC Color System, by B. S. Parmet of Motorola; A Four Gun Tube for Color TV Receivers, by J. Rennick and C. Heuer of Zenith; Latest NTSC Color System (Orange Cyan Wide Band), by R. D. Kell and A. C. Schoeder of RCA.

Reps Change Name

THE Representatives of Electronic Products Manufacturers, Inc. is the new name of the reps' organization formerly known as the Representatives of Radio Parts Manufacturers.

Electronic Parts Show Allocates Space

A TOTAL of 234 companies have reserved 374 display units for the 1953 Electronic Parts Show to be held May 18–21 at the Conrad Hilton Hotel in Chicago. It is estimated that 10,000 persons will attend the show.

NEW BOOKS

Advances in Electronics

EDITED BY L. MARTON. *Academic Press, Inc., New York, New York,* 344 *pages,* 118 *illustrations,* 1952, $7.80.

THE remarkable group of books, of which this is the fourth, comprises a series of tutorial articles on subjects chosen annually by a distinguished editorial board. The choice of subjects displays a catholic interest, ranging from the manufacture of cathode-ray tubes to mathematical treatises on electron scattering in solids.

As the preface to the first edition states: "The 'Advances in Electronics' is a yearly publication devoted to the general field of electronics. The term 'Electronics' comprises both physical electronics and engineering electronics; namely the basic physics of charged particles, on the one hand, and the methods and instrumentation for employing such charged particles usefully."

Rather a conservative statement in the light of Dr. Everitt's recent definition!

The articles usually run from 25 to 75 pages, there being seven in this volume:—

1. Electron Scattering in Solids, H. S. W. Massey, F. R. S.
2. The Scintillation Counter, G. A. Morton.
3. Fluctuation Phenomena, Aldert van der Ziel.
4. Electronic Digital Computers, C. V. L. Smith.
5. Modulation of Continuous-Wave Magnetrons, J. S. Donal.
6. The Magnetic Airborne Detector, Winfield E. Fromm.
7. Multichannel Radio Telemetering, M. G. Pawley and W. E. Friest.

None of these articles is exactly easy reading since space limitations force the maximum of compression. Naturally the skill with which the selection and compression of material is effected varies from article to article. On the whole the quality is quite high. Mr. Fromm's discussion of the MAD system is particularly likable. On the other hand Mr. Smith's article on computers suffers from too much packing. It could have been made much more readable with the increase of only a few pages.

The format of the books is attractive, the type easy to read, and typographical errors are few.

This series forms an excellent source of material for the research worker who wishes to broaden his interest and to keep abreast with advances in related fields.—KNOX MCILWAIN, *Hazeltine Electronics Corporation, Little Neck, New York.*

Applied Electronics Annual 1952

EDITOR, R. E. BLAISE. *British-Continental Trade Press Ltd., London. J. D. Griffiths, 3606-A Parkwood Dr., Greensboro, N. C.,* 240 *pages,* 1952, $8.00.

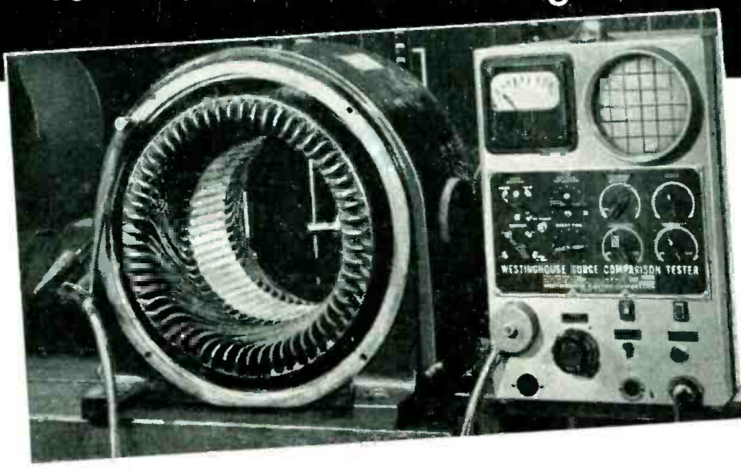
A SERIES of short articles on the applications of electronics to industrial operations, such as in textiles, medical diagnosis, motor control and high-frequency heating, plus articles on germanium, magnetic recording, underwater television and new materials for components. In addition there is a list of trade and technical societies and manufacturers of radio and electronic apparatus and components throughout the world, a list of trade marks and names, wholesalers, importers, etc. Interspersed with the text are advertisements of the principal British manufacturers.—K.H.

Principles of Radar

BY M. I. T. RADAR SCHOOL STAFF, *Third edition by J. F. Reintjes and G. T. Coate. McGraw-Hill Book Company, Inc.,* 985 *pages,* $7.75, 1952.

THE SUBJECT matter of this book is an expansion and reorganization of the earlier editions of the book. The scope can be appreciated by listing of the chapter headings and number of pages devoted to each: Pulsed Radar (54 pp); Timing Circuits (99 pp); Modulators (62 pp); Indicators (62 pp); Synchros and Servomechanisms (61 pp); Receivers (130 pp); Radio Frequency Transmission Lines (77 pp); Waveguides (68 pp); Resonant Lines and Cavities (84 pp); High-Frequency

Want more information? Use post card on last page.



Triode Oscillators (48 pp); Klystrons and Magnetrons (60 pp); Radio-Frequency Transmitting and Receiving Systems (89 pp); Antennas (64 pp); Propagation (18 pp); and Index (8 pp).

The original purpose of this book was to serve as a text for a course in radar principles for Naval Officers. As such it provided an excellent basis for study to bring electrical engineers who had not had access to the classified war time developments into position to understand the principles of operation of current radar systems. Thus, in addition to specifically radar subjects, much general information is included on subjects such as transmission line and waveguide theory, servomechanisms and high frequency operation of vacuum tubes.

Now that the Navy course is discontinued, there exists some question of the need for this third edition inasmuch as the more general subject matter is at an intermediate level below that normally given to communication engineering students or needed as reference material for engineers working in the field. As a survey text, this third edition is excellently organized, clearly written and well illustrated.—G. J. LAURENT, *Research Division, Philco Corporation, Philadelphia, Pa.*

Photoelectric Tubes

BY A. SOMMER, *EMI Research Laboratories. Methuen & Co., Ltd., London; John Wiley, New York.* 1952, 118 *pages*, \$1.90.

ANOTHER of the interesting and useful Methuen Monographs on Physical Subjects. In this second edition, care is taken to indicate that it deals with phototubes and not with photovoltaic or photoconductive cells. The new edition contains a new chapter on the theory of photoelectric emission, expanded material on multiplier phototubes and new material on image converter tubes.

Like the other monographs in this series, the book is in a handy pocket-size format and the contents are by men of high repute. The chapters cover the history of photo emission, photoelectric cathodes, matching of light sources and photocathodes, vacuum and gasfilled tubes, multiplier phototubes and applications of all types of light-sensitive tubes.—K. H.

THUMBNAIL REVIEWS

ELECTRICAL MEASURING INSTRUMENTS, Part One, Second Edition. Revised by George F. Tagg, chief research engineer, Evershed and Vignoles, Ltd. 598 pages, $12.00, John Wiley & Sons, Inc., New York. A classic dealing with the design, manufacture and use of fundamental electrical instruments.

THE CHEMICAL ELEMENTS. By Helen Miles Davis, editor Chemistry Magazine. Science Service, 1719 N Street NW, Washington 6, D. C. 160 pages, 1952, $2.00. Basic information on the 98 elements and particles plus a periodic table plus some hitherto untranslated accounts of the discovery of certain elements.

THE MILITARY ELECTRONIC STUDY. By William C. Urlovic, Pacific Mercury Research Center, Santa Barbara, Calif. 23 pages, 1952, free. For anyone contemplating, or engaged in, research on any subject for the armed forces. The philosophy, technique and pitfalls of setting up an organization, estimating study time and costs, maintaining good relations all round.

RADIO AND TELEVISION WORKSHOP MANUAL. By Sidney A. Diamond, Boston University, and Donald M. Anderson, Massachusetts Department of Education. Prentice-Hall, New York, N. Y. 1952, 300 pages, large format, $4.50. A "how-to" book for those who wish to be successful in front of a microphone or camera. Dialog, rules, tricks, music etc.

COMPUTING METHODS AND THE PHASE PROBLEM IN X-RAY CRYSTAL ANALYSIS. Edited by Ray Pepinsky. X-ray Crystal Analysis Laboratory, Pennsylvania State College, State College, Pa. 1952, 390 pages, large format, $7.50. Proceedings of a Conference on the subject held at State College in April 1950 under the auspices of the Rockefeller Foundation, the Office of Naval Research and Pennsylvania State College. Twenty papers and nine appendices.

PHYSICAL FOUNDATIONS OF RADIOLOGY. By Otto Glasser, Edith H. Quimby, L. S. Taylor and J. L. Weatherwax. Paul B. Hoeber, Inc. (Harper & Bros.), 1952, 581 pages, $6.50. A new and thoroughly revised edition of a well known text which, in the first edition, went through eight printings. Gives the history of x-rays, technical aspects of the use of x-rays, dosage considerations and measurement of dosage, plus new material on usage of radioactive isotopes. Small handy format, very practical.

BACKTALK

Smaller Necks

DEAR SIRS:

THE MEMORIES referred to in Frank Willey's letter in the November 1952 issue of ELECTRONICS (*Backtalk*, p 436) brought back others to this writer. Among the various $\frac{3}{4}$-inch neck tubes built in those days at General Electric was one for wide-angle deflection. It was of flat face and such short bulb length that it was promptly catalogued as the Squatron. We also successfully built tubes with neck stems of $\frac{3}{8}$-inch outside diameter. For my "Museum" I have kept one of these with a 2-inch screen. Its deflection yoke, built for the occasion by S. Hansen, is in a $\frac{7}{8}$-inch cube.

C. H. BACHMAN
Department of Physics
Syracuse University
Syracuse, New York

Electronic Embalming

DEAR SIRS:

YOUR November, 1952 issue of ELECTRONICS (p. 98) carrying the excellent paper by Gale & Burrill on "Electron Beams Sterilize Food and Drugs" once again calls to my mind my earlier contention that Van de Graaf generators with scanned beam output operating at from 2 to 10 million volts could be used for human cadaver preservation—electronic embalming, if you will!

This rather gruesome approach was promulgated by this writer in 1944 while still an engineering student at Ohio State University. Unfortunately, the idea was received rather badly, not for technical reasons but because of the possible social objections to the plan. Practically the plan would be two-fold, destroying the bacteria extant in the tissues of the deceased and curtailing enzymic action which would otherwise permit degeneration of the cadaver tissue.

Embalming is a time-honored science going back thousands of years. Cremation is also an ancient alternate technique. Practiced among the Jews, temporary packing in ice while awaiting burial is the third popular method of han-

RADIO–ELECTRONICS
A Preview of Progress
I.R.E. CONVENTION

RADIO ENGINEERING SHOW

405 EXHIBITS

WALDORF-ASTORIA HOTEL
GRAND CENTRAL PALACE
NEW YORK CITY

MARCH 23-26 1953

Come again–

Communications Men!

Welcome to the Radio Engineering Show—

March 23-26, 1953
at New York City

19 IRE Professional Groups have prepared skillfully organized symposia and technical sessions on all phases of radio, TV, and electronics. These papers will keep you up-to-the-minute on the developments which are to come in the next few years—for the IRE Convention Theme is:

Radio-Electronics
"A Preview of Progress"

The colorful Annual Meeting on Monday at 10 (opening morning) will feature the "Founders' Award". Social Events include the "Get Together Cocktail Party" Monday, and the Annual Banquet Wednesday, all at the Waldorf Astoria Hotel.

405 Exhibitors are using 58,680 square feet—the entire four floors of Grand Central Palace, to give you a "Preview of Progress" in the apparatus, components and instruments of Radio-Electronics. Registration: IRE Members $1.00, Non-Members $3.00. Register at Grand Central Palace, 47th & Lexington Avenue, or The Waldorf Astoria Hotel, 49th & Lexington Avenue, New York City.

THE INSTITUTE OF RADIO ENGINEERS

GAIR

FOLDING CARTONS

Sell on Sight!

Smartly designed and brilliant multicolor Folding Cartons by GAIR are solving packaging problems for many manufacturers who are as meticulous about their packaging as they are about their famous products.

Sales, profits and prestige are increased with the SELL-ON-SIGHT magic of GAIR MULTI-COLOR CARTONS.

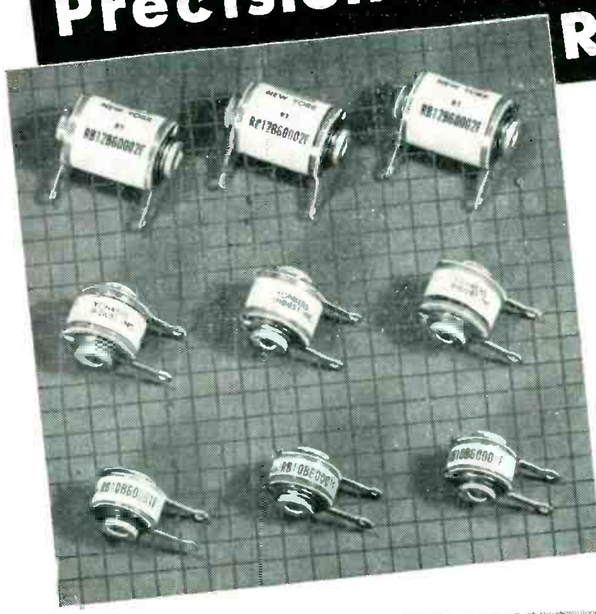
WRITE TODAY for samples and technical information.

GAIR

ROBERT GAIR COMPANY, INC.
155 EAST 44TH STREET, NEW YORK • TORONTO
PAPERBOARD • FOLDING CARTONS • SHIPPING CONTAINERS

PERMOHM

Precision Wire Wound RESISTOR



STABLE . . ACCURATE . . DEPENDABLE COMMERCIAL, SPECIAL and MIL-R-93A TYPES

Contractual Governmental Approval

Resistors made to your specifications. For full information write to YONKERS INDUSTRIES, INC. Resistors are available on short delivery to manufacturers and laboratories.

TOLERANCE: Standard tolerance within 1%. Any tolerance within 1/20% can be supplied at slight added cost.

Write for Bulletin NO. Y1

YONKERS INDUSTRIES, INC.
28 SCHOOL STREET, YONKERS, N. Y.

dling cadavers before interment.

Utilizing up to 10-million-volt Van de Graaf electron accelerator, an output of some 30 kw of scanned electron power output could sterilize (electrically embalm) a human cadaver dressed in his street clothes in about 60 seconds with apparatus amortized over a 20-year period at a cost per patient of some 19¢!

It is my estimate that such embalming would permit the cadaver to remain without decomposition, alteration in appearance or odor up to two weeks without any other treatment.

DAVID GNESSIN
New Rochelle, New York

WWV's Accuracy

DEAR SIRS:

IN THE November issue of ELECTRONICS is an article entitled "Industrial Frequency Standard" by H. W. Kline (p 130), in which a crystal oscillator is not used, a locked oscillator being synchronized with WWV's received signal. While WWV's claimed accuracy, as transmitted, is 2 parts in 100 magacycles, their usual accuracy is perhaps twice this, or one part in 10^8.

However, due to the Doppler effect, caused by the motion of the ionized reflecting layer in the stratosphere, the accuracy of the received signal is, usually, only about 5 parts in 10^7.

This effect has been known for several years. See such articles as: A Standard of Frequency, *Jour. IEE*, Jul., 1946; High-Precision Frequency and Time Standards, *Proc. IRE*, Jan., 1950; and my own article in the Western Union *Technical Review* for Apr. 1952. Also in the first footnote of an article by A. W. Warner, in the Sept. 1952 *Proc. IRE*, he states, "There is no known method of communicating a frequency accurate to one part in 10^8 or better from one place to another hundreds of miles away: . . .".

Even land lines, microwave relays, or coaxial cables will have some variable phase shift, although less than the Doppler effect of skywave transmission. To see the effect of the Doppler effect, an independent standard of high accuracy must be available at the receiving end of the circuit. I think that a correction of the accuracy of this type of standard might be desirable.

L. W. FRANKLIN
Radio Research Division
The Western Union Telegraph Co.
New York, N. Y.

Dowsers

DEAR SIRS:

THE CORRESPONDENT who asked to have his name withheld concerning water dowsers need not be so cautious. There are quite a few scientists of good repute working in this most interesting parapsychics field today on a purely mechanistic and communications theory basis.

There is no withcraft or supernatural effect involved, but some obscure magnetic, electric and infrared senses possessed by abnormally sensitive humans which are similiar to the uncanny homing, tracking and migrating senses of some animals. The water dowser's gifts appear to be related to the magnetic sense of homing pigeons and the infrared smell senses of insects. Endocardiographic readings taken by Prof. S. W. Tromp[1] indicate that nerve potential variations coincide with the magnetic and electric field variations about a dowser's body and the nerve reflex responses of his arm muscles and the divining rod. Running water is different from still water in that it develops a frictional electric charge which strongly effects a sensitive dowser's sensory motors. Bioelectrical fields have been measured at distances up to 15 feet from animals and plants.

Professor Tromp found that some dowsers got responses where there were no measurable currents, fields or radiations. This he eventually tracked down to abrupt changes in soil resistivity with geological equipment, according to a personal corespondence letter to the writer. Hence a dowser's body radiates either an electrical or infrared field and his fantastically sensitive nervous system picks up the tiny reflections from the soil boundary, which may also be a wet-soil boundary caused by a body of water. For discussions of such biological phenomena, see the papers of Burr, Yeagley, Rhine, Ravitz, Puharich, Rajewsky, Reich, Cazamalli, Miles, Beck, Humphrey et al, and the books on dowsers by Maby, Tromp and Roberts.

The blind little bat, for instance, emits a triple-modulated sonar pulse to clock distance objects by timing the pulse echoes, and close objects by analyzing the a-m and f-m modulation beats, to extract a maximum of information from a restricted bandwidth of 40 to 70 kc, and has applied Shannon's information theory millions of years before man appeared on this earth. A casual study of so-called "psychics" indicates that Mother Nature may be even better an empirical-methods engineer in communications than in the bat's little sonar-computor-servo blind-navigation system.

T. POWELL
Great Neck
Long Island, N. Y.

REFERENCE

(1) S. W. Tromp, "Physical Physics," Elsevier Press, Holland and New York, 450 pages, $8.00, 1948.

More On Dowsers

DEAR SIRS:

THE AUTHOR of the unsigned letter on the subject of dowsing and electronics in the *Backtalk* column of ELECTRONICS, December, 1952, (p 398) is perhaps unaware that:

(1) Dowsers are not infallible. For example, H. B. Nichols, in the *Scientific Monthly*, May, 1951, p 340, states that in New South Wales the dowsing history of several thousands of water wells was recorded by the government, and that the dowsed wells were consistently less successful than the undowsed locations. From this it might appear that chance, or possibly that more rare quality, common sense, could be as effective as dowsing.

(2) Competent geophysicists and geologists are not completely unaware of electronics as applied to water-finding, and the subject has received some attention by C. A. Heiland, "Geophysical Exploration," Prentice-Hall, New York

1940, and by J. J. Jakosky, "Exploration Geophysics," Times-Mirror Press, Los Angeles 1940, and by other authorities in the geophysical field.

(3) The possibility of the dowser's nervous system being stimulated by changes in some external force or electrical field has been recognized by S. W. Tromp, "Phychical Physics, A Scientific Analysis of Dowsing, Radiothesia and Kindred Divining Phenomena," Elsevier Press, New York 1949.

(4) The controversial subject of dowsing has received much attention (possibly more than it deserves) by scientists and others, including Kenneth Roberts, novelist, "Henry Gross and His Dowsing Rod," Doubleday, New York 1951. More recent and brief, and with twenty-nine references, is, "Water Witching: An Interpretation of a Ritual Pattern in a Rural American Community," by E. Z. Vogt, in the *Scientific Monthly*, Sept., 1952, p 175.

(5) Ground water, hydrology and water supply engineering are, and have been receiving continuous and costly research from industry and government, and presumably a few "electronics boys" are available and working.

(6) Experts in electronics are also "scientists".

BISHOP & BISHOP
Cassopolis, Michigan

Why?

DEAR SIRS:
IS IT NECESSARY that we be bound down to relatively horse-and-buggy tolerances on tube limits as manufactured for the mass market when more and more applications these days are in the atomic-and-jet classification? Rather than gear our precise instrumentation to wide-tolerance vacuum tube limits, it seems to me that it behooves tube manufacturers to work toward narrowing down those limits to keep step with today's progress. Maybe that is impossible to accomplish at the present time, but the feeling persists that at least as much time and expense should be put in that direction as is used to educate the

user to wide tolerances.

The special industrial and ruggedized series is a step in the right direction, except that they add just so much more to the confusion by bearing rouges' gallery numbers that bear absolutely no relation to anything—thus very successfully hiding their identify from the user and adding another to the already-too-long list of types to remember.

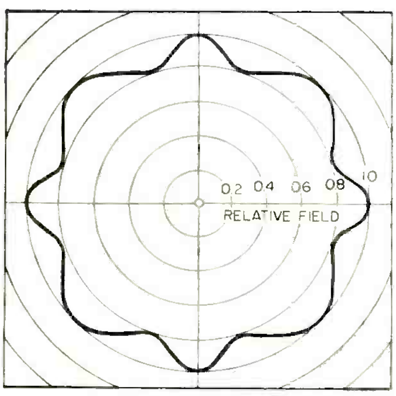
Even in the mass-produced home market, the use of the wide-tolerance tubes means engineering and servicing headaches.

Why cannot we clean house somewhat on both the ever-growing list of tube types and the thinking to back it up and assure that progress goes forward rather than being tied down to old-fashioned ideas?

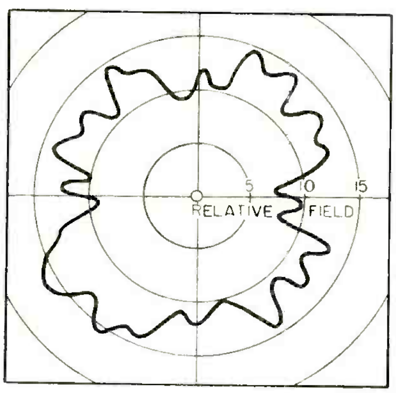
PHILIP C. TAIT
Emeryville, California

Calculated Curves

DEAR SIRS:
I WAS not very happy to see that you had to omit two calculated curves of antenna patterns in my

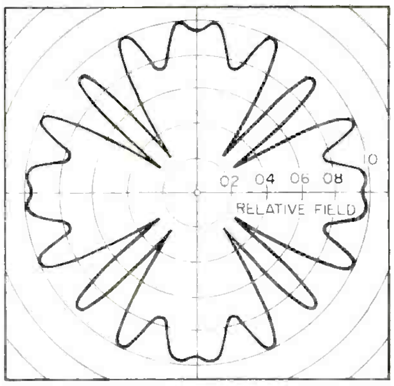


Calculated patterns for 90-degree skewed antenna

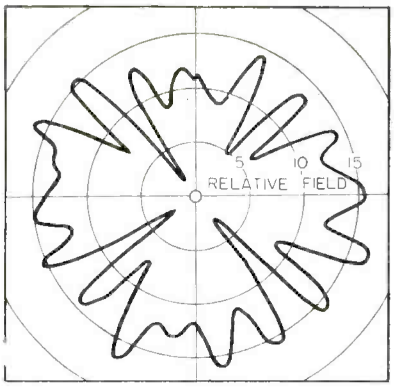


Measured pattern for 90-degree skewed antenna

Want more information? Use post card on last page.



Calculated pattern for antenna without skew



Measured patterns for antenna without skew

article, "Skewed Antenna at WJZ-TV" which appeared in the October issue of ELECTRONICS on page 130.

Among engineers it is quite well accepted to measure the success of a project by the correlation of calculated and measured work. In this case the measured patterns differ so much without the calculated results to substantiate these wide differences, there is reason to doubt the propriety of the work in the no-skew case. It is easy to obtain poor curves by an error in circuit arrangement or phasing.

M. W. SCHELDORF
Andrew Corporation
Chicago, Illinois

(Editor's Note: In order to show the close correlation between measured and calculated patterns, as requested by the author, we are reprinting the measured patterns below, along with copies of the calculated patterns that were omitted in editing the article.)

NIM

DEAR SIRS:

WE NOTE in the November, 1952 issue of ELECTRONICS the article "Digital Computer Plays NIM" (p 155), which brings to mind that The North Electric Manufacturing

CONTINENTAL

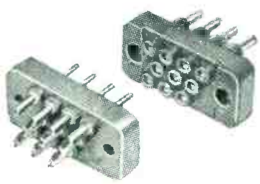
MINIATURE

Power CONNECTORS

SERIES 14

RACK TO PANEL TYPE

7-9-10-15 CONTACTS

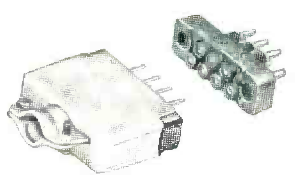


SERIES 14 FOR #14 AWG WIRE

These precision power connectors were developed to employ the same electrical and mechanical properties as our series 16 but were reduced by 25% in height with a larger solder cup for #14 AWG wire.
The disengagement force is also considerably reduced.

CABLE TO PANEL TYPE

7-9-10-15 CONTACTS

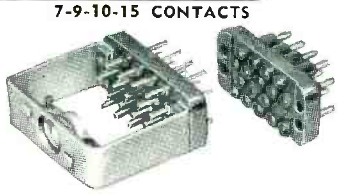


SPECIFICATIONS

MAXIMUM WIRE SIZE....#14 AWG
Creepage between contacts 7/32" MIN.
Air Space between contacts 3/32" MIN.
Breakdown voltage between contacts with connector engaged at sea level, normal conditions......5500 V.R.M.S.

CABLE TO PANEL TYPE

7-9-10-15 CONTACTS



ALUMINUM HOOD AND CABLE CLAMP IS AVAILABLE FOR ALL TYPES DESIGNATED BY ADDING "H" TO TYPE DESIRED, i.e.: 7-14 PH, Plug with Hood, 7-14 SH, Receptacle with Hood, 7-14 H, Hood only.

CATALOG WITH COMPLETE DETAILS — AVAILABLE ON REQUEST. TO DEPT. E-2

ELECTRONIC DeJUR U.S.A. INSTRUMENTS

DeJUR AMSCO CORPORATION

45-01 NORTHERN BOULEVARD, L. I. C. 1, N. Y.

Model 100A Phasemeter

New LOW COST—PRECISION Direct Reading PHASEMETER

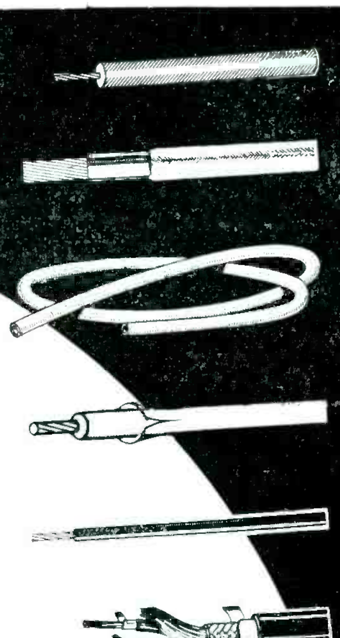
- 0° to 180° lead or lag in 90° expanded scale ranges.
- 2 cycles to 200 kilocycles.
- Error less than 4° from 20 cycles to 20 kilocycles; above 20 kilocycles and below 20 cycles increasing gradually to 8°.
- Input impedance approximately 20 megohms shunted by 10 mmf.
- Input voltage 1 to 50 volts sine wave; to 500 volts with accessory input dividers.
- Invaluable in the ***audio, ultrasonic, servomechanism, industrial control*** and ***acoustical*** fields for determination of phase characteristics and time relationships.
- Applicable to the power field and general laboratory use for power factor measurements and electronic component testing.

Literature on request.

Price: $145.

DELTRON INC.
P.O. Box 192 Glenside, Pa.

BIRNBACH *Electronic* WIRE & CABLE

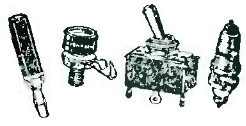


For ALL Your Wiring Needs!

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)
- 105° C. U.L. APPROVED
  Thermoplastic Hookup Wire
- JAN-C-76 WL-GLASS BRAID
  Solid or Tracer Colors
- MULTICONDUCTOR, SHIELDED CABLES
  To Meet Govt. Spec. #71-4945

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

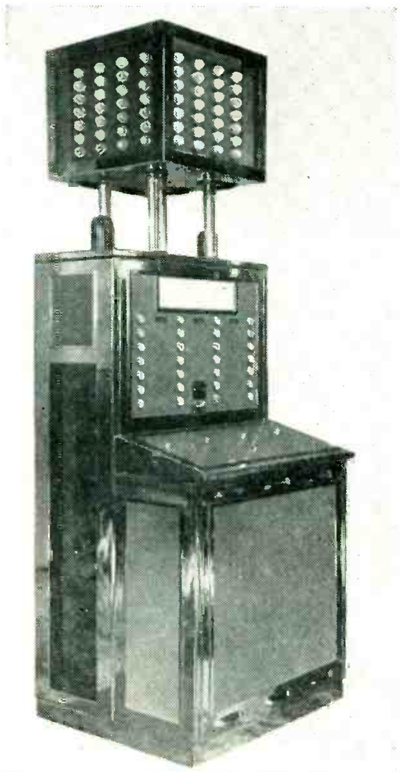
Quality Products for the Electronics Industries since 1923

BIRNBACH

BIRNBACH RADIO CO. INC.
145 HUDSON STREET
NEW YORK 13, N. Y.

WRITE FOR CATALOG 53-E

Want more information? Use post card on last page.



Relay-operated Nimatron played faultless NIM as early as 1940

Company built a similar machine in 1940. While it operated on relay principle only, the results were the same.

This machine was designed and built for Westinghouse and was displayed in the 1940 World's Fair in New York. It was also described in the August 1940 issue of *Popular Mechanics*.

This machine was known as a "Nimatron". We believe the machine is still on display in the Planetarium at Pittsburgh. The photograph shows the front of the machine, with four rows of seven lights and the operating buttons. The queue on the top merely repeated all of the lights in four directions. In the event the player won the game, a small token was delivered in the slot, lower center, front.

There were four counting chains which operated with the lights in each row and compared the powers of two to determine which play was winning. There was also an additional counting chain which kept track of the number of games and set up nine different starting combinations. All starting combinations were arranged so that the player could win if he did not make a mistake. However, once a mistake had been made, the machine took over and would never lose from that point. In cases where the player had a winning combination, the machine made random plays extinguishing one, two or three lights in rotation, the idea of this being to eliminate memorizing previous plays. This arrangement, together with the nine different starting combinations, gave an infinite number of plays, so that a previous winning combination would be very difficult to memorize and retain.

We thought perhaps you might be interested in knowing that this type of machine had been designed and manufactured at least twelve years prior to your publication of a similar machine designed by Maxson Corporation.

ERIC BROOKE
Chief Engineer, The North Electric Mfg. Corp., Galion, Ohio

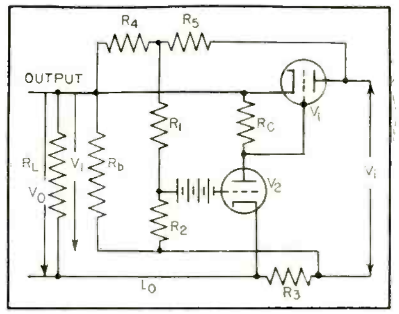
Zero and Negative

DEAR SIRS:

THIS REFERS to "Zero Impedance" in the *Backtalk* department of ELECTRONICS, p 385, May 1953.

Attention of your correspondent and readers is hereby drawn to my article "On Voltage Stabilizer Circuits" in the April, 1942 issue of the *Indian Journal of Physics*. Certain innovations for obtaining zero or negative internal resistance and others for perfect and more than perfect negative stabilization has been described there. I believe that is the first publication on stabilizer circuits giving satisfactory methods of obtaining readily these unusual performances. In their classic work published in *Rev. Sci. Instr.* in 1939, Hunt and Hickman have only made an observation (on the basis of a mathematical study of the effect of source resistance on the performance of stabilizers) that zero or negative internal resistance may be shown by a stabilizer having negative stabilization when working off a primary source of high internal resistance.

The usual two-valve stabilizer circuit cannot give five perfect stabilization—the change in output voltage dV_o can never become zero for a change dV_i in the input volt-



Circuit of zero or negative impedance power supply regulator

age although it may be very small in comparison. The very nature of operation of these circuits demand the presence of some control voltage at the grid of V_2. This control voltage is furnished by the change in the output voltage dV_o in the usual two-tube circuits. However the necessary control voltage may be easily supplied from the varying input voltage. In that case, no additional change in output voltage will be necessary to provide extra control and in this sense the circuit may be said to give perfect stabilization.

The circuit I developed is shown in the diagram.

The resistance R_3 between the cathode of V_2 and the negative line in the circuit brings about negative internal resistance in two-valve voltage stabilizer circuits. A simple analysis gives the internal resistance defined by the relation

$$R_o = -\left(\frac{\delta V_o}{\delta I_o}\right)_{V_i} \text{ as}$$

$$R_o = \left[\frac{1}{GA\beta} - R_3\left(\frac{1}{\beta} - 1\right)\right]$$

where G is the mutual conductance of V_1; A, the amplification given by V_2 and $\beta = R_2/(R_1 + R_2)$

It will be seen that by a suitable choice of the value of R_3, one can make the internal resistance zero or negative. A negative value of several hundred ohms is not difficult to attain.

The stabilization factor of the circuit remains practically unaffected by the inclusion of R_3 and is approximately given by $S_o = \beta A\mu$. where μ is the amplification factor of V_1.

B. M. BANERJEE
Institute of Nuclear Physics
Calcutta, India

PROFESSIONAL SERVICES

Consulting—Patents—Design—Development—Measurement

in

Radio, Audio, Industrial Electronic Appliances

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
MICROWAVE AND
PULSE TECHNIQUES
Plymouth 9-4237 60 Perry St., Belleville 9, N. J.

HANSON-GORRILL-BRIAN INC.
Products & Mfg. Development
ELECTRICAL - ELECTRONIC
HYDRAULIC - MECHANICAL
One Continental Hill Glen Cove, N. Y.
Glen Cove 4-1922

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-7-2933

R. W. HODGSON
RESEARCH & DEVELOPMENT ENGINEERS SPECIALIZING IN ELECTRONICS, NUCLEONICS, INSTRUMENTATION, SERVOMECHANISMS & CYBERETICS
Office—6600 Lexington Ave., Hollywood 38, Calif.
All Mail to Box 874, Sherman Oaks, Calif.
GLadstone 9680

R. W. HODGSON
PATENT AGENT SPECIALIZING IN ELECTRONICS
Registered to Practice Before the U. S. & Foreign Patent Offices
Office—6600 Lexington Ave., Hollywood 38, Calif.
All Mail to Box 874, Sherman Oaks, Calif.
GLadstone 9680

HOGAN LABORATORIES, INC.
John V. L. Hogan, Pres.
Applied Research, Development, Engineering
Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers, 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.

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, N. J.

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

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

PHYSICS RESEARCH LABORATORIES, INC.
Applied Mechanics, Thermodynamics, Heat Transfer, Optics, Magnetic and Electrical Devices, Electronics, Nuclear Physics.
507 Hempstead Turnpike,
West Hempstead, L. I., N. Y.

PICKARD AND BURNS, INC.
Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research, Development and Design 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

W. C. ROBINETTE CO.
MOTRON DEADBEAT HIGH GAIN SERVOS
Speed control of any Prime Mover ½% to .001% average. Electric Transmissions ½ to 50 HP plus controls—Zero droop—No load to full load.
802 Fair Oaks Ave. South Pasadena, Calif.
Py 11594

SKINNER, HARLAN AND IRELAND, INC.
Consulting Engineers
Specializing in Magnetic Materials and Their Application
Office and Laboratory Indianapolis 7, Indiana

THE TECHNICAL MATERIEL CORPORATION
Communications Consultants
Systems Engineering
General Offices and Laboratory
121 Spencer Place, Mamaroneck, N. Y.

TELECHROME, INC.
Electronic Design Specialist
COLOR TELEVISION EQUIPMENT
Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus
J. R. Popkin-Clurman, *Pres. & Ch. Engr.*
88 Merrick Rd. Amityville, L. I., 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

YARDNEY LABORATORIES, INC.
Research - Design - Development
Electro-Chemical Generators of Energy
105 Chambers Street WOrth 2-3534, 35, 36
New York 7, N. Y.

• CONTACTS •

FOR THE FIELD OF ELECTRONICS

This CONTACTS Section
supplements other advertising in this issue with these additional announcements of products essential to efficient and economical production and maintenance. Make a habit of checking this page, each issue.

UNDISPLAYED RATE

$1.50 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
POSITION WANTED & INDIVIDUAL SELLING OPPORTUNITY 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 $14.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. ELECT.

NEW ADVERTISEMENTS ADDRESS, N. Y. Office, 330 W. 42 St., N. Y. 36, for the *March issue closing February 2nd.* The publisher cannot accept advertising in the Searchlight Section, which lists the names of the manufacturers of resistors, capacitors, rheostats, 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)

SELLING OPPORTUNITY OFFERED

MANUFACTURERS REPRESENTATIVE wanted. Well-known contract fabricator of steel and aluminum enclosures, housings, cabinets, chassis, consoles, has numerous highly desirable territories open. Must be acquainted with project engineers and purchasing agents in the electronics industry and should have some engineering and manufacturing knowledge. We are interested in representatives who call on industry only, not jobbers. Write RW-6571, Electronics.

REPRESENTATIVE WANTED—Eastern Electronic and Machine parts manufacturer. Requires representation in Eastern New England, Chicago, and West Coast areas. RW-6577, Electronics.

POSITIONS WANTED

PROJECT ENGINEER, 11 years electronic engineering experience; 5 years radar and guided missile. Thoroughly familiar with system design. 2 years analog computer design. 4 years microwave, U.H.F. circuitry and antenna development. PW-6383, Electronics.

PATENT LAWYER Experienced in electronic art, over 3½ years corporate patent law practice, four years engineering design experience, excellent scholastic record, desires responsible position with small or medium size patent organization. PW-6542, Electronics.

SALES ENGINEER or manager—EE age 37. Selling Electronic Industry east coast. Will locate east or west coast. PW-6547, Electronics.

POSITIONS WANTED

ACCOMPLISHED TELEVISION Receiver Design Engineer. Specific background & experience in VHF-UHF tuner design, author & inventor. Strong in fundamental theory & practical experience in overall receiver design. Salary requirement $10,000. Royalties or other form of participation considered an important inducement. Foreign inquiries invited. PW-6535. Electronics.

POSITIONS WANTED

ASSISTANT TO Sales Manager in small electronic mfg. co. desires change with opportunity for advancement. New England area preferred. PW-6521, Electronics.

ELECTRONIC ENGINEER: 10 years experience 5 years U.H.F. antennas and circultry. 5 years I.F., video, pulse amplifier design. Desires position with television manufacturer. PW-6382, Electronics.

ENGINEERS-PHYSICISTS-DESIGNERS

for Permanent Position with

WILLOW RUN RESEARCH CENTER
UNIVERSITY OF MICHIGAN

Outstanding opportunities for:

RESEARCH ENGINEERS AND PHYSICISTS

with experience or advanced degrees in the field of

- Circuit Design
- Switching
- Digital Computer Logical Design
- Pulse Techniques
- Digital Computer Programming
- Radar
- Electromagnetic Theory
- Systems Analysis
- Servomechanisms
- Analog and Digital Computers
- Component Development
- Aerodynamics
- Cathode Ray Tube Displays
- Communications

Mechanical Designers and Draftsmen

with experience in mechanical designs. Assignments involve the design and layout of electro-mechanical devices at the development level.

TECHNICAL WRITERS

with electronics background. Good salaries and living conditions, excellent working conditions and fringe benefits, unusual opportunities for professional development and opportunity to carry on University graduate work while working full time. Moving expenses paid. U. S. citizenship required.

Interviews Arranged

Write, giving details of education and experience, to

B. W. WHEATLEY, Personnel Supervisor,
WRRC, University of Michigan,
Willow Run Airport, Ypsilanti, Michigan

EXECUTIVE ELECTRONIC ENGINEER

Engineer or Physicist with administrative experience required to direct Engineering Department of a company engaged in the design and manufacture of precision electronic test equipment. Major effort concentrated on commercial equipments.

Permanent responsible position with a progressive established company. Applicant must have Technical Degree and approximately 15 years experience.

Apply in writing to the President, giving full details. All replies held in confidence.

BOONTON RADIO CORPORATION
Boonton, New Jersey

ENGINEERS

SYSTEMS
RADAR
SERVO
COMPUTER

You gain MORE with W. L. MAXSON. Top salaries . . . greater opportunities . . . more responsibilities. Advance with W. L. Maxson.

BACKGROUND: Practical and research experience in advanced Electronic Circuits and Systems Engineering DESIGN & ANALYSIS, related to: Instrumentation, Fire Control, Communications, Navigation, or Optical Fields. Ability in management and supervision desirable.

If your skills are now being fully utilized in a vital defense industry please do not apply.

Kindly send resume and salary requirements to

The W. L. MAXSON Corp.
460 W. 34th ST., NEW YORK 1, N.Y.

A NEW Bendix Division!
A NEW Electronic Product!
NEW JOB OPPORTUNITIES

In our modern plant at York, Pennsylvania, this new division of Bendix Aviation Corporation is producing a new electronic product. This division has a big future; and this is your opportunity to get in on the ground floor, with excellent possibilities for rapid advancement. We need the following:

- **ELECTRONICS ENG.**
- **MECHANICAL ENG.**

Also We have many openings for men qualified by education or experience in all phases of electronics.

YOU BENEFIT

With the Bendix York Division, you will benefit from high wages, paid vacations and holidays and ideal living conditions in a beautiful suburban area.

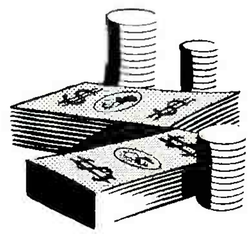
Write, Wire or Phone, Department Y-1

Bendix
AVIATION CORPORATION
YORK DIVISION

Phone: York 5521 — York, Penna.

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

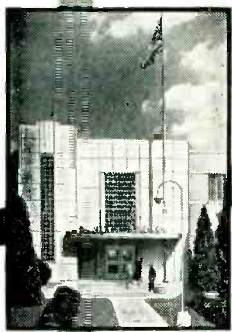
ELECTRONIC EQUIPMENT FIELD ENGINEERS—Specialists for domestic and overseas assignment on military electronic communications and detection gear.

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. 200B
Radio Corporation of America
30 Rockefeller Plaza, New York 20, N.Y.

RADIO CORPORATION of AMERICA

MAKE THIS YOUR HOME FOR IMPORTANT WORK UNDER IDEAL CONDITIONS



- TV RECEIVER DESIGN ENGINEERS
- ELECTRONICS ENGINEERS
- FIELD ENGINEERS
- TEST & INSPECTION ENGINEERS
- LAB. TECHNICIANS

NEEDED TO WORK ON: Radar, G.C.A., Mobile Radio, Auto Radio, Airborne Communication & Navigation Equipment, Television, Antennas, Microwave Equipment, Servo Mechanisms, Guided Missiles and Test Equipment Design.

YOU BENEFIT AT BENDIX RADIO: 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 country 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: TOWSON 2200
Makers of the World's Finest Electronic Equipment

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

DOUGLAS AIRCRAFT COMPANY, Inc.
LONG BEACH, CALIFORNIA

We desire personnel of the highest caliber—experienced in the field of airborne automatic electro-mechanical control equipment.

★

ENGINEERS

MECHANICAL DESIGN
ELECTRONIC
SERVO

DESIGNERS-LAYOUT MEN

ELECTRONIC
MECHANICAL

This work deals with the manufacture and development of highly complex equipment of the most advanced type in a new and expanding division of an established firm with 20 years of successful experience in the precision instrument field.

We cite a few of the good reasons why you might like to join our organization . . .

SALARY increases are based on merit and initiative—two weeks VACATION, HOSPITALIZATION BENEFITS, GM's own INSURANCE PLAN—POSITIONS ARE PERMANENT due to long range manufacturing and developing programs—EXPENSES incident to interviews and moving all absorbed by company—HOUSING and LIVING CONDITIONS among the best and finest of any along Lake Michigan.

- We have a Junior Engineering Training Program of one year for inexperienced engineering graduates. Opportunity to become acquainted with all phases of industry.
- For the convenience and direct use of engineers in our Engineering Department, we have our own model shop where highest skilled mechanics are employed.
- Educational opportunities for advanced degrees available at U. of W., Marquette. Technical engineering offered at Milwaukee Vocational School.

. . . all inquiries answered—write or apply . . .

★ *AC SPARK PLUG DIVISION*

GENERAL MOTORS CORPORATION

1925 E. KENILWORTH PL. MILWAUKEE 2, WIS.

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

Men of Vision

SCIENTISTS
ENGINEERS
DESIGNERS

apply CREATIVE engineering to research, development, and design . . . the KEY to SOLID SUCCESS at

GOODYEAR AIRCRAFT

If you are seeking a position where ingenuity, personal initiative, and ability count most, investigate the various opportunities offered by Goodyear Aircraft. We have openings for able, experienced personnel in the following fields:

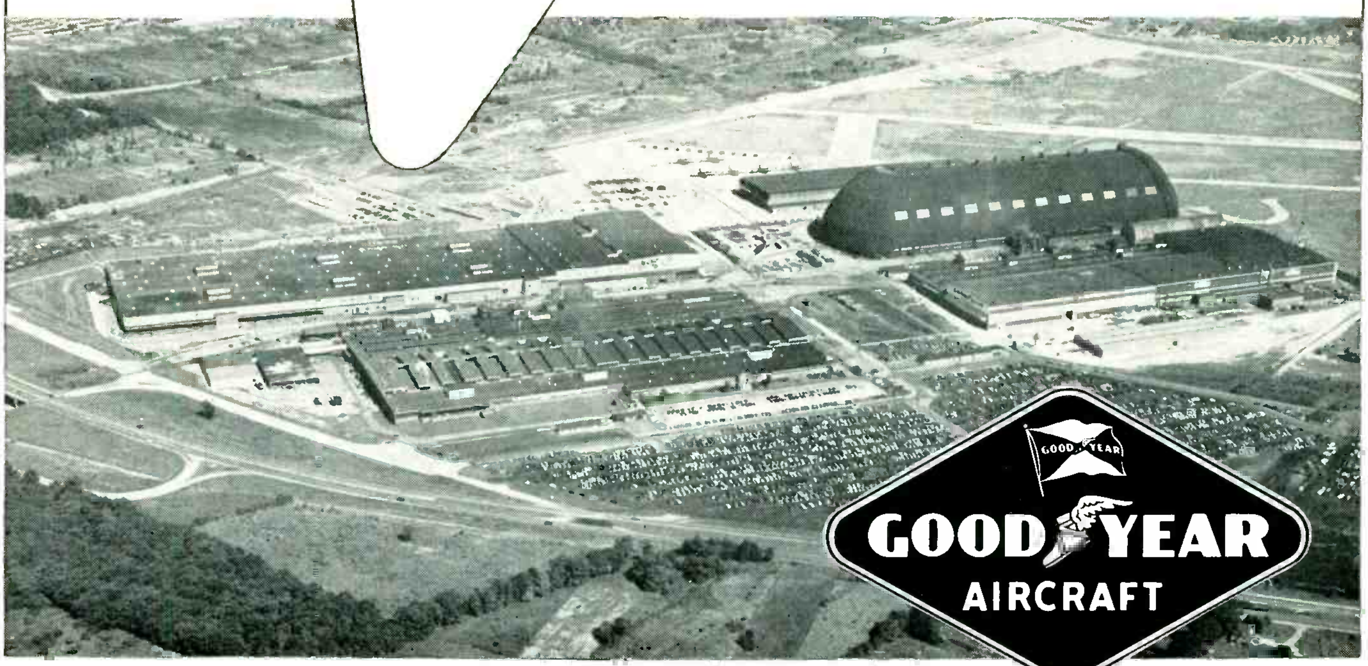
- Electrical Systems
- Circuit Analysis
- Analog Computers
- Servomechanisms
- Test Equipment
- Applied Mathematics
- Electronics
- Aerodynamics
- Physics
- Flight Test
- Stress Analysis
- Dynamics
- Microwave
- Structures
- Tool Design
- Tool Planning
- Tool Processing
- Industrial Engineering
- Estimation
- Time Study
- Plant Engineering
- Designing in All Fields

Openings also exist for welding, civil, and mechanical engineers with experience in metals fabrication. Needed too are personnel with ability and experience in technical editing, copywriting, illustration, and photography.

Positions are available at several levels; inquiries are also invited from recent graduates. Liberal salaries are based on education, ability, and experience. Paid vacations and holidays, sick leave, insurance, and retirement plans are added benefits.

Goodyear Aircraft is centrally located in the Great Lakes region . . . in the heart of northeastern Ohio. Akron, a community of 350,000, is a clean and friendly home town to thousands of Goodyear employees and their families who enjoy metropolitan living and fine cultural and educational advantages. Excellent parks, golf courses, and inland lakes give active, year-round enjoyment. The Aircraft division is a full-fledged member of the Goodyear family . . . a name famous the world over.

If YOU are interested in a secure future, write and give full details to
Mr. C. G. Jones, Salary Personnel Department



GOODYEAR AIRCRAFT CORPORATION • 1210 Massillon Road, Akron 15, Ohio

Engineers... Scientists...

Mechanical Engineers — Electrical Engineers

Servo Engineers — Aerodynamicists—Physicists — Mathematicians

Do You Know the MELPAR Story?

For complete information about the opportunities available for qualified engineers and scientists write to

PERSONNEL DIRECTOR

melpar, inc.

The Research Laboratory of Westinghouse Air Brake Co. and its subsidiaries

452 Swann Avenue, Alexandria, Virginia

MELPAR INC.

SYSTEMS ENGINEERS

For design and installation of radio communication systems of all types in HF, VHF and Microwave bands for use in foreign countries.

Applicants should have experience in either radio propogation studies and antenna design or in the application of telephone and telegraph terminal equipment.

These positions are not dependent on government contracts and would be based in New York with occasional overseas duty.

Send full details to

Personnel Dept.

Radio Corporation of America

RCA International Div.

30 Rockefeller Plaza

New York 20 New York

THE DE HAVILLAND AIRCRAFT OF CANADA LTD.

is requiring experienced engineers for development work on special new projects. Applicants should possess an honours degree together with at least two years industrial experience. Preference will be given to Canadian Nationals.

Employment is offered in four general categories as follows:—

(a) *Physicists.* Men with a sound background of basic physics to work on optical, electronic and mechanical devices.

(b) *Servo Engineers.* A thorough knowledge of basic servo-mechanism theory is essential together with experience in the design and operation of electronic servo systems. A knowledge of air-operated servos would be an advantage.

(c) *Gyro Engineers.* Applicants should have had first hand experience in development work on electrically driven gyros preferably from both the electrical and mechanical viewpoints. A knowledge of production techniques is essential.

(d) *Electro-Mechanical Engineers* to work on accelerometers, proportional relays, high-frequency motors and similar devices. A knowledge of production methods is desirable.

Successful applicants are to be sent to the U.K. for a period of one to two years to work on the research and development team of the parent De Havilland Company. After this period, they will return to Canada continuing the work at De Havilland, Toronto. There, a team of engineers will be built up with the U.K. trained personnel as a nucleus.

Please apply to: Mr. D. G. Simpson

The De Havilland Aircraft of Canada Ltd.

Postal Station "L", Toronto, Canada

ELECTRONIC ENGINEER WANTED!

An established business organization engaged in development and manufacture of products for VHF and UHF Television Application, requires an individual qualified to work independently, to organize, and to supervise development projects.

This position is to be permanent and will offer the opportunity for unlimited advancement to a successful career. Offers stimulating and congenial surroundings in a newly acquired plant.

Attractive Salary

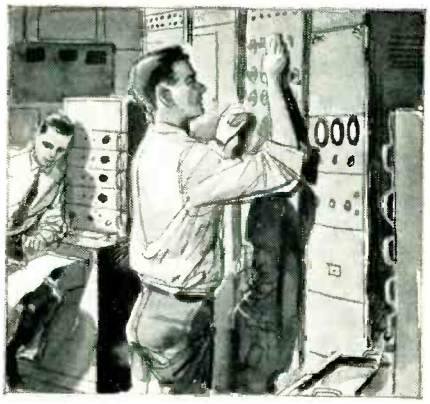
Write stating qualifications

Blonder-Tongue

LABORATORIES

526-536 North Avenue

Westfield, New Jersey



Design, development engineers . . . Here's a real success formula!

YOU + HONEYWELL = OPPORTUNITY[6]

IF you're an experienced design or development engineer who'd welcome the *right* change, be sure to look into the Honeywell success formula.

Opportunity raised to the sixth power refers to the six areas in which we now have excellent openings:

- Servomechanisms
- Aerodynamics
- Vacuum tubes
- Electromechanics
- Electromagnetics
- Supersonics

Duties of the jobs. Take on complex design work requiring analysis and decision to bring into design form the requirements for a new or modified instrument, device or control system.

Requirements. B. S. or M. S. in Electrical, Mechanical or Aeronautical Engineering.

Atmosphere. A company that understands engineering—where one out of every ten employees is actively engaged in engineering and research.

Openings. In Minneapolis, Philadelphia and Freeport, Illinois.

For details write H. D. Elverum, Personnel Dept. EL-2-12, Honeywell, Minneapolis 8, Minn. Ask for our book, "Emphasis on Research."

MINNEAPOLIS
Honeywell
H HONEYWELL *First in Controls*

ELECTRONIC ENGINEERS

Sperry

Wide range of experience including design of wide band receivers, radar display systems, analogue computers, servo systems & CR oscillographs . . . thorough knowledge of RF circuits, wave shaping, pulse forming, triggers & gates (microwave techniques unnecessary)

A FEW KEY POSITIONS . . .

Opening of our own manufacturing facilities creates permanent positions in research and development of vital, long-range products.

CONSIDER THESE ADVANTAGES . . .

. . . Gracious country living, free from big-city pressures, provides a relaxing atmosphere in which you can do your best work . . . yet within easy reach of the cultural advantages of New York City.
. . . Association with an established yet growing organization with few competitors in the field, where your merit and ability are given full consideration.
. . . Unusual company-paid benefits . . . 40-hour week with considerable premium overtime . . . moving expenses paid.

TAKE ADVANTAGE OF THIS OPPORTUNITY NOW!

Address all inquiries to J. H. McCann

SPERRY PRODUCTS INC.

DANBURY
CONNECTICUT

ELECTRONICS ENGINEERS

Project • Design • Group • Field • Junior • Senior

AIRCRAFT ARMAMENTS' development engineering program in the fields of radar, fire control and associated equipment has provided more openings for men at all levels of experience.

If you are considering a change and are looking for a young, growing company with a continuing program of development work, we would appreciate receiving your resume and would welcome the opportunity of providing you with information about our company.

D. J. WISHART
Director of Personnel

AIRCRAFT ARMAMENTS INC.
4415-17 REISTERSTOWN ROAD
BALTIMORE 15, MD.

WILCOX ELECTRIC COMPANY, INC.
of
KANSAS CITY, MISSOURI
requires

ENGINEERS!

with Experience in

- HF and VHF systems
- Aeronautical Equipment
- Application of Advanced Circuit Technique
- Ability to combine associated engineering skills in electronic systems

also needed

PROJECT ENGINEERS (2)

who can accept responsibility for successful completion of a system design

These positions are available in a company which supplies equipment to the major airways of the world.

Write stating Education & Professional history to:
A. E. HARRISON, Director of Engineering
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut Street
Kansas City 27, Missouri

The New Scientific Research Laboratory of the Ford Motor Company has openings for

ELECTRONIC ENGINEERS
ELECTRICAL ENGINEERS
PHYSICISTS

to research, design and develop electronic controls, instrumentation, and devices on a permanent, non-military program.

Positions available at various levels of engineering achievement.

FORD MOTOR COMPANY
Engineering Personnel
Oakwood Boulevard
West Dearborn, Michigan

STAVID ENGINEERING, INC.

has openings for

GRADUATE ELECTRONIC and MECHANICAL ENGINEERS

Experience in Design and Development of Radar and Sonar necessary.

Broad knowledge of Search and Fire Control Systems; Servo Mechanisms, Special Weapons, Microwave, Antennas and Antenna Mounts, etc. Mechanical Engineer should also have experience in packaging of Electronic Equipment to Gov't specifications including design of complex cabinets, shock mounts and sway brace structures.

FIELD ENGINEERS

Qualified to instruct in the operation and supervise installation, maintenance and repair of Radar, Sonar and allied electronic equipments in the Field.

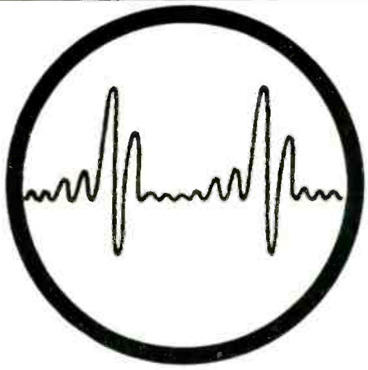
A chance to grow with a young and progressive company; salary and advancement commensurate with ability; liberal vacation, sick leave, 9 paid holidays, group life, sickness and accident insurance plans, and a worthwhile pension system.

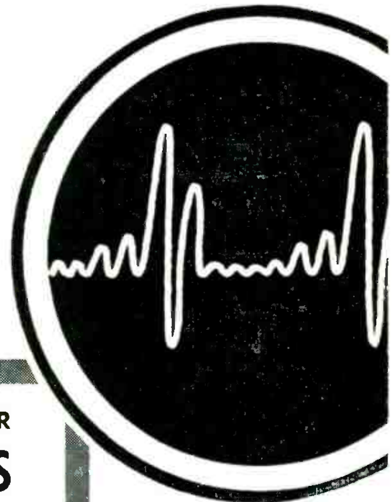
Personnel Office, 200 W. Seventh St.
Plainfield, N. J. - Tel. Pl. 6-4806

TRANSISTOR RESEARCH IN SUNNY ARIZONA

Motorola Research Laboratories offer healthful Phoenix, Arizona, resort climate living and a challenging program of research and development work in the field of semi-conductors and transistors. Physicists, metallurgists, chemists, and practical transistor scientists with specialized education or semi-conductor experience should investigate this opportunity for stimulating work in this field which is destined to revolutionize electronics. There are also several positions open for both experienced and inexperienced Ph.D's.

Write to Joseph A. Chambers, Manager, Motorola Research Laboratory, Inc., 3102 N. Ingleside Drive, Phoenix, Arizona. State education, experience and salary requirements in the first letter





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

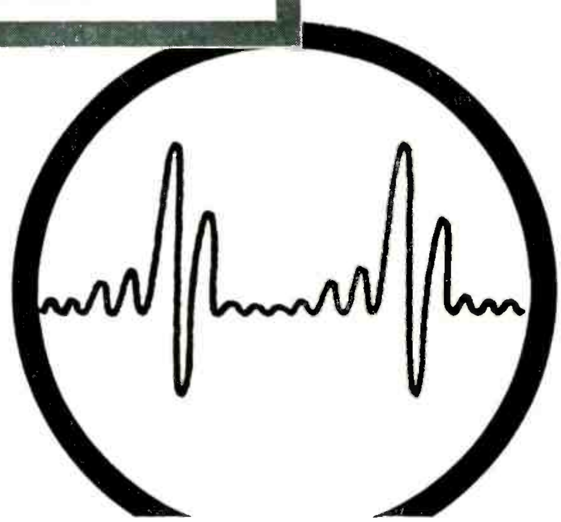
Generous travel allowances to those accepted. For free brochure, write Mr. H. T. Brooks, Engineering Dept. 900

CONVAIR

IN BEAUTIFUL

SAN DIEGO

3302 PACIFIC HIWAY
SAN DIEGO 12, CALIFORNIA



STAFF ENGINEERS

Design and Development

Leading Chicago Electronics firm is seeking the services of qualified men to fill several staff openings in its Electronic Design and Development Division. Persons selected will be given intermediate and advanced level assignments in our Television, Radio and Government Equipment Laboratories.

Experience in monochrome receivers, deflection and high voltage circuits, radiation interference, NTSC color receivers, color generating equipment or UHF systems essential.

These are permanent positions and offer excellent opportunities for advancement. Company has well planned, long range program of design and development.

Please write Mr. Walter Wecker, Personnel Division, giving related experience and educational qualifications.—Or telephone SPaulding 2-0100.

Interviews arranged at your convenience.

Admiral Corporation

3800 W. Cortland St. **Chicago 47, Illinois**

TO MEN WHO WANT THE BEST

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. And you'll receive liberal benefits including completely paid life, hospitalization, surgical, accident and health insurance.

ELECTRONIC DESIGNERS

Design of mechanical and electrical components and chassis in UHF and microwave systems

RADIO ENGINEERS

Development of radio and radar components & systems

ENGINEERS

Design of components for magnetic deflection of Cathode Ray Tubes

KOLLSMAN INSTRUMENT CORP.

80-08 45th Ave. Elmhurst, Long Island, N. Y.

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

ENGINEERS

ELECTRONIC ORGANS

Design

Development

Quality Control

Unusual opportunities exist with expanding manufacturer in a fascinating field. Send resume to President

ALLEN ORGAN COMPANY

Allentown, Pennsylvania

ENGINEERS or PHYSICISTS

A midwestern progressive manufacturer of electrical resistors, rheostats and allied components, is looking for experienced engineers or physicists interested in research and development or production engineering work in this field.

Replies from men with experience in specialized types of these components will be welcome. Excellent opportunity, attractive conditions. Give full details as to training and experience, state salary desired.

P-6431, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

DESIGN ENGINEER

TRANSFORMERS

Power and High Fidelity Audio and experience in one or more of the following:

Pulse Transformers, Filters, Magnetic Amplifiers

LANGEVIN MFG. CORP.

37 W. 65 St., N.Y.C. EN 2-7200

GOOD OPPORTUNITY

FOR

SALES-ENGINEER

Sales-engineer for leading electronics manufacturer to cover greater St. Louis area. Practical engineering background desirable. Give complete information concerning experience, education, previous employment, salary requirements. Write to

SW-6573, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRONIC ENGINEERS

We are looking for electronic engineers, with experience in the development of electronic digital computers, to work in the development of business machines. Plenty of opportunities for advancement.

Write, giving full details, including education and experience.

THE NATIONAL CASH REGISTER CO.
South Main and "K" Streets
Dayton 9, Ohio

RESEARCH ASSISTANTSHIPS

Ph.D. candidates in chemistry and M. S. candidates in chemistry electrical engineering (Electronics), chemical engineering, physics and geology are wanted by a South-western State University.

These positions provide part-time research duties with time for academic work toward advanced degrees. Stipends are up to $2,150 for 12 months. Nonresidents fees are waived.

P-5756, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

ENGINEERS-SWITCHES

Wanted for design and development work on switches of all types—microswitches: leaf-type; tap; etc.; for circuitry control. Progressive manufacturer of electrical parts in midwest. Reply with full details, give salary desired.

P-6408, Electronics
520 N. Michigan Ave., Chicago 11, Ill.

CAREER OPPORTUNITIES

ENGINEERS and PHYSICISTS

Desiring the challenge of interesting, diversified, important projects —
Wishing to work with congenial associates and modern equipment and facilities —
Seeking permanence of affiliation with a leading company and steady advancement —
Will find these in a career here at GENERAL MOTORS.

Positions now are open in ADVANCED DEVELOPMENT and PRODUCT DESIGN, INDUSTRIAL ENGINEERING, TEST and TEST EQUIPMENT DEVELOPMENT.

COMMERCIAL AUTOMOBILE RADIO
MILITARY RADIO, RADAR AND ELECTRONIC EQUIPMENT
ELECTRONIC COMPONENTS
TRANSISTORS AND TRANSISTOR AND VACUUM TUBE APPLICATIONS
INTRICATE MECHANISMS such as tuners, telemetering, mechanical linkage, controls, etc.
ACOUSTICS—loud speakers, etc.

Inquiries invited from recent and prospective graduates as well as experienced men with bachelors or advanced degrees in physics, electrical or mechanical engineering, chemistry, metallurgy.
Salary increases based on merit and initiative.
Vacations with pay, complete insurance and retirement programs.
Location is in a low living cost center.
Relocation expenses paid for those hired.

All inquiries held in confidence and answered—WRITE or APPLY to

DELCO RADIO DIVISION
GENERAL MOTORS CORPORATION
Kokomo, Indiana

FOR SALE

FOR SALE

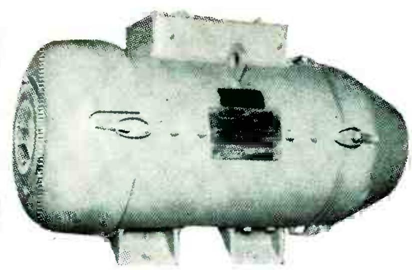
Special **RADAR TUBES** *Purpose*

ATTENTION MANUFACTURERS, LAB's. HAM'S!! We will pay you immediate and highest cash prices for special purpose tubes and *X'TAL Diodes* in any quantity. For a prompt quotation write to

MICROWAVE
425 Riverside Drive, New York City 25, N. Y.
Dept. 6B2

Or for immediate action Phone
Monument 2-1480 and ask for Miss Rainbow

MOTOR GENERATORS



NEW

1 KVA Allis Chalmers 230 Volt D.C. to 120 Volt, 60 Cycle, A.C., Single Phase, Speed 3600 R.P.M.—packed for export. $250.00

Immediate Shipment, F.O.B. Keyport, N. J.

C. C. GALBRAITH & SON, Inc.
99 Park Place New York, N. Y.

ERIE CERAMICONS

Large quantities in stock;
immediate delivery.
All values and tolerances.

N.P.O. & TEMPERATURE COEFFICIENT
FEED-THRU, STANDOFF, DISC, CERAMICONS.
LITTLEFUSE FUSE—ALL VALUES.

BELOW FACTORY PRICE.

CAP ELECTRONICS INC.
102 Warren Street
New York 7, N Y
WOrth 2 4363

GLASS TUBING

PYREX - NONEX - URANIUM
BULBS & CYLINDERS
WRITE FOR FREE MONTHLY LIST
HOUDE SUPPLY COMPANY
PHONE KEYPORT 7-1286
M. R. # 1 Box 85X Keyport, N. J.

T-47A/ART-13, T-47/ART-13, ATC Transmitters, DY-12 Dynamotors, LM & BC-221 Freq. Meters, SCR-694-C, Panoramic Adaptors, Teletype motors, parts, equipment.

ARROW APPLIANCE COMPANY
Box 19 Boston 1, Mass.
Tel: Richmond 2-0916, Lynn 8-3100

AVAILABLE FOR IMMEDIATE DELIVERY

One 2-Mev Van de Graaf Generator,

output 140-r per minute at 70 cm., inherent filtration equivalent to 6 mm. lead.

Rugged construction, stable and dependable output. Suitable for industrial radiography, for research (particularly where an electron current greater than 400 microamperes is desirable), or for radiation therapy.

Can readily be converted to proton or deuteron accelerator.

Offers and bids welcomed. Will consider exchange for equipment or materials needed for hospital expansion program.

Further details, photographs, or blueprints available on request.

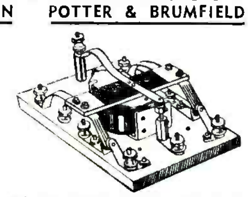
FS-6539, Electronics
1111 Wilshire Blvd., Los Angeles 17, Calif.

RELAY SPECIALISTS

AUTHORIZED FACTORY DISTRIBUTORS
STRUTHERS-DUNN POTTER & BRUMFIELD

100,000 RELAYS

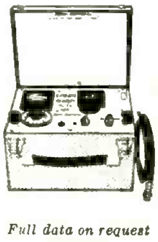
ALL TYPES



ADVANCE TYPE 400-1B Heavy Duty ANTENNA RELAY rated 1 KW r.f. D.P.D.T. plus S.P.N.O. ¼" pure silver contacts. 4200 ohm. coil operates on 20 ma or 110 v D.C. **$6.95**

RADIO DEVELOPMENT & SALES CO.
323 Atlantic Ave., Brooklyn 2, N. Y. ULster 5-0488

Micro-Wave Lavoie Freq. Meter 375 to 725 MCS

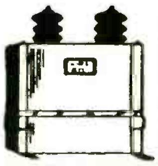


Model TS-127/U is a compact, self-contained, battery powered, precision (± 1 Mc) frequency meter which provides quick, accurate readings. Requires a standard 1.5V "A" and 45V "B" battery. Has 0.5 MIN. time switch. Contains sturdily constructed HI-"Q" resonator with average "Q" of 3000 working directly into detector tube. Uses 957, LS6 and 3S4 Tubes. Complete, new with inst. book, probe and spare kit of tubes. Less batteries.

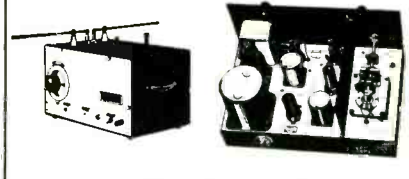
Full data on request

$79.50

HIGH VOLTAGE OIL CAPACITORS



.001	MFD	50,000V DC	$37.50
.01	MFD	5,000V DC	$2.95
.02	MFD	8,000V DC	$9.50
.025	MFD	50,000V DC	$45.00
.025/.025	MFD	50,000V DC	$59.50
.1	MFD	500V DC	$ .95
.1	MFD	3,000V DC	$2.95
.135	MFD	7,500V DC	$6.95
.15	MFD	12,000V DC	$7.50
.2	MFD	50,000V DC	$69.50
.25	MFD	15,000V DC	$22.50
.25	MFD	20,000V DC	$26.50
.25	MFD	50,000V DC	$79.50
1.	MFD	7,500V DC	$12.50
1.	MFD	15,000V DC	$44.50
2.	MFD	6,000V DC	$14.50



RADIO MODULATOR

Type BC-423-B, or tweeter, is a miniature keying unit, modulator and transmitter combined. A dipole mounted atop the tweeter case radiates a signal pulse at 205 megacycles modulated by pulses occurring at 4,098 CPS. Uses 2-6J7, 1-6F6, 1-955, 1-5W4 tubes. Operates from 115V. 60 cy. source. Brand new including tubes and instruction book....$29.50

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120DC to 120AC, 60 cy., 1 Ph., Complete with Magnetic Controller, 2 Field Rheos and full set spare parts including spare armatures for generator and motor. New..$295.00

2 KVA O'Keefe and Merritt. 115DC to 120AC, 50 cy., 1 Ph. Export Crated. New..........$195.00

MOTOR GENERATOR, TYPE CGU-2
Unit of U. S. Navy TCK-7 Transmitter
Motor: 2 H.P., 230 V.D.C., 10 amps.
Generator: 1800V. D.C., 0.4 A, 500V, D.C., 0.35A. 115 V.D.C., 1.5A, 12 V. D.C., 2A. 3480 R.P.M. Self excited. Brand new including spare armature $365.00

INVERTERS

Onan M-G.-215H. Navy type PU/13. Input 115/230, 60 cy., 1 Ph. Output: 115, 480 cy., 1 Ph., 1.2Kw and 26V DC at 4 amps. New..............$295.00

Leland Elec. Co. PE206A. Input: 28DC at 38 Amps. Output: 80V, 800 cy. 1 Ph., 485VA. New..$22.50

G.E. J8169172. Input: 28DC. Output: 115, 400 cy., 1 Ph. 1.5KVA. New....$32.50

G.E. 5AS131551IA. Model 218J. Input: 28DC. Output: 115, 400 cy., 1 Ph., 1.5KVA. Regulated. New....$89.50

Holtzer-Cabot M.G. 164. Input: 440, 3 Ph., 60 cy., Output: 70V, 146 cy. 3 Ph., 0.140KVA. New $67.50

Elcor. 74DC to 110AC, 60 cy., 1 Ph. at 2.4 Amps. New $39.50

DYNAMOTORS

Navy type CAJO-211444. Input: 105 to 130DC. Output: either 26DC at 20 amps. or 13DC at 40 amps. Radio filtered and complete with line switch. New $89.50

Type PE94CM. For SCR-522. Brand new in overseas cases $19.50

AMPLIDYNES

G.E. 5AM21JJ7. Input: 27VDC. Output: 60VDC. 150 Watts, 4600 RPM. Type MG-27-B. New $34.50

Edison 5AM31NJ18A. Input: 27VDC, 44 Amps. 8300RPM. Output: 60VDC at 8.8 Amps., 530 Watts. New $22.50

SMALL D.C. MOTORS

G.E. 5BA50LJ2A. Armature 27VDC at 8.3 Amps. Field 60VDC at 2.3A RPM 4000. H.P. 0.5. New $27.50

Oster E-7-5. 27.5DC. 1/20HP, 3600RPM. Shunt Wound. New $9.50

Dumore Co. type ELBG. 24VDC. 40-1 gear ratio. For type B-4 Intervalometer. New..........$8.50

BLOWERS

Westinghouse. Type FL. 115V, 400 cy., 6,700 RPM. Airflow 17C.F.M. New $9.50

E.A.D. Type J50-CW—60 cycle—NEW......$15.50

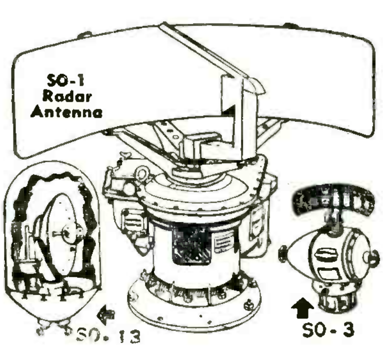
SYNCHROS

Ford Inst. Co. Synchro Differential Generator. Mod. 3 Type 5SDG. 90/90V. 400 cy., Ord. Dr. 173020. New $22.50

Armor. Synchro Differential Generator. Type 6DG. New $60.00

Hobart Mfg. Co. Synchro Differential Synchro Type XIX 115V. 60 cy. New....$9.50

RADAR EQUIPMENT



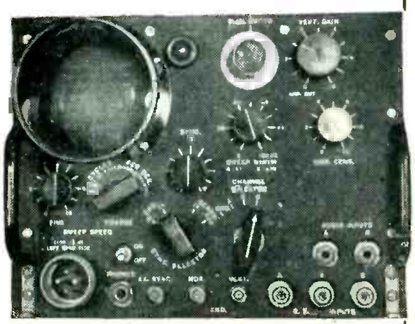
RADAR ANTENNAS

Type SO-1 (10CM) assembly with reflector, waveguide nozzle, drive motor, etc. New........$279.50

Type SO-3 (3 CM.) Surface Search type with reflector, drive motor, etc., but less plumbing. New in original cases $189.50

Type SO-13. (10CM.) Complete assembly with 24" dish, dipole, drive motor, gearing, etc. New $149.50
Also in stock — spare reflectors, nozzles, probes, right angle bends for SO-1 antennas.

MODEL AN/APA-10 PANORAMIC ADAPTER



Provides 4 Types of Presentation:
(1) Panoramic (2) Aural
(3) Oscillographic (4) Oscilloscopic

Designed for use with receiving equipment AN/ARR-7, AN/ARR-5, AN/APR-4, SCR-587 or any receiver with I.F. of 455 kc. 5.2mc or 30mc.
With 21 tubes including 3" scope tube. Converted for operation on 115 V. 60 cycle source.
Price **$245.00**

Gov't Cost $1800.00.
AN/APA-10 80 Page Tech Manual..........$2.75

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat. No. 80G184. KVA .945S-520P Volts 460/345/200/115. New $4.50

FILAMENT—400/2600 CPS. Input—0/75/80/85/105/115/125V. Output—5V3A/5V3A/5V6A/6.3V 0.5A. No. 7249010—New $1.95

PLATE WECO KS 9560 800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A (2700 V. Total). Elecstat shlded. Wt. 2.3 lbs. New....$2.95

Plate. Thordarson #T46889. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 5600V. Center tapped. 1.5KV. insulation. Brand new..........$29.50

PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V. Sec. #1: 930-930. Sec. #2: Three 6.3V windings $3.95

FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shlded. Wt. 0.5 lbs. New....$2.95

PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400 VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A (ins. 1500V)/5V2A/5V2A $4.95

RETARD. 400 cy. WECO KS9598. 4 Henry 100 MA $1.75

PULSE TRANSFORMERS

PULSE WECO KS-9563 Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000 peak. Wdg. 1-2=18 ohms. Wdg. 1.3=72 ohms. L of Wdg. 1.3=082H at 100 cps.......$3.95

PULSE. WECO KS-161310. 50 KC to 4MC, 1¾" Dia. x 1⅞" high. 120 to 2350 ohms. New....$3.95

High Reactance Trans. G.E. type Y-3502A.—60 cy., Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.8KV. Cat. 8318065G1. New $39.50

HIGH POT TRANSFORMERS

High Voltage Trans. Westinghouse Pri: 115. 60 cy. Sec: 15,000 C.T., 60 MA. Good for Hi-Pot test set up. C. T. ungrounded................$39.50

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC. New, with instruction book................$79.50

TS-47/APR Test Oscillator. Range on fundamentals 40 to 500 MC. Part of APR test set-up. New with instruction book...............$275.00

TS-487/U Peak to Peak V.T.V.M. New with instruction book $59.50

R111A/APR-5A Receiver. Range from 1000 to 6000 MC, with instruction book...........$575.00

APR-1 Receiver with TN-18 tuning unit 300 to 1000 MC. with instruction book..........$450.00

APR-1 Receiver with TN-17 tuning unit and instruction book $450.00

APR-1 Receiver with TN-16 tuning unit...$450.00

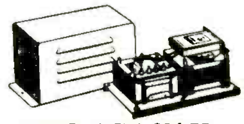
TU-58 tuning unit (110-370MC)...........$85.00

HIGH QUALITY CRYSTAL UNITS

Western Electric—type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in quantities, 5910-6350-6370-6470-6510-6610-6670-6690-7270-7350-7380 - 7390 - 7480 - 7580-9720. All fundamentals in KC. Good multipliers to higher frequencies ....$1.25 each

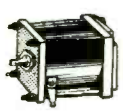
RAYTHEON VOLTAGE REGULATORS

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V. 60 Watts, ½ of 1% Reg. Wt. 20 lbs. 6½" H x 8¾" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized.



PRICE—NEW $16.75

SWEEP GENERATOR CAPACITOR



High speed ball bearings. Split stator silver plated coaxial type 5/10 mmfd. Brand new

Price $2.25

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed
Prices Subject to Change

ELECTRONICRAFT
INC.

27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

AMPLIFIERS

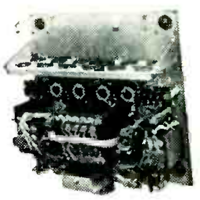
GE Servo type 2CV1C1 400 cycle
Constant Output Line RC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

ANTENNAS

MR-162 Coast Guard 23½ ft. whips
AS-33 APT-2, AT-38A/APT, AS-62/APS-13
AS-125/APR for APR-5A
TDY RADAR JAMMER HORNS
PARABOLOIDS, MAGNESIUM DISHES 17½" dia.
SCR-623-A (part of RC-153-B Antenna)
CU 64/APT Antenna matching unit 50 ohm unbal. to 100 bal.

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven



G. E. 400 CYCLE SERVO AMPLIFIERS

Type 2CV1C1

Brand New $29.50
Metal Dust Cover Included

SCR-522 EQUIPMENT

Complete BC-624C receivers and BC-625AM Transmitters including mounting racks, plugs, connectors, P.E. 94CM dynamotor. Brand new equipment with instruction manuals.

CRYSTAL DIODE

Sylvania 1N21B. Individually boxed and packed in leaded foil.
$3.00

Westinghouse "Variac type" Controllers: 600 watts: 110/220 designed as an adjustable speed controller but can be used for any application requiring a variable transformer. Brand new and an exceptional buy at $12.00

SOUND POWERED CHEST SETS

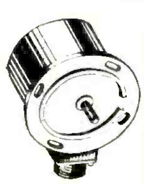
U. S. Instrument Co. No. A-260 Combination headset and chest microphone. Brand new, including 20 ft. of rubber covered cable.........$17.50 each

MISCELLANEOUS

Cathode Ray Shields for 3" tube	$3.75
Variac type Motor Controls 600 watt	$12.00
10 CM Waveguide 90° elbow	$20.00
Adel Clamps assorted types—write for samples	
Shock Mounts Lord #20	$.40
Shock Mounts U. S. Rubber #5150C	$.30
Commando Pole Jacks (Cook Elec. Co.)	$1.00
Switchboard Lamp Receptacles & Jewels	$.40
SCR522 Transmitter Receivers. Brand New	
Fire Detector Wilcolator No. A-4242. Ord. No. B 257736	$1.00
Dial Drive Assembly for Bendix, MN-28-Y	$4.50
Instruction Manual for SCR 193A, B, C, D, E	$2.00
Solenoid Cannon 24 V.D.C.—New	$1.45
Attenuators Tech-Lab 500/500 type 700	$4.75
Volume control Dual for BC-433G	$2.85
Switch 600 V., 60A. Bendix CB19078	$9.50
Switch Arkless 9 sec. Rotary	$4.50
Switch Arkless 16 sec. Rotary	$7.50
Switch Panels SA-2/FRC	$12.50
Switch Micro R-RL2T	$.65
Switch Navy Rotary #647491	$17.50
Contactor CRP-23AGO for SG-1 radar	$24.75
Band-Switch assembly for AR-88 receiver	$9.50
RT-7-AN/APN-1 Receivers	
BC-423B Modulators	
RC-1366M Jack Boxes—Large quantity	

LINEAR SAWTOOTH POTENTIOMETER

W.E. No. KS 15138



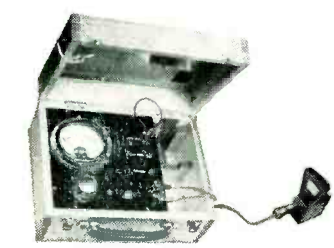
The d-c potentiometer consists of a closed type die-cast aluminum alloy frame consisting of a continuous resistance winding to which electric power is supplied through two fixed taps 180 degrees apart. Two rotating brushes (180 degrees apart and bearing on the resistance winding) and two take-off brushes are provided for the output voltage. Varying the position of the brushes varies the output voltage in accordance with a linear sawtooth wave. The potentiometer is excited with 24-volt direct current, is arranged for panel or bracket mounting, is approximately 3-11/16 inches in diameter, 3 inches deep, 4¾ inches long, and has an approximate weight of one pound. External connections are made through a standard AN type connector.

Brand New $5.75

RADAR EQUIPMENT

Model S.Q. 10CM Portable Radar Set. Operates on 90-130 volt, 60 cy., 1 Phase. Presentation: A, B and P.P.I. Complete with tech. manual and full set of spare parts.

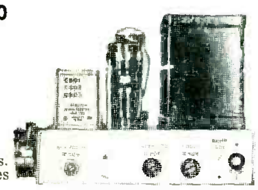
Model ASG-1 Radar with Parabola.
S.O.-11 Modulator unit.
Pulse Timer units for SD5 Radar.
Radar Crystal units—Raytheon 98.35kc.
S.O. Radar Accessory Control Panels.
S.O. Transmitter-Receiver units.
S.O. Radar Bearing Control Units.
Spare Parts Kit for S.Q. Radar.



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. Ideal for lab and school use. New. An exceptional value at $29.50

AN/APA-10 POWER SUPPLY



Input:
80 or 115 volts.
400 to 2600 cycles

Output:
1200 volts D.C. at 1.5 MA.
400 volts D.C. at 130 MA.
Includes tubes: 1—5R4GY, 1—2x2, 1—6AK5, cathode ray tube socket, resistance capacitance filter, two focus controls, an intensity control and 6AK5 reinserter circuit. Brand new.
Complete $13.75

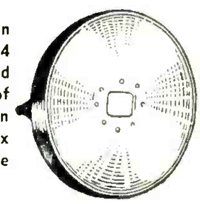
REPAIR PARTS FOR BC-348 RECEIVERS (H, K, L, R, Only)

Also BC 224 Models F. K., Coils for ant., r.f., det., osc., I.F., c.w. osc., xtal filters, 4 gang cond., front panels, dial assemblies, vol. conts., etc. Write for complete list and free diagram.

AUTO TRANSFORMER

G.E. 400 cy. Cat. No. 80G184 K.V.A. .945S—.520P Volts 460/345/230/115 New $4.50

PARABOLOIDS



17½" diameter, spun magnesium dishes, 4 inches deep. Reinforced perimeter. Two sets of mounting brackets on rear. Opening at apex for waveguide dipole assembly 1½ x 1⅝".

BRAND NEW ..... PER PAIR $12.50

G. E. BATTERY CHARGER

Charges 54 cell battery at from 1 to 10 ampere rate

Input 115V., 60 cy. 1 Phase.
The model 6RC89F16 Copper Oxide battery charger consists of a transformer, a secondary reactor, a copper oxide rectifying element, a ventilating fan, control circuits and auxiliary equipment necessary for proper operations. Transformer tapped for various supply voltage. Eight secondary taps for adjusting changing rate. Built into metal cabinet. Metered.

Complete with spare fan and fuses. New in original packing cases. Shipping weight approx. 305 lbs.

Price $255.00

RELAY

Clare octal base Relay No. 30FMX 115V. 60 cy. 0.140 amp. Res. 75 ohms. Makes two breaks one.

Brand new $2.45

RADAR REPEATER ADAPTERS

NAVY TYPE CBM-50AFO

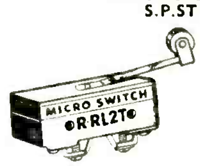
A repeater unit for video signals and trigger pulses designed to work in conjunction with standard Navy radar equipments wherein provision is made for operation of remote P.P.I. sets. This adapter provides four video and trigger pulse lines for operating one or more remote P.P.I. installations. The equipment contains its own D.C. power supply; 115 Volts, 60 cycles A.C. from ships' power supply line is required for operation. Dimensions are 31½ x 21 x 15 in.

Description:

A: Output Video Signal Lines.
B: Output Trigger Lines:
C: Video Amplifier Bandwidth. less than 3 db down at 5mc.
4 lines at +2 volts amplitude.
4 lines at +50—+65V. Amplitude.
Flat within 1 db from 60 cy. to 3.5mc.
Uses 8—6AG7, 1—OD3, 3—6SN7, 2—5R4GY.
Full details on request.

MICRO-SWITCH

S.P.ST NORMALLY CLOSED

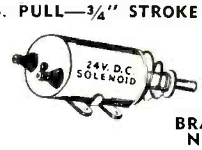


BRAND NEW $.85 EACH

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

24V DC SOLENOID

2 LB. PULL—¾" STROKE



BRAND NEW $1.45 Each

ELECTRONICRAFT INC.

27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

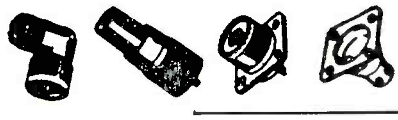
OIL FILLED CONDENSERS

MFD	VDC	Price	MFD	VDC	Price	MFD	VDC	Price	MFD	VDC	Price
2	400	$ .55	.1	1500	$ .69	1	6000	$9.95	1	25KV	$85.00
5-5	400	1.65	.5	1500	1.25	.1	7000 R'd	1.79	.001	50KV	24.50
1	600	.55	3	1500	2.50	.1-.1	7000	5.95	.025	50KV	42.50
2	600	.69	4	1500	2.95	.1	7500	2.85	.2	50KV	85.00
2	600 R'd	.69	.1-.5	2000	.95	.075-.075	8KV	6.50	.25	50KV	95.00
2-2	600 R'd	1.65	.25	2000	1.50	1	10KV	29.50	7.5	220VAC	1.95
3	600	.95	.3	2000	1.30	.1	12KV	8.95	1-3	330VAC	1.95
4	600	1.65	1	2000	1.95	1	15KV	45.00	10	330VAC	3.95
4	600 R'd	1.65	3	2000	3.75	.045	16KV	4.70	12.75	330VAC	4.10
5	600	1.75	12	2000	8.95	.05	16KV	4.95	15	330VAC	4.50
6	600	1.85	1	2500	2.75	.075	16KV	8.95	5	440VAC	3.10
8	600 R'd	1.85	1-1	2500	3.85	.25	20KV	19.95	2.9	660VAC	3.50
8-8	600	1.95	32	2500	15.80	1	20KV	54.00	7	660VAC	4.25
4-4-4	600	2.50	.5	3000	2.40				8	660VAC	4.50
4 x 3	600	2.50	1	3000	3.40						
10	600	3.25	2	3000	4.50						
1	1000	.65	.03	4000	1.25						
2	1000	.90	3 x .2	4000	2.95						
2	1000 R'd	.95	2	4000	6.95						
3.5-.5	1000	1.85	.1	5000	1.60						
4	1000	1.95	.2	5000	2.50						
6	1000	2.50	1	5000	4.88						
8	1000	3.25	2	5000	18.50						
1	1200	.85	5	5000	29.50						
1-1-1	1200	1.85	.01-.03	6000	1.65						

OILMITES

MFD	VDC	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

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	.65
		83-22J	1.40		

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS

IN STOCK

UHF—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG-22C/U	$1.20	UG-37/U	$17.50	UG-102/U	$ .80	UG-176/U	$ .12	UG-255/U	$1.95
UG-12/U	.95	UG-23/U	1.20	UG-57B/U	1.70	UG-103/U	.68	UG-177/U	.24	UG-260/U	.85
UG-15/U	1.25	UG-23B/U	1.50	UG-58/U	.70	UG-104/U	1.40	UG-185/U	.95	UG-261/U	1.10
UG-18/U	1.25	UG-23C/U	1.10	UG-58A/U	.90	UG-106/U	.15	UG-191/AP	.80	UG-262/U	1.10
UG-18B/U	1.05	UG-24/U	1.30	UG-59A/U	2.15	UG-108/U	2.60	MX-195/U	.75	UG-273/U	1.45
UG-19/U	1.60	UG-25/U	1.35	UG-83/U	1.75	UG-109/U	2.60	UG-197/U	2.80	UG-274/U	2.30
UG-20B/U	1.60	UG-27/U	1.25	UG-85/U	1.60	UG-146/U	1.95	UG-201/U	1.95	UG-275/U	5.50
UG-21/U	.85	UG-27A/U	2.25	UG-86/U	2.25	CW-159/U	.60	UG-203/U	.65	UG-276/U	2.75
UG-21A/U	1.50	UG-28A/U	2.95	UG-87/U	1.40	UG-166/U	32.50	UG-206/U	1.45	UG-290/U	.90
UG-21B/U	1.00	UG-29/U	.95	UG-88/U	.90	UG-167/U	3.75	UG-224/U	1.15	UG-291/U	.95
UG-21C/U	1.05	UG-30/U	2.30	UG-89/U	1.10	UG-171/U	2.25	UG-236/U	3.85	UG-306/U	2.65
UG-22/U	1.30	UG-34/U	9.75	UG-90/U	1.15	UG-173/U	.35	UG-245/U	2.25	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-254/U	2.75	UG-625/U	1.00

QUOTATIONS UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358	MC-277	PL-259A	PL-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	49121A	D-166132	ES-689172-1
M-360	PL-259	PL-293	TM-201				

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	650.00	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.

2 φ LOW INERTIA SERVO MOTORS

KOLLSMAN—15 Volt 60 cycle 4 watts 1500 RPM—new $22.50
PIONEER—10047-2-A 26 volt 400 cycle with 40:1 reduction gear $10.50
PIONEER—CK 13 115 volt 400 cycle—includes damping signal generator (autosyn) $47.50

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy. Sec. 6250V 80 MA—12.5 KV insulation $18.50
G.E.—Pri. 115V 60 cy. Sec. 6250/3850/2600V 56 MA 12.5 KV Insulation $18.50

ANTENNAS

AT-4/ARN-1 .... $ 8.25
AT-38A/APT (70 to 400MC) 13.70
AT-49/APR-4 (300 to 3300MC) 13.70
AN-65A (P/O SCR-521) 1.50
AN-66A (P/O SCR-521) 1.75
AIA-3CM conical scan 125.00
ASB Yagi—5 element 450 to 560MC 9.00
ASB Yagi—Double stacked 6 element 14.70
ASA Yagi—Double stacked 370 to 430MC 29.40

RELAYS

Sigma type 4AH—2000Ω 4 ma DC coil—SPOT contacts—hermetically sealed 5 pin plug-in base $3.30
Stevens Arnold type 171 Millisec relay—900 ohm coil SPST NO contacts $5.50
Cutler Hammer and Square D type B-7A contactor—24 VDC coil—SPST NO 200 Amp contacts $4.75
Price Bros. type 161-M—220 VAC contactor—SPST NO double bk 30A contacts $3.25
G.E. CR5181-1A6—115 V 60 cy. AC contactor—1PST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 amp Contacts $3.20

METERS

1 MA DC 3½" R Dejur Mod 310 (0-4KV scale) .$5.75
500 Microamps. DC—2½" round—Sun 4.30
1ma. DC Fan type—1" scale (rem. from equipt) 3.95
500 ma. DC 2½" R.—General Electric 2.95
5 amp. AC 4" R.—JBT 4.11
30 V DC 2½" R.—General Electric 3.95
3 amp. RF 3½" R.—Weston 6.00

CRYSTAL DIODES

1N21	$1.19	1N27	$1.79	1N41	$11.25
1N21A	1.69	1N31	8.10	1N42	18.75
1N21B	3.50	1N34	.66	1N45	.94
1N22	1.09	1N34A	.95	1N52	1.05
1N23	1.95	1N38	1.70	1N55	3.15
1N23A	3.25	1N39	6.25	1N60	.55
1N23B	4.25	1N40	10.60		

TYPE "J" POTENTIOMETERS

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	3/8"
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
650	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1 Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

$1.25 each

DUAL "J" POTS.—$2.95 ea.

50 SS	330 SS	2500 SS	2.5 meg SS
100 SS	500 SS	10K SS	5 meg SS
250 SS	1K SS	1 meg SS	1K/25K ⅜"

TRIPLE "JJJ" POTS.—$3.95 ea.

100K/100K/100K ⅜"   20K/150K/15K ⅜"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A-260   W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH

TS-10 Type Handsets $9.25

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400cy. 1φ: DC 30 Volts 60 Amps. Brand new $38.50
Eclipse-Pioneer type 1235-3A. Output-30 Volts DC 15 Amps. Brand New-Original Packing $15.50
PE-109 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
PU-7/AP Inverter-28 VDC to 115 VAC 400 cy 2500 VA (used) $75.00
Eclipse-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

TEST EQUIPMENT

- Gen. Radio 475B Frequency Monitor $200.00
- Gen. Radio 681A Freq. Deviation Meter .. 87.50
- I-72K Signal Generator 48.50
- Dumont 175A Oscilloscope 225.00
- Gen. Radio 757-P1 Power Supply 27.00
- A. W. Barber Labs. VM-25 VTVM 86.00
- TS-10A/APN Delay Line Test Set 45.00
- TS-19/APQ-5 Calibrator 185.00
- CWI-60AAG Range Calibrator for ASB, ASE, ASV and ASVC Radars 39.95
- CRV-14AAS Phantom Antenna for Transmitters up to 400 MC 11.75
- 3 CM Pickup Horn Antenna AT-48/UP ... 9.95
- I-138A Signal Generator—10 cm 185.00
- BC-221 Frequency meter 125.00
- CW—60ABM Frequency Meter—10 CM ... 97.50
- Weston Model 1 D.C. Milliameter 150/1500 MA with leather case 75.00

MISCELLANEOUS EQUIPMENT

AN/APA-23 Recorder $147.50
I-82F Selsyn Indicator 6.95
SCR-515 compl. w/dynamotor control box 69.50
Amperex 1B98 Gamma Counter 9.87
Powerstat 1226—115/230V Input—0-270V out. @ 9 amp 37.00
EIMAC-35T Ionization Gauge 5.95
FL-8 1020 cycle filter 2.95
RM-29 remote control unit 8.95
RM-14 remote control unit 8.95
RTA-1B 12/24V dynamotor 40.00
BC-1206-CM2 Receiver 12.95
ASB-4 Radar equip. Complete 69.75
RCA AVR-15 Beacon Recvr 18.50
Navy DP-14 Direction Finder complete 385.00
CU-24/ART-13 Antenna Loading Cond 4.95
T-85/APT-5 300-1600 MC Transmitter 175.00
PP-104/APT-5 Rectifier Unit for above 42.50
Sola #30807 Constant Volt. Transf. 250 VA. 49.00
BC-1016 Tape Recorder 350.00
AN/APA-30 .... 375.00
BC-910A Oscilloscope 147.50
BC-1068 Receiver 57.50
ATJ and ATK TV Block Equip .... Quote
BC-348 Receiver .... Quote
RTA-1B Transceiver .... Quote
T-47/ART-13 Transmitter .... Quote
Sperti 1S21 vacuum relay switch 9.50

PULSE TRANSFORMERS

UTAH 9262 9278 9280   UTAH 9318 9340 9350

G.E. K541318	Westinghouse 187AW2F
G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G828	Westinghouse 232-BW-2
G.E. 68G929G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2468B	Philco 352-7150
G.E. K-2469A	Philco 352-7071
G.E. K-2744B	Philco 352-7178
AN/APN-9 (901756-501)	Raytheon UX-7350
AN/APN-9 (9011756-502)	Raytheon UX-10066
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (352-7251)	W.E. D-163247
Westinghouse 132-AW	W.E. D-163325
Westinghouse 139DW2F	W.E. D-164661
Westinghouse 166AW2F	W.E. KS-9563
Westinghouse 176AW2F	

SPARE PARTS FOR ARMY AND NAVY RADIO, RADAR & SONAR EQUIPMENT

AN/APS-2	AN/APN-4	AN/ARC-5	QCB
AN/APS-3	AN/APN-9	SF	QCJ
AN/APS-4	AN/ARC-1	SL	QCL
AN/APS-15	AN/ARC-3	SO	WEA
etc.	etc.	etc.	etc.

QUOTATIONS UPON REQUEST

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P. 7.5 KV. "E" Circuit 1 Microsec. 200 PPS 67 ohms imped. 3 sections $4.30
7.5 E3-3-200-67P. 7.5 KV. "E" Circuit 3 Microsec. 200 PPS. 67 ohms imped. 3 sections $6.75
7.5 E4-16-60-67P. 7.5 KV. "E" Circuit 4 sections. 16 microsec. 60 PPS. 67 ohms imped $8.25
10-E4-.85-750-50P. 10 KV. "E" circuit. .85 microsec. 750 PPS. 50 ohms imped., 4 sections. $26.25
10-E4-2.2-375-50P. 10 KV. "E" circuit. 2.2 microsec. 375 PPS. 50 ohms imped., 4 sections. $26.25
15 E4-.91-400-50P. 15 KV. "E" Circuit .91 microsec. 400 PPS. 50 ohms imped. 4 sections ... $37.50
15-A-1-400-50P. 15 KV. "A" Circuit. 1 microsec. 400 PPS. 50 ohms imped $32.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST.   PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

CABLE ADDRESS - "LECTRONIC PHILADELPHIA"

GUARANTEED BRAND NEW

TUBE SPECIALS

STANDARD BRANDS ONLY

Receiving Tubes	
OOA	$1.50
O1A	.67
OZ4	.74
OZ4A	.90
1A3	.71
1A5GT	.72
1A6	.72
1A7GT	.91
1AB5	.89
1B3GT	.99
1B4P	1.17
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	.74
1H6G	.99
1H6GT	1.01
1J5G	.74
1J6G	.95
1L4	.69
1LA4	.87
1LA6	1.10
1LB4	1.01
1LC5	.81
1LC6	.93
1LD5	.93
1LE3	.93
1LH4	.82
1LN5	.91
1N5GT	.85
1N6G	.97
1P5GT	.69
1Q5GT	.99
1R4	.69
1R5	.89
1S4	.71
1S5	.81
1T4	.81
1T5GT	.71
1U4	.86
1U5	.81
1V	.69
1X2	1.09
2A3	1.28
2A5	.79
2A7	.89
2B7	.79
2E5	.94
2X2	.89
2X2A	1.85
3A4	.65
3A5	1.89
3A8GT	2.25
3B7	.57
3C6	1.15
3D6	.57
3LF4	.91
3Q4	.77
3Q5GT	.83
3S4	.77
3V4	.87
5AZ4	.69
5R4GY	1.59
5T4	1.91
5U4G	.69
5V4G	1.07
5W4	.82
5X4G	.87
5Y3GT	.59
5Y4G	.71
5Z3	.87
5Z4	1.11
6A4	1.35
6A6	1.17
6A7	1.05
6A8	1.08
6AB4	.99
6AB7	1.05
6AC5GT	1.19
6AC7	1.11
6AC7W	3.25
6AD6G	.98
6AD7G	1.31
6AE6G	.89
6AF6G	.89
6AG5	.87

6AG7	1.59
6AH6	1.39
6AJ5	2.50
6AK5	1.10
WE-6AK5	2.85
6AK5W	3.05
6AK6	.99
6AL5	.69
6AL5W	2.90
6AQ5	.89
6AQ6	.79
6AR5	.79
6AS5	.99
6AS6	3.30
6AS7G	4.53
6AT6	.63
6AU5GT	1.21
6AU6	.69
6AV6	.63
6B4G	1.60
6B5	1.20
6B7	.97
6B8	.99
6B8G	.85
6BA6	.72
6BA7	1.20
6BC5	.88
6BC7	1.10
6BD5GT	1.60
6BD6	.99
6BE6	.72
6BF5	1.10
6BF6	.83
6BG6G	1.92
6BH6	.99
6BJ6	.99
6BK7	1.60
6BL7GT	1.45
6BN6	1.59
6BQ6GT	1.26
6C4	.65
6C5	.75
6CB6	.89
6C6	.88
6C8G	.96
6CD6G	2.40
6D6	.88
6D8G	.83
6E5	1.10
6F5GT	.83
6F6	.99
6F6G	.99
6F7	.85
6F8G	.91
6G6G	1.06
6H6	.83
6H6GT	.83
6J5	.75
6J5G	.64
6J5GT	.64
6J6	1.09
6J7	.99
6J7GT	.79
6J8G	1.28
6K5GT	.99
6K6GT	.69
6K7	.83
6K7G	.88
6K8	1.22
6L5G	1.06
6L6	1.87
6L6G	1.79
6L6GA	1.59
6L7	1.08
6L7G	.95
6N7	1.19
6N7GT	1.10
6P5GT	.96
6Q7	.99
6Q7G	.89
6R7	.99
6S4	.72
6S7	1.06
6S7G	.99
6SA7	.84
6SA7GT	.74
6SB7Y	1.05
6SC7	1.20
6SC7GT	1.05
6SD7GT	.94
6SF5	.83
6SF5GT	.80
6SF7	.69
6SG7	.91
6SH7	.89
6SH7GT	.89
6SJ7	.89
6SJ7GT	.89

6SK7	.89
6SK7GT	.89
6SL7GT	.96
6SN7GT	.89
6SN7WGT	2.30
6SQ7	.75
6SQ7GT	.75
6SR7	.81
6SS7	.99
6ST7	1.25
6T7G	1.09
6T8	1.11
6U5	1.19
6U7G	.88
6V6	1.60
6V6G	.89
6V6GT	.79
6W4GT	.72
6W6GT	.99
6X4	.59
6X5GT	.59
6Y6G	.99
6ZY5G	.89
7A4	.79
7A5	.88
7A6	.83
7A7	.83
7A8	.83
7AD7	1.44
7AH7	1.08
7B4	.83
7B5	.83
7B6	.83
7B7	.83
7B8	.89
7C4	.69
7C5	.83
7C7	.83
7E5	1.20
7E6	.58
7E7	.83
7F7	.99
7F8	1.59
7G7	1.32
7H7	.83
7J7	1.32
7K7	1.32
7L7	.97
7N7	.97
7Q7	.83
7R7	.94
7S7	1.11
7V7	1.11
7W7	1.11
7Y4	.73
7Z4	.89
10	.45
12A	.65
12A6	.71
12A6GT	.69
12A7	1.16
12A8GT	.77
12AH7GT	1.32
12AL5	.89
12AT6	.59
12AT7	1.15
12AU6	.79
12AU7	.95
12AV6	.63
12AW6	1.20
12AX7	1.08
12BA6	.72
12BA7	.95
12BD6	.99
12BE6	.70
12C8	.77
12F5GT	.79
12H6	.69
12J5GT	.69
12K8	.83
12Q7GT	.67
12SA7	.89
12SA7GT	.89
12SF5	.79
12SF5GT	.79
12SF7	.79
12SG7	.99
12SH7	.73
12SJ7	.79
12SJ7GT	.89
12SK7	.81
12SL7GT	1.03
12SN7GT	.99
12SQ7GT	.79
12SR7	.89
12SR7GT	.89
12X3	1.19
12Z3	.89
14A4	.97

14A7	.97
14B6	.93
14B8	1.09
14C5	1.29
14C7	1.15
14E6	1.09
14E7	1.29
14F7	.93
14H7	.93
14J7	.93
14N7	.93
14R7	.93
14W7	.93
14X7	.93
19	.89
19T8	1.16
22	1.16
24A	.79
25A6	1.16
25L6GT	.89
25Z5	.99
26	.79
27	.69
28D7	1.75
30	.72
30 Spec	.48
31	.62
32	.99
32L7GT	.87
33	.99
34	.99
35/51	.79
35A5	.89
35B5	.87
35L6GT	.81
35W4	.55
35Y4	.81
35Z4GT	.69
35Z5GT	.59
36	.69
37	.69
38	.69
39/44	.59
41	.71
42	.89
43	.89
45	.89
45Z5GT	.79
46	.81
47	.99
48	1.60
49	1.19
50	1.41
50A5	.91
50B5	.88
50C5	.88
50L6GT	.79
50Y6GT	.92
53	.95
55	.99
BK55B	.40
L55B	.32
56	.69
57	.89
58	.89
59	1.24
70L7GT	.91
71A	.79
75	.89
76	.69
77	.69
78	.79
79	.89
80	.65
81	1.41
82	1.19
83	1.11
83V	1.45
84/6Z4	.79
85	.79
89Y	.55
117L7GT	1.89
117P7GT	1.89
117Z3	.74
117Z6GT	.97
FM-1000	1.59
Cathode Ray Tubes	
2AP1	$9.75
2AP5	9.75
3AP1	10.25
3AP4	10.25
3BP1	7.95
3CP1	2.25
3DP1	4.85
3DP1A	6.75
3EP1	4.95
3FP7	4.95

3FP7A	6.95
3GP1	4.95
3HP7	4.91
4AP10	4.75
5AP1	5.95
5AP4	4.75
5BP1	5.75
5BP4	5.75
5CP1	4.95
5CP7	9.50
5FP7	4.95
5HP1	5.75
5HP4	5.75
5JP1	26.50
5JP2	26.50
5JP4	26.50
5LP1	19.75
5LP5	19.75
5MP1	10.65
7BP1	8.75
7BP7	7.95
7BP12	14.95
7BP14	14.95
7CP1	14.95
9GP7	12.85
9LP7	9.95
10BP4	18.50
10FP4	24.50
12DP7	16.50
12GP7	16.50
12HP7	16.50
902P1	9.95
905	4.45
Photo Cells	
1P21	$35.00
1P23	4.10
1P24	1.27
918	1.65
919	1.95
923	1.35
927	1.85
931A	6.95
1645	1.95
Thyratrons & Ignitrons	
OA4G	$1.32
EL-C1A	4.75
2A4G	1.25
2B4	2.10
2C33	4.95
2D21	1.55
3C23	9.95
3C31/EL-C1B	3.95
3C45	17.50
4C35	27.00
EL-C5B	9.95
5C22	53.45
C6A	6.75
C6J	9.95
FG-17/5557	5.25
FG-33	17.50
FG-41	122.50
FG-67	14.80
FG-81A	4.95
91	7.85
FG-95/5560	26.25
FG-104/5561	24.60
FG-105	19.50
FG-166	95.00
FG-172	39.50
FG-178	14.50
RX-233A	4.95
FG-235A/5552	94.50
FG-271 5551	62.50
393A	8.60
394A	4.77
GL-415/5550	39.50
KU-610	12.50
KU-623	39.50
KU-628	22.25
KU-634	39.50
WL-652/5551	62.50
WL-654/659	82.00
WL-672	22.00
WL-677	39.50
WL-681/5550	39.50
722A	3.75
884	1.85

885	1.90
1665	1.80
1904	14.80
2050	1.80
2051	1.15
Transmitting & Special Purpose Tubes	
OA2	$ .95
OA3	1.51
OB2	1.10
OB3	1.29
OC3	1.20
OD3	1.15
1B21A	2.85
1B22	3.25
1B23	9.95
1B24 (West)	12.95
1B24(Sylv)	18.95
1B24A	39.50
1B26	3.73
1B27	19.50
1B29	2.90
1B32	3.95
1B35	11.00
1B36	12.50
1B38	32.50
1B40	4.95
1B41	47.50
1B42	9.80
1B54	32.50
1H20	.88
1S21	9.50
1Z2	3.75
2B22	2.20
2C21	.75
2C22	.75
2C26	.49
2C26A	.49
2C34	.49
2C39	22.00
2C40	16.25
2C42	26.50
2C43	19.25
2C44	1.50
2C46	29.50
2C51	5.75
2E22	1.85
2E24	4.10
2J21A	9.95
2J22	9.95
2J26	26.50
2J27	24.50
2J31	39.50
2J32	42.50
2J33	39.50
2J34	39.50
2J36	85.00
2J37	13.70
2J38	17.50
2J39	49.50
2J40	39.50
2J48	49.50
2J49	65.00
2J50	39.50
2JB51	2.50
2J54	67.50
2J55	87.50
2J56	150.00
2J61	45.20
2J66	165.00
2K23	37.50
2K25	33.50
2K26	107.15
2K28	34.50
2K29	26.00
2K33	295.00
2K45	145.00
2K54	135.00
2K55	135.00
2X2A	1.85
3B22/EL-1C	2.95
3B23	4.75
3B24	5.25
3B24W	7.95
3B25	4.50
3B26	3.75
3B27	4.20
3B28	7.75
3C24	1.85
3C27	6.95
3C37	32.50
3D21	1.98
3D21A	4.75
3E29	14.50
3J31	115.00

4-125A	29.50
4A1	1.18
4B22/EL-5B	8.95
4B24	5.75
4B25/EL-6CF	8.95
4E27	17.25
4J36	150.00
4J38	120.00
4J50	375.00
4J52	400.00
5D21	26.50
5J29	18.50
6-8B	.85
6AN5	5.95
6AR6	3.35
6C21	29.50
6C24	52.50
6F4	5.95
6J4	7.95
7-7-11	1.19
10T1	.88
10Y	.45
13-4	.80
15E	2.35
15R	.95
REL-21	2.25
24G	1.85
HK-24	3.95
RK-25	3.82
FG-32/5558	6.75
RK-34	.49
35T	4.95
35T Ion gauge	5.95
35TG	4.95
REL-36	.78
RK-47	4.92
EF-50	.79
VT-52	.65
53A	5.60
RK-59	2.44
VT-62(Br)	1.15
RK 63	22.50
VT-67	.48
RK-69	2.25
72	1.32
73	1.32
RK-75	3.50
VR-75/OA3	1.51
75T	5.80
VR-78	.64
VR-90/OB3	1.29
VT-98 (Br)	65.00
C100E	2.30
100R	2.90
100TH	10.25
WE-101F	3.62
WE-102F	2.85
VR-105/OC3	1.20
WE-113A	1.32
HY-114	.75
WE-117A	.95
F-123A	8.95
WE-124A	3.80
F-127A	22.50
VT-127A	3.60
AB-150	12.50
VR-150/OD3	1.15
FG-190	12.15
HF-200	16.50
203A	7.40
203B	6.33
204A	49.50
CE-206	3.15
211	.95
WE-211D	12.50
WE-211E	12.50
212E	42.50
WE-215A	.24
217C	8.95
221A	1.95
227A/5C27	4.60
WE-231D	2.25
232CH	240.00
WE-244A	5.20
WE-245A	2.35
WE-249B	3.50
WE-249C	3.50
250TH	22.50

250TL	22.50
WE-252A	5.65
WE-254A	5.90
WE-257A	3.77
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	9.75
304TL	9.75
307A	5.50
WE-309A	6.45
WE-310A	7.50
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
WE-399A	4.70
417A	16.95
434A	17.50
446	1.95
446A	1.95
446B	2.25
450TH	42.50
450TL	42.50
451	1.39
471A/1B21A	2.75
503AX	1.65
506AX	1.47
507AX	1.47
527	17.50
530	17.20
531	8.25
532A	3.95
WL-533	65.00
559	2.20
561	3.50
HY615	.49
WL670A	8.70
700A	24.50
700B	24.50
700C	24.50
700D	24.50
701A	6.95
702A	2.95
702B	4.25
703A	6.95
704A	.95
705A	2.75
706AY	45.00
706BY	45.00
706CY	45.00
706FY	45.00
706GY	45.00
707A	9.95
707B	22.50
708A	4.85
709A	4.87
710A	1.70
713A	1.45
714AY	10.75
715A	6.75
715B	12.75
715C	26.50
717A	1.47
718AY	45.00
718BY	45.00
720DY	75.00
721A	4.90
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
WL-787	9.80
788Y	1.40
800	1.88
801A	.48
803	4.95

805	4.50
806	24.50
807	1.70
808	2.65
809	2.40
810	10.95
811	3.60
813	10.50
814	3.95
815	2.95
816	1.45
826	1.45
828	13.48
829	9.95
829A	14.50
829B	14.50
830B	3.95
832	7.95
832A	9.95
833A	45.00
836	4.10
837	1.85
838	3.25
841	.49
843	.59
845	5.75
845W	6.75
849	29.50
851	67.00
852	22.60
860	4.95
861	24.50
864	.39
865	1.28
866A	1.48
869B	45.00
872A	3.95
874	1.45
876	1.60
878	1.85
886	3.50
954	.39
955	.70
956	.49
957	.49
958A	.69
959	1.50
991	.45
1003	.90
CK-1005	.79
CK1006	3.75
E-1148	.35
1201	1.20
1203	.69
1291	.69
1294	.69
1299	.69
1602	2.25
1613	1.20
1614	2.00
1616	1.07
1619	.39
1622	2.30
1624	1.95
1625	.45
1626	.39
1629	.39
1630	.95
1631	1.38
1632	.75
1636	3.10
1638	.70
1642	.75
1644	1.17
1655	1.90
1960	.70
5611	135.00
5651	3.05
5654	2.90
UX-6653	.65
7193	.75
8005	5.95
8011	.87
8012	2.60
8013	2.75
8013A	4.90
8016	1.05
8020	1.39
8025	6.95
9001	1.75
9002	1.50
9003	1.75
9004	.55
9005	1.95
9006	.35
189048	3.79
189049	3.79
199698	2.69

IMMEDIATE

DELIVERY FROM STOCK

GENERAL ELECTRIC — ARMA
CONTROL INSTRUMENT — BENDIX
FORD INSTRUMENT — KETAY
HENSCHEL — DIEHL

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 BLOWN FUSE INDICATORS

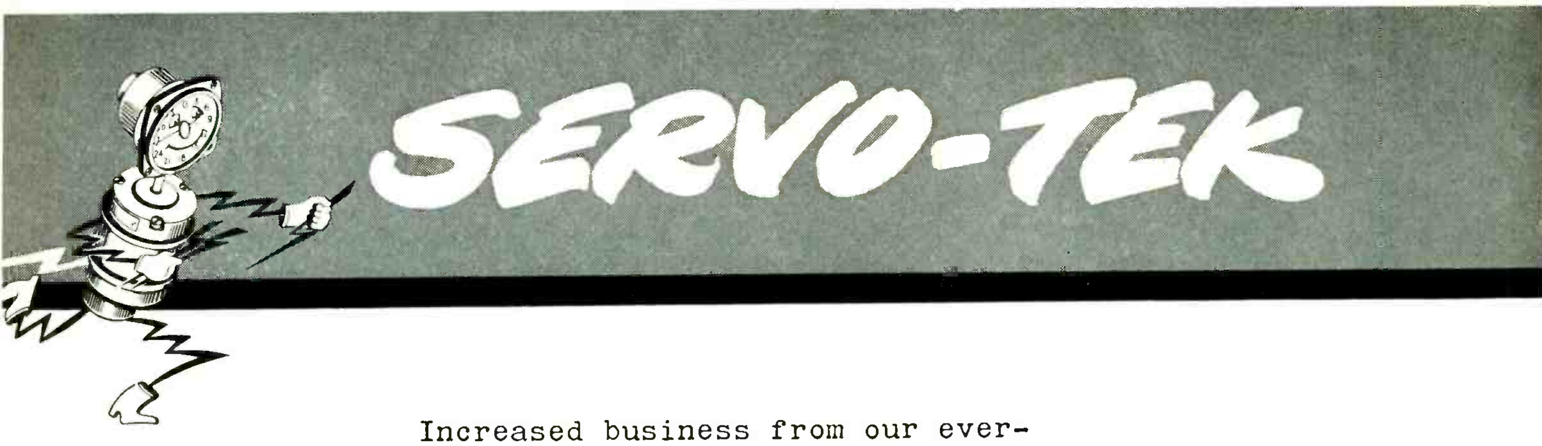
Terms 20% cash with order, balance C. O. D. unless rated. All prices net F. O. B. our warehouse, Phila., Penna., subject to change without notice.

CABLE ADDRESS - "LECTRONIC PHILADELPHIA"

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3



Increased business from our ever-expanding list of accounts . . . and a desire to give these customers the utmost in service . . . has prompted us to move our facilities from Paterson to adjacent Hawthorne, N.J. Here we have built twin plants with more than twice the office, service, storage, and shipping space as in our previous quarters.

Our greatly increased capacity now permits us to stock many more items — and in much larger quantity — so that immediate delivery is assured. Every shipment carries our guarantee to meet original manufacturers' specifications.

NEW LOCATION

1086 GOFFLE ROAD
HAWTHORNE, NEW JERSEY
HAwthorne 7-3100

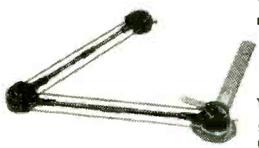
IS ON THE MOVE

SYNCHROS • DC MOTORS • AC MOTORS • INVERTERS
SERVO MOTORS • ACTUATORS • GEAR MOTORS • GENERATORS

GUARANTEED TO MEET ORIGINAL MANUFACTURERS' SPECIFICATIONS

ELECTRIC PNEUMATIC RAM

Standard Type FQ. 6 inch push-pull cylinder. Operates with any air pressure up to 350 pounds. Control valve is electrically operated with 24 volts D.C. Ideal for remote or automatic control. Stock #SA-370 .... each $12.50



DRAFTING MACHINE

Will save many hours of labor on plans, schematics, drawings, etc. Each arm 18 inches long with full ball-bearing construction. Designed by Brunning for the Navy and modified by Servo-Tek to be equivalent of their standard machine, with chucks to hold standard vertical and horizontal scales. Supplied with one 18 inch Brunning scale. Packed in special fitted wooden box. Stock #SA-375 each $39.50

Additional 12 inch scale for above. Stock #SA-376 .... each $4.85

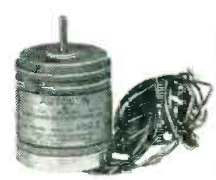
HIGH H.P. AIRCRAFT MOTORS
All 24-28 volts D.C.

SA-340 Electric Specialty .75 H.P. @ 3800 rpm.
SA-341 Elec'tric Spec'lty 1.75 H.P. @ 6000 rpm.
SA-325 Electric Specialty .25 H.P. @ 3800 rpm.
SA-270 General Electric .5 H.P. @ 4600 rpm.
SA-199 National Mineral 1.0 H.P. @ 5800 rpm.
SA-154 General Indust's .125 H.P. @ 8500 rpm.
SA-279 Holtzer Cabot .5 H.P. @ 3600 rpm.

Prices on request.

400 CYCLE TRANSTAT

115 volts, 400 cycle, single phase input. 75 to 120 volts at 6 amperes max. output. Completely enclosed with AN connector for input and output. Locking device for permanent setting. Stock #SA-368 .... each $12.95



BENDIX AY-201-3-B
HIGH PRECISION AUTOSYN

For use as transmitter or control transformer in controlled (servo) circuits. Average electrical characteristics: input voltage — nominal excitation, 26 volts, 400 cycles, single-phase; input current — milliamperes, 65; input power — watts, 0.33; input impedance — (stator open) — ohms, 80 + j400; rotor resistance — (DC) — ohms, 42; brush contact resistance — (DC) ohms — 0.5 @ 300 rpm max; stator output voltages — (line to line) 11.8 volts; stator resistance (DC) — ohms, 10.8; phase shift — (rotor to stator) — degrees 5.5; accuracy (against standard) spread — minutes 15 max.

PIONEER 10047-2A SERVO MOTOR

400 cycle, 2 phase low inertia drag cup servo motor. 26 volts fixed phase, 45 volts maximum variable phase. Makes excellent rate generator. Stock #SA-90 .... each $12.50

208 VOLT AIRCRAFT ACTUATORS

In stock various 208 volt, 3 phase, 400 cycle Actuators, including all the other actuators used with the Northrup Flying Wing. **Prices on request.**

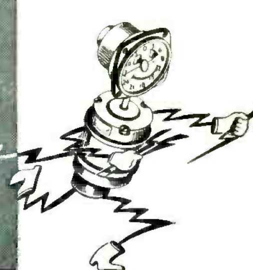
WRITE FOR LISTING

Prices F.O.B. Hawthorne

Telephone HAwthorne 7-3100

Servo-Tek
PRODUCTS CO.
INCORPORATED

1086 GOFFLE ROAD
HAWTHORNE, NEW JERSEY



ALNICO FIELD MOTORS

(Approx. size overall) . . . 3¾" x 1¼" diameter)
Delco-Type 5069230: 27.5 volts; DC; 145RPM **$19.95 ea.**

PM Motor. Delco Type #5069370: 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½, diameter 0.125" **$12.50**

PM Motor. Diehl Mfg. SS FD6-21; 27.5 volt; DC Alnico Field; 10,000 r.p.m.; dimensions 1" x 1" x 2" long; shaft extension ½", diameter 0.125" **$12.50**

AC CONTROL MOTOR

Diehl Mfg. Co., FPE-25-7, 20 Volts, 2 ph 1600 RPM, .85 amps **$15.00**

Diehl Mfg. Co., FPE-25-11: 75 to 115 volts; 11 amps. 60 cycle, 2 phase 2 pole. Low inertia motor, 5 watts output **$30.00**

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.**

AIRESEARCH: 115V; 40 CPS; Single phase 6500 RPM; 1.4 amp; Torque 1.6 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 $17.50 ea.

SMALL DC MOTORS

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 3½" **$7.50 ea.**

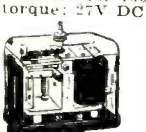
(Approx. size....4" long x 1¼" dial.)

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. 56 RPM, 1.02 amp. **$15.00 ea.**

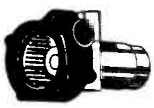
General Electric-Type 5BA10AJ52C; 27 volts, DC; .5 amps. 8 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible **$15.00 ea.**

GENERAL ELECTRIC DC MOTOR Mod. 5BA10AJ64. 160 r.p.m.; 65 amp; 12 oz.-in. torque; 27V DC .... **$19.95 ea.**



WESTINGHOUSE OVER-CURRENT RELAY: Type MN. adjustable from .04-.16 amp. (1210991). External reset push button. Enclosed in glass case . . . hand calibrated. NEW LOW PRICE. **$14.95**

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.**

MICROPOSITIONER

Barber Colman AYEZ 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.**

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. .... **$80.00 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.**

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.**

SOLA TRANSFORMERS

One KVC, 210-270 Volts, 240 Sec., 3-Phase

#30663 .... $175.00

FILAMENT. Gen. Elec. #7466321: Primary 110/125 Volts. Secondary 11 Volts. 65 Amps. 975 KVA. Shipping wt. approx. 60 pounds. **$24.95**

FILAMENT. AMERTRAN #29048: Primary 115 Volts, 50/60 cycle. Secondary 5 volts. 190 amp. Shipping weight approx. 75 lbs. **$36.50**

VARIABLE. AMERTRAN #29144: 250 VA. 103-126 commutator range. fixed windings. 115 volts, max. 2.17 amps **$19.95**

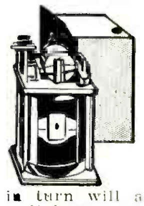
METERS

AMMETER: DC; 2" 100-100. complete with external shunt .... **$5.95 ea.**

AC Volt. Westinghouse. Type NA-35—3-inch round. F.S.-10 MA .... **$6.95 ea.**

AMP METERS: DC., 0-300 amps, 3" round type complete with external shunt. **$6.95 ea.**

ELAPSED TIME METER. Aero Instrument Co.—Model 1001. Records operating time of AC electrical and electronic equipment. Registers up to 9.999.9 hours in 1/10th hour increment . . . then automatically resets. Diameter 3½" with glass covered face, 120 VAC; 60 cycle. NEW . . **$14.95**



SCHWEIN REMOTE CONTROL DUAL GYRO

Free and rate gyro type 45600. Contains two 28 volt DC constant speed gyros . . . one operates horizontally, the other vertically. Vertical master gyro influences horizontal gyro position, which in turn will actuate a series of limiting switches controlling any number of electrical devices. Both gyros turn in excess of the 30,000 rpm. Size 8" x 4¼" x 4¼". Comes with metal cover .... **$22.50 ea.**

Immediate Delivery

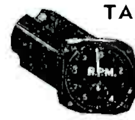
ALL EQUIPMENT FULLY GUARANTEED

All prices net FOB Pasadena, Calif.

PIONEER GYRO FLUX GATE AMPLIFIER

Type 12076-1-A. complete with tubes **$27.50 ea.**

TACHOMETER INDICATOR
SINGLE

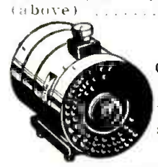


Sensitive Type, Kollsman Mark V; Range 0-3500 RPM in 3½ revolutions of the indicating pointer **$9.95 ea.**

TACHOMETER GENERATOR

Pioneer Instrument Mark V. screw mount. Used with Kollsman Mark V Indicator .... **$25.50 ea.**

Tachometer Indicator and Generator (above) .... **Both $33.50**



G. E. GENERATORS

General Electric Type 5ASB-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 FJE13-9 (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**

GENERATORS

Eclipse-Pioneer; 716-3A (Navy Model NEA-3A) OUTPUT: 115 VAC; 10.4 amps; 800 cycle, single phase; 28.6 VDC; 60 amps @ 2400 rpm; spline drive; self exciting; wt. 60#.

BRAND NEW in original box . . . **$39.95 ea.**

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

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 Cyc. .... **$50.00 ea.**

5F Motor (115/90 volt—60 cyc.) . . **$60.00 ea.**

5G Generator (115/90 volt—60 cyc.) **$50.00 ea.**

5/DG Differential Generator (90/90 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**

REPEATER. BENDIX C-78410; 115 Volt. 60 Cycle .... **$37.50 ea.**

REPEATER. AC synchronous 115 V., 60 cycle, C-78863 .... **$15.00 ea.**

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**

2JF51 Selsyn Control Transformer: 105-55 Volts; 60 Cycle **$50.00**

2JD5J2 Selsyn Motor: 115-90 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.**

2J1H1 DIFFERENTIAL GENERATOR: 57.5 —57.5 Volt; 400 cycle .... **$12.50 ea.**

2J1G1 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 **$25.50**
AY6—26 Volt—400 cyc .... **$4.95 ea.**
AY30D—26 Volt—400 cyc .... **$25.00 ea.**
AY14D **$14.00**
AY34 .... **$20.00**
AY20—26 Volt—400 cyc .... **$12.50 ea.**

PIONEER TORQUE UNITS

TYPE 12604-3-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 12606-1A 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

Buy TOP Radio-Electronic Values!

JAN TUBES

OB3/VR90	$ .85	832A	$ 8.50
OC3/VR105	.85	836	3.00
3E29	12.95	GL8002R	95.00
6C21	12.95	9003	1.00
204A	75.00	3BP1	5.95
368AS	7.00	5FP4	3.95
371B	.75	12GP7	14.95

FILAMENT TRANSFORMERS

AMERTRAN 5 VOLT C.T.—10 AMP SEC. 230 VOLT 50/60 CYCLE PRIMARY 25,000 VOLT TEST

Stock No. 6212A Price Each **$10.00**

CHICAGO TRANSFORMER—10 VOLT C.T.—6.5 AMP. SEC. 230 VOLT 50/60 CYCLE PRI. 5000 VOLT TEST

Stock No. 6213A Price Each **$5.00**

TEST SETS

IE-36 FOR SCR 522 .... $35.00
EE-65G TELEPHONE TEST SET $25.00

POWER TRANSFORMER

PRI: 115 VOLT 60 CYCLE
SEC: 488V. C. T. @ 95MA 6.3 VOLT @ 6.2 Amps. HERMETICALLY SEALED. P/O R-19/TRC-1

Stock No. 6114A Price Each **$2.00**

SENSITIVE RELAY SPST—2MA—6500 Ohms. Stock No. 102152A. Price Each $1.25.

RADAR OSCILLATOR APR-5

Sig. Cr. Stk. No. 2C 2784. Used for tuning 1000-3100 Mg.

POWER TRANSFORMER

Horizontal Double Half Shell Type. Pri.: 117 Volt—60 Cycle. Sec.: 265-0-265 V.A.C. @ 40 Ma. Sec.: 6.3 V.A.C. @ 1.65 Amps. Mtg. Centers 2½" x 2". H.V. Center Tap is grounded to core.

Stock No. 6183 Price Each **$1.25**

HIGH FIDELITY TRANSFIRMER

P. P. 10,000 ohm to 250 ohm Line. Frequency Response 30 to 20,000 C.P.S. plus or minus 1 DB. Grey Rectangular Case 3" x 2½" x 3⅝" high. Bottom Solder Lug Terminals. 4 Stud Mtg. Bolts.

Stock No. 5792A Price Each **$3.50**

HIGH CURRENT FILAMENT TRANSFORMER

Primary 115 VAC 60 Cycle. Secondary 1.25 VAC at 100 Amp.

Stock No. 5783A Price Each **$5.00**

.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

AN/APQ-13 MODULATOR UNIT

Signal Corps # 2CK2537-13 W.E. NNO. D-151754. Oil filled modulator containing a pulse amplifier and associated rectifier. **$125.00 ea.**

SYNCHRO CAPACITOR

3 x .6 MFD. 90V 60 Cycle. 3 Bakelite insulated terminals. 2½" x 1¾" x 3⅛" high can.

Stock No. 6158A Price Each **$1.50**

4 WATT RHEOSTAT

Type M200R 4 Watt 200 Ohm Wire Wound Rheostat. ⅜" bushing. ⅜" long. ¼" diam. shaft. $25.00 per 100

Stock No. 6137A Price Each **30¢**

J-38 KEYS

Signal Corps Type J-38 Keys

Stock No. 5293A Price Each **85¢**

HIGH VOLTAGE TRANSFORMER

21,000 volt 100MA. Half Wave oil filled. Maloney Electric Co.

Stock No. 5728A Price Each **$300.00**

MICA CAPACITORS

Sizes from 10 to 7,000 MMFD in CM20, CM 30, CM35 and CM40 case sizes. Tan mica and silver mica.

Complete lists with prices available upon request.

G. E. SATURABLE REACTOR

15 KVA. #67G469 **$100.00**

72 OHM COAX

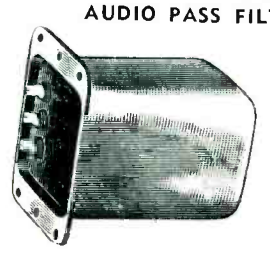
Plastoid RG-59/U Coax.

Stock No.		Price
5324A	1000 Ft. Spools	$60.00
5325A	100 Ft. Coils	7.00

83-1R COAX CONNECTOR

Stock No. 5657A Price Each **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.

ONAN GAS-DRIVEN GENERATOR

14 V-2500 WATT D.C. $225.00

GAS DRIVEN LIGHT PLANT

125V 3 Phase 3KVA 50-60 Cycle
$395.00

SWITCHBOARD BD74

RCA and KENRAD

Individually Boxed

JAN 826's

75¢ Each 100 Lots **85¢ ea**

RAYTHEON

Individually Boxed

JAN VT-127's

25¢ Each 100 Lots **35¢ each 3 for $1.00**

10 MFD. — 600 VDC

Sprague No. R2-157. 10 Mfd. 220 VAC 600 VDC Capacitator with Universal Mounting Ring. 2-7/16" Diameter. 3¾" high. Bakelite insulated terminals.

Stock No. 5958A Price Each **95¢**

TRANSMITTING MICAS

Stock No.	Cap.	Test Volts	Type No.	Price Each
5493A*	.01	1000	1445	.35¢
5494A	.02	1000	144T	.40¢
5495A	.006	1200	A2	.40¢
5496A	.0001	1500	BE 15	.20¢
5498A	.001	2500	4	.30¢
5499A	.001	5000	F	.60¢
5600A	.0036	5000	A2	$1.00
5601A	.15	1000V	XS	1.90
5602A	.00007	2500V	3	.90¢
5603A	.00005	3000V	15L	1.00
5604A	.0001	5000V	F2L	1.00
5605A	.0003	5000V	F21	1.00
5606A	.000025	10,000	PL-34L	1.95
5607A**	.00015	10,000	PL-315	7.95

*Supplied with Meter Bracket
**D.C. Working Voltage
OTHER TYPES AND SIZES AVAILABLE

BUTTERFLY CONDENSERS

FIG. 1

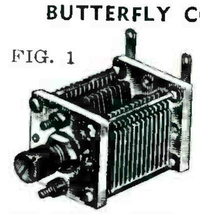
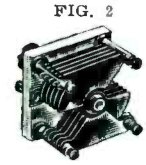


FIG. 2



9-62 mmfd per section. 6-34 mmfd sections in series. Double ceramic end plates and bearings. ¼" diam. shaft. 5/16" long. 065 Plate spacing end plates 1-⅜" square.

Stock No. 5076-A Fig. 1 Price Each **90¢**

4-22 mmfd per section. 3-12 mmfd sections in series. Single ceramic end plate 1-⅜" square. ¼" diam. x ¼" long shaft.

Stock No. 5077-A FIG. 2 Price Each **60¢**

AN-109A WHIP ANTENNA

$1.25 w/base. .75 less base.

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. ½" above Chassis. Soder Lug Terminals—All Terminals Marked.

Stock No. 5254A Price Each **$2.65**

TERMS:

Open Account 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

NEW YORK'S RADIO TUBE EXCHANGE

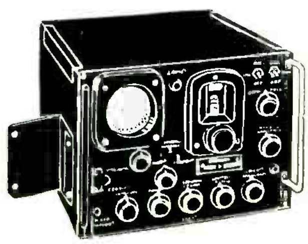
TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OA2	$1.40	2J21A	17.95	4E27	17.50	RK-73	1.95	450TH	45.00	806	27.50	955	.55
OA3	1.10	2J22	17.95	4J25	199.00	100TH	9.95	450TL	45.00	807	1.69	956	.69
OB2	1.35	2J26	27.75	4J26	199.00	FG95	24.95	464A	9.95	808	3.50	957	.29
OC3	1.25	2727	29.95	4J27	199.00	FG105	19.00	471A	2.75	810	11.00	958A	.69
OD3	1.25	2J31	29.95	4J31	199.00	203A	8.95	527	15.00	811A	3.95	991	.65
C1B	3.95	2J32	69.95	4J32	199.00	211	.95	WL530	3.50	813	9.95	F1148	.35
1B21A	2.75	2J36	105.00	4J33	199.00	217C	18.00	WL531	22.50	814	3.95	1280	1.25
1B22	3.95	2J38	17.95	4J37	199.00	242C	10.00	WL533	17.50	815	3.50	1611	1.95
1B23	9.95	2J39	12.50	4J38	89.00	244A	12.95	700A/D	25.00	816	1.45	1613	1.38
1B24	17.95	2J40	35.00	4J39	199.00	249C	4.95	701A	7.50	829	12.95	1616	2.95
1B26	2.95	2J42	200.00	4J41	199.00	250TH	22.50	703A	6.95	829A	13.95	1619	.89
1B27	13.50	2J49	109.00	C5B	3.95	250TL	19.95	705A	3.95	829B	15.95	1622	2.75
1B32	4.10	2J50	195.00	5BP1	6.95	274A	3.00	707A	17.95	830B	2.50	1624	2.00
1B38	33.00	2J61	45.00	5BP4	6.95	274B	3.00	707B		832	7.95	1625	.45
1B42	19.95	2J62	45.00	5CP1	6.95	304TH	10.00	714AY	17.95	832A	9.95	1851	1.85
1B51	9.95	2K25	29.50	5D21	21.00	304TL	10.00	715A	7.95	833A	49.95	2050	1.85
1B56	49.95	2K28	37.50	5JP1	27.50	307A	4.95	715B	12.00	834	7.95	2051	1.80
1B60	69.95	2K29	37.50	5JP2	19.50	310A	5.95	715C	25.00	836	4.95	8012	4.25
1N21	1.35	2K41	150.00	5JP4	27.50	311A	6.95	717A	1.95	837	2.95	8013	2.95
1N21A	1.75	2K45	149.50	WE6AK5	2.50	312A	3.95	718AY/EY	48.50	838	6.95	8013A	5.95
1N21B	4.25	2V3G	2.10	C6A	12.50	323A	15.00	719A	29.50	845	5.59	8019	1.75
1N22	1.75	3BP1	7.50	C6J	10.95	327A	3.95	721A	3.95	849	52.50	8020	3.50
1N23	2.00	3E24	5.50	7EP7	7.95	328A	6.95	722A	3.95	851	80.50	8025	6.95
1N23A	2.75	3B24W	7.50	7DP4	10.00	350A	6.95	723A/B	24.95	860	4.95	PD8365	89.00
1N23B	4.25	EL3C	5.95	12AP4	55.00	350B	5.95	724A	4.95	861	29.50	9001	1.75
1N34A	.96	3C22	120.00	15E	1.95	357A	20.00	724B	6.95	866A	1.79	9002	.95
1N43	2.50	3C24	1.95	15R	.95	368AS	6.95	725A	9.95	869B	57.50	9003	1.75
2B22	1.95	3C31	3.95	NE16	.68	371B	2.95	726A	24.00	869BX	35.00	9004	1.75
2B26	3.75	3DP1A	10.95	FG17	6.95	385A	4.95	726B	56.00	872A	3.95	9005	1.90
2C34	.35	3DP182	12.00	KY21A	8.75	388A	2.95	726C	69.00	878	1.95	9006	.35
2C40	10.00	3E29	15.50	FG33	12.95	394A	7.95	728AY	27.00	884	1.95		
2C43	20.00	3GP1	5.50	35T	4.95	MX408U	.75	730A	24.00	885	1.75		
2C44	.90	4A21	2.75	45 Special	.35	417A	17.95	801A	1.00	889R	199.50		
2D21	1.75	4B26	6.95	RK39	2.95	434A	19.95	802	4.25	914	75.00		
2E22	2.75	4C27	25.00	HF50	1.75	446A	1.95	803	7.95	931A	5.00		
2E30	2.75	4C28	35.00	VT52	.25	446B	5.40	805	5.95	954	.35		

Minimum Order

$25.00

MICROWAVE TEST EQUIPMENT

TS148/UP SPECTRUM ANALYZER



Field type X Band Spectrum Analyzer, Band 8430-9580 Megacycles.

Will check Frequency and Operation of various X Band equipment such as Radar Magnetrons, Klystrons, TR Boxes. It will also measure pulse width, c-w spectrum width and Q or resonant cavities. Will also check frequency of signal generators in the X band. Can also be used as frequency modulated Signal Generator etc. Available new complete with all accessories, in carrying case.

Also available of new production TS147/UP and TS239A Synchroscope.

MOUNTED QUARTZ CRYSTALS IN FT241A HOLDERS WESTERN ELECTRIC

370KC	402	433	462	490	516
372	403	434	463	491	518
374	404	435	464	492	519
375	405	436	465	493	520
376	406	437	466	494	522
377	407	438	468	495	523
379	408	440	469	496	525
380	409	441	470	497	526
381	411	442	472	498	527
383	412	443	473	501	529
384	413	444	474	502	530
385	414	445	475	503	531
386	415	446	476	504	533
387	416	447	477	505	534
388	418	448	479	506	536
390	419	450	480	507	537
391	420	451	481	508	538
392	422	452	483	509	540
393	423	453	484	511	
394	424	454	485	512	
395	425	455	486	513	
396	426	456	487	514	
397	427	457	488	515	
398	429	458			
400	430	459			
401	431	461			

$1.00 Each

10 for $8.00, Postpaid

Other test equipment, used checked out, surplus.

TSK1/SE K Band Spectrum Analyzer
TS3A/AP Frequency and power meter S Band
RF4A/AP Phantom Target S Band
TS10/APN Altimeter Test Set
TS12/AP VSWR Test Set for X Band
TS13/AP X Band Signal Generator
TS14/AP Signal Generator
TS15/AP Flux Meter
TS16/AP Altimeter Test Set
TS19/APQ 5 Calibrator
TS33/AP X Band Power and Frequency Meter
TS34/AP Western El Synchroscope
TS35/AP X Band Signal Generator
TS36/AP X Band Power Meter
TS47/APR 40-400 MC Signal Generator
TS69/AP Frequency Meter 400-1000 MC
TS100 Scope
TS102A/AP Range Calibrator
TS108 Power Load
TS110/AP S Band Echo Box
TS125/AP S Band Power Meter
TS126/AP Synchroscope
TS147 X Band Signal Generator
TS251 Range Calibrator APN9
TS270 S Band Echo Box
TS174/AP Signal Generator
TS175 Signal Generator
TS226 Power Meter
TS239A Synchroscope

SURPLUS EQUIPMENT

32A Ferris Noise Meter
APA10 Oscilloscope and panoramic receiver
APA38 Panoramic Receiver
APS 3 and APS 4 Radar and Parts
APR 4 Microwave Receiver
APR5A Microwave Receiver
APT2 Radar Jamming Transmitter
APT5 Radar Jamming Transmitter

MINIMUM ORDER
25 Dollars

YOU CAN REACH US ON TWX NY1-3235

Cables:
TELSERSUP

SPECIAL

Wide Band S Band Signal Generator 2700/3400MC Using 2K41 or PD 8365 Klystron, Internal Cavity Attenuator, Precision individually calibrated Frequency measuring Cavity. CW or Pulse Modulated, externally or internally.

Large quantities of quartz crystals mounted and unmounted.
Crystal Holders: FT243, FT171B others.
Quartz Crystal Comparators.
North American Philips Fluoroscopes Type 80.
Large quantity of Polystyrene beaded coaxial Cable.

LIBERTY ELECTRONICS, INC.
135 LIBERTY STREET NEW YORK 6, N. Y.
PHONE WORTH 4-8262

SEE OUR PREVIOUS ELECTRONICS ADS FOR LISTINGS OR WRITE FOR CIRCULARS

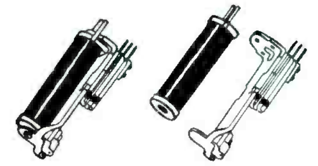
RELAYS! RELAYS! RELAYS!

324 CANAL ST., N.Y.C., 13, N.Y. WAlker 5-9642

Universal general corp.

TERMS:—All Prices F.O.B. Our Plant. Rated Firms Net 10 Days. All Others Remittance with Order. Orders Under $10 Remittance With Order, Plus Approximate Shipping Charges (overage will be returned.)

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.

107 COOK, 3-6VDC, 6 make, 1 break (5As, 1C), 12 ohm. Part of BC654, #R407 .... $ 3.95

CLARE, 6500 ohm, 8maDC, 3 makes (3As), R276 .... 4.25

5035A7 AUTOMATIC, 1300 ohm, 3maDC, SPST n.o. (1A), #103 .... 1.75

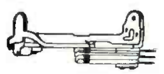
A18258 BENDIX (Cook 102) 8-12 VDC, Copper Slug, Slow Release, SPDT, 200 ohm. Part of SCR 522, #R365 .... 2.49

R5229A1 AUTOMATIC 6VDC, 3PST n.o. (3As), 75 ohms, Slow Release, #412 .... 2.50

R5021A1 AUTOMATIC 1300 ohm, 20maDC, SPST n.c. (1B), #R413 .... 2.95

FRAMES

(For Cost of Relay Add Price of Frame to Price of Coil)



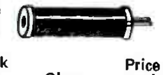
Stock No.	Contacts	Price each	Stock No.	Contacts	Price each
F101	1A	1.25	F111	1B, 2A	1.75
F102	2A	1.50	F114	1B, 3A	2.00
F103	3A	1.75	F108	1B, 1A, 1C	2.00
F104	4A	2.00	F107	2B, 1A	1.75
F105	5A	2.25	F112	2B, 2A, 2C	3.00
F106	1A, 1B	1.50	F118	2B, 5A, 1C	3.25
F107	1A, 2B	1.75	F113	5B, 2A	2.75
F108	1A, 1B, 1C	2.00	F121	5B, 1C	2.75
F109	1A, 1C	1.75	F122	1C	1.50
F110	1A, 2C	2.25	F123	2C	2.00
F111	2A, 1B	1.75	F109	1C, 1A	1.75
F112	2A, 2B, 2C	3.00	F116	1C, 4A	2.50
F113	2A, 5B	2.75	F117	1C, 5A	2.75
F114	3A, 1B	2.00	F121	1C, 5B	2.75
F115	3A, 2C	2.75	F110	2C, 1A	2.25
F116	4A, 1C	2.50	F115	2C, 3A	2.75
F117	5A, 1C	2.75	F108	1C, 1A, 1B	2.00
F118	5A, 2B, 1C	3.25	F118	1C, 5A, 2B	3.25
F120	1B	1.25	F112	2C, 2A, 2B	3.00
F106	1B, 1A	1.50			

FRAMES WITH MICROSWITCH

F125	1A, 1C (Microsw.)	1.75
F126	1A, 1A (Microsw.)	1.75

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	K106	1100/500 Dual	2.00
K102	12	1.25	K111	1300	1.75
K103	250	1.25	K112	2000	2.25
K104	450	1.50	K113	3000	2.50
K105	500	1.50	K114	3600	2.50
K106	500/1100 Dual	2.00	K115	4600	2.75
K107	750	1.50	K116	6500	2.75
K108	900	1.75	K130	11,300	3.00
K109	1000	1.75	K118	40,000	3.25

A-C COILS

Stock No.	Voltage	Price each
K119	6V AC	1.75
K120	24V AC	1.75
K121	110V AC	2.50

SLOW ACTION COILS

Stock No.	Ohms	Slow Action	Price each
K122	33	Make	1.50
K123	75	Release	1.50
K124	200	Release	1.50
K125	300	Make	1.75
K126	2000	Make	2.00
K127	2500	Release	2.00

A = Normally Open; B = Normally Closed; C = Double Throw.

SHORT TELEPHONE RELAYS

A11996 CLARE. (H77519-1) 24VDC, 3PST n.o. (3As), 2000 ohm, #R94 .... $ 1.75

6385 ARC 12VDC, SPST n.o. (1A), 10A contact, 200 ohm. Part of **ARC5** or SCR 274N, #R13 .... 1.50

C58180 BENDIX. 12VDC, DPDT & SPST n.c. (2C, 1B) 150 ohm. **Part of SCR522**, #R58 .... 2.00

A22268 CLARE. 12VDC, SPST n.o. (1A), 200 ohm, #R411 .... 1.50

5586 W.E. 12-24VDC, SPST n.o. (1A), 425 ohm, #R414 .... 1.25

D170788 W.E., 4850 ohm, 8maDC, SPDT, #R92 .... 2.50

CLARE 24V DC, SPDT(1C), 500 ohm #R278 .... 2.75

CLARE K102, 6ma DC, 3500 ohm #R30 .... 3.49

AUTOMATIC. 1.5V DC, DPST n.c. (2Bs), 5 ohm, #R280 .... 3.00

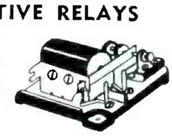
W.E. D169615, 5800 ohm, 6 ma DC, 2Bs, 1C #R261 .... 2.75

CLARE B16198, 24VDC, 500 ohm 1E, #R262.. 3.00

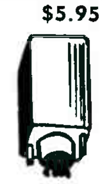
G.M. D282377, 8-12VDC, 90 ohm, 1C, 1F (Break, Make, Make) #R263 .... 3.00

ULTRA SENSITIVE RELAYS

KURMAN BK35 — Nominal Operating Characteristics, 11,000 Ohms, 0.4 Ma. 4V DC SPDT. Adjustable contacts and armature. #R277. 10 for $55.00. 100 for $475.00.



$5.95 each



SIGMA 5RJ; 5000 ohms Hermetically sealed SPDT; 1.5 ma. DC, #R281

$6.95 each

AMPERITE THERMAL TIME DELAY

Single Pole Normally Open 2.40 ea.

No.	Volts AC/DC	Delay Sec.	No.	Volts AC/DC	Delay Sec.
R946	115	60	R316	24	2
R947	115	30	R950	6	60
R948	115	15	R951	6	30
R943*	115	5	R952	6	15
			R953	6	5

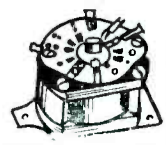
* Edison Type 501

SELENIUM RECTIFIERS

Full-Wage Bridge Types

Current (Continuous)	18/14 Volts	36/28 Volts	54/42 Volts	130/100 Volts
1 Amp.	$1.25	$2.20	$3.60	$8.95
2 Amps.	2.20	5.60	6.50	10.50
2½ Amps.	.....	.....	.....	13.00
4 Amps.	3.75	6.75	8.75	.....
5 Amps.	4.95	7.95	12.95	27.00
6 Amps.	5.50	9.00	14.00	36.00
10 Amps.	6.75	12.00	20.00	45.00
12 Amps.	8.50	16.00	25.50	52.50
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	.....	.....
36 Amps.	25.50	45.00	.....	.....

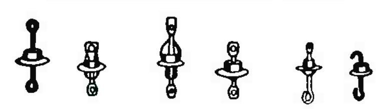
ROTARY RELAYS



These relays are manufactured by Price Brothers Co. for operation at the voltage indicated. Application of this voltage causes the mechanism to rotate 30°. All are provided with shafts for use with standard wafer switch decks.

Volts D.C.	Ohms	Mfgr. No. Price	Mfgr. No. Zenith	Switch Decks	Stock No.	Price Each
6	8.3	75-17	—	None	R254	$1.50
6	8.3	75-16A	—	None	R255	1.50
6	8.3	75-15A	—	None	R256	1.50
14	2/125	5228	85G37V	2 {Ceramic 1A, 1C / 2A, 1B}	R257	2.50
14	2/125	4199	85G13V	2 {3A, 1C / 3B}	R258	2.25
28	7/230	75-1	—	2 {3C, 1B / 1B, 1C}	R259	2.00
28	7/230	77-1	—	2 {2C, 1B / 1B}	R260	2.00

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 300 Seals (20 types)	15.00	postpaid in USA

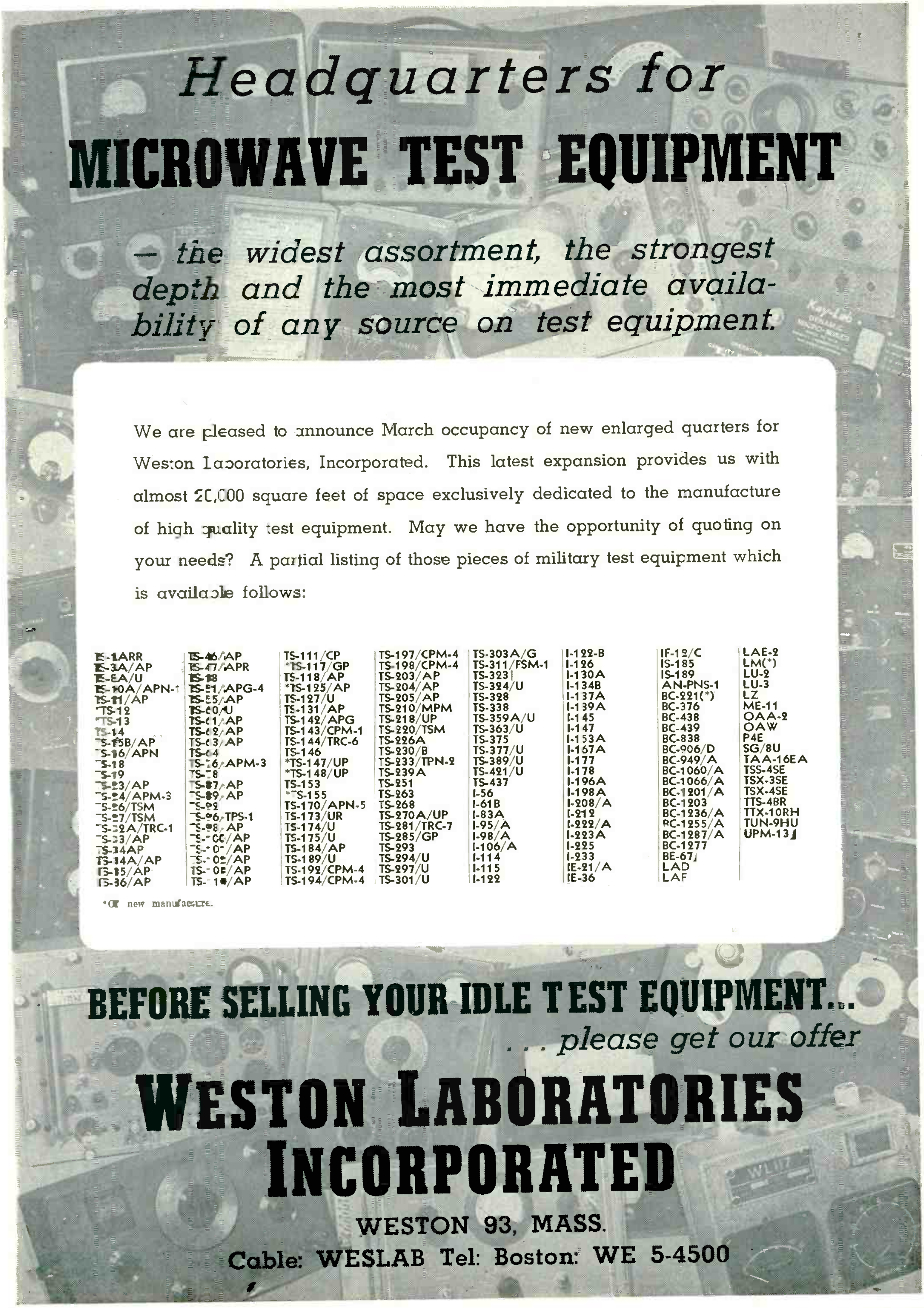
MU-METAL LAMINATIONS

Es, Fs, Is, Ls. Ten Sizes. Quantities Available.

Sample Kit, 6 lbs, Sufficient Quantity of Each Size for One Unit—Postpaid in U. S. A. **$19.75**

H-F TIE POST

Low-loss Melamine Insulation, pictured actual size (4-40 Thread) $7.50/C $67.50/M



Headquarters for

MICROWAVE TEST EQUIPMENT

— the widest assortment, the strongest depth and the most immediate availability of any source on test equipment.

We are pleased to announce March occupancy of new enlarged quarters for Weston Laboratories, Incorporated. This latest expansion provides us with almost 20,000 square feet of space exclusively dedicated to the manufacture of high quality test equipment. May we have the opportunity of quoting on your needs? A partial listing of those pieces of military test equipment which is available follows:

TS-1ARR	TS-46/AP	TS-111/CP	TS-197/CPM-4	TS-303A/G	I-122-B	IF-12/C	LAE-2
TS-3A/AP	TS-47/APR	*TS-117/GP	TS-198/CPM-4	TS-311/FSM-1	I-126	IS-185	LM(*)
TS-8A/U	TS-48	TS-118/AP	TS-203/AP	TS-323	I-130A	IS-189	LU-2
TS-10A/APN-1	TS-51/APG-4	*TS-125/AP	TS-204/AP	TS-324/U	I-134B	AN-PNS-1	LU-3
TS-11/AP	TS-55/AP	TS-127/U	TS-205/AP	TS-328	I-137A	BC-221(*)	LZ
*TS-12	TS-60/U	TS-131/AP	TS-210/MPM	TS-338	I-139A	BC-376	ME-11
*TS-13	TS-61/AP	TS-142/APG	TS-218/UP	TS-359A/U	I-145	BC-438	OAA-2
TS-14	TS-62/AP	TS-143/CPM-1	TS-220/TSM	TS-363/U	I-147	BC-439	OAW
TS-15B/AP	TS-63/AP	TS-144/TRC-6	TS-226A	TS-375	I-153A	BC-838	P4E
TS-16/APN	TS-64	TS-146	TS-230/B	TS-377/U	I-167A	BC-906/D	SG/8U
TS-18	TS-76/APM-3	*TS-147/UP	TS-233/TPN-2	TS-389/U	I-177	BC-949/A	TAA-16EA
TS-19	TS-78	*TS-148/UP	TS-239A	TS-421/U	I-178	BC-1060/A	TSS-4SE
TS-23/AP	TS-87/AP	TS-153	TS-251	TS-437	I-196A	BC-1066/A	TSX-3SE
TS-24/APM-3	TS-89/AP	*TS-155	TS-263	I-56	I-198A	BC-1201/A	TSX-4SE
TS-26/TSM	TS-92	TS-170/APN-5	TS-268	I-61B	I-208/A	BC-1203	TTS-4BR
TS-27/TSM	TS-96/TPS-1	TS-173/UR	TS-270A/UP	I-83A	I-212	BC-1236/A	TTX-10RH
TS-32A/TRC-1	TS-98/AP	TS-174/U	TS-281/TRC-7	I-95/A	I-222/A	BC-1255/A	TUN-9HU
TS-33/AP	TS-100/AP	TS-175/U	TS-285/GP	I-98/A	I-223A	BC-1287/A	UPM-13
TS-34AP	TS-10[illegible]/AP	TS-184/AP	TS-293	I-106/A	I-225	BC-1277	
TS-34A/AP	TS-10[illegible]/AP	TS-189/U	TS-294/U	I-114	I-233	BE-67	
TS-35/AP	TS-10[illegible]/AP	TS-192/CPM-4	TS-297/U	I-115	IE-21/A	LAD	
TS-36/AP	TS-110/AP	TS-194/CPM-4	TS-301/U	I-122	IE-36	LAF	

*Of new manufacture.

BEFORE SELLING YOUR IDLE TEST EQUIPMENT...
...please get our offer

WESTON LABORATORIES INCORPORATED

WESTON 93, MASS.
Cable: WESLAB Tel: Boston: WE 5-4500

COMMUNICATIONS EQUIPMENT CO.

SHOCK MOUNT RACKS

FT-156	FT-265A	MT-62/ARC-5
FT-162	FT-338	MT-167-U
	FT-449	
FT-185	FT-487	MT-170A
FT-225	MT-5/ARR-2	MT-171A

SILVER MICA BUTTON COND.

MMF	MMF
40	180
50	185
175	500

PRICE $7.00/100
2000 MMF 15.00/100

CERAMICON TYPE CAPACITORS

MMF	MMF	MMF
14	50	125
15	51	180
20	60	200
27	62	240
30	65	345
47	82	

PRICE $5.00/100

COAX CABLE

RG8/U
RG9/U
RG34/U
RG37/U
RG57/U

ID-24 ARN-9 Dual 0-200 Micro-amp. Movement in 3" Case. ILS Equipment $9.95

932 PHOTO TUBE

Gas Phototube having SI Response. particularly sensitive to Red and Near infrared Radiation. Can be used with incandescent light source. Send for data. Price .... 75¢

MICA CAPACITORS

CM-45—2500 V. TEST

MFD.	Price	MFD.	Price	MFD.	Price
.01	$0.85	.0024	.60	.0075	.80
.015	.85	.0025	.60	.0076	.80
.02	.85	.0027	.60	.008	.80
.04	.85	.003	.60	.0085	.80
.001	.60	.004	.60	.0005	.60
.0015	.60	.005	.60	.00085	.60
.002	.60	.0056	.60	.00015	.60
.0022	.60	.006	.60	Write For Many Others	
.0023	.60	.0063	.60		

CM-55—2500 V. TEST

MFD.	Price	MFD.	Price	MFD.	Price
.00001	$0.29	.001	.35	.0075	1.79
.000025	.29	.0015	.35	.0076	1.79
.00003	.29	.0016	.35	.008	1.79
.00005	.29	.0017	.35	.01	1.10
.000075	.29	.002	.50	.015	1.10
.0001	.29	.0023	.50	.02	1.10
.00015	.29	.003	.50	.025	1.10
.00025	.29	.004	1.79	.027	1.10
.0003	.29	.005	1.79	.03	1.10
.0004	.29	.006	1.79		
.0005	.35	.0063	1.79	5000 V Test	
.00075	.35	.0069	1.79	.0015	1.75
.00085	.35	.007	1.79	.002	2.00

UNIVERSAL SUPPLY KIT

Delivers 230V @ 40MA DC. From 110/220VAC 60 CY. Kit Consists of 1-PWR Transformer, 1-5 HY @ 40MA Choke, 2-8 MFD @ 450V Filter Cond. 1-6x5 Tube. A great buy at only $3.95

INTERPHONE TRANSFORMER SET

Rig your own interphone. Kit consists of 1-Input Transformer (Matches 4 or 6 OHM SPKR to Grid) and 1-Output Transformer (Matches 50L6, 35L6, 25L6, etc., to 4 or 6 OHM Speaker Set of 2 XMRS. ONLY $1.00

12-14V SUPPLY KIT

Delivers 12-14VDC at 3.5A from 115V. 60 cy.. Kit contains 1—Transformer Rated 18.5V, 4A. 1—Selenium Rectifier, F. W. Bridge $6.95

24 VOLT TRANSFORMERS

For operating surplus gear, toy trains, gadgets, etc. Operates from 115V. 60 cy., supplies 24 VAC at 1.2 Amp., herm. sealed and cased .... A Great Buy at Only $1.49

RECTIFIER TRANSFORMERS

Pri: 115V. 60 Cy. Sec: 28V/3.1A, 26V/8.4A 7.3V/14A $12.95
Pri. 210/215/220/225/230/235/240V, 60 Cy., 1 Phase Sec: 11/10/7.5/5VCT @ 35A $19.50
Pri: 115V 60 Cy: Sec: 8.1V @ 1.5A $1.39
Pri: 115V 60 Cy. Sec: 18.5V @ 5A $4.25

FLEXIBLE COUPLING SHAFTS

MC 215

(ALL LENGTHS IN INCHES)

34	163	260
135	186	

MC 124

(ALL LENGTHS SHOWN IN INCHES)

23	61	120	175
29	65	140	205
39	103	161	241
52	114	166	348

PRICE: MC 124 or MC 215

2¢ PER IN.

SELENIUM RECTIFIERS—Full-Wave Bridge Types

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	......	......
36 Amps.	25.50	45.00	......	......

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 16.95
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 .050A 5VCT/3A 2.25
CT-99A 2x110VCT .010A 6.3/1A, 2.5VCT/7A 3.25
CT-403 350VCT .026A 5V/3A 2.75
CT-931 585VCT .086A 5V/3A, 6.3V/6A 4.25
CT-456 390VCT 30 MA 6.3V/1.3A, 5V/3A 3.45
CT-160 800VCT 100 MA 6.3V/1.2A, 5V/3A 4.95
CT-931 585VCT 86 MA 5V/3A, 6.3V/6A 4.99
CT-442 525VCT 75 MA 5V/2A, 10VCT/2A, 50V/200 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/200 MA, 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-38A	6.3V/2.5A, 2.5V/7A, 2.5V/7A., 7500 VDC Test	$3.45
FT-674	8.1V/1.5A	1.10
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-468	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, 16KV Test	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V A 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

ITEM	Rating	Price
PT-699	300/150V/.05A, 300/150V/.05A	$2.79
PT-302	120-0-120V/350 MA	4.69
PT-108	17,600V/144 MA	120.00
PT-671	62V/3.5A	7.95

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-129	230V	3850V 3.12KVA	42.59
STP-823	137V	222VCT/.3A	2.35
STP-08B	50V	2x750V/.001A	1.79
STP-622	210/220/230	5000V/1A	59.75
STP-945	210/220/230	550-0-550V/.3A	5.95

Special Comb. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STC-16A	220V	260V/.03A, 100V/1A, 6.3V/4.2A	$4.69
STC-609	220V	220V/3A	6.95

CIRCUIT BREAKERS

AM 1614—80: 28VDC 80 AMP $1.59
AM 1614—100: 28VDC 100 AMP $1.69
KJ—600V, 115 AMPS, UP TO 1000% OVERLOAD RATING. TRIP ADJ. 10 MIN.—INST $21.95

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set
PE86	28	1.25	250	.060	RC 36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA0515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK 11
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 376
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

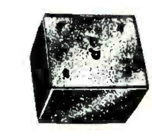
INVERTERS

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
LELAND No. 10536: IN: 28 VDC, 12A. OUT: 115V, 115VA, 400 CY 3 PHASE. EXC. COND $70.00

This Month's Special

PHASE-SHIFTING HELMHOLTZ COILS 0-360 DEGREES $3.95
BLEEDER RESISTOR, TYPE-HA. 3000 OHM—25W, 7500 OHM—5W, 23 OHM—1W, 23 OHM—1W WITH MTG. BRACK .... .69¢
SA4A/APA-1 Motor Driven Coaxial Ant. Switch DPDT, Continuous Operation from 24VDC. Completely Enclosed $24.50
MP-22 MAST BASE Mobile Antenna Mount 4.59
SA1A/APN-1 Altitude Limit Switch for APN-1 Altimeter 7.95
ALTITUDE INDICATOR for APN-1 .... 12.50
C-387-D Final P.A. Coil for BC610 2-3.5 MC, Variable Link 4.89
RA-74 Power Supply for Super Pro 69.50
J-17/ARC-5 Junction Box for ARC-5 .... 7.95
J-22/ARC-5 Junction Box 3.49
SUPERSONIC CRYSTALS, Rochelle salt .... .50 ea.
MOTOR, 24vdc, 3 HP 3800 rpm, New 75.00
TV LEAD-IN WIRE, 300 ohms, HI-Q, Lo-Loss .... $17.50/M FT Roll
BC 306 ANTENNA TUNING UNIT, NEW 6.95
R9/APN-4, New, With Tubes 75.00
ID6/APN-4, New, With Tubes and Crystal 75.00
A-62 Phantom Antenna 8.50
2 Meter Choke, 1000 MA, 20-144 .... 8/ 1.00
Supersonic Crystal Head, M-1, 22-27KC HI-2 .... 27.45

FILTER CHOKES



Stock	Description	Price
CH-366	20H/.3A	$6.95
CH-322	.35H/350 MA—10 Ohms DCR	2.75
CH-141	Dual 7H/75 MA, 11H/60 MA 5KV DC Test	4.69
CH-119	8.5H/125 MA	2.79
CH-69-1	Dual; 120H/17 MA	2.35
CH-8-35	2/.5H/380 MA/25 Ohms	1.79

Stock	Description	Price
CH-776	1.28H/130 MA/75 ohms	$2.25
CH-344	1.5H/145MA/1200V Test	2.35
CH-43A	10HY/15MA—850 ohms DCR	1.75
CH-366	20H/300MA	6.95
CH-999	15HY/15MA—400 ohms DCR	1.95
CH-511	6H/80MA—310 ohms DCR	2.45
CH3-501	2 x .5H/400MA	2.79
CH-188M	5HY 200MA	1.79
CH-488	10HY .030A	1.19
CH-791	Dual 1.75-.125 HY 100 MA	1.27
CH-981	15HY .110A	1.59
CH-22-1	1 HY .100A	1.17
CH-779	.6 HY .490A	1.25
CH-25A	SW .09/.018 HY 3/.3A	8.95
CH-922	10000 HY O MA	2.75
CH-043	2.2 HY 80 MA	.98
CH-89A	2 x 1.52H @ .167A	1.39
CH-69A	Mult. Choke SECT. 1. Swing 3-12H/.52-.05A SECT. 2. Smooth 5H/.52A SECT. 3. Swing 3.25-18H/.138-014A SECT. 4. Smooth 3.4H/.138A	14.95
CH-445	0.5 HY/200 MA, 32.2 OHMS, 3000V.T.	1.39
CH-170	2X0.5H/380 MA, 25 OHMS	2.79
CH-533	13.5H, 1.0 AMP DC, 13.5KV INS	39.95

INTERPHONE AMPLIFIER

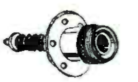
Easily converted to an ideal Inter-Communications set for office, home or factory. Original. New w/conversion diagram $4.75

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-2 Chas. Rosen Phone: Digby 9-4124

COMMUNICATIONS EQUIPMENT CO.

PULSE EQUIPMENT



H/I-Volt Pulse Bulkhead. Feed-thru. Fits UG-36 Connector—as shown $15.00

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 KW (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. # K2731 Repetition Rate: 635 PPS. Pri. Imp: 50 Ohms, Sec. Imp: 450 Ohms. Pulse Width: 1 Microsec. Pri. Input: 9.5 KV PK. Sec. Output: 28KV PK. Peak Output: 800 KW Bifiar 2.75 Amp. $65.00

U-10198 Pri: 4-5KV, 97A Pk Sec: 18KV, 26A, PRR-350-500 Cy. Duration 1.3 usec $42.50

D-166173: Video. Ration = 50:900 Ohms 10KC—2MC $12.50

G.E.K.-2745 ..... $39.50

G.E.K.-2744-A. 11.5 KV High voltage. 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1 microsec. @ 600 PPS $39.50

W.E. D169271 Hi Volt input pulse Transformer $27.50

G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100 KW G. E. $34.50

G. E. K2748A. Pulse Input line to magnetron $36.00

Ray UX 7896—Pulse Output Pri. 5v. sec. 41v $7.50

Ray UX 8442—Pulse inversion—40v + 40v $7.50

RAY UX7361 ..... $5.00

PHILCO 352-7250, 352-7251, 352-7287

UTAH 9332, 9278, 9341.

RAYTHEON: UX8693, UX5986 ..... $5 ea.

W.E.: D-166310, D-16638, KS 9800, KS9948.

DELAY LINES

D-168184: 0.5 microsec. up to 2000 PPS 1800 ohm term $4.00

D-170499: 25/.50/.75 microsec. 8 KV 50 ohms imp. $16.50

D-165997: 1¼ microsec. $7.50

RCA 255686-502. 2.2μ sec. 1400 ohms $2.00

PULSE NETWORKS

G.E. #6E3-5-2000-50P2T, 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS 50 ohms impedance $6.50

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

7.5E3-3-200-6FT. 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, 21KV Test $37.50

G.E. 25E5-1-350-50 P2T. "E" CKT. 1 Microsec. Pulse @ 350 PPS. 50 ohms impedance $69.50

TEST EQUIPMENT

● Signal Gen.	RCA 710A, 370-560 MC	350.00
● Signal Gen.	20A Microvolter	175.00
● TS 10A	Altimeter Test Set	32.50
● TS 16/AP	Altimeter Test Set	
● TS 36	Power Meter, 3 CM.	
● TS 47/APR	Test Osc. 50-3000 MC	325.00
● TS 56/AP	Slotred Line, 500 MC	325.00
● TS 127/UP	Wavemeter, 300-700 MC	72.50
● TS 69/AP	Wavemeter, 340-1000 MC	72.50
● TS 70/AP	Pwr. Meter, 200-800 MC	
● TS 110/AP	Echo Box, 2400-2700 MC	

THERMISTORS VARISTORS

D167018	$1.50	D171812	$1.50
D167332	1.50	D172155	1.50
D167613	1.50	D167176	1.50
D166228	1.50	D168687	1.50
D164699	2.50	D167208E, D171858	1.50
D163903	1.95	308A, 27-B	1.50
D166792	2.15	D168403	2.15

MICROWAVE COMPONENTS

S BAND—3" x 1½" W.G. 10 CM.

DIRECTIONAL COUPLER. Broadband. 20 db. Coupling. Type "N" Takeoff. Complete with all Hardware. Navy # CABY-47AAN-2 ..... $37.50

WAVEMETER 2700-3400 MC. Reaction Type with counter Dial—Mfg., W.E. $92.50

REACTION WAVEMETER. Mfg. G.E. 3000-3700 MC. Misc. Head $125.00

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 6AK5 (2040, 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

F 29/SPR-2 FILTERS, type "N" input and output Hi-Pass Over 1000 MC $12.50

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

HOMEDELL-TO-TYPE "N" Male Adapters, W.E. #D167284 ..... $2.75

I. F. AMP STRIP: 30 MC 120 d.b. gain, 2 MC Bandwidth, uses 6AC7's—with video detector. 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

COAXIAL FILTER, F3/APR-2, LO-PASS, BELOW 400 MC $32.50

⅞" RIGID COAX—⅜" I. C.

ROTARY JOINT, Stub-supported, UG 46/UG 45 fittings $27.50

10 CM STABILIZER Cavity, tunable, standard UG46/UP 45 fittings $45.00

RG 44/U RIGID COAX, stub support. 5 ft. sections, with UG46/UG45 connectors $12.50

RT. ANGLES for above $4.50

RIGHT ANGLE BEND, with flexible coax output pick-up loop $8.00

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—1" x ½" W.G. 3 CM.

CROSS-GUIDE COUPLER. Main Section 7" long with 90 deg. bend (E-Plane). 2½" radius. Broadbanded coupling figure is 20 db. individually calibrated $22.50

1" x ½" waveguide in 5' lengths. UG 39 flange to UG40 cover $7.50

Rotating joints supplied either with or without deck mounting. With UG40 flanges ..... each $17.50

Bulkhead Feed-thru Assembly (As Shown) $15.00

Pressure Gauge Section 15 lb. gauge and press nipple $10.00

Pressure Gauge, 15 lbs. $2.50

Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius, 90 deg. bend $4.50

Twist 90 deg. 5" choke to cover w/pres nipple $6.50

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

UG 39 Flanges ..... $ .85

90 degree elbows. "E" or "H" plane 2½" radius $12.50

45 degree twist $8.00

APS-4 Under Belly Assembly, less tubes $375.00

MICROWAVE RECEIVER, 3 CM.

SENSITIVITY: 10-13 MICROWATT 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

K BAND—½" x ¼" W.G. 1.25CM.

APS-34 Rotating joint $49.50

Right Angle Bend E or H Plane, specify combination of couplings desired $12.00

45° Bend E or H Plane, choke to cover $12.00

Mitered Elbow, cover to cover $4.00

TR-ATR-Section. Choke to cover $4.00

Flexible Section 1" choke to choke $5.00

"S" Curve Choke to cover $4.50

Adapter, round to square cover $5.00

Feedback to Parabola Horn with pressurized window $27.50

90° Twist $10.00

MAGNETRONS

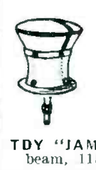
Tube	Tube	Tube
2J27	2J49	720BY
2J31	2J61	725-A
2J21	700	730-A
2J22	706	QK 62
2J26	2J62	QK 61
2J32	3J31	QK 60
2J37	5J30	2J56
2J38	718DY	2J32
2J39		

400 CYCLE TRANSFORMERS

(All Primaries 115V, 400 Cycles)

Stock	Ratings	Price
352-7039	640VCT @ 380MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
12033	4540V/250MA	17.50
K59584	5000V/290 MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V 2.5A 6.3V/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 OV @ .005A	7.45
352-7196	1140V/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	900V/75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300 VCT. 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	526VCT/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, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 465V/.6A, 44V/10A, 6.3V/23.5A, 6.3V/1.8A, 5V/9A, 2X2.5V/1.75	17.95
TRANSTAT	IN: 115V, 400 CY. OUT: 75-120V, 6.0 Amps.	12.95
M-7467886	2X140V/.014A, 120V/.012A, 1200VRMS Test, P/O MX-8/APG-2	4.95
352-7102	6.3V/2.5A	1.45
M-7472426	1450V/1 MA, 2.5V/1.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A P/O ID-39/APG-13	4.95

MICROWAVE ANTENNA EQUIPMENT



AT49A/APR—Broadband Conical, 300-3300 MC. Type N Feed. (AS SHOWN) $12.50

AS-31/APN-7: 10 cm Polyrod in Lucite Ball. Type N Fitting Coax Feed. $22.50

Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4½" x 3'. New $100.00

Dipole for above $12.00

TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New $150.00

Parabolic Peel. Radiation pattern approx. 25 deg. in horizontal 33 deg. in vertical planes $35.00

Cone Antenna. AS 125 APR. 1000-3200 mc. Stub supported with type "N" connector $14.50

AS14A/AP. 10 CM pick up dipole assy. complete w/length of coax and "N" connectors $3.50

AS46A/APG-4 Yagi Antenna, 5 element array $22.50

30" Parabolic Reflector Spun Aluminum dish $4.85

RADAR ANTENNAS

AS-12/APS-3	AS-125/APR
AS-17/APS-2	AS-217/APG-15
AS-13/APG-2	AT49/APR
AS69/APT	AS-14/AP

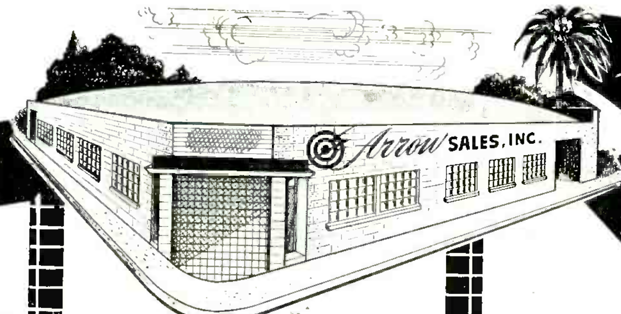
30' SIGNAL CORPS RADIO MASTS

Complete set for erection of a full flat top antenna. Of rugged plymold construction telescoping into 3 ten-foot sections for easy stowage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx. 300 lbs. Sig. Corps No. 2A289-223-A. New ..... $49.50 per set

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-2 Chas. Rosen   Phone: Digby 9-4124

FOLLOW ARROW FOR MILITARY ELECTRONICS



ATR-13 TRANSCEIVER

Dynamotor powered, either 14 or 28 V. Shock mounted, remotely controlled, transceiver. Tunable receiver, range 108-160 M.C., 4-channel crystal controlled VHF transmitter, built-in provisions for omni. Weight, complete with plugs, less cable, 19 Lbs. Less crystal, new **$245.00**

Radar

AN/APS-3 Complete	APT-1	RC-1841FF
APR-4 New Complete	APT-2	RC-214
APR-5	APT-3	RC-224
APS-4 New. Complete	APT-4	RC-266
APS-6 New. Complete	Mark 16	RT34/APS13
	MD4/APS2	T-85/APT-5
	MD5/APS3	
	MD22/UPN2	
	MD38/APQ13	

PORTABLE RADAR

Model SQ. 12 cm. Used on small ships. Has PP1 indicator. Max. range 20 miles. 1 Kw. output. Operates from 110 VAC. 60 cps. P.U.R.

AN/ART-13 PARTS

Part #	Item
Transmitter	T-47A/ART-13
564916	Barometric Switch
565027	4-Pile Ceramic, Variable Cap.
K7890443	6-Pile Ceramic, Variable Cap.
564605	4 Centralap-Type 843-003 Cap Assembly
Antenna Loading	CU-25

GAS ENGINE POWER SUPPLY

1½ Kw. 110 V. 60 cps. Complete gas engine power supply. New, with spare parts. P.U.R.

GOVERNMENT, AIRLINES & 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.

Test Equipment — Complete Line

DuMont 224-A Oscilloscope		TS159
1-77 Hickok Tube Checker		TS-159/TPX
1-208 FM Signal Generator		TS170/ARN
RPC Model 644 Multimeter		TS-173/UR
Hewlett Packard 200-C		TS-174/UR
I-198	TS27/TSM	TS175/UR
BC-638	TS-33	TS182/UP
BC-1255	TS34/AP	TS184A/AP
IE-36	TS-35/AP	TS204/AP
I-95	TS36/AP	TS-218
I-96-A	TS-45A/APM-3	TS251
I-122	TS-59/APN	TS311A/UP
I-130A	TS61/AP	TS323/UP
I-139	TS62/AP	I-146
I-145	TS89	TS-268/U
I-212	TS92	Boonton Mod. 78B Sig. Gen.
I-222	TS100/AP	
TS-3A/AP	TS-102	Boonton Type 102F Sig. Gen.
TS10A/APN	TS111/CP	
TS12/AP	TS-118/AP	LAD Sig. Gen.
TS16/APN	TS126	LAE-2
TS19/APQ	TS127/U	LAVOIEFreq. Meter: 300 600 Mc.
TS-23/APN	TS131	
TS24A/ARR-2	TS-148/UP	

SUPREME TEST EQUIPMENT

Model 600 Tube and Set Tester........$89.50
Model 616 Tube and Battery Tester.... 69.50

FLUX METER

For measuring flux density between magnet poles. Has two meters in series with a potentiometer and battery for power supply. Range: 500-4000 Gauss in 3 scales. Requires 1 battery which mounts in case. NEW...........$37.50

MISCELLANEOUS

MINE DETECTOR: SCR-425 for prospecting, mining, etc. NEW...................$59.50
LP-21 LOOPS: Mod. LM, AM, A. Excel. cond.

TRANSCEIVER—MODEL 52

5W. 2-way, 2-channel radio transmitter-receiver unit. Complete with tubes, battery charger, microphone. Less crystal and antenna. Operates from 6 V. battery. New...............$89.95

Headsets & Handsets

HS-23	HS-38	TS-13-C
HS-30	TS-10-G	HS-18
HS-33	T-26	EE-8

TRANSTAT

11-5 KVA50/60 cycles. Commutator range 0-115 V. Max. 100 amp. Good cond...$125.00

Specials

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

RA-52 RECTIFIER

Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 VDC @ 50 W. Metered high voltage (0-15-KV) and current (10-20 MA). NEW....$74.50

EQUIPMENT WANTED!

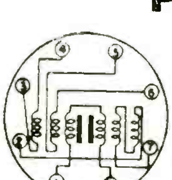
To meet government and industrial orders we urgently need all types of new and used Test Equipment, Radar, Receivers, and Transmitters. WE PAY HIGHEST PRICES. Tell us what you have.

Arrow SALES INC.

Mailing Address: P. O. BOX 3878-E, N. HOLLYWOOD, CALIF.
Office-Warehouse: 7460 VARNA AVE., N. HOLLYWOOD, CALIF.
POplar 5-1810 • STanley 7-6005 • Cable Address: ARROWSALES

PULSE TRANSFORMER

Tube base plug in type



TYPE UX 7350
Each Coil—50-T#36E
Max. DC Res. Ohms
1 & 8= 4.02Ω
2 & 7=4.542Ω
3 & 4=2.357Ω
5 & 6=2.185Ω

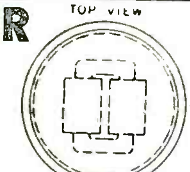
Here are precision made, high quality compact pulse transformers wound on hypersil cores. They are built in octal bakelite tube bases and can be adapted to many uses. They are completely impregnated and sealed.

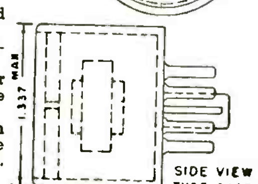
SUGGESTED USES

★—Blocking Oscillator, Multivibrator and Scope Circuits.
★—Wherever Accurate Timing and Triggering are necessary.
★—Unexcelled in circuit applications for generating low power and low voltage pulses.
★—Can be used in circuits utilizing repetition rates from 0 to well over 1 MC and pulse widths ranging from .05 Microsecond up.

Price **$4.50** each Immediate Delivery

TOP VIEW





SIDE VIEW TUBE BASE

HATRY and YOUNG
THE *Elect* IN ELECTRONICS
811 Boyston St., Boston 16, Mass. CO 7-4700

L. A. HAM SHACK SELLS FOR LESS

METERS:
WESTON • SANGAMO
All New • All D. C. • 2" Square

0—5 Ma
0—15 Ma
0—50 Ma
0—100 Ma
0—200 Ma
0—300 Ma
0—500 Ma
$3.29 EACH or 3 for $9.00

0—2 Ma $3.95

Mfg'rs inquiries: lots over 100

Voltmeter. 2" sq. 0 to 20 volts.............$3.29
DC Voltmeter. 2" sq. 0 to 300 v w/ext resistance. Compl. ....$3.95. 3 for $9.95
RF Ampmeter. 2" sq. 0 to .5 amp..........$3.95
Ampmeter. 2" rd. 0 to 50 amps............$3.29
Ampmeter. 2" sq. 0 to 50 amps...........$3.29 3 for $9.00
3" Round Meters. DC. All new. 0 to 15. 0 to 30. 0 to 300 mills...$4.95 each. 3 for $11.95
Milliampmeters. 2½" rd. 0 to 30 mills. Each $3.95
Milliampmeters. 2" rd. 0 to 50 ma. 0 to 5 ma. movement ....$3.29. 3 for $9.00
Thermocouple. 2" rd. 350 ma. HF........$3.29

Cash with order. California orders please include 3½% Sales Tax. Please include approx. postage. Excess refunded. What have you in surplus? Submit.

L. A. HAM SHACK
1306 Bond St. at Pico. • Los Angeles 15, Calif.

SUPERIOR VALUES FROM
AMERICA'S LARGEST ELECTRICAL CONVERSION HOUSE

400 CYCLE MG UNITS

LOUIS-ALLIS 3 UNIT MG SET. Consists of 5 HP motor operative at 220/440-3-60 directly coupled to alternator with output of 115 volts, 1 ph., 400 cyc. and with exciter unit all mounted on steel base. 1.8 K.V.A. Price $565.00

AMERICAN 400 CYCLE SETS. A precision built motor generator set ideal for laboratory test work. Consists of 10 H.P. motor directly connected to alternator with output of 5 KVA, 120/208 Volts, three phase, 400 cycles. With electronic exciter—voltage regulator. Frequ. variation ±5%; Voltage variation±1%; Total harmonic cont. 1.2%. PRICE $1850.00

GENERAL ELECTRIC 400 CYCLE UNITS. Operate at 26 VDC 100 Amp. Output: 115 VAC 1Φ, 400 CPS. 1500 V.A. With filter system built-in. Price.... $39.50

WINCHARGER PU-7/AP; Input 28 VDC. 160 Amps. Output:115 VAC. single ph. 2500 V.A. 400 C.P.S. Frequency and voltage regulation built-in. Price... $97.00

WINCHARGER PU-16/AP INVERTER. Type MG750. Input: 28 volts, 60 amp. Output: 115 volts, 6.5, amp., 400 cyc., 1 ph. Brand new. Price.............. $69.50

PE 109 INVERTERS. Input 13.5VDC 29A; Output 115V 400 cy. 1.53A 8000 RPM...................... $59.95

HOLTZER-CABOT MG218. Compact 2 bearing units for low current 400 cycle output. Operative at 115 VDC, 2.3 amp. Output: 110 Volts, 1.0 amp. 1 ph. 400 CPS. Brand new. PRICE......................... $79.50

BOGUE THREE PHASE MG SETS. Consists of Motor 10 H.P. operative at 220/440-3-60 Self-exc. alternator with output of 120/208V. 3ϕ, 400 cyc. 5 KVA. Brand New .... PRICE. $1850.00
With Voltage Regulator............. PRICE. $1950.00

BTH 400 CYCLE M-G SETS. Consists of an alternator of 6 KVA with output of 115 volts, 1ϕ, 400 CPS. V belted drive to 10 HP. motor operative at 220/440-3-60. Excitation provided by dry disk rectifier. Complete with field rheostat. SPECIAL PRICE............ $998.00

LOUIS ALLIS FREQUENCY CHANGER SETS. Prl: 25 H.P. 220/440-3 60; Sec. 15/10.8 K.W. 3300/2200 RPM/ 306/220 Volts 35/35 Amps. 2 ph. 500/360 C.P.S. Brand new. PRICE......................... $1250.00
We can supply these units for 400 cycle output and with transformers to supply 3 phase, wye output. Write for further information.

50 K.V.A. 400≈ MG SETS

We have been fortunate in acquiring a quantity of **KATO 400 Cycle Alternators** that we have made up into motor generator sets and are thus enabled to offer these at a very attractive price. These sets consist of a 75 H.P. Motor operative at 220/440 Volts, 3 Phase, 60 Cycles, 1750 R.P.M. which are coupled directly to a self-excited alternator with output of 50 KVA, 120/208 Volts, 400 CPS, 3 Phase. These motor-generator sets are BRAND NEW and complete with compensator for motor starting and field rheostat for voltage output control. Voltage regulator can be supplied at $100.00 additional to price as quoted. We will be pleased to supply complete specifications relative to frequency and voltage variation and harmonic content.
SPECIALLY PRICED! $5525.00

G. E. INVERTER UNITS. Model 5AT121JJ2B; Input: 24 VDC. 55 amp. 8000 RPM. Output: 115 Volts, 3 phase, 400 CPS. 750 VA. and secondary output of 26 Volts, single phase. 400 CPS. 250 VA. With automatic voltage and frequency regulation, built in. Rebuilt and warranted equal to new. Similar to Model 153F. SPECIAL PRICE $97.50

400 CYCLE COMBINATION I AND 3 PHASE MOTOR GENERATOR. Consisting of 20 HP Synchronous 220/440V. Motor V belted to two self excited alternators. GeneratorI: Bogue 5 KVA 120/208 Volts, 3 Phase, 400 CPS with voltage regulator. Generator II: Onan 4 KVA, 115 Volts, single ph. 400 CPS with voltage regulator. Motor and both alternators and two voltage regulators are mounted on welded channel iron base complete with motor starting compensator. SPECIAL PRICE $3175.00

WESTINGHOUSE AMPLIDYNE TYPE MG SEST

Motor: Type CS. Fr. 204, 208 v. 3 ph., 60 cyc., 4 amps. 1.5 HP, directly connected to 2 DC gen. (1) 125 VDC. 2.8 amp., .35 KW. Gen. (2) 250 VDC, 2 amp., sep. exc. 35 volts. The 3 units are contained in one housing. Brand new. The generators have similar characteristic of an amplidyne with a set of control fields and are completely enclosed with rubber gaskets on the enclosing covers, which can be removed for increased KW output. An exceptional value at......................... $183.00

WE CAN SUPPLY MOTOR-GENERATOR SETS TO ANY FREQUENCY SPECIFICATIONS AND FOR ANY APPLICATION CONSULT OUR ENGINEERING DEPARTMENT

BRITISH MADE 400 CYCLE SETS. Consists of 10 H.P. Motor. operative at 220-3-60 V-belted to Alternator with output of 6 KVA, 115 V. 1ϕ, 400~. Complete with GE voltage regulator. Brand new.
PRICE $1095.00
MARCONI MG. UNIT. Operates at 110 VDC with output of 250 watts, 115 volts, 1 ph. 300 cyc. With field rheostat for 400~ output. PRICE........ $80.00
400 CYCLE, 3 KVA MG SET. Consists of 5 HP Motor operative at 220-3-60 V-belted to self-exc. alternator with output of 3 KVA, 120 Volts, single ph. 400 cyc. PRICE $588.00
LELAND MG. SET. Consists of 5 HP Motor operative at 220-3-60 direct connected to self exc. alternator with output of 3 KVA, 120/208 V. 3 ph. 400 cyc.
PRICE $960.00
GREAT LAKES 400 CYCLE UNIT. Output of 2 KVA, 120 V. single ph. 420 Cyc. with motor operative at 220/440-3-60. Compact two bearing unit. Rebuilt. PRICE $320.00
SPECIAL MG. SET. Motor: 2.5 HP. 220/440-3-60. Self-exc. Alternator with output of 1.25 KVA, 115 V. single ph. 400 cyc. PRICE.................. $325.00
GENERAL ELECTRIC 400 CYCLE SET. Motor: 5 HP., 220/400 Volts, 3ϕ, 60 ~ V-belted to alternator with output of 3 KVA, 220 Volts, 1ϕ, 400 ~, with exciter and voltage regulator on same base, making completely integral unit. PRICE.......................... $799.00
KATO MG SET. Motor: 12.5 HP, 220/440-3-60. Output: 7.5 KVA, 230 Volts, 1ϕ, 350 cyc. with direct conn. exciter. Brand New. PRICE............... $1395.00
PIONEER MODEL GHF175. Input: 11.5 Volts, 34 Amp. Output: 140 Volts, 1.2 Amp. single ph. 350 cycles. 2100 RPM. Supplied with field rheostat to deliver 400 Cycles. PRICE..................... $66.50
GENERAL ELECTRIC TYPE PE218D. Input: 27 VDC. 100 Amp. 8000 RPM. Output: 115 V. 1ϕ, 400~. 1500 VA. Brand new. PRICE................. $44.50
BOGUE 7.5 KVA MOTOR GENERATOR SET. Motor: 10 HP., 220/440-3-60 direct connected to self-exc. alternator with output of 7.5 KVA, 120/208 Volts, 3 ph. 400 cycles. Wye connected. Harmonic content 1.2%. PRICE $2150.00
With GE Voltage regulator................... $2250.00

800 CYCLE MG UNITS

ONAN 800 CYCLE MG UNIT. Employing 5 H.P. Motor operative at 220/440 Volts, 3ϕ, 60 Cy. V belted to self-exc. generator with output of 1.5 KVA, 115 Volts, single ph. 800 CPS, and secondary output of 500 Watts 28.5 VDC 17.5 amperes. PRICE.... $375.00
ECLIPSE 800 CYCLE GENERATORS. Flange mounting with spline shaft. Output is 115 VAC 10.4 Amp. 90% P.F. 800 Cycles, 1200 V.A. with secondary output of 28.5 VDC, 60 Amperes. Self excited.
PRICE $44.50
H.F. MOTOR GENERATOR, G. E. Model 5LY126A4. Motor: 115 VDC direct connected to Generator 24-32 VDC. 78 amps., and to alternator 120 VAC. 720 cycles, 1 ph. KW-2¼ $289.00
CONTINENTAL DC/AC SET. Motor: 1.5 HP, 230 VDC. 3440 RPM. Output: 120 VAC. 6.6 amps., 8 KW. 800 cyc., 1 ph., also output of 14 VDC, 4 amps., Model CG21637. Compact 2-bear. units. Completely rebuilt.
PRICE $114.50
Also available for operation at 115 VDC at the same price. Same set operative at 440 V, 3ϕ, 60 ~ $119.75
ESCO DUAL FREQUENCY UNITS. Motor operates at 120 VDC. 10 amperes. Delivers 70 Volts at 120 Cycles or 200 Volts at 720 Cycles. PRICE............ $125.00
BENDIX-ECLIPSE 800 CYCLE AERO UNIT. Input: 24-28 VDC. 75 amps. Output: 115 V. 10.5 Amp. 800 C.P.S. Complete filter system mounted thereon.
PRICE $46.75
INVERTER UNIT PE206A. Input: 27.5 VDC. 28 amp. Output: 80 Volts, single ph. 800 CPS. 500 VA.
PRICE $42.50

500 CYCLE MG UNITS

BRITISH MADE 500 CYCLE MG SETS. Motor: 230 Volts, 3 PH—50 Cycles. Alternator: 5 K.W. 180 Volts, 27.8 Amp. 500 Cycles. Excitation—110 VDC. When used at 60 Cycle current, Output is 600 cycles, 220 Volts. PRICE $535.00
CROCKER-WHEELER 500 CYCLE MG SET. Compact 2 bearing Unit. Operative at 120 VDC, 7.3 amps. Output: 250 Volts, 5 amp. 500 cycles. Rebuilt.
PRICE $88.88
CROCKER-WHEELER 500 CYCLE SET. Operate at 110 Volts, D.C. 29.6 Amps. Output: 120 Volts, single ph. 500 cycles 2.5 KW. PRICE................ $146.95
GE DUAL OUTPUT MG SETS. Consist of Motor rated 3 H.P. 220/440 V. 3ϕ, 60 Cy. directly coupled to 2 generators. Output .5 K.W. 220 Volts, 2.27 Amp. 525 Cycles. Also .5 K.W. 110 Volts, D.C. 4.55 Amp. 3 separate units mounted on common bed plate.
PRICE $150.00
G.E. MG SET MODEL 5LY56AB5A. Motor: 1.1 HP. 250 VDC, 4 amp. Generator: 600 watts, 125 VAC. 4.8 amp., 500 cyc., 1 ph. PRICE..................... $89.50
HOLTZER-CABOT 500 CYCLE MG SET. Motor: 110 VDC. GENERATOR: 5 KVA 230 VAC. 1ϕ 500 Cyc. Rebuilt. PRICE $271.50

HIGH FREQUENCY UNITS

ELECTRIC SPECIALTY FREQUENCY CHANGERS. Type BFS52/BFRS354 Input: 230 Volts, 3 Ph. 60 cy. 3600 RPM. Output: 250 Volts, 20 Amps. single ph. 180 Cyc. 5000 VA. 3000 Watts. Brand New. Compact ball bearing units for operation of Hi-cycle equipment. SPECIAL PRICE $160.00
NORMAND ELEC. CO. (BRITISH MFG.) MG UNIT. Motor: 220 VDC. 8.8 amp. 2 HP. 4200 RPM. directly connected to H. F. alternator with output of cyc. 1200 watts. Exc. 24 VDC. PRICE........ $149.00
ELECTRIC SPECIALTY HIGH FREQUENCY CONVERTER UNIT. Primary: 32 VDC. 16 amperes, 3000 R.P.M. Ball Bearings. Secondary: 350 volts. 1500 cycles. .75 amps. 275 V.A. Single Ph. Built-in frequency control. Specially Priced at............ $30.00
BENDIX POWER MG SET. Consists of G.E. 2 HP Rep-Ind Motor, 115 volts, single phase, 60 cyc. directly connected to Bendix alternator with output of 120 volts, 700 cyc., 600 watts and DC output of 14.5 volts. DC, 22 amp. Brand new. PRICE................. $225.00
HIGH FREQ. UNIT. Motor: 24 VDC 50 amp. Alternator: 17 VAC. 1300-1600 cyc. sep. exc. at 24 VDC, 1.25 BHP, 4000 RPM. Made in Canada by Electric Tamper & Equ. PRICE....................... $82.50
Alternators only to same specifications as above, sep. exc. at 24 VDC. PRICE......................... $44.50
WESTINGHOUSE 180 CYCLE ALTERNATORS. 750 V.A. Output: 110 Volts, 3 Phase, 180 C.P.S. 3000 R.P.M. Separately excited at 110 VDC. Price.. $65.00
Also available with built-in exciter. Price...... $94.00
GENERAL ELECTRIC HIGH FREQUENCY UNIT. Operating at 440-3-60 .75 amp. Output: 70 Volts, 3 ph. 148 cyc. 220 Watts, 1.8 amperes. An ideal unit for experimental work or for operation of equipment. SPECIAL PRICE $46.50
WESTINGHOUSE HIGH FREQUENCY UNITS. Input: 115 Volts, D.C. 2.7 Amps. Autput: 14.4 Volts, .139 Amp. 450-2550 Cycles. Frequency variation is obtained with built-in controller on end of unit.
PRICE $48.50
BURKE ALTERNATOR. 62.5 KVA. 220 Volts, 3 Ph. 180 Cycles, 1800 RPM, separately exc. at 125 VDC. 80% P.F. Type ACR-7. Complete with auxiliary exciter MG set and field rheostat. Ball bearings. Will deliver 400 cycles at 4000 RPM. Rebuilt. PRICE.... $1375.00
IDEAL FREQUENCY CHANGER SET. Motor operative at 220-3-60 with direct connected induction type alternator with output of 12.5 KVA, 220 V, 3 ph. 180 Cyc. PRICE $445.00
BURKE FREQUENCY CHANGER. Operative at 440-3-60 with output of 12.5 KVA, 230 Volts, 3 ph. 180 cycles. Two bearing machine with direct connected exciter. PRICE $575.00
MARCONI 3 KW UNIT. Operative at 110 VDC. 2400 RPM has output of 3 KW, 500 Volts, 6 amp. 240 cycles. Can be used with field rheostat for 400 other intermediate frequency. PRICE.................... $125.00
BRITISH HIGH FREQUENCY UNIT. Operates with input of 110 VDC will deliver 200 watts, with adjustable frequencies up to 10,000 cycles. Controlled by knob at one end of machine. PRICE................. $85.00
ESCO HIGH FREQUENCY MACHINE. Input: 110 Volts, 8 Amp. 2900 RPM. Output: 125 Volts, 8 Amp. 1 KVA, single ph. 580 cycles. PRICE......... $119.75
HOLTZER-CABOT M-G UNITS. Operative at 115 VDC. 8.2 Amp. 1950 RPM. Output: .575 KVA. 55 Volts, 6 Amp. 3 Phase, 195 Cycles. PRICE.... $142.00
HOLTZER-CABOT FREQUENCY CHANGER. Input: 115 Volts, 3 Ph. 60 Cycles. Output: .22 KVA., 70 Volts, 3 Ph. 145 Cycles. PRICE................. $142.00
GENERAL ELECTRIC HIGH FREQUENCY MG. Consists of motor and dual output generator mounted on steel base. Motor operates at 220/440-3-60 direct connected to alternator with output of 115 Volts, 1 Ph. 1050 Cycles, 1 KVA and 115 Volts, DC., 2 KW. With field rheostat. PRICE..................... $525.00
WESTINGHOUSE HF UNITS. Input: 115 VDC. Output: 17 Volts, 1050 to 1650 cycles. Variation of frequency accomplished by built in, knob controlled rheostat. PRICE $25.50
GENERAL ELECTRIC 180 CYCLE GENERATORS. We have several 50 KVA units with output of 225 Volts, 3 phase, 180 cycles, 80% PF. with direct connected exciter. Rebuilt and fully guaranteed. PRICE.. $690.00

OTHER SPECIAL VALUES

CORNELL DUBILIER VIBRATOR TYPE INVERTER UNITS. Input: 105-125 VDC: Output: 115 VAC, 1ϕ, 60 cyc. 65 watts, with built-in relay which automatically starts unit with connected load. SPECIAL PRICE $9.90
BACH-SIMPSON ELECTRONIC INVERTER. DC Input: 115 Volts. Output: 115 Volts, 1ϕ, 60 cyc. 24.5 watts, modified square wave, with built-in relay which automatically turns on inverter with connected load. Contains 8 50L6 GT Tubes. Brand New.
SPECIAL PRICE $12.95
ESCO AC MOTORS: built-in magnetic brake for quick reversing. Double shaft, ball bearings. Rated: 2½ HP— 30 minutes, marine duty: 440-3-60. Brand new in original cases. SPECIAL PRICE............ $37.50
SPECIAL SERIES MOTORS: no name plates, ¼ HP operates at either 110 Volts DC or AC: ½" shaft. Reconditioned $9.85
WATTHOUR METERS. 110/110 Volt DC operation. Used but in A1 condition. 5 amp................. $3.75
10 amp.... $4.35 15 amp.... $5.00 25 amp.... $6.00
CROMPTON-PARKINSON ALTERNATORS. 3 KVA. .7 PF. 110 VAC. 1ϕ, 60 cyc. 1800 RPM. sep. exc.
PRICE $170.00

WILLIAM I HORLICK COMPANY

IF IT'S FROM ONE FREQUENCY TO ANOTHER; FROM DC TO AC OR AC TO DC, IF IT'S FROM ONE VOLTAGE TO ANOTHER, THEN CALL ON US.

Est. in 1922
266 SUMMER ST.
BOSTON 10 MASS.

SELENIUM RECTIFIER UNITS

HEAVY DUTY—30 VOLT DC OUTPUT:

115/200 V. Three Phase 400 Cycle Input:
TYPE 143 w/Transformer & VR 100 Amp.....$69.50
TYPE 3FS-5 w/Trans., VR, & Blower—200 Amp. $69.50
TYPE-52A-11 Rectifier Only, Cased, 200 Amp..$39.50
TYPE A-1 Recifier Only, Cased, 300 Amp....$49.50

BATTERY CHARGING RESISTOR PANEL

115 VDC—6.67 ohms 30 Amps Max. Switching High-Low-& Off. Charging rate: 6-2 Volt Cells: High 30 A.; Low 15 A.—12-2 Volt Cells: 25.8 High; Low 12.7—15-2 Volt Cells: High 23.7; Low 11.6. Complete with Cable. Panel size: 21" x 22" x 10". Mfg. by Ward Leonard—NEW........Price: $29.95

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

MOUNTING AND CLAMPS:

FT-154 for BC-348 Receiver $2.50
FT-470 Mounting & Clamp.... 1.00
MC-476 Maple Ball for above—f/Fairlead.... 1.00
MC-396 Wood Clamp for Fairlead.... .75
M-235 Bobbin & 250 Ft. W-106 Antenna Wire.. 3.50
WT-7 Weight for Training Antenna.... 1.50

CORDS—CABLES

C-501 Cord—f/GN-45 Generator $2.50
CD-318 Cord w/PL-68 & SW-141 & JK-48F... .89
CD-307 Cord 6.5 Ft. w/PL-55 & JK-26.... .89
CD-604 Cord w/C-410 Trans. & PL-54 Plug... .89
CD-365 Cord for LP-21-Loop 1.75
MC-215 Tuning Shaft for 274N.... 2.00

PLUGS AND CONNECTORS

PL-118 Plug for I-81 and 1-82 ....$1.50
PL-112 Plug for LP-21 Loop.... 1.25
PL-P-103 Plug for BC-348 .... 1.50
MC-211 Rightangle Adapter for Comm. Sets... .50
M-359 Rightangle Coaxial Connector .... .25

ANTENNA EQUIPMENT

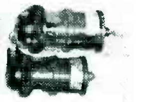
MAST BASES—INSULATED:

MP-132 BASE—(As illustrated at left) 1" heavy coil spring. 2" insulator. Overall length: 11-½". Weight: 2-¾ lbs. Price $3.95

MAST BASE—Insulated type with heavy coil spring and 5" dia. insulator. Requires 1 inch hole for mtg. Weight: 9 lbs. $5.95

MAST SECTIONS For ABOVE BASES

Tubular steel, copper coated, painted, in 3 ft. sections, screw-in type. MS-53 can be used to make any length with MS-52-51-50-49 for taper. Any section ....50¢ Each
Larger Diameter Sections: MS-55-54....$1.25 Each.
AN-104B Antenna—100-156 MC.—Copper $5.95
AN-104B Antenna—100-156 MC.—Steel 3.95
AN-104A Antenna—100-156 MC.—Copper 3.00
AN-104A Antenna—100-156 MC.—Steel 2.00
AN-117 Whip Steel—6 Ft. length.... 1.50
AN-109A Whip Steel, 5 Ft. w-Base.... 1.50
AS-27/ANR-5 Ram's Horn, 10 MC.—USED... 5.95
AT-37/APT Stub—113-115 MC. 6.95
AT-42/APT-3 or APT-1 Stub—113-150 MC.... 6.95
AS-97/ARQ-8 Spike with coaxial load in base.. 4.95
AS-61/ARN-5-Half-Wave Dipole—335 MC.... 3.95
AT-2/APN-2 .... 4.95



SELSYN

2J1G1 CONTROL TRANSFORMER WITH CAPS. 57.5 VOLT; 400 CYCLE. NEW: $5.95 Ea.

DYNAMOTORS:

DYNAMOTOR and BLOWER: 9 Volts DC input: output 450 Volts 60 MA. 4500 RPM. **At 6 Volts DC** input; output 260 Volts 65 MA. 3000 RPM......$4.95

Input	Output	Stock No.	Price
14 V. DC	600 V. 300 MA.	BD-36	$9.95
12 V. DC	220 V. 70 MA.	DM-24	6.95
12 V. DC	220 V. 100 MA.	DM-18	4.95
12 or 24 V. DC	440 V. 200 MA. & 220 V. 100 MA.	D-104	14.95
14 V. DC	375 V. 150 MA.	DM-375	8.95
14 V. DC	330 V. 135 MA.	DM-330	7.95
14 V. DC	500 V. 500 MA.	PE-59	14.95
12 or 24 V. DC	275 V. 110 MA.	USA/0516	3.95
12 or 24 V. DC	500 V. 50 MA.	USA/0515	3.95

ALSO—PE-73; PE-86; DM-53; DM-33; 5055; DM-416; PE-101, etc.

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 cage, 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

AERIAL WIRE—Phosphorus Bronze #16 Stranded. 200 lb. test. Weatherproof. 150 ft. on Reel. RL-3 with Clips $1.50

TELEPHONE WIRE—3 Cond. copper & steel. 525 ft. $4.75

AIRCRAFT CONTROL CABLE—3/32"—7 x 7 Strand, Weatherproofed, Galvanized, Preformed, 920 lb. test. Ideal for Television Guying and many other uses. Prices: 4-½¢ per Ft.—1000 Ft. or more at 4¢ per Ft.

DC SMALL MOTORS:

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

27 **VDC**—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 BN38HA10..$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

24 **VDC**—Reversible—3.7 RPM, 40 lb. Torque. Shaft Size: 21/32" x 5/16". Motor Size: 5-½" x 4-1/32" x 3-5/16". Also operates 24 VAC. Philco No. 441-1008 ....$5.95

MOTOR—GENERATOR:

Navy type CCL-211014, 115 VDC—¾ HP—1750 RPM. Generator 27 VDC, 9.3 Amp. Direct Drive Price: $89.50

Standard Test Leads, 4" x 1-½" Prods. .... Pair: 39¢ — 3 for $1.00

Phone Plug—Nickel Plated, Screw Terminals.... Ea.: 39¢ — 3 for $1.00

ADDRESS DEPT. E • All Prices Are F.O.B., Lima, Ohio • 25% Deposit on C.O.. Orders

FAIR RADIO SALES

132 S. MAIN ST. LIMA, OHIO

AIRCRAFT ELECTRONICS

ARC—1's, ART—13's, RTA 1B's, BC348's
AND COMPONENT PARTS FOR ABOVE

WRITE OR CALL FOR BULLETIN

MERRICK ELECTRONICS
166-08 DOUGLAS AVE. JAMAICA, N. Y.
RE 9-5960

PREMIER

Special Purpose and Transmitting Tubes

MX408U	70c	304TL	9.95
RKR 72	48c	450TH	37.50
VT25A/2C25	50c	450TL	62.00
2C26A	40c	708A	1.20
2C34/RK34	60c	715A	6.39
2E22	2.95	715B	7.75
2J21A	9.50	800	1.75
2J31	20.00	801	1.20
2J32	25.00	807	1.55
2J33	25.00	808	2.69
2J34	25.00	813	8.75
2X2/879	74c	826	69c
3BP1	5.95	850	4.20
3DP1	3.95	860	3.95
3E29	12.95	864/VT24	60c
5BP1	3.95	866A	1.59
5BP4	3.95	872	2.75
5CP1	3.95	954	25c
6-8B	1.00	955	35c
C6J	8.95	1089	1.30
6C21	21.95	1090	1.30
7BP7	5.95	1616	69c
10BP4	10.95	1625	35c
12LP4	12.95	1629	25c
100TH	6.95	1632	72c
211	.59	1642	70c
215A/VT5	1.20	1661	90c
250TH	19.95	8020	98c
250TL	16.95	9006	27c

No minimum order

TV PICTURE TUBES

One Full Year Guarantee—All Types

SIZE	PRICE	SIZE	PRICE
10-inch	$9.95	17-inch	$16.95
12-inch	$11.95	19-inch	$18.95
14-inch	$13.95	20-inch	$19.95
7-inch	$15.95	21-inch	$20.95
16-inch	$15.95	No Minimum Order	

SPECIAL TUBE BUYS

1B3GT	.57	6BC5	.46	12AU7	.47
1L4	.50	6BD6	.41	12AV7	.47
1R5	.48	6BE6	.40	12AX4GT	.54
1S5	.39	6BG6G	1.21	12AX7	.53
1T4	.49	6BH6	.50	12BA6	.38
1U4	.48	6BJ6	.41	12BE6	.40
1U5	.39	6BQ6GT	.77	12SN7GT	.47
3A4	.54	6C4	.32	19T8	.70
3Q4	.54	6CB6	.46	25BQ6GT	.77
3S4	.51	6CD6G	1.58	25L6GT	.43
3V4	.52	6S4	.41	35B5	.41
5U4G	.36	6S8GT	.63	35C5	.41
5Y3GT	.25	6SD7GT	.77	35L6GT	.45
6AG5	.46	6SL7GT	.53	35W4	.26
6AK5	.86	6SN7GT	.47	35Z5GT	.31
6AL5	.36	6T8	.70	50B5	.41
6AQ5	.41	6V6GT	.40	50C5	.41
6AT6	.32	6W4GT	.40	50L6GT	.43
6AU6	.37	6X4	.29	117Z3	.34
6AV6	.37	12AT6	.32	Minimum order 100 of each type	
6AX4GT	.54	12AT7	.61		
6BA6	.38	12AU6	.37		

Critical tubes are always on hand and at the right prices . . . in quantity

We Will Be Pleased to Quote Special Prices for Large Quantity Purchases
OVER 1,000,000 TUBES IN STOCK

Since 1926 Prime Source for

TUBES Receiving Special Purpose and Picture Tubes

PARTS All Types - All Brands - Special Lots

- Manufacturers
- Jobbers
- Exporters

We invite your inquiries on electronic components of all descriptions!

PREMIER T.V. RADIO SUPPLY
Division of Continental Corp.
3241 W. North Ave. • Chicago 47, Ill.
ARmitage 6-5550

COMPASS

COMMUNICATIONS COMPANY

393 GREENWICH STREET
NEW YORK 13, N. Y.

CABLE ADDRESS: COMPRADIO, N. Y.

ALL PHONES: BEEKMAN 3-6509

WE MAINTAIN OUR OWN FULLY EQUIPPED TESTING LABORATORY TO TEST AND GUARANTEE ANYTHING WE SELL

TCS—Collins mfd. Navy radiotelephones for shipboard and mobile use, complete with all accessories for operation from 12, 24, 110, 230 volts d.c. and 110 or 220 volts a.c.

TDE—Navy or commercial marine transmitters, complete 110 & 220 volts d.c. and a.c.

TBK—Navy high frequency transmitter, 2-20 mcs; 500 watts output. Supplied complete with m/g and starter for d.c. or a.c. operation.

TBM—same transmitter but with speech input equipment to give 350 watts phone.

TBL—Navy all-wave transmitter; 350 watts output: CW and phone. Supplied complete with m/g and starter for d.c. or a.c. operation.

TAJ—Navy intermediate freq. transmitter, 175-550 kcs; 500 watts output. Supplied complete with m/g and starter for a.c. or d.c. operation.

SCR-284—the famous mobile and ground station for field use. Large quantity of complete sets available.

MAG—10 cm. portable link radar transmitter receivers, 6-volt operation.

TBN—200-500 kcs, complete with 220/440 volt, 3 ph. 50-60c. power supply—conservatively rated at 1 kw. output.

SCR-510 and 610 in quantity.

RADAR BEACONS

AN/CPN-6 .... **3 cm.**
AN/CPN-8 .... **10 cm.**
YJ and YG .... **for shipboard use**
AN/CPN-6 .... **3 cm.**
AN/CPN-8 .... **10 cm.**

AND TUBES— SPECIAL PURPOSE and TRANSMITTING TYPES

THIS IS A SAMPLE LISTING • WRITE FOR OTHER ITEMS & UNLISTED PRICES

Tube#	Selling Price	Tube#	Selling Price	Tube#	Selling Price	Tube#	Selling Price	Tube#	Selling Price	Tube#	Selling Price
O1A	write	2J33	100.00	4C27	25.00	304TH	9.75	813	9.00	1625	.65
OC3	$1.60	2J34	write	4C28	35.00	304TL	9.75	829A	12.00	1626	.75
OD3	1.50	2J36	100.00	4C35	27.50	307A	5.00	832A	10.00	1629	.65
C1A	6.00	2J38	49.50	4D32	write	339A	35.00	833A	42.50	1636	3.00
C1B	7.00	2J39	49.50	4E27	17.50	371B	2.50	836	4.75	1642	3.50
C6A	write	2J42	100.00	4J25	175.00	388A	2.75	837	2.75	2050	2.00
C6F	12.50	2J49	100.00	4J26	175.00	446A	2.00	843	write	8012	4.25
C6J	write	2J50	75.00	4J28	175.00	446B	3.75	849	50.00	8020	3.50
1B22	3.95	2J61	75.00	4J29	175.00	450TH	45.00	851	45.00	8025	7.00
1B23	10.00	2J62	75.00	4J30	write	450TL	45.00	860	5.00	9001	1.65
1B24	write	2K22	write	4J31	175.00	464A	9.50	861	write	9002	1.50
1B44	write	2K25	35.00	4J33	190.00	705A	3.25	865	.40	9003	1.75
2B22	4.95	2K26	150.00	4J52	350.00	706AGY	45.00	872A	3.85	9004	1.75
2B26	3.75	2K29	35.00	5C22	write	707B	12.50	874	1.50	9005	1.90
2C40	18.00	2K36	write	5J23	write	714AY	17.50	889R	195.00	9006	.50
2C43	25.00	2K41	150.00	5J26	350.00	715B	17.50	891R	250.00		
2D21	1.70	2K45	100.00	5J29	write	720	write	892	150.00		
2E22	3.75	2K54	150.00	6C21	29.50	721A	3.75	892R	250.00		
2J21	17.50	2K55	100.00	10Y	1.25	723A/B	25.00	2X2/879	1.75		
2J22	17.50	3B24	5.40	100TH	9.00	724B	6.50	K1069P7	write		
2J26	27.50	3B27	10.00	204A	60.00	725A	write	1614	write		
2J27	27.50	3B28	9.00	211	1.00	730A	45.00	1616	2.75		
2J31	27.50	3C31	5.75	250TH	30.00	803	7.00	1619	.75		
2J32	65.00	3E29	15.00	250TL	30.00	807	1.65	1624	2.00		

Also:
IGNITRONS
PLIOTRONS
PHANOTRONS

ALL TUBES GUARANTEED. ALL PRICES ARE F.O.B. OUR WAREHOUSE, AND ARE SUBJECT TO CHANGE WITHOUT NOTICE

K-RK-ARC-UG-PL-AN

CONNECTORS

In Stock for Immediate Delivery

Connector Corporation
OF AMERICA

137 Hamilton St., New Haven 11, Conn. Phone: Spruce 7-2513

New York Phone: LExington 2-6254

ALL NEW JAN TUBES

1B29	$2.25	*	10Y	$.45
1N26	7.75	S	120A	7.50
1T4	.55	A	121A	2.95
2C40	7.25	V	211/G.E.	1.25
2C46	25.00	E	394A	3.95
2E22	1.50	*	417A	17.00
2J32	22.50	*	446B	3.50
2J33	22.50	C	507AX	1.35
2J34	22.50	O	721A	2.25
2K22	35.00	M	931A	4.75
2K23	27.50	P	954	.45
3C24/24G	1.75	A	955	.45
3DP1	3.50	R	957	.65
3GP1	3.75	E	1005	.55
5CP1	4.00	*	1616	1.25
5LP1	20.00	*	1629	1.25
5NP1	4.50	S	1644	.75
6AC7	.80	A	2051	.95
6AS6	2.00	V	7193	.45
6H6	.50	E	8020	1.75
6J4	6.25	*	9004	.45
6J5	.55	*	9006	.35

Write for other types not listed above.

Minimum order $10.00 F.O.B. N.Y.C.

Rated Firms send P. O.

ALLIED ELECTRONICS SALES

74 Cortlandt Street, New York 7, N. Y.

Phone BArclay 7-5839-5840

WIRE-CABLE TUBES PARTS

CORDAGE

CO-122 3 conductor each #22 AWG neoprene jacket 550' lengths
CO-127 single #14 AWG braided and tinned copper braid shield

MULTI-CONDUCTOR

2 conductor AWG 12
7 conductor AWG 14
14 conductor AWG 16
11 conductor shielded AWG 20
2 conductor AWG 18
7 conductor AWG 16
19 conductor AWG 16
6 conductor AWG 20
10 conductor AWG 16
22 conductor AWG 16
2 conductor shielded AWG 10

AMOUR

DRIA-23 DHFA-100 FRIA-4

SINGLE CONDUCTOR AWG 10

shielded cable with terminal lug each end 100' and 150' lengths

WIRE

AWG 18 copperweld
AWG 29 tinned copper
Resistance wire AWG 32
AWG 22 with nylon core plastic insulation

LINEAR WIRE WOUND POTENTIOMETERS

10 Ohm	25 Watt	$.90	15000 Ohm	25 Watt	$1.70
15	25	.95	20000	25	2.00
20	25	.95	6	50	1.60
25	25	.95	150 w/sw ch	50	2.15
50	25	.95	200 w/sw ch	50	2.15
100	25	.95	10000	50	2.95
200	25	1.20	15	75	2.95
350	25	1.20	.5 Meg 1" Shaft AB "J"		1.45
500	25	1.20	200,000 1/8 SD AB "J"		1.40
1000	25	1.30	200 1/8 SD AB "J"		1.40

SPECIALS

80-86 Crystal in Holder $2.50
Balloon with Hydrogen Generator $2.50
300 Feet Aerial Wire $2.00

MICROWAVE TEST EQUIPMENT

10 CM echo box CABV 14ABA-1 of OBU-3, frequency range 2890 MC — 3170 MCS. Direct reading micrometer head. Ring prediction scale plus 9% to minus 9% Type "N" input. Resonance indicator meter. With accessories, spares and 10 CM directional coupler. Brand New.

TUBES

2C34	$.45	801A	.25	9006	.30
2X2/879	.55	803	3.60	C5B	8.00
3B24	4.95	826	.65	CK 70	4.15
3C24	1.60	864	.25	E1148	.30
7C4/1203A	.70	931A	4.45	HY 615	.20
10Y	.35	955	.30	RK 73	.45
15R	.65	957	.35	5BP4	4.25
30 Spec	.40	CK 1005	.45	5FP7	1.75
39/44	.25	CK 1007	.90	1J6 G	.70
45 Spec	.35	1626	.35	1B3 GT	.80
WE 203A	6.75	1629	.25	3A4	.60
316A	.60	2051	.10	5U4G	.57
WL 531	4.95	7193	.50	6K6GT	.60
713A	.90	8011	1.50		

HI VOLTAGE FILTER CHOKES

.4 HY 4.5 Amp DC 3 ohms 1230 RMS to ground. New.
1 HY 3.2 Amp DC 3.5 ohm GE69G459. New.
1.7-3 HY 2 AMP DC 34,000 VDC GE Y346A. New.

NAVY ENTERING TYPE INSULATOR

Porcelain flanged bowl with brass rod, fittings and aluminum shield. Dimensions 4⅜" high, 6-5/16" OD at base. Brand new $4.50.

10 CM ROTATING ANTENNA

24" Parabola in turret 360° span at 12 RPM DC, motor control and reversing switch New.

TIME DELAY SWITCHES

1 Minute 115 VAC 60 cycle Enc. in Waterproof Metal Case. New $5.25
3 Micro Switches Contact at 40-41-42 Second Time Delay 110 VAC Motor New $4.50
Thermo Switch 50° to 300° F 115 VAC @ 6A 230 VAC @ 5A
Breaks Contact with increase in Temperature. New $1.35

CONTACTORS

DPST 115 VAC 60 cycle 15 Amp De-Ion Line Starter Westinghouse $6.95
DPST 115 VAC "AB" #700 $5.95

RELAYS

12 VDC DPST Allied Control Box 32...$1.25
24 VDC DPDT Allied Control BJD36 $1.45
24 VDC 3PDT 8 Amp..........$1.50
110 VAC DPST 1 Amp Contacts Struthers Dunn CKA 1970..........$3.65
115 VAC DPST Struthers Dunn CXA 2997.$3.65
220 VDC DPDT Struthers Dunn CK 2122..$4.50
230 V 50 cycle DPDT G.E. 12HGA11A2..$4.00

OIL FILLED CONDENSERS

MFD	VDC	Each	Ten	MFD	VDC	Each	Ten
1	600	.85	.80	.5	2000	2.00	1.90
2	600	.95	.95	.25	3000	2.85	2.80
4	600	1.40	1.40	.5	3000	2.95	2.90
5	600	1.65	1.60	.2	5000	4.50	4.25
1-8	600	2.50	2.35	.1	7500	3.95	3.95

METERS

Portable 0-25 Amps AC Weston #433 Brand New $37.50
Switch Board Panel 0-100 Amps DC Weston #269 with 100 Amp Shunt Brand New $24.95

EQUIPMENT

Walkie-Talkies 2.3-4.6 MC
MN-26Y Bendix Compass Receiver
BC-733 Glide Path Receiver
DAB 3—Direction Finder
RDF Receiver Equipment 200-550 KC Fixed Tuned

SWITCHES—BATHTUB—OIL FILLED—MICA CONDENSERS—POTENTIOMETERS. SEND FOR CATALOG

COMET ELECTRONIC SALES CO.

22 Washington St. Tel. BEacon 2-7863 Brighton 35, Mass.

TERMS: Minimum order $5.00 — Mail orders promptly filled—All prices F.O.B. Boston, Mass. Send M.O. or check. Shipping charges sent C.O.D. 25% deposit required with all C.O.D. orders.

RESISTORS EB-GB-HB *all makes*

	1-99 ea.		100-999 ea	
½ Watt	.06	EB	— 4.00/C	Lots of 1000 of each special prices
		other makes	2.75/C	
1 Watt	.09	GB	— 6.00/C	
		other makes	4.50/C	
2 Watt	.15	HB	—10.00/C	
		other makes	6.50/C	

Above are prices for Resistor 10% tolerance.
For 5% tolerance add 100%

POTENTIOMETERS "J"

	1-9 ea.	10.49 ea.	50 + over
Single J	1.80 ea.	1.50 and up (x)	1.20 and up (x)
Dual JJ	5.50 ea.	4.25 and up (x)	3.85 and up (x)
Triple JJJ		on spec. quote	

(x) depends on bushing, shaft and taper

CERAMIC CAPACITORS and DISCS

any makes any values 5.-per C and up or 35/M and up

• *IMMEDIATE DELIVERY from stock in New York* •

LEGRI S Company

158 West 99 St., New York 25, N. Y. Phone: University 5-4110

Since 1945—Resistors is our business.

SAVE ON TUBES · BRAND NEW TUBES · GUARANTEED TUBES

OA2	$1.00	2J34	27.50	4J29	149.50
OA3/VR75	1.10	2J36	110.00	4J30	195.00
OB2	1.40	2J37	12.50	4J31	99.50
OB3/VR90	1.09	2J48	27.50	4J41	99.50
OC3/VR105	1.00	2J55	85.00	4J52	200.00
OD3/VR150	.90	2J56	149.50	4X150A	27.50
1B22	2.25	2J61	39.50	4X500A	85.00
1B23	8.95	2J62	39.50	C5B	7.50
1B24	9.50	2K22	39.50	5AP1	4.50
1B26	2.35	2K23	39.50	5BP1	4.50
1B27	14.50	2K25	28.50	5BP4	4.50
1B32	3.10	2K26	79.50	5CP1	4.50
1B42	17.50	2K28	32.00	5C22	35.00
1N21B	2.75	2K29	23.95	5D21	19.95
1N21C	14.95	2K45	110.00	5FP7	1.95
1N22	1.25	2K46	360.00	5FP14	16.50
1N23	1.25	2K48	Write	5GP1	4.50
1N23A	2.25	2K54	Write	5HP1	6.95
1N23B	3.50	2K55	Write	5HP4	4.95
1N6	7.50	2K56	1.15	5JP1	19.95
1N34	.69	3AP1	8.95	5JP2	19.95
1N34A	.79	3B23	4.95	5JP4	19.95
1N38	1.50	3B24	4.95	5JP5	19.95
1N40	8.50	3B24W	7.50	5J23	59.50
1N47	4.50	3B26	3.50	5J29	11.95
1N55	2.75	3B28	6.50	5J30	39.60
1N56	.89	3BP1	4.95	5R4GY	1.50
1N58A	1.25	3C22	75.00	5T4	1.98
1N60	.60	3C23	9.95	C6L/5528	12.50
1N63/K63	2.39	3C24/24G	1.50	6AJ5	1.95
1N64	.30	3C27	3.75	6AK5WE	1.50
1N69	1.10	3C31	3.15	6AL5W	1.75
1Z2	2.95	3C33	9.95	6AN5	3.65
VS-2	9.50	3C45	14.95	6AR6	2.25
2C21/1642	.69	3DP1	3.95	6AS6	2.30
2C39	27.50	3DP1S2	9.95	6BL6	Write
2C40	9.95	3E29	13.95	6BM6	Write
2C43	15.00	3FP7	1.95	6C21	24.50
2C44	1.19	3GP1	3.95	6F4	4.50
2C51	6.95	3HP7	3.95	6J4	6.95
2C52	4.95	4-125A	25.00	6K4	3.50
2D21	1.80	4B24	6.95	6SN7WGT	2.50
2D21W	2.49	4C27/CV92	17.50	6SU7GTY	Write
2E24	4.65	4C28	35.00	7C23	69.50
2E25A	4.50	4C35	27.25	9LP7	4.95
2J21A	6.95	4E27	14.95	12AY7	3.00
2J22	6.95	4J21	129.50	12DP7	16.95
2J26	14.95	4J22	129.50	12GP7	25.00
2J27	14.95	4J23	129.50	12HP7	13.50
2J31	27.50	4J26	129.50	15E	1.25
2J32	39.50	4J27	129.50	15R	.69
2J33	27.50	4J28	129.50	FG-17/5557	3.95

T-20	3.75	FG-235A	Write
RX-21	5.95	250R	8.95
FG-27A	4.05	250TH	18.00
FG-32	12.95	250TL	9.95
45 Spec.	.32	FG-253A	Write
RK47	4.95	FG-258A	Write
FG-57	13.95	274B	3.25
RK60/1641	1.95	279A	Write

YOUR SURPLUS WANTED
We Pay Highest Prices!

HY69	4.50	282A	Write
CRP-72	.75	301A	Write
RKR-72	.75	304TH	8.95
CRP-73	.75	304TL	7.95
RKR-73	.75	307A/RK75	4.25
75T	6.95	308A	Write
75TL	6.95	310B	12.95
83V	1.10	315A	.75
VT98-Br.	19.95	327A	4.50
98R	5.95	331A	10.95
100TH	8.50	349A	8.50
FG-104	29.95	350A	5.95

5 FIGURE VEEDER ROOT COUNTERS MODEL S-1 only **95¢**

Size 3/4" wide x 1-5/16" long. Dovetail mounting—removable lever.

FG-105	19.00	350B	3.95
VU-111	.95	355A	Write
HF120	9.95	371B	.75
F-123A	7.75	374B	3.95
VT-127A	3.75	383A	1.49
HF-140	Write	398A	8.95
FG-172	29.50	394A	3.95
HF200	14.50	417A	8.50
201A	98.00	423A	4.50
201C	98.00	434A	19.95
204A	49.50	446A	1.19
205F	Write	446B	3.50
211/VT4C	.75	450TH	42.50
217C	4.95	451	3.95
221A	1.95	464A	10.95
RX233A	3.50	469	13.95

471	2.25	803	3.75	979	Write
527	12.95	804	10.95	930D	Write
530	16.95	805	3.25	991	.39
531	5.75	807	1.59	1005	.69
532	2.98	807W	9.95	1006	4.50
559	1.19	808	2.95	1007	.89
575	13.95	809	2.95	K1069P7	Write
587	Write	810	10.95	1613	Write
605CX	Write	811	2.90	1616	.90
609	Write	812	2.75	1619	.39
KU610	22.00	813	11.95	1624	1.45
615	Write	814	2.95	1625	.39
632	19.95	815	2.90	1626	.39
KU676	39.50	826	1.95	1629	.39
WL677	39.50	828	9.95	1631	1.50
700A	16.50	829	9.95	1642	.69
700B	14.95	829B	11.95	1644	.89
700C	16.50	830B	2.75	2050	1.40
700D	16.50	832A	9.95	2051	1.10
701A	4.50	833A	34.95	5514	3.40
702A	2.75	836	3.45	5516	5.50
703A	4.25	837	1.45	5523	Write
704A	Write	838	3.98	5536	175.00
705A	1.75	845	8.50	5611	115.00
706AY	39.50	851	55.00	5635	8.95
706BY	39.50	852	19.95	5646	8.95
706CY	29.50	861	19.95	5651	2.75
706FY	45.00	864	.39	5654	2.00
706GY	45.00	865	.98	5670	4.30
707A	7.95	866A	1.50	5672	1.50
707B	14.95	866JR	1.25	5676	3.35
708A	3.95	869B	53.00	5687	4.25
713A	.95	872A	3.25	5694	2.60
714AY	5.50	874	1.10	5702	6.50
715A	6.25	876	.59	5703	1.95
715B	8.95	881	1.50	5704	4.50
715C	22.75	884	1.40	5787	6.00
717A	.98	889R	139.50	5814	3.25
719A	24.50	905	3.25	5844	4.50
720AY	249.50	923	1.25	5915	1.00
720BY	249.50	927	1.25	6026	2.25
721A	2.95	931A	5.95	8005	6.95
721B	12.50	953B	Write	8012	1.95
722A	1.95	953D	Write	8014A	59.50
723A/B	18.95	953E	Write	8020	1.25
724B	2.75	954	.33	8025	4.95
725A	7.50	955	.49	9001	1.25
726A	Write	956	.49	9002	.98
726C	59.50	957	.49	9003	1.50
730A	25.00	958A	.69	9004	.69
801A	.39	959	2.95	9005	1.95
802	3.95	977CX	Write		

Special: VACUUM CAPACITORS
12 mmfd., 20,000 v. $ 7.50
12 mmfd., 32,000 v. $10.00

Special: VACUUM CAPACITORS
50 mmfd., 32,000 v. $12.50
100 mmfd., 20,000 v. $14.50

All Prices F.O.B. Los Angeles, subject to change without notice. Minimum order $3.00.

J. S. H. SALES CO.

Dept. E-21, 7552 Melrose Ave.
Los Angeles 46, California

Thousands of other types in stock. Send us your requirements.

QUARTZ CRYSTALS

NEW LISTING

Made from the finest Brazilian Quartz. Will provide a high degree of activity and frequency stability. All tested and marked by the manufacturer to a very close tolerance. In the frequencies outlined below the crystals itemized under the heading "From & To" are mostly in progressive frequencies between the limits shown (as for example: "From 3300 to 3377," are as follows: 3300KC, 3301KC, 3302KC—, 3377KC.) are of limited quantities in each frequency. Those listed singly are in quantities of 50 or more.

FT243

Prong centers ½", Prong dia. 3/32"

Price $1.15 ea. (25 for $25.00)

FROM	TO	FROM	TO	FROM	TO
1915	1995	6225		8025	
2030	2065	6250		8050	
2175	2155	6275	6292	8100	8175
2300		6300	6375	8206	8275
2320	2390	6400	6498	8300	8375
2420	2490	6500		8385	
2604		6506.6	6675	8400	8475
2605		6700	6775	8500	8575
3105		6825	6875	8600	8650
3652	3689	6815		8786.25	
3729	3799	6830		8808.75	
3805	3823	6900	6975	8876.25	
	4100	6978.75		8921.25	
4104	4150	7228	7281	9135.0	
4244	4290	7325	7375	9342	9399
4305	4397	7458.75		9405	9499
4400	4480	7440	7475	9500	
4600	4690	7500	7597	9516	9589
4800	4898	7606	7673.3	9608	9638
4913	4941	7625		10075	
5100	5195	7650		12608	12698
5300		7675		12700	12783
5320	5897.5	7700		12800	12890
5500		7725		12902	12998
5630		7728.8		13004	13009
5633.3		7750		13010	13099
5655.5		7751.25		13100	13196
5677.7		7773.75		13213	13299
5700		7775	7790	13302	13361
5706.6	5775	7800		13400	13496
5722.2		7825		13500	13554
5744.4		7850		13837	13897
5800	5892	7875		13903	13996
5900	5975	7900		14038	14092
5955		7925		14110	14198
6025	6075	7950		16585.55	
6150		7925		17170	
6175		7906	7968		
6100	6173.3	8000			

CR 1A/AR or FT241

Prong Spacing ½", Prong dia. ⅛"
Price 79¢ ea. 12 for $9.00

FROM (Frequencies in KC)	TO	FROM (Frequencies in KC)	TO
2853		7620	
3988		7625	
4188		7650	
4285		7738	
4300	4374	7740	
4788		7750	
5020	5090	7760	
5100		7770	
5120	5180	7775	
5200	5295	7778	
5250		7780	
5300	5396	7790	
5410		7800	
5470		7810	
5500		7825	
5468		7830	
5470	5780	7850	
5810		7851	7880
5891		7900	
5910		7910	
5923	5960	7925	
6011	6080	7930	
6130	6195	7940	
6203	6275	7950	
6270		7970	
6300	6375	7975	
6370		7990	
6400	6499	8002	
6490			8010
6500	6590	8007	
6600	6685	8012	
6744			8092
6815	6877	8205	8298
6905	6980	8308	
7140		8300	8370
7270		8407	
7330		8412	
7460		8405	8490
7500		8506	8561
7540		8645	
7541.6		8630	8650
7560		8985	
7600		11677	

FT214A

SPECIAL TYPE WE.

Prong spacing 1" CTS.
Prong Size 3/32" dia.

These are in successive steps of .1 MC variation from 20.0 MC to 27.9 MC

Suitable for low frequency purposes (1/54 of Stated Values)

Price $1.15 ea.

UNASSEMBLED CRYSTALS

consists of quartz crystal plates made for FT243 holders. Furnished complete with holders, electrodes, springs and all hardware.

Price .29 ea.

Crystal plates available in the following frequencies:—

7533	7750	7873	8475
7541		7950	8750
7550	7775	8275	
7640	7800	8325	
7650	7825	8450	
7700	7850		

EDLIE ELECTRONICS, Inc.

154 Greenwich Street
New York, N. Y.
Telephone DIgby 9-3143

Excellent "RW" Values!

RA-52 RECTIFIER

Transtat controlled to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 VDC @ 50 W. Metered high voltage (0-15 KV) and current (0-20 MA). New **$74.50**

SCR 625 Famous Army Mine-Detector For Prospectors, Miners, Oil Companies, Plumbers, etc.

This unit is being offered now at a considerable reduction in price. Recently advertised at $79.50 it is now available in the same brand new wrappings in suitcase style carrying case (less batteries) at

$59.50 **WHILE THEY LAST!**

Used, $39.50

TS159/TPX
COMBINATION SIGNAL GENERATOR AND FREQUENCY METER

Freq. range: 150-200 MC., crystal calibrated. Has separate 30MC signal output, crystal cal: 3-stage, AF amplifier. Power measurements by built-in VTVM circuit. 0-1 MA. meter as 2-range voltmeter. Built-in 400 cps. voltage regulated power supply. New **$69.95**

WOBULATOR
BUILD TV-FM-AM SWEEP GENERATOR

You can build "Versatile Sweep Frequency Generator" with APN-1 magnetic units... **$5.95**

RM 29 with the TS-13 handset **$14.95** ea. **2 for $27.50**

RL-42 Reversible Motor with antenna reel and clutch, used................. **$2.95**

WRITE FOR PRICES

BC1033	BC376	LP21LM
APS13	BC638	TS61
ARN7	RA42	TS92
SCR269F&G	RTA1B	BC1277
SCR619	CRT3	BC1287
BOONTON SIG. GEN. 1. 26 B	MP10	APR-4
TS 100/AP	MN26Y	MN26C

WANTED!

All TS, APR, APS, ARC, ARN, ART, SCR, R89 and BC equipment . . . write today!

Quote lowest prices in your first letter

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

V&H

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, R89B/ARN-5 and BC-733D. Modified to flag alarm.

BC-611 & BC-721 HANDIE TALKIES, Plus SPARE PARTS, Quantity available.
IE-17 TEST SET
AN/ARN-7 COMPLETE
SCR-269 COMPLETE
TBS 4 & 5, NEW, COMPLETE
AN/ARC-1 VHF EQUIPMENT
BC-348 RECEIVERS
BC-342 RECEIVERS

31 KVA BUDA DIESEL PLANT

3 phase, 110 V, 60 cycles. Spare parts and generator available. Has been run only 40 hours.

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-13A 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 Command Equipm't
BC-1016	R-4/ARR-2 Receivers
APA-6 INDICATOR	BC-640 VHF XMTR
APA-11 INDICATOR	SCR-510
APA-17 RADAR	SCR-522
HS-33 HEAD SETS, NEW	MG-153
MG-149F & H	

SPARE PARTS

SCR-720	SCR-522
SO-7	AN/ART-13
AN/ARN-7	AN/ARC-1
SCR-269	BC-611

SCR-718 A, AM, B & C

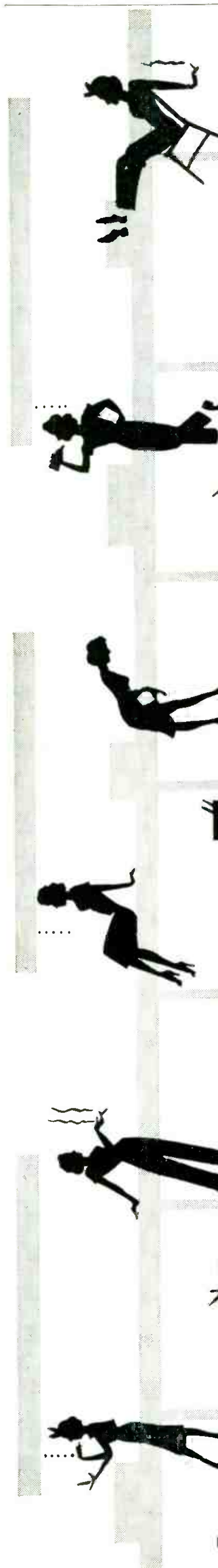
Altimeter equipment—complete

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.

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-20
Los Angeles 6, California
Phone: REpublic 3-1127



STOP COSTLY SHUT-DOWNS!

PHONE WELLS FOR ANY ELECTRONIC COMPONENTS

IMMEDIATE DELIVERY

Write for Catalog

FROM WORLD'S LARGEST STOCK . . . SEeley 8-4143

WELLS SALES INC. 833 W. Chicago Ave., Chicago 22, Ill.

END OF YEAR CLEARANCE ON OUR ENTIRE STOCK OF SPECIAL PURPOSE & TRANSMITTING TUBES. ADDITIONAL DISCOUNTS FOR QUANTITY SHIPMENTS

OA2	.89	5C30/C5B	3.75	357A	14.95	830B	2.75
OA3/VR75	1.04	5CP1	4.50	371B	.79	832A	8.50
OB2	1.05	5D21	24.00	388A	1.29	841	.39
OB3/VR90	1.05	5FP7	1.95	394A	4.75	843	.25
OC3/VR105	1.10	C5B	3.75	417A	14.95	846	49.95
OD3/VR150	.85	5R4GY	1.49	450TH	42.50	860	3.75
1B22	1.95	C6A	5.75	530	16.95	861	21.50
1B26	2.25	6AK5	.79	531	6.75	864	.75
1B27	12.50	6K7G	.45	533	19.95	865	1.25
1B29	2.45	7BP5	14.95	559	.95	866A	1.35
1B36	7.50	7C4	.35	HY615	.15	872A	3.59
1B56	24.50	7E5	.39	700A	17.50	874	.69
EL1C	2.49	10Y	.75	701A	4.95	876	.59
1D8GT	.59	12A6	.59	702A	2.49	879	.49
1L4	.59	24G	1.49	703A	2.75	931A	4.25
1R4/1294	.69	RK34	.39	704A	.89	954	.32
1T4	.59	45 Special	.29	705A	1.69	955	.45
2C21/1642	.44	FG17	4.50	706AY-DY	39.50	956	.45
2C22/7193	.29	RK72	.75	706EY-GY	39.50	957	.45
2C26A	.15	RK73	.75	707A	7.95	958A	.59
2C34/RK34	.39	RK75	5.75	708A	3.75	E1148	.29
2C40	7.50	REL5	19.95	710/8011	.75	1608	3.95
2C43	14.95	FG81A	3.49	713A	.92	1616	.69
2C44	.95	VT90	.75	714AY	4.95	1619	.35
2J22	7.50	VT98	19.95	715A	4.95	1625	.40
2J26	14.95	100TH	7.75	715B	6.95	1626	.40
2J27	14.95	HY114B	.50	715C	19.95	1629	.30
2J39	19.50	VT127	1.75	717A	.98	1636	2.95
2J40	26.50	205B	1.49	721A	1.75	1642	.59
2J61	39.50	211	1.75	722A	1.89	2051	.95
2J62	39.50	211(VT4C)	1.75	724B	2.49	7193	.30
2V3G	.75	217C	6.95	725A	6.75	8011	.75
2X2	.49	250TH	18.50	800A	1.75	8012	2.75
3B7/1291	.39	250TL	16.95	801A	.45	8013A	2.95
3B22	2.49	285A	4.95	803	3.75	8020	1.25
3C24	1.49	286A	6.95	805	3.50	8021	1.95
3C28	4.95	304TH	6.50	807	1.59	8025A	5.45
3CP1/S1	1.49	304TL	8.75	808	2.25	9001	1.25
3D6/1299	.35	307A	5.75	811	2.75	9002	.95
3D23	4.75	316A	.49	811A	3.50	9003	1.25
3FP7	1.75	328A	4.95	812	2.75	9004	.35
3Q4	.49	329A	7.25	812A	3.50	9006	.25
4B28	2.95	331A	6.95	813	13.95	6 Amp Tungar	
4J42/700A	17.50	350B	3.95	814	2.95	Bulbs	2.45
5AP1	3.49	353A	3.95	829B	12.95		

SEND US YOUR INQUIRIES ON TYPES NOT LISTED

MARITIME INTERNATIONAL COMPANY

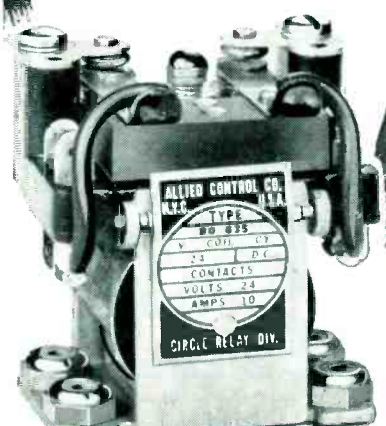
11 STATE STREET — NEW YORK 4, N. Y.

Phone: DIgby 4-3192 — Cable Address: FOXCROFT

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

Telephone
SEeley 8-4146

Relay Sales

833 W. CHICAGO AVE.
DEPT. 4, CHICAGO 22, ILL.

ELECTRONIC EXPEDITERS

SUPPLYING

THE NEEDS OF INDUSTRY — GOVERNMENT — FOREIGN PURCHASING COMMISSIONS

WITH

COMMUNICATIONS EQUIPMENT, RECEIVING AND TRANSMITTING TUBES, ELECTRIC WIRE AND CABLE . . . . . AIRCRAFT ELECTRONICS— INSTRUMENTS— HYDRAULICS

PROMPT ATTENTION GIVEN TO ALL INQUIRIES

Rated—Dun & Bradstreet

Electronic Expediters

Dept. WW, 225 N. Wabash Avenue
Chicago 1, Illinois • ANdover 3-0841
Cable Address: "ELEXPEDITE" • TWXCG1510

PHOTOCON SALES

417 N. Foothill Blvd. — *SY camore 2-4131*
Pasadena 8, Calif. — *RY an 1-6751*

FREE 24 PAGE WINTER SURPLUS SALES CATALOG

WANTED new or clean used electronic surplus. Please state exact description of the condition and details of modification. Indicate lowest price in first letter.

TS-323 Freq. Meter 20-480 mc.		PUR*
Hewlett-Packard 410A VTVM.	Like new	$185.00
Signal Generator Model 804 8-330 mc.	Exc.	PUR*
Simpson Genescope Model 480	New	275.00
LM & BC-221 Frequency Meter with cal. book, crystal, and tubes	Exc.	95.50
TS-352/U Weston Test Set	Exc.	150.00
TS-148/UP	New Mfg.	PUR*
Signal Generator 196A	Like new	PUR*
Million Signalizer Radio & TV.	Like new	PUR*
Dumont 208 Scope	Exc.	PUR*
TS-146/UP X-Band Signal Generator	Exc.	PUR*
305B Floor model Oscilloscope 9" tube RCA mfg.	Exc.	PUR*
TS-34/AP Portable Oscilloscope	Exc.	350.00
TS-12 Text Set for X-Band Box 1 & 2 complete	Exc.	PUR*
APR-4 Search Receiver		PUR*
Tuning Units for APR-4 Receiver		PUR*
BC-348, BC-312, BC-342 Receivers		PUR*
APS-3	Exc.	PUR*
SCR-284 Fields Sets	Exc.	PUR*
APN4A or B	Exc.	PUR*
APR-5A	Exc.	PUR*
SCR-545 Radar Trailer		PUR*
Type 120A Q Meter 130-210 mc. Boonton Radio Corp.		PUR*
Antenna AT 104/(APN19)	New	17.50
Automatic Pilot Inverter Type DA Input 28VDC, @ 12 amps. Output 115V., 3 phase, 400 cps. 115VA.	Exc.	80.00
T-17 Hand Microphone with cord and PL-68	Exc.	4.50
Impedance Bridge 650A General Radio	Like new	PUR*
HS-23 8000 ohm. Used $2.95	New	5.95
HS-18 8000 ohm. Used 1.75	New	2.25
HS-23 600 ohm. Used 3.50	New	6.95
HS-38 600 ohm. Used 1.75	New	2.25

*PUR—PRICE upon request.

NOTE: One of the largest and most complete electronic surplus stocks in the country. We have thousands of tubes, capacitors, plugs, accessories, transmitters-receivers, test equipment, etc. Send us your requirements.

TERMS: Prices F.O.B. Pasadena, California. 25% on all C.O.D. orders. Californians add 3% Sales Tax. Prices subject to change without notice.

JAN TUBES

OA2	.90
OB2	1.00
OC3	1.00
OD3	.90
1AE4	1.25
1E1	.50
1B22	2.00
1B24	9.50
1B26	2.00
1B37	15.00
1P23	2.75
1Z2	3.75
2C22	.25
2C26	.25
2C26A	.40
2C34	.60
2C40	12.50
2C51 (W.E.)	5.75
2D21	1.35
2E25	5.00
2J21A	6.50
2J26	15.00
2J27	15.00
2J31	22.50
2J32	25.00
2J33	25.00
2J34	25.00
2J40	35.00
2J61	35.00
2J61A	45.00
2K22	45.00
2K23	35.00
2K25	35.00
2K28	27.50
3A4	.85
3A5	1.50
3B4	2.25
3B24	4.75
3B24W	7.50
3B26	3.50
3B27	3.75
3B28	7.50
3BP1	4.75
3CP1	1.75
3CP1/S1	1.50
3D23	4.50
3DP1	3.75
3E29	14.50
3EP1	4.50
3Q4	.75
3S4	.75
4B24	5.75
5D21	15.00
5J29	11.50
5R4GY	1.50
6-4	.50
6-4B	.75
6AG7	1.25
6AJ5	1.35
6AK5	.65
6AK5WE	1.50
6AK5W	2.00
6AK6	1.00
6AL5	.60
6AQ5	.50
6AR6	2.75
6AS7	4.25
6AMP-Tungar	4.00
6B8	.75
6C4	.50
6H6	.75
6H6G	.75
6J5	.50
6J6	1.00
6J6W	3.50
6K7	.65
6L6	2.00
6L6G	1.50
6N7	1.10
6SC7	.85
6SF5	.75
6SG7W	3.75
6SJ7	.75
6SJ7Y	.85
6SL7	.75
6SN7	.75
6V6GT	.75
6V6GTY	.85
6X5GT	.75
6Y6	1.25
7AG7	1.75
7C24	110.00
10Y	.35
12A6	.75
12AU7	1.00
12J5GT	.60
12K8Y	.60
12SG7	.75
12SG7Y	2.85
12SK7	.75
12SL7	.75
12SN7	.75
12SR7	.75
24G	1.25
25Z6GT	.85
81	.50
101L WE	1.00
203Z	4.50
227A	4.50
247A	8.50
252A	7.50
286A	7.50
304TH	6.75
304TL	7.50
307A	4.50
313C	2.75
316A	1.25
327A	4.25
371A	.75
394A	3.75
412A WE	1.25
417A	15.00
450TL	35.00
471A	2.25
700-A/B/C	25.00
702A	3.00
704A	.75
707A	7.50
708A	4.50
715B	8.50
717A	1.25
718CY	35.00
728AY-GY	35.00
801A	.35
805	3.50
807	1.25
807W	7.50
826	.75
827R	125.00
829B	12.00
835	17.50
837	1.25
861	20.00
872AS	3.00
874	.90
954	.25
955	.35
956	.35
957	.45
958A	.60
1616	.65
1625	.35
1626	.35
1630	.85
1632	.70
1633	.70
1644	.75
2050	1.25
2051	1.00
5643	7.50
5654	2.75
5670	5.50
5686	3.75
5687	5.25
5702	4.00
5703	1.50
5704	2.50
5726	2.10
5744	4.00
5763	1.50
5787	4.50
5829	2.25
6101	Write
6035	50.00
6099	Write
8013	2.50
8020	1.25
9006	.35
CE2	1.50
CE2A	3.50
CE2B	3.50
CE2C	2.50
CE2T	1.50
CE25	1.25
CE25C/927	2.50
ELC1B	3.25
ELC5B	2.50
ELC6A	3.50
ELC6J	7.50
ELC6C	14.50
FG57	17.50
FG97	22.50
FG105	17.50
GL691	1.75
HY31Z	2.50
HY114B	.50
HY615	.25
KC4	47.50
KC4-3	37.50
KY21A	8.75
LVR	3.50
QK117	50.00
QK117A	65.00
RK34	.75
RK47	4.50
RK72	1.00
RK73	1.25
RX212	15.00
SD828A	7.50
VS1	12.50
VT31	50.00
VU508	1.50
WL481	1.00
WL532A	3.00
WL670A	7.50
ZB120	2.25
45X674	10.00
5AP1	3.75
5BP4	3.75
5HP1	4.75
5SP7	Write
7BP7	7.50
7HP4	7.50
9LP7	4.50

102 WARREN STREET **ROSE PRODUCTS COMPANY** NEW YORK 7, N. Y.

REctor 2-8078-9

NEW GUARANTEED METERS

R.F. AMMETERS

2	WESTON 425, 3″ round	@	$8.50
2.5	SIMPSON 35, 3″ round, S.C. type IS-111, SC stock # 3F311	@	6.50
2.5	WESTON 425, 3″ round	@	8.50
3	WESTINGHOUSE NT-35, 3″ round SC Stock 3F1003.3, AWS type MR35W003RFAA	@	7.50
5	GENERAL ELECTRIC DO-44, 3″ Round	@	7.50
8	SIMPSON, 2″ rd., SC type IS-89	@	5.50
8	WESTON 425, 3″ square	@	10.50

D.C. VOLTMETERS

0–10	SIMPSON 25, 3″ rd	@	$8.85
0–15	SIMPSON 27, 3″ sq	@	8.85
0–50	G.E. DO-41, 3″ rd	@	6.50
0–50	WESTINGHOUSE NX-35, 3″ rd	@	6.95
0–150	SIMPSON 25, 3″ rd	@	8.85
0–300	SIMPSON 25, 3″ rd	@	8.85
0–500	SIMPSON 25, 3″ rd	@	8.85

A.C. VOLTMETERS

0–3	SIMPSON 55, 3″ rd	@	$8.10
10	SIMPSON 59, 4″ x 4½″	@	9.75
15	G. E. AW-41, 2″ rd. black scale, cal. for 800 cycles	@	3.95
75	WESTON 517, 2″ rd. metal non-flanged case	@	3.50
300	BURLINGTON 22A, 2″ rd. metal case	@	6.00
500	SIMPSON 55, 3″ rd. with external resistor	@	13.50

A.C. AMMETERS

5 AMPS	SIMPSON 55, 3″ rd	@	$8.10
15	SIMPSON 55, 3″ rd	@	8.10
100	SIMPSON 55, 3″ rd. 5 Amp mvt., with 100:5 transformer	@	15.60
150	WESTINGHOUSE NA-35, 3″ round, 5 Amp mvt., with 150:5 transformer	@	13.50
500	SIMPSON 55, 3″ rd. 5 Amp mvt. with 500:5 transformer	@	15.60

D.C. MICROAMMETERS

15–0–15	WESTON 731, 3″ sq. fl. case	@	$18.50
0–25	WESTON 731, 3″ sq. fl. case	@	17.50
0–50	SIMPSON 29, 4″ x 4½″	@	13.05
0–100	SIMPSON 25, 3″ rd	@	11.25

D.C. MILLIAMMETERS

0–5	WESTINGHOUSE RX-33, 2″ square	@	$3.50
0–5	GRUEN (Triplett) GW124, 2″ round	@	4.00
0–15	SIMPSON 25, 3″ rd. AWS type MR35W015DCMA	@	6.00
0-50	GRUEN (Triplett) GW522, 2″ round	@	4.00
0–150	G.E. DW-41, 2″ rd	@	4.50
0–150	WESTINGHOUSE RX-35, 3″ square	@	5.50
0–200	SIMPSON 25, 3″ rd. AWS type MR35W200DCMA	@	5.95
0–300	GRUEN (Triplett) 3″ rd. MR35W300DCMA	@	5.50
0–400	TRIPLETT 321-T, 3″ rd. (made for Garfield Med. App. Co.)	@	4.50
0–800	DEJUR 312, 3″ rd. S.C. Stock # 3F980	@	4.50

GASOLINE HEATER
Motorola GN3-24A

Ideal for boats, bungalows, transmitter stations, etc., and any place where a quick heat is required in volume. Very efficient and economical. 15,000 BTU per hour! One gallon gasoline lasts 6 hours! Internal combustion type—safe to use! Designed for heating of B-29 and PBM-3 Bombers.

Operates on 24-28 volts D.C. Easily adapted to 110 volt AC by use of transformer and rectifier.

Approximately 12″ x 9″ x 10″. Complete with tech manual, all accessories, and self contained 1 gal. tank with provisions for connection to auxiliary fuel supply.

Government Cost Approximately $240.00. Your Cost Only $29.50.

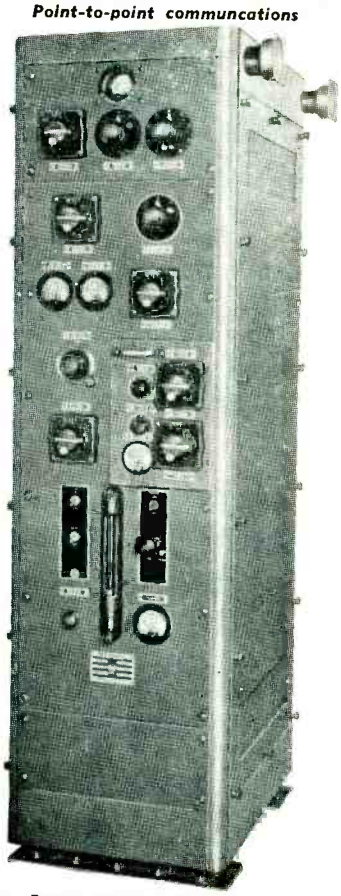
This only a partial listing. We also stock a wide variety of shunts, transformers and multipliers.

MARITIME SWITCHBOARD
INSTRUMENTS—ACCESSORIES
WOrth 4-8217
338 Canal Street New York 13, New York

All items are new in original cartons and are fully guaranteed. All prices are net, F.O.B. New York City.

R.C.A. Model MI-8167
TRANSMITTERS

Point-to-point communcations



Freq. Range: 2000 to 20,000 Kcs.
Output: 350 Watts C.W. 250 Watts Radio telephone
Input: 190 to 250 Volts AC 50/60 cps.
Size: 60″ high, 17″ wide, 27″ deep.
Tubes: 807s, 813s, 805s, 866s.
Crystal Oscillator unit built-in, fully shielded and stable. All self contained including antenna network. Master Oscillator unit (available) fits in place of Xtal unit. Speech amplifier is only external unit and has 110/220 v. AC input, four stages, high gain. Total net weight, 625 lbs.

Complete! New! From Stock! Quantities! Prices on Request.

COMMUNICATION DEVICES CO.
INCORPORATED
2331 Twelfth Ave. N. Y. 27, N. Y.

Portable Instruments

Molded Bakelite case 7″ x 4½″ x 3″

D.C. MICROAMMETERS
5..10..50 microamperes
THERMOCOUPLE MILLIAMMETERS
1, 5..5..10 milliamperes
THERMOCOUPLE VOLTMETERS
5 to 500 volts

Available in multiple range combinations

Precision Electrical Instrument Co.
146 Grand Street New York 13, N. Y.

AN Connectors, complete stocks on hand. Blue pthalate, melamine or bakelite with cadmium plated or sand blast shells. Write for four page reduced price list.

Up to **80%** discount!

Coaxial Connectors, 21,468 pieces in stock in 152 different types.

Write for latest price list.

HAROLD H. POWELL & Co.
2104 Market Street Philadelphia 3, Pa.

148 CHAMBERS ST., NEW YORK **BUY** AND OR **SELL** RECTOR 2-1591

We do both!—Electronic Equipment and Parts of every description. No lot too large. TOP PRICES. Ask us to help you. RAPID ACTION ALWAYS.

ELECTRONIC SURPLUS BROKERS

Columbia
GEM OF THE SURPLUS

RA-38 RECTIFIER
110 VAC 60 cycles, single phase input, Hi-voltage, heavy duty power supply. Many uses such as radar, and commercial heat induction. Like new $595.00

DC-625 MINE DETECTOR
New Special $59.95

RADAR EQUIPMENT
All popular gear for land, sea and air. Write for Information.

110 V. VARIACS
18 amp $42.50
60 amp $75.00
100 amp $149.50

METERS
A.P.R.—5 .... P.U.R.
SCR-284. Complete. New & used. Guar .... P.U.R.

TEST EQUIPMENT Price On Request
BC-221 T6-47 TS-34 IE-19
TS-10 TS-16 TS-127 LM IE-36

EE-8 FIELD PHONES
USED Ea. 522.50
Per pair 39.95
NEW Ea. 35.00
Per pair 65.00

TUBES! BIG VARIETY! BOXED!
2J36	$95.00	813	$10.95	715C	$18.75
304TL	8.95	829B	9.95	833A	29.95
1B24	8.95	830B	1.95	1B27	9.95
730-A	19.95	832A	9.95	2C39	29.95
723A/B	13.95	MANY OTHERS			

BC-611 HANDY TALKIE. Checked out. New and used .... P.U.R.
RA-62 RECTIFIER. 110 VAC. Power supply for SCR-522. used .... $100.00. New $125.00

HEADSETS & HANDSETS—Checked Out
HS-30.	Used	$1.95	HS-30.	New	3.50
HS-23.	New	4.95	HS-33.	New	5.95
HS-33.	Used	3.95	TS-9.	New	9.95
T-17.	Used	5.00	T-17.	New	9.95
TS-9.	Used	7.95	T-17D.	New	9.95
TS-13.	New	$9.95			

AIRCRAFT EQUIPMENT
BC-375. 100 W. Aircraft Xmtr. Complete installation. New and used .... P.U.R.
MN-26C RADIO COMPASS. Complete ... $89.50
SCR-522 VHF TRANSMITTER-RECEIVER. 24 V. Complete 150.00
SCR-274N or ACR-5 (Medium or VHF frequency) Complete installation available .... P.U.R.
LORAN APN-4 Complete 150.00
APN-1 ALTIMETER. Complete 49.50
ARC-4 VHF TRANSCEIVER. 12 or 24 V. P.U.R.

ARC-1	SCR-269-G	TA-2J24
ARC-3	BC-348	TA-6
RTA-1B	BC-733-D	TA-12
ART-13	R-89/ARN-5	ARR-5
APT-9	ARN-7	ARR-7

ATTENTION: PURCHASING AGENTS!
IF YOU NEED IT—WE GOT IT!
WE STOCK COMPLETE LINE: Inverters, Motors, Meters, Dynamotors, Power Supplies. Prices upon Request.
Write for Quantity Discounts.

REMEMBER: WE ALSO BUY NEW AND USED RADIO GEAR. WE PAY TOP DOLLAR AND WILL BEAT ANY COMPETITIVE PRICE! WRITE US TO SELL ANYTHING IN ELECTRONICS. SWIFT REPLY GUARANTEED!

COLUMBIA ELECTRONICS SALES
522 South San Pedro St., Los Angeles 13, Calif.

Radar
SCR-545A Search and Track. Complete trailer, power supply and spare parts. Nearly New. Write for description and price.

Transformers & Chokes
- * New 10 K.W. Amertran oil cooled plate transformers 115v./230v. 60 cy. single phase primary, 17,600 volts, .5 amp. secondary. Can be furnished center tapped or two wire 8800 volts, 1.0 amp. State primary and secondary voltage desired. Priced $75.00 each f.o.b. Los Angeles.
- * Filament, American Transformer Co. Spec. 29106, Type WS, .050 KVA. 50/60 cy. S.P., 35 KVA test, 12 KV d-c operating. Pri. 115 v., Sec. 5 v., 10 amps w/integral stand-off insulator and socket for #371,872, etc., rectifier tubes. $15.00 each. Transtat, line voltage regulator, 115 v. 60 cy. Range 103-126 v. 2.17 amp. Amertran Spec. #29144. $9.50 each.
- * Battery Charger, G.E. Cat. #WS-99316. Pri. 105-115-125 V. 60 C. Sec. 105-90-75-60-45-30 v. @ 6 amps. each side of center tap. Voltage reduced 10% and 20% thru tapped primary; two x 5 v. 18 amp. C.T. (Tungar filaments) and two x 7 v. 10 amp. 7¼" h. x 8-¾" w. x 5½" d. Wt. 56 lbs. New, orig. packing. G. E. Price $52.00. $17.50, 2 for $30.00.
- * Choke, swinging 15,000 v. d-c line, ripple frecuency 120, 149 ohms. .02 amp. @ 900 henrys; .52 amp. @ 25 henrys; 48% ripple. Amertran Spec. #29107. $42.00.

*Capacitors
9.12 mfd., 1265 v. 60 c. a-c or 4000 v. d-c power factor correction 5.0 K.V.A.R. Cat. #2528908. $17.50
.25-.25, 6000 v. d-c or .125 @ 12,000 v. d-c., Fast Cat. #A7548 oil. $3.75.
1.25/1.25 mfd., 7500 v. Pyranol Cat. #26F360. $17.50

*Resistors
Fixed w.w. 160,000 ohm, 200 w. ferrule ends..$1.00
Fixed, w.w. 5,000 ohm, 200 w. ferrule ends.. 1.00

*Meters & Multipliers
Westinghouse Type R-5, 1 meg. precision meter multiplier resistors, wire wound, non inductive, ½% tolerance. Can be screwed together for any desired total. New. $4.00 each.
Ammeter, a-c, 3" Westinghouse NA-35 or Weston Model 476, 3 amps, f.s. deflection; scale calibrated 0-120, includes doughnut type current transformer w/200-5 ratio at 25-133 cy. $8.50.

*Relays
Allen-Bradley overload relay, 110 v. 60 cy. Cat. #810. Adjustable 6.3 to 18.1 amps. $7.95 each.
Westinghouse, 110 v. 60 cy. D.P.S.T. 15 amp. contacts with interlock. $4.95 each.

*Rectifiers, Dry Disc
Cu. S. FWB 1.8 v. d-c @ 1 amp....$.75 4 for 2.50
Selenium, FWCT, 2.2 v. d-c @ 3 amp .75 4 for 2.50
Selenium, HW, 36 v. d-c @ .2 amp. .75 4 for 2.50
Selenium, FWB, 54 v. a-c @ 1.6 amp........ 3.60
Selenium, FWB, 154 v. a-c .6 amp........ 5.50
Selenium, FWB, 180 v. a-c .4 amp........ 5.50

*Stand Off Insulators, Ceramic
1¼" dia. x 5" .... $ .90 ea.
1¼" dia. x 6" .... 1.00 ea.
1¼" dia. x 8" .... 1.25 ea.
All sizes with metal caps and bases.

High Voltage Rectifier Power Supply
Variable output 0-15,000 v. d-c @ 500 mills. Input 115 v. 60 cy. single phase. Army type RA-38. Size 63½" x 53-¾" x 56-⅞". Wt. 2040 lbs. Units are new, complete with spare tubes and remote control. Write for detailed information.

** Quantities available—subject to special discounts.*

EPCO
1527 E. Seventh Street Los Angeles 21, Calif.

WHOLESALE ONLY

ELECTRONIC COMPONENTS
AIRCRAFT EQUIPMENT
HYDRAULICS

RADIO & ELECTRONIC SURPLUS
13933-9 BRUSH STREET
Detroit 3, Mich. TO 9-3403

S BAND
converter—RF end & 2 stage 15 mc. I.F. Navy type CG-46ABW cavity autodyne mixer using 446B lighthouse tube designed to cover 2850 to 3150 megacycles (approx. 9.5 to 11 Cm). Tuning by self contained 115v 60 cy. reversible 1 rpm Bodine motor with limit switches. Comes set up to cover range once in 5½ minutes. Complete with tubes & motor less power supply, in case 11" x 6½" x 7¼". Brand New $124.50
Cavities & other parts of the CG-46ABW & CG-55ACQ units of Mark II Radar available.

30-40 Mc Link xmtr 25UFM of SCR-298, $59.50

Many other items. Send for Bulletin.

EMPIRE ELECTRONICS COMPANY
409 Ave. L. Brooklyn 30, N. Y. Cloverdale 2-2411

LARGE INVENTORY
OIL FILLED CAPACITORS CONNECTORS
BATHTUB CONDENSERS SWITCHES
TYPE "J" AND "JJ" POTENTIOMETERS
IMMEDIATE DELIVERY
LEMAR ELECTRONICS CO.
135 LIBERTY ST. N. Y. 6, N. Y.
PHONE: BARCLAY 7-8675

TUBE REBUILDING
Large Transmitting and Power types
Economical © Guaranteed
FREELAND PRODUCTS CO.
700 DRYADES ST., N. O., LA.

RADAR **SPECIAL PURPOSE TUBES** **RADAR**

All Tubes listed below are fully guaranteed and in stock for immediate shipment.

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
OA2	$0.90	1N45/400C	1.25	2K33	290.00	4C35	14.90	6C21	24.50	CK531DX	1.95	807	1.60
OB2	1.30	1P21	42.50	2K34	225.00	4J52	295.00	6F4	6.00	CK532DX	1.95	814	3.50
1B22	3.75	1Q26 G.E.	79.50	2K35	390.00	5C22	51.50	6J4	6.85	CK533AX	1.25	815	2.90
1B24	11.95	1R4/1294	.79	2K39	135.00	5D21	22.50	6K4	4.90	CK536AX	1.10	829B	12.95
1B27	12.90	2C39	23.95	2K41	149.50	5R4GY	1.55	6L6	2.19	CK537AX	3.25	832A	9.50
1B36	9.90	2C39A	30.00	2K42	142.50			6L6G	1.25	CK538DX	1.25	833A	35.95
1B42	14.95	2C40 Jan	15.95	2K43	139.00			6L6 GAY	2.25	CK542DX	1.15	931A	5.25
1B60	69.50	2C42	25.95	2K44	139.50			6SN7 WGT	2.70	CK543DX	1.20	1620	5.95
1D21/631P1	5.00	2C43	17.95	2K45	145.00			6SU7GTY	2.50	CK544DX	1.15	1622	2.70
1N21	1.20	2C51	6.15	2K46	349.50			12K8Y	.85	CK546DX	2.29	2050	1.49
1N21A	1.70	2D21	1.49	2K47	475.50			FG104	28.90	CK547DX	2.25	5651	2.95
1N21B	2.95	2E24	4.60	2K48	125.00			FG105	18.95	575A	14.90	5654	2.75
1N21C	18.90	2E25/HY65	4.95	2K50	700.00			FG172	32.00	702A	3.00	5656	6.75
1N23	1.30	2E26	3.00	3B24	5.20			300-B	12.50	703A	5.90	5670	4.95
1N23A	2.40	2E30	1.99	3B24W	7.90			307-A	3.95	705-A/8021	2.25	JRP 5676	1.35
1N23B	3.45	2E43	1.35	3C22	99.50			350-B	4.75	707-B	14.25	5687	5.40
1N25	5.15	2J32	38.50	3C23	10.50	5T4	2.25	355-A	13.95	715-B	8.50	CK5697	4.95
1N26 (W. E.)	8.50	2J34	34.50	3C33	14.50	C6J	8.50	393-A	11.50	715-C	21.95	CK5702	5.95
1N27	2.50	2K22	50.00	3C45	17.95	6AH6	1.25	394-A	4.75	721A	2.25	CK5703	1.49
1N31	3.00	2K23	45.00	3E29	14.50	6AK5	1.25	434-A	18.00	723A/B	19.50	CK5704	3.95
1N32	24.00	2K25	32.50	3K22	325.00	6AK5W	3.00	CK501DX	.75	724A	3.50	5744	1.50
1N34	.65	2K25/723A/B.	25.90	3K23	375.00	6AN5	3.95	CK509AX	1.75	724B	3.50	5814	3.50
1N40	7.50	2K26	159.00	4C28	24.00	6AR6	3.25	CK522AX	1.25	726B	49.50	5829	5.49
1N41	9.50	2K28	31.95	4C33	60.00	6AS6	3.25	CK526AX	1.45	726C	59.25	CK5875	1.75
1N42	18.00	2K29	28.90	4C35	26.50	6AS7G	4.50	CK528AX	1.62	804	12.95	8014A	52.50

Highest Cash Prices Paid for Your Special Purpose Tubes! Any Quantity 1 to 1,000.

Above Listing is only partial. *Write or Phone if your requirements are not listed.*

ALL TUBES ARE NEW, MOST WITH JAN MARKINGS AND IN ORIGINAL CARTONS.
TERMS: NET 15 days to rated firms. "All Prices" subject to change without notice.

MICROWAVE EQUIPMENT SUPPLY CO.
425 Riverside Drive - Dept. 6B1
N. Y. C. 25
MOnument 2-1480

WANTED!

• RADCOM pays highest prices for surplus equipment, parts and tubes

- TCS-7 and up • SCR 274N, SCR-300
- SCR 399 Equipment JB 70, JB 60, BC-939A, BC-610-E, RA-63, EE8, BC-614-E, PE95, PE197, Trailer K-52, Cords, LS-3
- SCR-508 . . . BC-604, BC-603, FT-237, Crystal Sets
- SCR-506 . . . BC-653-A, BC-652-A, DM-40-A, FT-253-A, BC-658-A
- BC312, 342, 348, 1000 Receivers
- SCR522 Equipment, RA-34 Rectifiers
- ARC-1, ARC-3, ART-13
- Transmitters BC 696, R89/ARN-5A, MN 62, Test Equipment SCR-211, 1-208.
- Selsyns—All kinds . . . Magnetrons.
- Generators—GN 45—All kinds
- 5 KW Gas Generators PE 75, PE 95, PE 197
- Plugs and Connectors. Technical Manuals
- Tubes—Special Purpose, Lots

Telegraph WUX, Newark *Bigelow 2-6666*

Always Right With Earl White

RADCOM Engineering Co.

8 LIVINGSTON ST. NEWARK 3, N. J.

COMPETITORS*

TEAM UP TO BRING YOU ONE GREAT ELECTRONICS FIRM GEARED TO SERVE YOU WITH

HARD-TO-FIND PARTS & EQUIP.

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!

Attn: 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!

HARJO SALES CO

* Formerly CANDEE-AIRCO combined with Alvaradio Sales Co.

4109 BURBANK BLVD.
P. O. Box 1187
Magnolia Park Station
BURBANK, CALIFORNIA
CHarleston 0-1486 • ROckwell 9-1070

WE BUY...

all kinds of

DOGS

•

SURPLUS MATERIAL
Aircraft & Electronics

- *Amplidynes*
- *Dynamotors*
- *Motor Generators*
- *Switches*
- *Wire*

or What Have You?

ATLAS EQUIP. CO.

229 Southwest Blvd.
KANSAS CITY, MO.

NEED

#241 Dumont Oscilloscopes
#804-C Signal Generators

H. FINNEGAN
49 Washington Ave. Little Ferry, N. J.

WANTED

Federal type
103B Voice-frequency Ringers
Signal Corps type TA-3/FT.

W-4814, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED

Western Electric gray-finished
EQUIPMENT CABINETS

For 19" panels. Heights of 2' 6", 3' 6", 7' 0" and 7' 6".

W-5956, Electronics
330 W. 42 St., New York 36, N. Y.

Will buy "ALL"

ART-13 / type T-47A, $200.00.
ART-13 / type T-47, $150.00.
BC-348 unmodified, $75.00.
BC-348 modified, $55.00.
APN-9, $200.00.
ARC-3 complete, $750.00.
R77 Receivers, $400.00.
ARC-1, $600.00.
BC312, $65.00.
BC342, $60.00.

Ship via Express C.O.D., subject to inspection to:
H. FINNEGAN
49 Washington Ave. Little Ferry, N. J.

WANTED

- AN/TRC-1 Equipments.
- T14 Transmitters.
- R19 Receivers.
- TS32 Test Oscillators.

Any condition or quantity

W-3858, Electronics
330 W. 42nd St. New York 36, N. Y.

WANTED

BD110 Telephone Switchboards, BD100 Telegraph Switchboards, BD90 Power Boards, EE101 V-F Ringers, BE72 Cabinets, FM19 Frames, RA43, REC30, KS5988, RA87, RA37, RA91 Rectifiers. BD101 Test Boards, SB6 Switchboards. Type CF1A, CF3A, CF2B Carrier Equipments. Any condition and quantity.

W-6205, Electronics
330 W. 42 St., New York 36, N. Y.

WE BUY AND SELL GOVERNMENT SURPLUS

electronic components, units, wire, etc.
Your Inquiries Invited

LAPIROW BROS.
1649 Hoffner St. Cincinnati 23, Ohio
Kirby 1285

TELEPHONE EQUIPMENT & PARTS

New TS9 handsets with flip switch in handle .... $7.00 each
New W.E. Co. F1W handsets with rubber cord & PL47 plug .... $7.00 each
Reconditioned TS9 handsets ... $4.95 each
C-161 repeat coils .... $3.50 each
Desk telephones with ringer box and dial **Complete** $9.00
New Transmitters like and interchangeable with WECO F1 & HA1 .. $1.25 each
Reconditioned Sound power field telephones .... $25.00 each
Sound power handsets with cord & alligator clips .... $10.00 each
Sound power R.C.A. receiver and transmitter units .... $2.50 each
Reconditioned Army EE8 telephones, tested .... $20.00 each
Operator head & chest sets HS19 $5.50 each
WECO 20 line Jack strips 275-217 Mtg. $9.00 each
Keys, lock make & Break positions, 10 per strip .... Complete $7.00
New C-158 holding coils ...... $0.50 each
Dials—WECo 5h, A.E. 24A36 Federal $3.50 each
Cords telephone rubber 3 conductor $0.50 each—4 Cond. $0.60 each
Induction coils C-105 .... $1.00 each
Kellogg 82A .... 5 for $1.00
Relays UA 38 WEco .... $1.95 each
SW-141-V with cords CD318A & containing PL68 Plug & Jack JK48 $2.00 comp.
Generators. 5 bar $5.00 ea.; 3 bar $3.00 ea. 2 bar $2.00 ea.

Terms: Check with order F.O.B. Brooklyn 5, N. Y.

EASTERN TELEPHONE COMPANY
323 VANDERBILT AVENUE
BROOKLYN 5, N. Y. MA 2-3753

WE BUY

All kinds of surplus electronic equipment and components.

ELECTRONICRAFT, Inc.
27 Milburn St. Bronxville 8, N.Y.
BRonxville 2-0044

New "SEARCHLIGHT" Advertisements

received by February 2nd will appear in the March issue subject to limitations of space available.

Classified Advertising Division
ELECTRONICS
330 West 42nd St. New York 36, N. Y.

Standard Brands **Electronics, INCORPORATED** *All Items Fully Guaranteed*

We Own and Have In Stock All Items Listed Below.

Note: This is only a partial listing of our vast inventory of electronic components.

TUBES

1B22 1B23 1B24 1B26 1B27 1B32 1B35 1B36 1C21 1L22 1P21 1P23 1P28 1P40 1P42 1-V 2AP1 2AP1-A 2B22 2C22 2C26 2C34 2C39 2C40 2C43 2C44 2C46 2C51 2D21 2E22 2E24 2E26 2J22 2J26 2J27 2J31

2J32 2J34 2J37 2J50 2J54 2J54-B 2J61 2K22 2K23 2K25 2K28 2K29 2K33 2K33-A 2K34 2K36 2K43 2K44 2T4-C 3AP1A 3B22 3B23 3B24 3B25 3B26 3BP1 3C21 3C22 3C23 3C24 3C37 3C45 3CP1 3D21-A 3DP1 3DP1-A

3DP1-S2 3E29 3EP1 3FP7 3FP7-A 3GP1 3J30 3JP1 3RP1 4-65A 4B22 4B25 4C35 4D32 4E27 4J32 4J36 4J37 4J63 5AP1 EL5BHD 5BP1 5BP4 5CP1 5C21 5C22 5D21 5FP7 5GP1 GL-5J29 5J30 5JP2 5LP1 5LP5 6AN5 6C21

6C24 6G12 6K4-A 7BF7 7BP7 7C23 7H12/6G12 7JP4 10 10T1 RK-12 13-4 15-E 15-R 19BG6 RK-20A TUF-20 D-21 REL-21 RX-21 22 23D4 25-T 26 FG-27A 28D7 33 RK-34 35T-G 35-T 36 38 39/44 42 44 44-GA

53-A VR-54 T-55 58 RK-59 RK-60 QK-60 QK-61 RK-65 VR-65 HY-69 71-A CEQ-72 RKR-72 CV-73 RKR-73 B-74 75-T 76 77 CTL-77 FG-81A 82 83-V 89 VR-90 VR-91 FG-95 C-100-E 100-TH HF-100 FG-104 FG-105 VR-105 VU-111 X-111

111-A HY-114-B 117N7-GT C-120 121-A VR-150 CV-172 211 212-E RX-215

310-A 310B 311-A 313-C 316 316-A 327-A 332-A 348A 350-A

CK-501-LX GL-502 527 559 GL-562 575-A HY-615 616 635 651

40 KILOWATT TRANSFORMER AND CHOKE KIT FOR THE PRESS WIRELESS PW-40. NEW

227 RX-233-A 233-A 249-B 249-C 250-R 250-TH 257 267-B 271-A 274-B 300-B HF300 HY-302 304-TH 304-TL 307-A

350-B 355-A CK-359-A 368-AS 371-B 388-A 393-A 394-A 410-R 417-A GL-434-A 446 446-A 446-B 464 GL-471-A

ZP-653 WL-672 700-A 700-D 702-A 703-A 704-A 705-A 706-AY 706-B 706-BY 706-CY 706-GY 706-EX 707-A 707-B 707-BY

708-A 709-A 713-A 714-AY 715-A 715-B 715-C 717-A 719-A 720-CY 721-A 723A/B 724-A 724-B 725-A 726-A 726-C 728-EY 1-800-E 801-A 803 805 807 808 809 810 811 812 813 814 815 816 822 826 SD-828-A 828

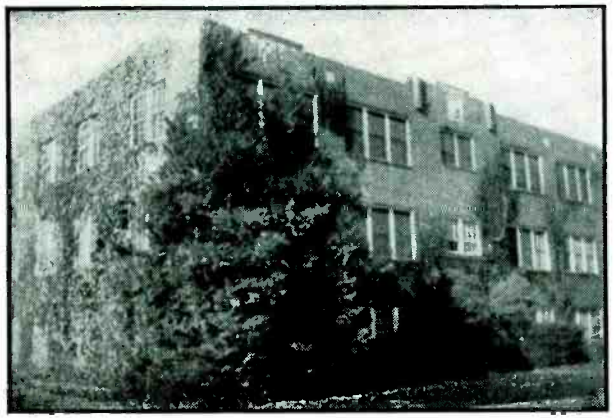
829 829-B 830-B 832 832-A 833 833-A 836 837 838 841 843 849 851 860 CG-861 864 865 869B 869-BX 872-A 873 874 884 885 SD-917 918 921 925 927 931-A 935 954 955 956 957

958-A 959 966-A CK-1006 CK-1089 CK-1090 R-1130 R1130-B 1201 1203-A 1232 1273 1294 1299 1299-A 1603 1612 1613 1616 1619 1620 1624 1625 1626 1629 1630 1631 1632 1633 1634 1635 1636 1638 1641 1644 1655

1656 1808-P1 1960 2050 2051 5022 5558 CK-5608 5692 5693 6050 7193 8000 8005 8011 8012 8013 8013-A 8014-A 8016 8020 8025 9002 9003 9004 9005 9006 AX9903 CRC-38022 38089-X 38222 CK-38233 D-79512 VT-25C VT-52 VT-127-A

PULSE TRANSFORMERS

UTAH:		
9280	9340	X 124 T3
9287-D	9350	X 143 T3
9318	X 124 T2	X 146 T1
RAYTHEON:		
UX 7307	UX 7361-A	UX 10066
UX 7350	UX 8092	U 12920
WESTINGHOUSE:		
1P1	132 AW	145 EW
1P2	132 BW	145 EW2
1P4	132 BW2	145 EWP
1P8	132 DW	166 AW
1P26	133 AW	176 AW
1P29	134 EW	301445-1
GENERAL ELECTRIC:		
68G813	80G58	K 2478
68G894	80G59	K 2721-A
68G909	80G625	K 2728
68G979	K 2449	K 2746-A
80G13	K 2460	



SPECIAL

MOTOR STARTING CONDENSERS
110 Volts 60 Cycles
POPULAR BRANDS

3276	145-175 mfd	$1.02
95758	161-180 mfg	1.12
3292	162-198 mfd	1.14
3289	180-220 mfd	1.37
3928	200-240 mfd	1.42
3251	218-262 mfd	1.22
3915	234-286 mfd	1.64
3825	243-270 mfd	1.64
3275	243-292 mfd	1.68
3242	324-389 mfd	1.83
3225	400-480 mfd	2.12
3224	485-580 mfd	2.86

• *OUR PRICES ARE COMPETITIVE WITH THE LOWEST EXISTING MARKET* •

Write - Phone - Telegraph

Electronics, INCORPORATED

92 Broad Street, Babson Park 57, Mass.
Wellesley 5-5210-1

INDEX SEARCHLIGHT

February, 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.

ADVERTISERS INDEX

TO THE ADVERTISERS

February, 1953

SEARCHLIGHT SECTION
(Classified Advertising)
H. E. Hilty, Mgr.

WHAT IS *YOUR* PROBLEM?

PERSONNEL?

Do you need competent men for your staff? Do you need men to fill executive, sales or technical positions?

EMPLOYMENT?

Are you one of the readers of ELECTRONICS seeking employment in any of the above capacities?

OPPORTUNITY?

Are you looking for or offering a business opportunity of special interest to men in the electronics industry?

EQUIPMENT?

Surplus new or used? Do you have any to offer? Or do you want to purchase some?

The solution to any of these problems can logically be found *first* among the *other* readers of ELECTRONICS. You can get their attention—and action—at a relatively low cost through the SEARCHLIGHT SECTION of

ELECTRONICS
330 West 42nd Street New York 36, N. Y.

PRECISION RESISTORS

Over 2½ Million in Stock

"TAB"—Specialists in Precision Resistors
No Mfrs Choice—We Ship Types in Stock

0.116	271	1225	3333	1650	110000
0.42	275	1250	3384	16800	115000
0.425	280	1260	3500	17000	116667
0.607	286	1300	3509	17500	120000
0.7	289	1350	3600	17977	130000
1.03	299	1355	3700	18000	135000
1.3	300	1400	3730	18300	140000
1.75	310	1488	3760	18380	141000
2.5	311.5	1495	3900	18500	145000
3	320	1500	4000	18800	147000
3.83	325	1510	4030	19000	150000
4	330	1518	4200	19500	155000
4.35	340	1600	4220	20000	160000
5	350	1640	4280	20441	165000
5.025	360	1646	4300	20500	166750
6.25	366.6	1650	4314	21000	167000
6.5	370	1670	4440	21500	169200
7	375	1680	4444	22000	175000
7.8	380	1710	4500	22500	180000
7.9	389	1712	4700	22990	180600
8	390	1740	4720	23000	185000
10.38	400	1770	4750	23150	186600
11.25	410	1800	4850	23325	190000
12	414.3	1818	4885	23400	198000
13.52	418.8	1830	4900	23500	200000
14.2	425	1850	5000	24000	201000
14.25	426.9	1865	5100	24600	205000
14.5	427	1892	5710	25000	210000
15	430	1894	5235	25200	215000
16	440	1895	5270	25400	220000
17	450	1896	5300	25833	225000
19	452	1897	5500	26000	229000
19.2	460	1898	5600	26500	230000
20	470	1899	5730	26600	235500
22	475	1900	5770	27000	238000
23	478	1901	5910	27500	240000
24	480	1902	6000	28000	245000
25	487	1903	6100	28430	250000
26	500	1904	6125	28500	265000
28	510	1905	6140	29000	268000
30	520	1906	6200	29500	270000
31.5	525	1907	6300	29990	275000
37	540	1908	6495	30000	294000
48	550	1909	6500	31000	300000
49	560	1910	6800	31500	307500
50	575	1911	6840	32000	311000
51.78	580	1912	6990	33000	314000
55	588	1913	7000	35000	316000
56.7	600	1914	7320	36000	325000
60	612	1915	7500	37000	330000
63	620	1916	7700	38140	333500
68	625	1917	7717	38500	350000
74	633	1918	7900	39000	353500
75	640	1919	7930	39500	375000
80	641	1922	7950	40000	380000
81.4	645	1924	8000	41400	390000
88	649	1926	8094	42000	400000
89.8	650	1960	8200	43000	402000
95	657	1980	8250	45000	420000
100	665	2000	8500	47000	422000
101	670	2045	8700	47500	425000
103.2	673	2080	8770	48000	430000
105	675	2095	9000	48660	450000
105.7	680	2141	9100	49000	458000
107	681	2142	9445	50000	470000
110	684	2145	9500	51000	472000
120	689	2150	9710	52000	478000
121.2	697	2160	9800	55000	500000
125	699	2180	9900	56000	510000
130	700	2187	9902	57065	520000
135	711	2195	10000	58333	521000
147.5	733	2200	10430	60000	525000
150	740	2250	10500	61430	543000
160	750	2300	10600	62000	550000
165	800	2400	10900	64000	560000
170	806	2450	10936	65000	570000
175	820	2463	11000	66600	575000
179	850	2485	11400	66650	600000
180	854	2490	11500	67500	620000
182	899	2500	11690	68000	650000
182.4	900	2525	12000	70000	654000
200	910	2600	12500	72000	660000
209.4	917	2625	12800	73500	680000
210	946	2635	13000	75000	690000
216	978	2700	13100	80000	700000
220	1000	2750	13500	82000	750000
220.4	1030	2850	13550	84000	761300
225	1056	2860	13600	85000	800000
230	1059	2870	14000	85750	813000
235	1067	2900	14250	88000	820000
240	1100	3000	14400	90000	850000
245	1110	3100	14500	91000	860000
245.4	1150	3163	14550	93000	900000
250	1155	3259	14600	93300	910000
260	1162	3290	15000	95000	930000
270	1200	3300	16000	100000	950000

Any Size Above, Each 35c; Ten for $3.29

MEGOHMS

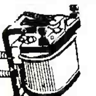
1.	1.579	2.7	4	6.7	10
1.1	1.65	2.75	4.23	7	11.55
1.2	1.75	2.8	4.25	7.5	12
1.25	1.8	2.855	4.5	7.62	12.83
1.3	1.9	3	5	7.74	13
1.35	2	3.3	5.1	8	13.83
1.39	2.11	3.5	5.5	8.02	30
1.4	2.2	3.673	6	8.5	51
1.5	2.25	3.75	6.5	9.05	
1.57	2.5	3.9	6.6	9.5	

Any Size Above, Each 70c; Ten for $6.49

Vacuum Precision HiVolt Resistors

Megohms — .12/.25/.6/.75/.83/.99/1/1.5/2/3/3.75
½% Accy .... Ea. $1: .... Ten for $7.50

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 24VDC/5A CTS **98c; ALLIED ..... 6 for $5.00**
SPNO 115VAC/15A CTS S'Dunn **$2.98**
DPDT & SPNO 12VDC/10A CTS $2.98; ..... **4 for $10.00**
DPDT Clare SK5010, Octal Base, 18-28V 2A Contacts, Nitrogen Sld. ..... **$1.49; 4 for $5.00**
DPNC & SPNO Clare Telephone Type, 115VAC Octal Base **SPECIAL** **$4.25**

Soldering Iron Guns 115VAC

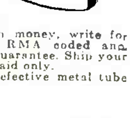
"WELLER" 100 Watt & Lite Post paid **$8.69**
"WEN" 250 Watt & Lite Post paid **10.00**
Famous Make Fully Guaranteed

INFRARED SNOOPERSCOPE
SEE IN DARK TUBE

Image-Converter Tube HiSensitivity simplified design 2" dia. Willemite screen—Resolution up to 350 line/in. Complete data & tube, ea. **$4.98; 2 for $9.49**

SNOOPERSCOPE PWR SUPPLY
1800VDC/35MA, Using Doubler Crkt. Transformer, Rectifiers, Sockets, Resistors, Capacitors and Diagram **115V/60cy Over $6.98**

ONE YEAR GTD TV PICTURE TUBES



10BP4	$13.98
10BP4A	14.49
12 Inch Glass	17.95
12 Inch Metal	21.98
14 Inch Rectangular	20.95
16 Inch Glass	22.95
16 Inch Metal	23.98
17 Inch Rectangular	23.49
19 Inch Round	27.98
20 Inch Rectangular	21.95
21 Inch Rectangular	30.98

Your old pict. tube is worth money, write for trade-in-allowance toward RMA coded and dated tubes with one year guarantee. Ship your defective picture tubes prepaid only. When ordering metal tube, defective metal tube is required.

"TAB"
THAT'S A BUY

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W/Sec. Max.	Each
U5W	GE FT105	100	$5.98
U10	GE FT114	100	7.25
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT 210	200	9.98
53GT	GE FT 403	500	13.50
VA	SYLV. 4330	200	9.98
23MT	FT 214	250	9.98
22ST	FT 110	200	9.98
353GTQ	FT 503	5000	49.98
V4X4	X400	200	10.98
DX	SPRGFA100	150	9.00

Write for Complete "THRIFTLITE" Data Boosterpacks, Ext lites. Units for Focal plane shutters & accessories. We Buy, Sell & Swap.

HIV PHOTOFLASH KIT

Includes V4X4 Flash Lamp Rated 200 Watt Seconds. Flash Lamp Holder & 8" Reflector & Cable. 115V/60Cy Inpt Power Transformer & 50 Watt Sec Multi Section Capacitor Bank. All Resistors, Capacitors, Rectifiers & Sockets.
SPECIAL **$24.98**

LO-VOLT PHOTOFLASH KIT

Includes DLX15 Flash Lamp Rated 200 Watt Sec. Flash Lamp Holder & 8" Reflector & Cable Power Transformer & **CD** Flash Capacitors, (2) 200 Mfd Each W/Output of 100 Watt Sec. All Resistors, Capacitors, Rectifiers & Sockets, **$29.98**
Extra Flash Lamp Holders W/8" Reflector & Cord **$3.98**; W/Lamp V4X4 or DLX **$12.98**

PHOTOFLASH CAPACITORS

100MFD 500WVDC	$1.89
200MFD 450WVDC	2.89
300MFD 450WVDC	4.39
15MFD/330VAC/1500VDC Intermittent	3.98
25MFD/330VAC/1500VDC Intermittent	6.49
16MFD/600VAC/2800VDC Intermittent	6.95
16MFD/660VAC/3000VDC Intermittent	7.49
32MFD/1.2KVDC/23W. Sec	7.95
27MFD/1.2KVDC/2KV Int. 54W. Sec	8.95

VARIAC

Made by General Radio. Model 200CU Rated 0–135 Volts at 5 Amps, Reconditioned, Tested, and Guaranteed. **"TAB" Special $16.98**
Variac Brushes 5 Amp. **49c: 5 for $2.00**
Rheostat Model "P" 300 ohm 200 Watt **$3.98; 2 for $7.**

RHEOSTATS

2 ohm 50W Model J	$2.25; 5 for $10.00
6 ohm 25W Model LH	1.98; 3 for 5.00
15 ohm 25W w/knob	1.98; 3 for 5.00
20 ohm 50W Model J	2.35; 6 for 12.00
60 ohm 50W w/knob	2.49; 3 for 7.00
100 ohm 50W Model K	2.25; 3 for 6.00
200 ohm 25W Model D	1.98; 5 for 9.00
250 ohm 25W	ea. 1.39; 4 for 5.00
350, 500, 5000 ohm Slotted shaft, 25 watt	79c; 3 for 2.00

★ TEST EQUIPMENT ★

MODEL 103 AC/DC 24 ranges VOM; AC & DC 10 rngs to 3000V, DB-5 rngs to—64DB, AC currents 3 rngs to 600 MA, DC current 4rngs to 1.2 amp, ohms 2 rngs to 1 megohm. Std mfgr **"TAB"** GTD display models.
SPECIAL Post Paid $17.49
MODEL 102 Pocket multimeter features; AC & DC 10 rngs to 3000V, AC current 3 rngs to 600 MA, DC current 4 rngs to 1.2 amp, ohms 2 rngs to 1. megohm. Compact accurate & durable construction. Std. Mfgr. **"TAB"** GTD display Model.
SPECIAL Post Paid $13.98
MODEL 106 Vacuum tube volt meter, features include: AC & DC 10 ranges to 1000V, ohms 5 ranges to 1000 megohms, 5 DB ranges. AC Range freq. response 25 to 100,000 cycles. Designed for field alignment of TV & Radio sets. Std mfgr. **"TAB"** GTD display model.
SPECIAL Post Paid $33.49
MODEL 106 VTVM in kit form.
SPECIAL Post Paid $22.98
MODEL HVP 30,000 volt probe for Model 106. Display model **"TAB"** GTD. **SPECIAL** Post Paid $8.25

PARTS CABINETS

50 Draw Hvy Steel 34½"H/18"W/9"L/65 lbs Draws 3"W/2½"H/8"L **$40.00**
100 Draws as above. 135 lbs **$65.00**
27 Draw Hvy Steel 37"H/30¾"W/14¾"L/120 lbs. Draws 3"H/9"W/12"L **$39.95**

DYNAMOTORS

INPT 6VDC, output 200V/100ma, or 12/24V Output 500V/50ma P Magnt. As Illustrated 6.95
Inpt 28VDC/1.4A out 250V/60ma 3.69
D104 Inpt 12 & 24V, Outpt 225V/100ma, 440V/200ma **SPECIAL** 11.98
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

SELSYNS

2J1H1 GE Selsyns	2 for $6.98
2J1F3 GE Brand New 115V/400cy ea.	9.75
C78248 Sync. Trans. 115/60cy $39.95;	2 for 75.00
C78249 Sync. Diff. 115V/60cy 12.95	2 for 25.00
Sync. Trans. C-69405-2 Type 1-1	2 for 90.00
Sync. Repeater 115/60cy Type 11-4	2 for 99.00
Bendix Autosyns AY1 & AY5	2 for 4.95
Bendix AY20 New Orig Crtns	12.98

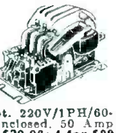
866A KIT AND XFORMER

2 Tubes, Sckts, xfmr 115v 60cyc Inpt, outpt, 2.5vct, 10A/Hvinsul. **SPECIAL** 55.49

DIODE PROBE TUBE

Unexcelled for **No-Loss VHF** testing. Ultra sensitive subminiature-envelope. **New**, w/data VR92 ..... **25c; 5 for $1.**

CONTACTOR



G. E. 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, 15 HP/220V, 25HP/600V. Control Inpt. 220V/1PH/60-Cy. Contacts rated 45 Amp Enclosed, 50 Amp Open. **SPECIAL** ..... **$29.98; 4 for $99**

OIL CAPACITORS

Mfd	Each
50wvdc	
4	$0.40
150 wvdc	
1-1-3-5	.69
250wvdc	
2x.25	.35
300wvdc	
1.2	.39
400wvdc	
.1	.49
.5	.59
1	.69
4	.98
6	1.08
8	1.19
10	1.39
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.034	.30
.1	.35
.25	.39
.5	.42
1	.52
2	.65
5	2.25
6	2.59
7	2.89
10	3.10
2x.1	.59
2x.25	.78
2x.5	.89
2x1	1.05
2x2	1.25
2x8	3.25
3x.05	.75
3x.22	.85
3x.25	.98
700wvdc	
4	1.50
800wvdc	
.1	.69

Mfd	Each
1000wvdc	
.45	.59
1	.79
2	.85
5	2.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.49
.75	1.69
1	1.79
5	3.49
6	3.98
2000wvdc	
.1	1.49
2x.1	1.69
1	1.75
2	2.98
3	3.69
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
2	4.45
4	7.89
4000wvdc	
2	8.98
5000wvdc	
.2	4.49
4	19.98
7000wvdc	
.002	1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49
10000wvdc	
.03	3.49
12000wvdc	
.02	4.98

Mfd	Each
12500wvdc	
2	95.00
15000wvdc	
.0016	9.98
25000wvdc	
.00025	7.49
1	95.00
AC RATED	
220vac/600dc	
2	.69
4	.89
5	1.29
225vac/630dc	
3.3	.79
230vac 630dc	
5	1.29
330vac 1000dc	
1.25	.63
1.5	.70
1.75	.98
2	.33
2.5	.90
2.8	.95
3	1.00
4	1.29
5	1.49
15	3.98
25	6.49
405vac/1200dc	
.15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98

2MFD/330VAC/1000WVDC "CD" RDN CAN **3 for $1.00; 10 for $3.00; 100 for $25**
9MFD/220VAC/600VDC **$1** ..... **12 for $10**
Quantity Users Write for Special Prices

TRANSFORMERS

All 115 V 60 Cyc Input TV & CR Pwr Xfmr up to 20" Tubes. Hi Volts to 20 KV (w/quadrupler ckt.) ALL Tubes. PL & Fil wndgs 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, 3.5V/1.75A CSD Kenyon Hvins, 4/BC412 Replmnt **$7.98**
1000VCT/45MA, 795VCT/80MA, 360VCT/55MA, 3X5V/3A, 6.3VCT/1A, 6.3VCT/.3A CSD HVINS CAN BE USED 2X RATING RAYTHEON, HIPERSIL CORE **$4.98**
950VCT/100MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A WESTERN ELECT **$5.49**
900V/35MA, 2X2.5V/2A, XCLENT 1800V DBLER TWO 2X2 FIL. WNDGS **$3.49**
900V/3MA, 6.3V/2A, 2.5V/3A **$2.98**
840VCT/110MA, & 530VCT/21MA, 2X5V/3A, 6.3VCT/1A, 6.3VCT/.3A **$4.98**
770VCT/85MA, 5V/2A, 6.3V/3.5A **$3.98**
770V/2.5MA, 2.5V/3A HVINS HMSLD includes FILTER PARTS 4-scope **$3.69**
760VCT/120MA, 2.5VCT/10A, 6.3VCT/2A, 5V/3A, 10V/3.25A **$6.98**
720V/85MA, 5V/3.5A, 6.3V/3.5A **$2.98**
700VCT/120MA, 2X6.3V/3A, 6.3V/1A Price ..... **$3.98**; Two for **$7.25**
650VCT/150MA, 5V/3A, 6.3V/2.1A **$2.98**
570V/150MA, 5V/3A, 12V/4A HSLD **$4.49**
500VCT/60MA, 6.3V/4A HSLD **$2.98**
480VCT/80MA, 6.3VCT/4A, 5V/3A **$2.69**
420VCT/90MA, 6.3V/1.9A W/INPUTS 6, 12, 24, 115VDC & 115 230VAC @ **$1.98**
550VCT/150MA, 5V/3A, 6.3V/5A **$3.49**

FILTER CHOKES

Dual 30 Hy/60ma Csd	$.98
15Hy/40ma AC/DC sets, 3 for	.98
12Hy/80ma/3KVins	2.25
10Hy/75ma	1.25
10Hy/125ma/UTC/Csd/H'Sld/1KVins	1.69
50Hy/125ma/Csd/H'Sld	2.89
12Hy/300ma/5KVins	4.95
20Hy/300ma or 15Hy/400ma/12KVins Kenyon	8.95
13.5Hy 1Amp/17KVins/Raytheon	39.95
Dual 2Hy/300ma USN $1.25; 2 for	1.98

FILAMENT TRANS.

2.5V/2A @ 79c, 2 for $1.49, 10 for	$6.49
2.5VCT/10A 5KVINS	3.59
2.5VCT/20A/12KV INSUL CSD HSLD	7.98
5VCT/10A, 4KV INSUL CSD HSLD	5.95
5VCT/10A/12KV INSUL G.E	8.25
5V/60AMP CSD KENYON, HVINS	13.98
5V/115A CSD KENYON HVINS	16.95
6.3VCT/.6A 1 KV INS CSD HVINS	1.98
6.3VCT/.7A NAVY HSLD HVINS	1.98
6.3V/1.5Amp CHANNEL MTG	.98
6.3V/2Amp CHANNEL MTG	1.59
7.5VCT/12A CSD KENYON 15 KVINS	10.95
12.6VCT/1.25A CSD HMSLD	1.98
24V/1.25A CSD @ $1.98 Two for	3.49
2X12V/2A or 24V/2A @ $3.89 Two for	6.98
24V/6A CSD @ $4.98 Two for	9.49
42.5V/2A SEL RECT TRANS	4.85
INPT 110 & 220 V., OUTPT 12.6 VCT/3.5A, 16.6V/1.25A	6.98

SPEED DRILLS
29 PIECE SET

Chrome Vanadium Speed Steel, machinists or tool makers drills, or for all purpose use. Standard full length 1/16" to 1/2" by 64ths. With cased Huot drill index. Delivered Prepaid **$9.98**
12 piece set; 1/16 to 1/2 less drill index. Delivered Prepaid **$3.98**

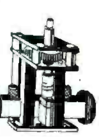
TUBE CLAMPS

926B-5, 926B-16, 926B, 929-1, 930-19, 926B-19, 926A-10 ..... **5 for $1.00**

"TABS" TUBE SPECIALS
BROKEN KEYS OR CRACKED BASE ELECTRICALLY PERFECT & GTD.

1B3GT, 6H6, 6K6GT, 6SN7GT 12SN7GT ..... **Each 50c; 5 for $2.00**
6BG6G, 6BQ6GT, 12SG7, 19BG6, 6L6G, 6L6GA ..... **Each 79c; 3 for $2.00**

MICROWAVE



Klystron Mtg Assy (723 AB) & Coupling to 2 Type "N" Co-Ax Fittings **$9.98**
Two for **$18.00**
1 Microsecond Delay Line **$2.95; 4 for $10.00**
Microwave Lighthouse Assy —P/O RT39 APG5 & 15. osc and Tr Cavities, Type N Coupling. Uses 2C43, 2C40, 1B27, Tunes 24–2700 MC Less Tubes. **SPECIAL $20.00; 2 for $36.00**
Watt Meter Low Power. Used with Bolometer Bridge Measures Low Level Microwave Power. Balanced Barretter Bridge Direct Reading. Self Calibrating Range 50 Microwatts to 10 Milliwatts.
SPECIAL **$119.00**
X Band Adaptor UG39 to UG40 Choke to Plane Flange ..... **$1.69; 4 for $6.00**

PULSE TRANSFORMERS

PULSE-XFMR 1000 Pulse Per Sec, 5 Watt, TR1025 P/O LU-3 Test Equipment **$7.98**
7.5 KV Pulse, Pri 4 KV, 50–1000 ohm imped. Permalloy Core, W Eco **$14.98**
Pulse Blocking Osc. 3 wndgs. Video Interstage 1:1 ratio, 32 mh wndgs. H'Sld. HiVins, GE. **$1.98**
Pulse Blocking Osc. 3 wndgs. 1:1:1 ratio 1 mh wndgs GE H'Sld, HiVins **$2.98**
Pulse Blocking Osc. Video Interstate 3 wndgs 1:1:1 ratio, 4.3 mh wndgs, GE, H'Sld, HiVins 1. Micro Second rise time **$2.98**
PULSE SHAPING Xfmr Raytheon UX12819, 1 MU Sec. 2000 CY **$7.95**
UTAH 9340 P/O CP-5A/APS15 ..... **$9.00**
Write for Details on Pulse Units

MICA CAPACITORS

Brand NEW Made to Rigid Gov't Specs.

Fig. B. .001 mf. 10c, .006 mf. 23c; .01 mfd. 35c
Fig. C. Solder Lug Terminals & Mtg Holes

Mfd.	Each
600 WV	
.0001	$0.29
.001	.42
.002	45
.004	.53
.005	.55
.006	.59
.008	.63
.01	.66
.02	.76

Mfd.	Each
600 WV	
.03	1.19
1200 WV	
.002	.66
.004	.68
.005	.71
.01	.78
2500 WV	
.00047	.59

Fig. D. Screw Term & Mtg.

Mfd.	Each
600 WV	
.0001	$0.29
.00055	.37
.00085	.42
.0012	.44
.003	.49
.005	.54
.015	.71
.02	.78
.03	1.19
.033	1.29
.039	1.98
.04	2.09
.05	2.39
1200 WV	
.001	.61
.002	.66
.0051	.71
.0068	.75

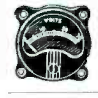
Mfd.	Each
1200 WV	
.01	$0.78
.013	.89
.03	1.89
.033	2.39
2500 WV	
.0004	.59
.002	1.09
.0022	1.09
.0024	1.13
.0035	1.19
.0036	1.19
.0043	1.29
.005	1.45
.006	1.55
.01	1.89
.015	2.19
3000 WV	
.005	1.65

Fig. E. Upright Xmtg Micas

Mfd.	Each
250 VDC	
.05	$0.47
.02	2.59
1500 VDC	
.04	.89
.05	1.08
2000 VDC	
.003	1.08
.005	1.19
.006	1.25
.01	1.39
.015	1.68
.02	1.98
.03	2.35
2500 VDC	
.0025	1.08
.006	1.65
3000 VDC	
.00005	.78

Mfd.	Each
.0001	$1.08
.0003	1.15
.0007	1.19
.0055	1.39
3000 VDC	
.0055	1.35
.008	1.79
3500 VDC	
.000033	.78
5000 VDC	
.000082	1.65
.0001	1.79
.00015	2.29
.00018	2.39
.0003	2.75
.00043	2.85
.0006	3.59
.001	3.89
.01	4.79

METER SPECIALS



0-30VDC Aircraft Type "AN" as Illustrated ..... **$1.95; 3 for $5.25**
0-25MA DC Weston **$6.98**
0-60ADC "AN" ..... **$3.25; 3 for $9.**
0-240ADC "AN" **$3.49; 3 for $9.75**
— 20 + 3VU Weston 301 Vol. Level Indicator **$16.98**

BENCH TOOLS

Pliers 6" Long Nose & Side Cutters ..... **$.89**
Pliers 6" Side Cutters ..... **.89**
Pliers Linesmans 7" Heavy Duty ..... **.79**
All (3) Pliers Listed Above **2.25**
Drill Set 9 pcs. 1/16" to 1/4" Hardened & Tempered Tool Steel, Plastic Case. **39c; 3 for $1.**
Screw Driver Set 6 pcs. magnetized. Hammer-Proof Plastic Handle, 4 Standard, 1 Recess, 1 Stubby. SPECIAL ..... **.98**
Utility Screw Driver Set. 3 Standard, & 2 Recess Interchangeable Blades. W/Wrap Around Plastic Case. SPECIAL ..... **.79**
Screw Driver Set 6 pcs. Plastic handle, 3 Standard 1 Recess, 1 Stubby, 1 Pocket ..... **.89**
4 in 1 Screw Driver Set, blades fit in handle **.59**
Offset Screw Driver Standard & Recess ..... **.19**
Quick Return Spiral Screw Driver & Drill, with 3 Drill Bits & 1 Sd Blade. **SPECIAL** .. **2.25**

VARIABLE CONDENSERS

RUD Dual 75mf ea. Sect 1000V Gap. HF .. **1.10**
JOHNSON 70H30 70mmf/3kv Gap. **1.29**
Cardwell Neut ZT/12 mmf 500 Volt **98c**
CARDWELL TK-300-US 53 to 312 mmf. Can be made Split Stator. BRAND NEW **$9.98**
Vernier Drive 10 to 369mmf, each **59c**
Midget 3 to 15 mmf, Midline, each **29c**
2½ Meter Butterfly Cndsr 30mmf w/RF Tank & Choke ..... **59c; 2 for 98c**

TELEVISION ANTENNAS

Conical antenna, sturdy prefab const. Versatile 72, 150 or 300 ohm match. 8 elements & 100 ft of all copper twinex, cross bar and hardware **$5.98**
Double Vee all channel antenna, Hvy duty aluminum construction. Inclds mounting clamp & 100 ft of twinex **$4.50**
Window Antenna 4 element conical, all channel, sturdy construction. Easy to mount **$3.95**

THAT'S A BUY **"TAB"** THAT'S A BUY

Dept. 2E 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 NYC. Add. Sphr. Charges & 25% Dep. Tubes Gtd via R-Exp. only. Prices Subject to Change Without Notice.

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery.

Current (cont.)	18/14 Volts	26/18 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1AMP	1.35		2.15	3.70	7.50
2AMP	2.20		3.60	5.40	10.50
4AMP	3.75		6.75	10.25	
5AMP	4.25		7.95	12.95	25.25
10AMP	6.75	9.98	12.75	20.00	40.00
12AMP	8.50		16.25	25.50	45.00
20AMP	13.25	16.20	25.50	39.00	79.50
24AMP	16.25		32.50	45.00	98.00
30AMP	20.00	24.30	38.50		
36AMP	25.00		48.50		

Full Wave Selen Rect & Trans, in Kit Form. All 115V/60cy inputs.
up to 14VDC at 12 amps........ $18.98
up to 28VDC at 12 amps........ 28.98
up to 28VDC at 48 amps........ 117.00
up to *20VDC at 6 amps........ 12.98

RECTIFIER XFMRS

18.8—19.2—20.4—21.4 Volts/12 Amp.... $10.98
31—32—34—36 Volts/12 Amp 2 Kvins... 13.98
18—12—9—CT—9—12—18V/4 Amp..... 8.75
18—12—9—CT—9—12—18V/12 Amp.... 16.75
36VCT—24V—18V/24—Amp........ 35.75
18V/2A....2.75; 18V/4A........ 3.95

BATTERY CHARGER RECTIFIER

10-0-10 Volts (CT) 120 Amp (Fan Cooled). Replace Your Old inefficient Sulphide Rect. with the New Selenium Types. **SPECIAL**. $13.75

RECTIFIER CHOKES

4 Amp	.07 Hy	.6 Ohm	$7.95
12 Amp	.01 Hy	.1 Ohm	14.95
24 Amp	.004 Hy	.025 Ohm	29.95

SHARPENING STONE

INDISPENSABLE for Lab or Workshop. Finest Silicon Carbide No. 124 Carborundum Co. Unsurpassed for Precision Grinding of Crystals Knives, Fine Tools—6" x ⅝".....45c; 3 for $1.00

"TAB" THAT'S A BUY

400 CYCLE XFMRS

G-E M7472401P1 3140, 3030, 2920, 2810V/35 Ma........ $4.98
WE KS9608 1233vct/350Ma, 1140vct/70Ma 5.98
G-E M7472443P1 788V/200Ma, 210V/15Ma, 5V/2A........ 4.95
G-E M7472469 6.3V/7A, 6.7V/.9A, 6.3V/.3A 3.98
WE KS9604 6.3V/4.65A, 6.3V/.3A........ 3.49
WE KS9603 6.3V/3A, 5V/2A........ 2.98
WE D163412 6.3V/1A........ 1.95
LANGEVIN 702556 6.3V/.6A........ 1.49
FREED 11686 5V/10A........ 4.95
WE KS9602 5V/4A........ 2.98
FREED 11685 2.5vct/10A CSD........ 4.95
LANGEVIN 702720 5V/6A, 13 KVINS.... 4.98
WED 164533 6.3V/1.25A, 6.3V/1.25A........ 1.98

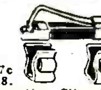
AUDIO COMPONENTS

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 $4.49:...2 for $7.98
With **UTC** Vatimatch........ $5.49
UTC Varimatch 600 Ohm input Voice Coil........ $1.98
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

CIRCULAR SLIDE RULE

Equiv to 12"—Only 2¼" Radius. LAMINATED—Print Stays On! Mult, Div, Sqs, Cubes & Roots. Log. Decimal Equiv Data. Case........98¢
Parallel Rules. Precision Drafting Tool Mfr. BRUNING 6" wide. For Radiomen, Engineers, Students—Unsurpassed for Quick Ckt Diagrams.
SPECIAL........**39c; 3 for $1.00**
Ball Pens Red & Blue GtD........**5 for $1.00**
Ball Pens Draftsman Black GtD.....**2 for $1.00**

CIRCUIT BREAKER FUSES



PUSH TO RESET

Amps 3-5-7-10-15-20 Ea. 27c
4 for **$1.**; 25 for **$5.**; 100 for **$18.**
Circuit Breaker Fuse W/2 Mounting Clips 39c; 3 for....$1.00; 20 for....$5.98; 100 for....$25. Fuse is 3AG Size. Operates up to 24 Volts. Please State Amps (current) desired.
Heinmann Magn Bkrs, Amps; 0.22, 2, 3, 5, 7, 9, 12, 15, 20, 30, 35, 40, 80, 180........**Each $1.69; 10 for $15.98**

TEST CORDS

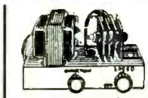
15 Foot Extension Cord Hv Duty. Rubber Covered Insulation. As Illus......$1.10
6 Foot Line Cord W/Plug Rubber Covered...55c
4 Foot Test Cord. Plug & (2) Alligator Clips Attached........**59c; 2 for 98c**
4 Foot Instrument Test Leads, High Quality Red & Black........**59c; 2 for 98c**

KITS AND COMPONENTS

SPRGE CRP 3 Vert Integrator Netwk 3 Res-3CNDSR only **3 LEADS 29c. 5 for $1.00**
DISC CERAMIC 2X.004MFD/600V **6 for $1.00**
50 PWR Magnifier & Condsr..69c, **4 for 2.00**
Silver & Mica Cndsrs........**30 for 2.50**
Controls, 50 ohm to 2 Meg........**10 for 2.50**
Resistors, ½ & 1W, to 2 Megs....**100 for 2.98**
Vitreous W W Resistors........**5 for .69**
Sockets, Asstd. 8, 7, 5, 4P........**25 for 2.49**
Iron Core Slug & Screw........**50 for 1.00**
Knobs, Asstd. w/Insert........**10 for .98**

TABOGRAM
WRITE FOR IT
WE STOCK LARGE VARIETY OF COMPONENTS. TELL US YOUR NEEDS
SELL US YOUR TUBES & EQUIPMENT

"HO" RAIL PACK



0 to 12VDC/2 Amp Variable DC supply, uncased and completely built—inpt. 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad includes voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives.....$10.95
2 for $20.00

STORAGE BATTERIES

36 Volt WILLARD Mini-BRAND NEW 5 oz Designed Portable Equip. Models...**98c; 4 for $3**
(4) 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........ 2.49
6V/6AH Batt. W/Acid........ 2.69
6V/40AH Willard........ 6.98
6V/40AH Batt. W/Acid........ 9.25
Hydrometer 1.06 to 1.24 Sp Grav. USN... 1.98
Spec Grav Ind & Merc. Thermom........ .98
Acid is Shipped in Bottles. R'Exp only

VACUUM CAPACITORS

25 MMF 7.5KV........54.98
50 MMF 7.5KV........ 6.98
100 MMF 20KV........19.95
100 MMF 7.5KV........ 5.98
12 MMF 20KV........ 9.98
50 MMF 20KV........12.98
12 MMF 32KV........14.98

CONNECTOR AND CABLES

831R/SO239 Receptacle........$0.50
10 for $3.90
831SPN/PL259A Plug........$0.65
10 for 5.50
831SP/PL259 Plug $0.50:10 for 4.75
83-IJ/PL258 Junction........ .95
83-IT/M358.....$1.25; 10 for 11.00
CORD CD307A **W/JK26 & PL55 5 ft long**..1.09
CORD Same as above **8 ft $1.29; 12 ft long**..1.49
CORD RG8U COAXIAL CABLE **per ft**........12
RG59U Cable **per ft $0.08**........**100 ft $5.98**
300 Ohm All Copper TV Twinex, Durable Hvy Web........**100 ft $1.49; 1000 ft $12.49**

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

OA2	$0.95	2E25/HY65	5.15	6A3	.90
OA3/VR75	1.04	2E26	2.88	6A4	1.89
OA4G	1.05	2E30	1.95	6A5G	2.39
OB2	1.37	2E31	1.49	6A6	.80
OB3/VR90	1.09	2E32	1.49	6A7	.85
OC3/VR105	1.15	2E36	1.49	6A8GT	.90
OD3/VR150	.90	2E41	1.54	6AB4	.79
OY4	2.53	2E42	1.49	6AB5/6N5	1.33
OZ4	.60	2E43	1.49	6AB7/1853	.98
C1A/ELC1A	9.75	2G21	1.49	6AC5GT	1.00
O1A	.69	2J21	8.75	6AC6G	.95
VS-1	12.49	2J21A	8.90	6AC7	.80
1A3	1.10	2J22	7.69	6AD7G	1.29
1A4P	.79	2J30	69.00	6AG5	.79
1A5GT	.79	2J31	27.00	6AG7	1.39
1A6	1.49	2J31A	79.95	6AH5G	1.49
1A7GT	.95	2J32	37.00	6AH6	1.22
1AD4	1.49	2J33	27.00	6AJ5	1.40
1AE4	1.80	2J34	27.00	6AK5	.74
ELC1B/3C31	3.45	2J36	108.00	6AK5W	2.98
1B3/8016	.81	2J37	12.70	6AK6	1.05
1B4P	.89	2J38	11.75	6AL5	.54
1B5/25S	.99	2J39	44.00	6AL7GT	1.29
1B7GT	.99	2J42	187.00	6AN5	2.90
1B21/471A	2.85	2J48	24.25	6AQ5	.55
1B22	2.20	2J49	34.00	6AQ5W	3.98
1B23	9.90	2J50	21.25	6AQ6	.81
1B24	9.45	2J52	249.50	6AQ7GT	1.29
1B26	2.45	2J55	85.00	6AR5	.79
1B27	12.75	2J56	149.00	6AR6	2.98
1B32/532A	3.90	2J61	49.95	6AS5	.79
1B35	10.98	2J62	49.45	6AS6	2.43
1B37	16.98	2K22	49.95	6AS6W	3.20
1B38	29.95	2K23	29.00	6AS7G	4.14
1B40	4.95	2K25	39.95	6AT6	.63
1B41	49.95	2K25/723AB	31.58	6AU5GT	1.10
1B42	18.00	2K28	32.00	6AU6	.59
1B46	1.98	2K33	300.00	6AV5GT	1.29
1B53	49.95	2K35	398.00	6AV6	.49
1B56	38.50	2K41	145.00	6AW6	1.89
1B58	175.00	2K42	145.00	6AX4/6U4	.79
1B60	69.75	2K43	135.00	6AX5GT	.79
1B63	50.00	2K46	360.00	6B4G	1.23
1B63A	75.00	2K47	460.00	6B5	1.19
EL1C	2.70	2K48	118.00	6B6G	.89
1C5GT	.89	2K50	698.00	6B7	.95
1C6	.79	2V3G	.98	6B8G	.60
1C7G	.89	2W3GT	.98	6BA6	.63
1D5GP	.99	2X2	.48	6BA7	1.27
1D7G	.89	2X2A	1.53	6BC5	.63
1D8GT	.89	3A1	.99	6BC7	1.23
1D21/631P1	3.89	3A5	.81	6BD5GT	1.65
1E5	.99	3A8GT	1.59	6BD6	.83
1E7G	.99	3B4	2.65	6BE6	.59
1F4	.69	3B5	.98	6BF5	.98
1F5G	.79	3B7/1291	.69	6BF6	.65
1F6	.89	3B22	2.70	6BF7	2.55
1F7G	.89	3B23/RK22	4.95	6BG6G	1.39
1G4GT	.89	3B24	5.40	6BG7	1.98
1G5G	.89	3B25	4.50	6BH6	.63
1G6GT	.79	3B26	3.70	6BJ6	.69
1H4G	.89	3B28	7.90	6BK7	2.15
1G5GT	.72	3C6/XXB	1.49	6BL7GT	1.45
1H6GT	.79	3C22	77.00	6BN6	1.49
1J5G	1.20	3C23	9.90	6BN7	1.69
1J6GT	.79	3C31/C1B	3.45	6BQ6GT	1.20
1L4	.65	3C33	14.98	6BQ7	2.15
1L6	.98	3C34/HK24	5.49	6BY5G	1.45
1LA4	1.19	3C45	15.48	EL6C/8C	16.98
1LA6	.99	3D6/1299	.69	6C4	.50
1LB4	1.29	3D21A	4.98	6C5GT	.55
1LC5	.79	3D22	13.98	6C6	.57
1LC6	1.39	3D23	4.90	6C7	1.26
1LD5	.99	3E29	14.95	6C8G	.80
1LE3	.99	3K22	275.00	6C21	29.45
1LH4	.89	3K23	405.00	6C36	.69
1LN5	.79	3K30	300.00	6CD6G	1.69
1N5GT	.72	3LF4	1.29	6D4	2.70
1P5GT	.79	3Q4	.75	6D6	.89
1P42	5.60	3Q5GT	1.29	6D7G	.89
1Q5GT	.70	3S4	.85	6D8G	.85
1R26	69.00	3V4	.75	6E5	.79
1R4/1294	1.29	4-125A	29.95	6E7	1.39
1R5	.79	4-250A	40.95	6F4	6.20
1S4	1.19	4-1000A	108.50	6F5	.95
1S5	.79	4B23	16.98	6F6	.79
1S21	7.90	4B27	4.98	6F6GT	.79
1T4	.79	4B32	9.50	6F7	.85
1T5GT	.99	4C25/HK54	5.98	6F7G	1.29
1U4/5910	.73	4C33	59.00	6F8G	.85
1U5	.79	4C35	27.25	6G6G	.90
1V	.79	4C36	15.98	6H6	.60
1V2	.70	4E27/257	14.50	C6J/5C21	6.95
1X2	.95	4J22	148.50	6J4	6.66
1Y2	6.98	4J31	98.00	6J5GT	.47
1Z2	3.98	4J34	194.00	6J6	.63
2A3	1.78	4J42/700	27.00	6J7	.72
2A4G	1.19	4J52	350.00	6J8G	1.19
2A5	.69	4J56	498.00	6K4	5.15
2A6	.69	4T4/2	5.95	6K4A	6.45
2A7	.69	4X-150A	45.00	6K5GT	1.09
2AC15	4.98	4X-500F	85.00	6K6GT	.59
2AS15	4.98	5AX4GT	.54	6K7	.75
2B7	.89	5AZ4	1.35	6K8	1.08
2B22	3.90	C5B/5C30	3.95	6L5G	.75
2C21/1642	.67	EL5BHD	16.98	6L6	2.09
2C22/7193	.33	5C21/C6J	6.95	6L6G	1.35
2C26	.19	5C22	49.95	6L6GA	1.35
2C26A	.47	5C30/C5B	3.95	6L6GAY	2.29
2C33/RX233A	3.49	5D21	27.45	6L7	.80
2C34/RK34	.69	5D23/RK65	36.50	6N4	2.39
2C36	27.00	5J29	12.40	6N6G	1.69
2C39	21.00	5J23	59.00	6N7GT	.80
2C39A	29.50	5R4GY	1.39	6P5GT	.89
2C40	7.29	5R4GYW	1.75	6Q7	.89
2C43	14.75	5T4	2.49	6R7	.77
2C43/464A	9.49	5U4G	.69	6R8	1.39
2C44	1.20	5V4G	1.10	6S4	.85
2C50	3.69	5W4	.89	6S7G	.83
2C51	6.45	5X4G	.79	6S8GT	.92
2C52	5.98	5Y3GT	.43	6SA7GT	.63
2D21	1.26	5Y4G	.79	6SA7GTY	3.37
2E5	1.19	5Z3	.89	6SB7Y	1.19
2E22	1.95	5Z4	1.49	6SC7	.90
2E24	4.69	C6A	6.75	6SD7GT	.80

6SF5	.77	12AZ7	1.49	35B5	.79	117Z7GT	1.49	CK537AX	3.04
6SF7	.73	12BA6	.59	35C5	.69	F123A	7.90	CK538DX	.98
6SG7	.72	12BA7	.79	35L6GT	.79	T125	12.49	CK539DX	2.19
6SH7	.61	12BD6	1.23	35T	6.95	F127A	19.98	CK541DX	1.99
6SJ7	.70	12BE6	.59	35TG	5.45	VT127A	3.90	CK542DX	.99
6SK7GT	.69	12BF6	.85	35W4	.59	CV148	4.98	CK543DX	.99
6SL7GT	.69	12BH7	1.29	35Y4	.69	150T	14.50	CK544DX	.99
6SN7GT	.70	12BV7	1.35	35Z3	.79	FG166	49.00	CK546DX	1.99
6SN7WGT	2.25	12BZ7	1.25	35Z4GT	.69	FG172	29.00	CK547DX	1.98
6SQ7GT	.63	12C8	.65	35Z5GT	.59	182B	1.20	550P1	19.95
6SR7	.63	12F5GT	.65	REL36/6J4	.49	FG190	12.80	CK571AX/5886	2.49
6SS7	.75	12H6	.65	36	.65	HF200	21.00		
6ST7	.98	12J5GT	.49	37	.69	T200	22.98	CK573AX/6029	3.49
6SU7GTY	2.69	12J7GT	.75	3835	.59	201A/CX301A	.98		
6SZ7	1.05	12K7GT	.89	RK39	2.89	203A	5.98	575A/975	13.75
6T7G	.85	12K8	.69	39/44	.59	205B/VT2	1.69	WL579	10.49
6T8	.98	12Q7GT	.55	CRC40	.59	CE206	3.15	WL579B	12.98
6U5/6G5	.99	12S8GT	.98	T40	4.29	211/VT4C	.45	601B	.19
6U6GT	.83	12SA7GT	.69	TZ40	3.98	CE215	8.98	HY615	.25
6U7G	.55	12SC7	.80	40	1.09	RX215	9.95	616	37.00
6V3	1.89	12SF5GT	.72	HY40Z	3.75	WE215A	.18	KU627	18.00
6V6	1.39	12SF7GT	.49	41	.79	217C	8.75	WL652	65.00
6V6GT	.57	12SG7	.83	42	.69	227A	4.98	WL670A	11.98
6V8	1.99	12SH7	.63	43	.85	231	1.20	WL673	117.00
6W4GT	.57	12SJ7GT	.59	45	.69	242C	3.95	WL676	39.95
6W6GT	.89	12SK7	.72	45S/VT52	.65	244A	4.15	WL686	35.00
6W7G	.85	12SL7GT	.65	45Z3	.69	247A	9.95	701A	5.89
6X4	.59	12SN7GT	.75	45Z5GT	.89	250R	9.90	702A	3.29
6X5GT	.59	12SQ7GT	.63	46	.89	250TH	22.25	702B	5.98
6Y6G	.89	12SR7	.63	47	.99	250TL	17.75	703A	4.75
6Y7G	.89	12X3	.90	48	1.17	HK254	14.49	704A	.98
6Z7G	.89	12Z3	.89	RK48A	6.85	262B	3.98	705A/8021	1.98
6ZY5G	.89	14A4	.87	RK49	7.50	274B	3.45	707A	7.90
7A4/XXL	.73	14A7/12B7	.75	49	.83	276A	9.89	707B	13.50
7A5	.73	14AF7/XXD	.83	50	1.19	300B	11.50	710A/8011	.95
7A6	.73	14B6	.65	50A5	1.19	T300	26.98	713A	.98

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Contract Nos.

7A7	.69	14B8	.89	50B5	.79	HF300	24.30	NL714	5.95
7A8	.69	14C5	1.07	50C5	.69	304TH	8.90	714AY	5.90
7AD7	1.49	14C7	.95	50C6	1.49	304TL	8.90	715A	6.00
7AF7	.89	14E6	.99	50L6GT	.69	307A/RK75	4.20	715B	8.40
7AG7	1.00	14E7	1.09	50X6	.89	310A	6.25	715C	19.80
7AH7	1.19	14F7	.95	50Y6GT	.79	311CH	10.95	717A	.90
7B4	.69	14F8	.83	50Z7G	.98	311CT	10.50	718BY	48.45
7B5	.73	14H7	.83	52	.99	311T	10.50	718CY	48.45
7B6	.73	14J7	.83	53	.69	313C	2.98	719A	28.50
7B7	.73	14N7	.87	T55	8.79	316A	1.49	721A	2.49
7B8	.83	14Q7	.73	55	1.06	323A	24.25	721B	12.50
7C4	.73	14R7	.80	56	.85	327A	4.95	722A/237	2.45
7C5	.69	14S7	.98	57	.79	5340	2.98	723A	11.95
7C6	.69	14W7	1.09	58	.79	350A	6.50	723A/B	25.00
7C7	.69	14X7	1.23	RK59	1.45	350B	4.95	724A	3.95
7C23	72.00	15E	1.98	59	1.78	353A	4.65	724B	3.45
7C29	69.95	15R	.89	RK60/1641	1.95	HK354	24.98	725A	8.49
7E5/1201	.65	FG17	3.95	RK61	3.05	355A	14.15	726A	14.25
7E6	.53	18	.98	T60	10.49	368AS	7.49	726B	45.00
7E7	.73	19	.69	HY69	4.98	371B	.90	726C	52.00
7F7	.73	19BG6G	1.79	70A7	1.50	380A	.79	800	1.85
7F8	1.25	19T8	1.09	70L7GT	1.50	383A	1.49	801A	.45
7G7/1232	.89	19V8	1.62	71A	.79	393A	8.90	803	3.89
7H7	.73	T20/1623	3.79	CRP72	1.20	394A	4.90	805	3.90
7J7	.89	TUF20	5.19	CRP73	1.49	FP400	15.98	807	1.65
7K7	1.10	TZ20	3.79	73	1.67	WE417/5842	18.50	808	2.59
7L7	.83	20	1.17	NR74	.29	WL417A	8.95	809	2.43
7N7	.79	RK20A	8.95	HY75	4.59	GL434A	18.45	810	9.95
7Q7	.69	RX21	3.75	75	.99	446A	1.05	811	2.90
7R7	.83	22	.99	76	.79	446B	3.89	811A	3.79
7S7	.92	24	.85	77	.69	450TH	45.00	812	2.70

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

7T7	1.03	24A	1.10	78	1.05	450TL	52.00	813	12.49
7V7	.79	24G/3C24	1.90	79	.89	460/HF200	15.95	814	2.75
7W7	.95	25A6	1.09	80	.69	WL468	13.95	815	2.98
7X7/XXFM	.89	25A7	2.98	81	1.60	GL471A	2.69	816/866Jr	1.07
7Y4	.49	25AC5GT	1.59	FG81A	3.90	CK501X	1.26	826	.95
7Z4	.65	25AV5GT	1.29	82	1.19	CK501AX	2.20	828	11.29
8DC-15	4.98	25BQ6GT	1.19	82V	1.39	GL502A	1.79	SD828	.98
10Y	.35	25C6	1.18	83	1.45	CK502AX	1.49	829	11.49
CV11	5.25	25L6GT	.69	83V	1.79	CK503AX	1.49	829B	12.45
12A	.57	25W4GT	.89	84/6Z4	.99	CK505AX	1.79	830B	3.49
12A5	1.39	25Y5	.79	85	.79	CK506AX	1.49	832	7.65
12A6	.59	25Z5	.79	89	.75	RH507	9.98	832A	9.65
12A7	.90	25Z6GT	.99	VR92	.25	CK509AX	1.79	833A	39.45
12A8GT	.65	26	.79	FG95/5560	24.85	CK510AX	2.49	834	5.95
12AC7	1.19	27	.69	FG98	19.95	CK512AX	1.45	836	4.75
12AH7GT	1.45	FG27A	8.70	100TH	7.83	CK522AX	1.29	837	1.45
12AK5	1.98	HV27	10.95	102D	2.98	CK525AX	1.29	838	3.98
12AK5W	2.98	RK28A	4.89	102G	2.98	CK526AX	1.49	843	.39
12AL5	.75	28D7	1.95	FG104	37.98	CK527AX	2.84	845	5.95
12AT6	.52	30	.70	FG105	17.64	CK528AX	1.49	849	29.45
12AT7	.81	31	.59	VU111	1.45	CK529AX	1.79	852	19.98
12AU6	.72	HY31Z	2.75	HY114B	.75	GL530	22.00	860	4.90
12AU7	.63	32	.49	HY115/145	.79	CK531DX	1.89	861	23.95
12AV6	.49	FG32/5558	13.85	117L/M7GT	1.59	531	6.98	864	.39
12AV7	.98	32L7GT	1.49	117N7GT	1.79	CK532DX	1.89	865	1.29
12AW6	1.79	33	.59	117P7GT	1.39	WL532	3.98	866A	1.50
12AX4GT	1.20	34	.69	117Z3	.59	CK533AX	1.29	868/CE1C	3.49
12AX7	.79	35/51	.89	117Z4GT	1.39	CK534AX	.99	869	36.95
12AY7	2.95	35A5	.79	117Z6GT	1.19	CK536AX	.99	872A	3.29

874	1.39
878	1.95
884/6Q5G	1.80
885	1.45
893A	250.00
917	2.59
922	1.85
919	2.75
923	1.00
925	1.69
927/CE25	1.49
930	1.20
931A	5.00
954	.25
955	.39
956	.36
957	.45
958A	.67
967/FG17	3.95
973	16.95
991	.45
FM1000	1.50
CK1005	.85
CK1006	3.49
CK1007	.89
CK1027	2.98
CK1028	15.98
CK1089	2.99
CK1090	2.93
R1100	5.00
R1130	12.00
E1148	1.35
HY1231Z	5.39
1612	1.90
1613	.89
1616	.74
1619	.25
1620	4.70
1622	2.69
1624	1.90
1625	.33
1626	.33
1629	.29
1630	.97
1631	.74
1632	.77
1633	.73
1634	.73
1635	1.89
1636	3.19
1644	.95
2000T	149.50
2050	1.47
2051	1.15
5516	5.98
5517	3.39
5594	6.65
5608A	5.95
5637	6.98
5638	12.61
5647	8.25
5651	2.34
5654	2.79
5656	6.90
RK5657	350.00
5663	1.85
5670	5.30
CK5672	1.29
CK5676	1.29
CK5678	1.89
5634	14.98
5686	3.90
5687	5.49
5894	3.65
CK5697	3.49
CK5702	3.49
CK5703	1.29
CK5704	1.89
5718	10.15
5719	12.25
5726	1.79
GL5727	4.49
5744/CK619CX	1.69
5749	1.98
5751	5.45
5763	1.70
CK5783	6.69
CK5784	6.98
5812	2.99
5814	3.64
CK5829	4.39
5840	12.34
CK5851	7.79
CK5875	1.69
5881	2.69
X6030	4.49
8002R	99.50
8005	7.25
8008	6.49
8012	2.89
8013	2.75
8013A	6.45
8014A	28.95
8020	1.25
8025A	4.75
9001	1.55
9002	.95
9003	1.50
9004	.42
9006	.39

C'Ray Tubes

2AP1	9.70
3AP1	9.75
3AP1A	14.25
3AP5	18.00
3BP1	5.75
3BP1A	14.98
3BP5	18.00
3DP1	4.75
3EP1/1806P1	4.85
3FP7	.98
3FP7A	14.98
3GP1	4.20
3GP4	16.50
3HP7	3.40
3GP5	18.00
3HP14	14.98
3GP7	18.00
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.40
5AP1	3.45
5BP1	4.25
5BP4	4.25
5CP1	4.50
5CP1A	18.49
5CP7	11.75
5CP5	30.00
5FP7	1.49
5HP1	5.70
5HP4	5.70
5JP2	19.25
5JP4	26.75
5JP5	35.00
5JP7A	39.00
5LP1	22.25
5LP2	27.50
5LP7	29.95
5LP4A	33.00
5MP1	10.50
5RP7A	89.50
7BP1	8.65
7BP7	6.50
7EP4	17.98
7JP4	18.39
9GP7	12.75
9LP7	2.98
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	14.75
12HP7	14.75
905	3.49
912	89.98
913	9.98
914A	45.00

Xtal Diodes

1N21	.98
1N21A	1.55
1N21B	3.00
1N21C	21.50
1N22	1.25
1N23	1.35
1N23A	2.35
1N23B	3.49
1N25	4.98
1N26	8.75
1N27	1.55
1N29	3.50
1N32	23.75
1N34	.64
1N34A	.90
1N35	1.65
1N38	1.43
1N38A	2.19
1N40	7.95
1N39	4.15
1N40	7.95
1N41	9.98
1N42	17.50
1N43	1.69
1N44	1.21
1N45	1.39
1N46	.69
1N47	5.49
1N48	.59
1N51	.45
1N52	1.62
1N54	.89
1N55	2.35
1N55A	3.89
1N56	.89
1N57	.89
1N58	1.19
1N58A	1.49
1N60	.60
1N61	2.10
1N63/K63	2.49
1N64	.69
1N67	1.95
1N69	1.98
K34	1.35
CK705	.77
CK706	.54
CK707	1.80

Other Type Diodes in Stock

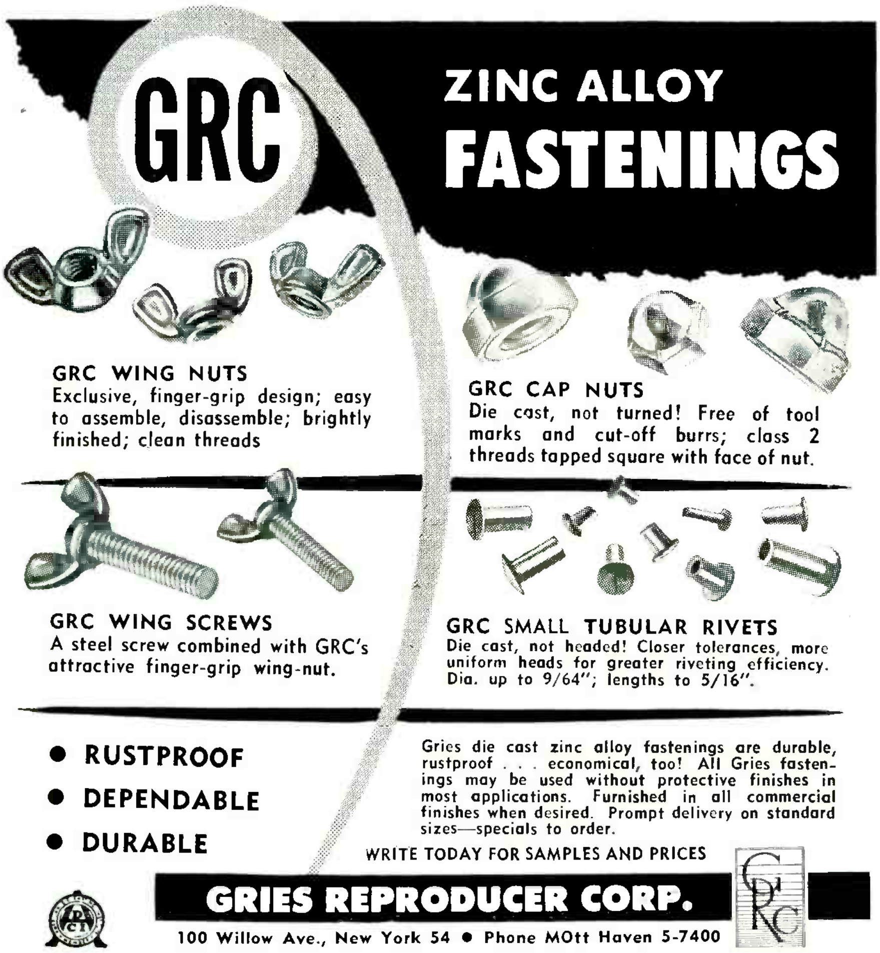
Money Back Guarantee (Cost of Mdse Only) $5 Min. Order F.O.B. N.Y.C. Add Shpg. Charges & 25% Dep. Tubes Gtd. via R-Exp. only. Prices subject to Change Without Notice.

THAT'S A BUY **"TAB"** THAT'S A BUY

Dept. 2E 111 Liberty Street, New York 6, N. Y., U.S.A. STORE: 111 LIBERTY STREET

REctor 2-6245

INDEX TO ADVERTISERS

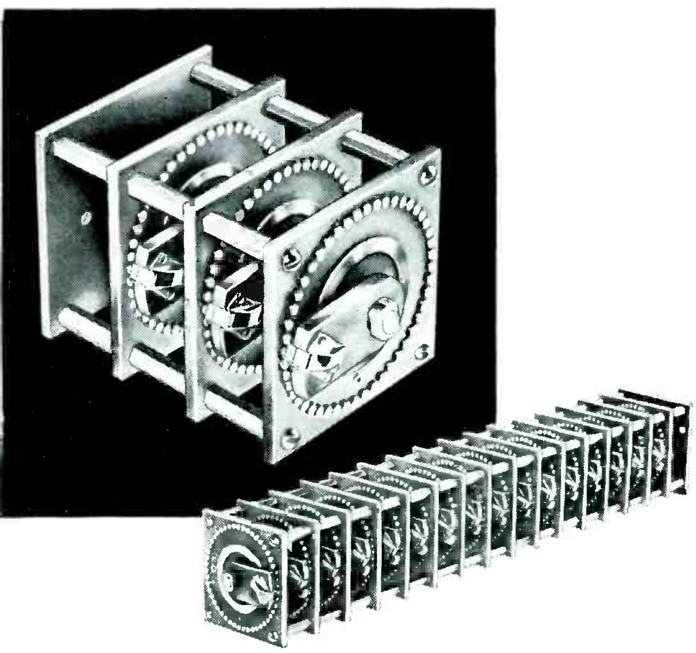

GRC
ZINC ALLOY
FASTENINGS
GRC WING NUTS
Exclusive, finger-grip design; easy to assemble, disassemble; brightly finished; clean threads
GRC CAP NUTS
Die cast, not turned! Free of tool marks and cut-off burrs; class 2 threads tapped square with face of nut.
GRC WING SCREWS
A steel screw combined with GRC's attractive finger-grip wing-nut.
GRC SMALL TUBULAR RIVETS
Die cast, not headed! Closer tolerances, more uniform heads for greater riveting efficiency. Dia. up to 9/64"; lengths to 5/16".
• RUSTPROOF
• DEPENDABLE
• DURABLE
Gries die cast zinc alloy fastenings are durable, rustproof . . . economical, too! All Gries fastenings may be used without protective finishes in most applications. Furnished in all commercial finishes when desired. Prompt delivery on standard sizes—specials to order.
WRITE TODAY FOR SAMPLES AND PRICES
GRIES REPRODUCER CORP.
100 Willow Ave., New York 54 • Phone MOtt Haven 5-7400


Hermetically Sealed
HYCOR
SERIES H
2.1 MEGOHMS
±0.1%
Precision Resistors
The New Series "H" Hycor Precision wire-wound resistors have been developed to meet the increasingly stringent requirements of the electronics industry.
The resistors are permanently sealed in a high stability plastic compound which virtually immunizes them against the effects of HIGH HUMIDITY, MECHANICAL SHOCK and AMBIENT TEMPERATURES UP TO 135° C. They will conform to JAN R-93 or MIL R93A specifications. Hycor Series "H" Precision wire-wound resistors have a temperature coefficient of 25 parts per million per degree C. and are available in resistances from 0.1 ohm to 6 megohms.
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
For further information contact your nearest Hycor representative or write for Bulletin H

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.

New Switch on SWITCHES by DAVEN



DAVEN not only supplies switches from its hundreds of standard units, but can also effect *quick changes* from standard units to special switches by using components at hand.

As a result, you are able to select, from thousands of variations, the right switch for your particular requirements.

And . . . here's a *new switch* for problems that defy solution with standard components. If your prototype is that of an unusual piece of equipment and requires a switch not yet developed, DAVEN will engineer it for you.

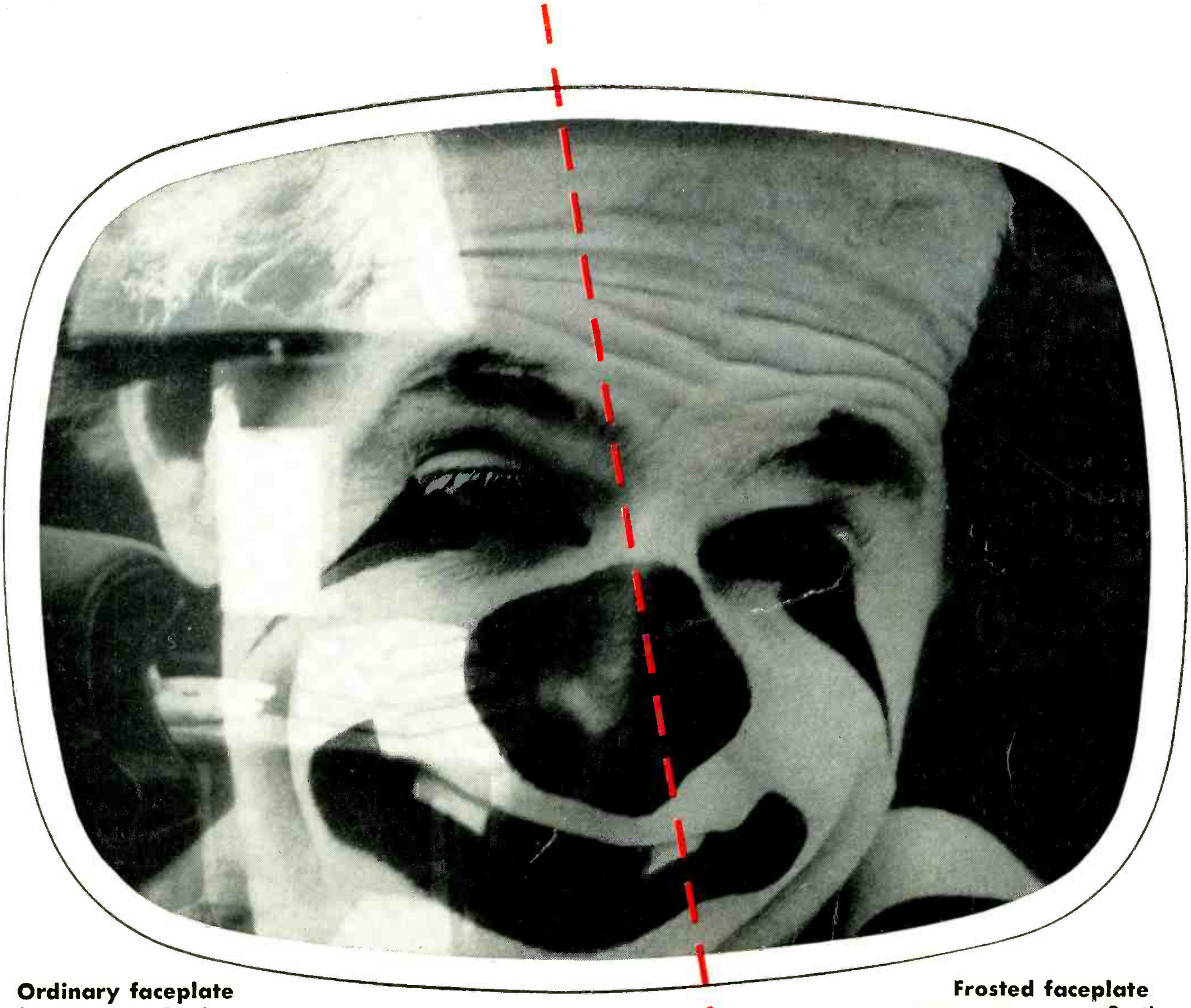
This is a service which DAVEN is singularly well qualified to perform by reason of its skilled engineering staff and exceptional facilities. For more than a generation, DAVEN has built up a Development Department that is second to none in solving difficult switch problems.

Furthermore, because only DAVEN has the patented "knee-action" rotor, units can be produced with a greater number of switch positions and poles in a smaller space than was ever possible before.

Why not call on DAVEN today to assist with your development project, especially if you need switches that must render maximum performance in minimum space.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

It's FREE Write for your copy of DAVEN's new, 28-page brochure on SWITCHES.



Ordinary faceplate
shows room reflections

Frosted faceplate
suppresses room reflections

Reflection-free

HERE YOU SEE what can happen to a TV picture when viewed in a lighted room. The untreated faceplate of the ordinary picture tube shows disturbing reflections of room lights and objects . . . but the frosted faceplate of a metal-shell kinescope SUPPRESSES ANNOYING REFLECTIONS . . . gives a clear, vivid picture over the entire faceplate.

Today, this feature of "freedom from annoying reflections" adds extra consumer appeal to your 1953 set designs . . . extra spark to your merchandising programs. Now get these important sales benefits at low cost, specify RCA metal-shell kinescopes . . . the picture tubes that have faceplates frosted to suppress distracting and annoying reflections.

For technical data . . . or design assistance on RCA kinescopes . . . write RCA, Commercial Engineering, Section 42BR.

Or 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.**

RCA-21AP4
Metal-Shell Kinescope (Magnetic Focus)

RCA-21MP4
Metal-Shell Kinescope (Low-voltage, Electrostatic Focus)

RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES ***HARRISON, N. J.***