FEBRUARY · 1952
PRICE 75 CENTS

Starts This Issue ..... page 4
INDUSTRY REPORT

electronics

A McGRAW-HILL PUBLICATION

A Complete image, using NTSC field-test signal specifications

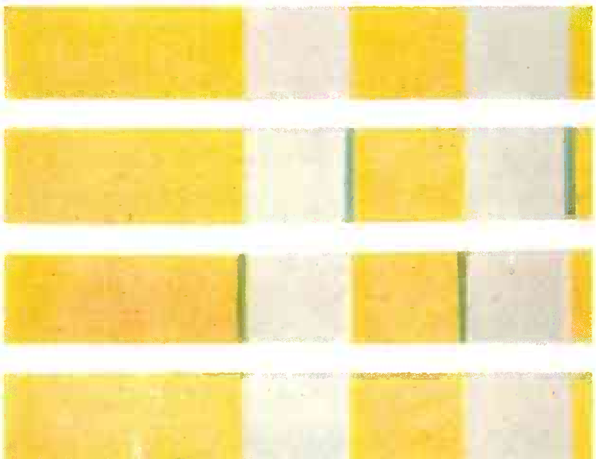
B Successive fields of A, showing effect of phase error

C Monochrome image resulting when chromatic signal is removed from A

NTSC
Color Television Images

(see page 88)

D Chromatic image resulting when monochrome signal is removed from A



E Yellow and white bars, showing removal of color fringes by color phase alternation

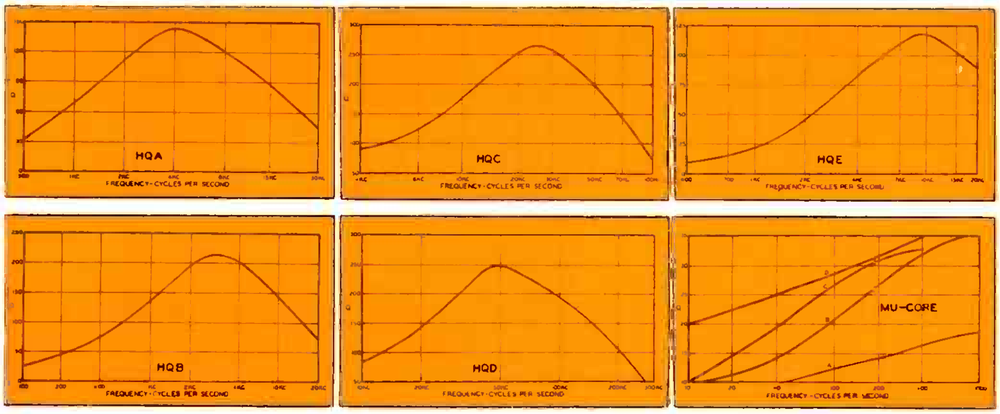
PERMALLOY DUST TOROIDS FOR MAXIMUM STABILITY...

The UTC type HQ permalloy dust toroids are ideal for all audio, carrier and supersonic applications. HQA coils have Q over 100 at 5,000 cycles... HQB coils, Q over 200 at 4,000 cycles... HQC coils, Q over 200 at 30 KC... HQD coils, Q over 200 at 60 KC... HQE (miniature) coils, Q over 120 at 10 KC. The toroid dust core provides very low hum pickup... excellent stability with voltage change... negligible inductance change with temperature, etc. Precision adjusted to 1% tolerance. Hermetically sealed.

HQA, HQC, HQD CASE
1 13/16" Dia. x 1 3/16" High

HQB CASE
1 5/8" x 2 5/8" x 2 1/2" High

HQE CASE
1/2" x 1 5/16" x 1 3/16" High



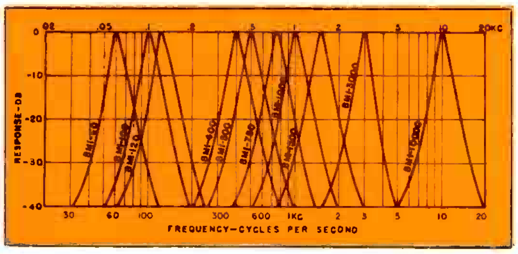
Type No.	Inductance Value		Net Price
HQA-1	5	mhy.	$7.00
HQA-2	12.5	mhy.	7.00
HQA-3	20	mhy.	7.50
HQA-4	30	mhy.	7.50
HQA-5	50	mhy.	8.00
HQA-6	80	mhy.	8.00
HQA-7	125	mhy.	9.00
HQA-8	200	mhy.	9.00
HQA-9	300	mhy.	10.00
HQA-10	.5	hy.	10.00
HQA-11	.75	hy.	10.00
HQA-12	1.25	hy.	11.00
HQA-13	2.	hy.	11.00
HQA-14	3.	hy.	13.00
HQA-15	5.	hy.	14.00

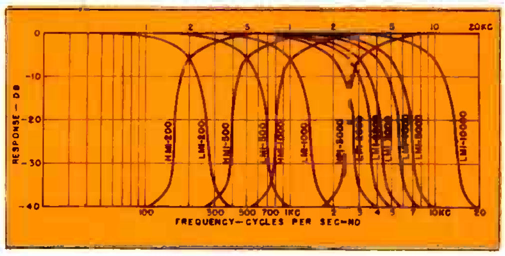
Type No.	Inductance Value		Net Price
HQA-16	7.5	hy.	$15.00
HQA-17	10.	hy.	16.00
HQA-18	15.	hy.	17.00
HQB-1	10	mhy.	16.00
HQB-2	30	mhy.	16.00
HQB-3	70	mhy.	16.00
HQB-4	120	mhy.	17.00
HQB-5	.5	hy.	17.00
HQB-6	1.	hy.	18.00
HQB-7	2.	hy.	19.00
HQB-8	3.5	hy.	20.00
HQB-9	7.5	hy.	21.00
HQB-10	12.	hy.	22.00
HQB-11	18.	hy.	23.00
HQB-12	25.	hy.	24.00

Type No.	Inductance Value		Net Price
HQC-1	1	mhy.	$13.00
HQC-2	2.5	mhy.	13.00
HQC-3	5	mhy.	13.00
HQC-4	10	mhy.	13.00
HQC-5	20	mhy.	13.00
HQD-1	.4	mhy.	15.00
HQD-2	1	mhy.	15.00
HQD-3	2.5	mhy.	15.00
HQD-4	5	mhy.	15.00
HQD-5	15	mhy.	15.00
HQE-1	5	mhy.	6.00
HQE-2	10	mhy.	6.00
HQE-3	50	mhy.	7.00
HQE-4	100	mhy.	7.50
HQE-5	200	mhy.	8.00

UTC INTERSTAGE AND LINE FILTERS

FILTER CASE M
1 3/16 x 1 11/16,
1 5/8 x 2 1/2 High





These U.T.C. stock units take care of most common filter applications. The interstage filters, BMI (band pass), HMI (high pass), and LMI (low pass), have a nominal impedance at 10,000 ohms. The line filters, BML (band pass), HML (high pass), and LML (low pass), are intended for use in 500/600 ohm circuits. All units are shielded for low pickup (150 mv/gauss) and are hermetically sealed.

STOCK FREQUENCIES

(Number after letters is frequency)
Net Price $25.00

BMI-60	BMI-1500	LMI-200	BML-400
BMI-100	BMI-3000	LMI-500	BML-1000
BMI-120	BMI-10000	LMI-1000	HML-200
BMI-400	HMI-200	LMI-2000	HML-500
BMI-500	HMI-500	LMI-3000	LML-1000
BMI-750	HMI-1000	LMI-5000	LML-2500
BMI-1000	HMI-3000	LMI-10000	LML-4000
			LML-12000

United Transformer Co.

150 VARICK STREET • NEW YORK 13, N. Y.

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

electronics

A PUⱯ-HILL -ION

FEBRUARY • 1952

ABP February, 1952 ELECTRONICS Member ABC and ABP Vol. 25, No. 2 ABC

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, Publications Division; Ralph B. Smith, 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 ten days for change of address. Please indicate position and company connection on all 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. Pan American countries, $15.00 a year; $25.00 for two years. All other countries $20.00 a year; $30.00 for two years. Enteredas 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 1952 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved. BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, WC. 2; Washington, D. C., 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 3, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.

marion "tamper-proof" hermetically sealed running time meter

REGISTERS OPERATING TIME OF MACHINE TOOLS, ELECTRONIC, ELECTRICAL OR GENERAL INDUSTRIAL EQUIPMENT

SPECIFICATIONS

- Registers in 1/10 hour steps to 9999.9 or hour steps to 99999
- Hermetically sealed, glass to metal
- Moisture-proof, dust-proof
- Drawn steel case provides magnetic shielding
- Self-starting synchronous motor
- Moderately priced

Marion's new Running Time Meter is absolutely tamper-proof because it is sealed in a drawn steel case. Designed for a wide range of operating temperatures, it is also ideal for use in hazardous atmospheres. The easy-to-read dial is viewed through tempered glass crystal which is fused directly to the case.

Powered by a durable self-starting synchronous motor, available for 110-125, 220-250 volts . . . 50 or 60 cycle A. C. . . . the Marion Running Time Meter occupies no more panel space than an ordinary 3½" meter.

Demands of our national mobilization program come first, of course, but we will gladly supply further information and serve you to the best of our ability.

MARION ELECTRICAL INSTRUMENT CO., 401 CANAL ST., MANCHESTER, N. H.

marion meters

MANUFACTURERS OF MARION *Ruggedized* PANEL METERS

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,
Avenue Jean Stobbaerts, 43,
Brussels.

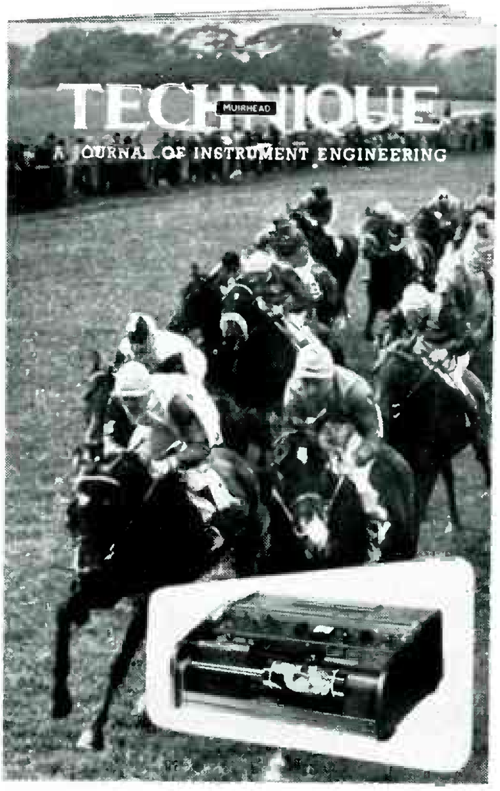
CANADA
The J. W. Ellis Industries,
42, Lombard Street,
Toronto.

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.

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

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

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 59

MUIRHEAD & Co. Ltd.

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

PRECISION MUIRHEAD ELECTRICAL INSTRUMENTS

INDUSTRY REPORT

Trends in the News

What It Costs to Build a Television Station

Investments range from modest $135,000 minimum to cool $593,500 or more

PEANUTS will not pay for a new television station, even if you get a break on legal and engineering fees and land, add to an existing transmitter building or build a new one as low as $1.50 per cubic foot and omit fancy fixtures.

Neal McNaughten, director of engineering for the National Association of Radio and Television Broadcasters, has checked with existing stations concerning real-estate and construction costs, and with manufacturers of transmitters and towers. He comes up with these estimates of minimum overall budget:

City (*with power and antenna height*)	Without Studio	With New Trans. Bldg.	Complete, With Dual Camera Chain
under 50,000 pop. (*1 kw, 300 ft**)	$135,000	$159,000	$219,000
50,000–250,000 (*2 kw, 500 ft†*)	184,750	211,750	274,000
250,000–1,000,000 (*10 kw, 500 ft†*)	200,000	237,500	299,750
over 1,000,000 (*50 kw, 500 ft†*)	244,500	292,000	356,250

* Add $12,500 if tower is self-supporting instead of guyed; † add $38,500 if tower is self-supporting.

▶ Maximum Power More—McNaughten's conservative figures cover the cost of new television stations using minimum effective radiated powers permitted by the Federal Communications Commission under a new ruling soon to become official policy. Maximum powers permitted under the same ruling would be 100 kilowatts on channels 2 to 6 and 200 kilowatts on channels 7 to 13. Complete very-high-frequency television stations using such powers would cost $593,500 in the first case and $587,500 in the second, including remote-pickup truck and double-hop microwave relay equipment. Ultra-high-frequency stations, when these are licensed, would cost at least $1,500 more.

NARTB will soon distribute a booklet titled *Television Construction Costs* to its members. The booklet will break down station costs into individual items, give many more facts useful to existing and potential licensees.

Navy Reports On Electronics Production

TOTAL PRODUCTION of the electronics industry in the current fiscal year (July 1, 1951-June 30, 1952) will reach $4 billion, says the Office of Naval Materiel, Department of Defense. A report, not yet publicly released, states that planned military production for '52 will represent 58 percent of the total.

A Navy survey of 367 companies engaged in manufacturing electronic equipment shows that large companies estimate 56 percent of total planned production will be for military use; smaller companies will produce 70 percent for the military. Eighty companies are now doing military work exclusively, while 29 report that none of their production is for the armed forces.

"No Electronic Bottlenecks So Far"—NPA

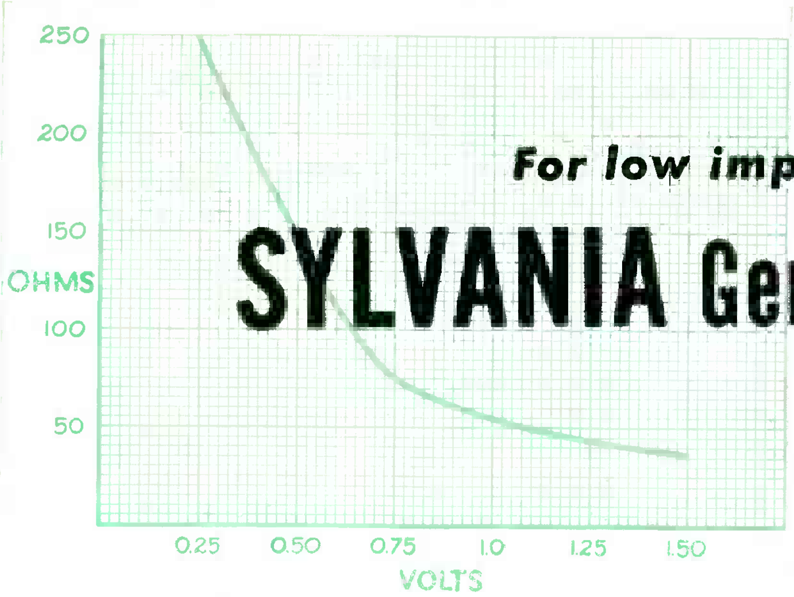
30-months of military equipment production covered by present funds.

ALLOCATION OF MATERIALS to electronic equipment producers is in good shape. So said E. T. Morris and J. A. Milling of NPA and Col. C. A. Poutre of Munitions Board at industry meeting in Washington January 11th. To date no single case of military electronic equipment production stoppage due to shortage of material has been encountered and none is anticipated so long as supply of nickel holds up.

At the electronics meeting, fifth scheduled with press and representatives of large defense industries (others: metals, machine tools, construction, chemicals) it was predicted that in 1952 electronic consumer durables would be down 32 percent below 1951, industrial electronics up 20 percent and military electronics up 165 percent. Even with military running far above the 1951 rate, materials are expected to be available for all needs, except possibly nickel. Nickel supplies seem ample, but processing and distribution, from producer to tube plants, is so complicated that NPA feels some may be lost in the shuffle. Substitution for nickel in components other than tubes must accelerate.

▶ Material Allocations—Other tricky question is the delicate balance between electronic end products and components that go into them. Of all materials allocated except steel, 80 percent now goes into components, 20 percent to end products. In steel, due to consump-

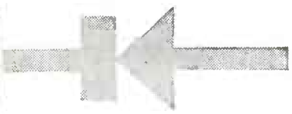
INDUSTRY REPORT →



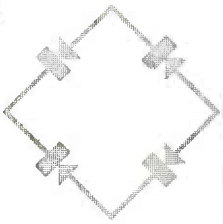
For low impedance applications...

SYLVANIA Germanium Diodes

Typical 1N56 Resistance Characteristic



1N56 DIODE with a potential of +1 volt will pass a current of 15 ma. or more. With a potential of −30 volts, less than 300 μa. will flow.



For Carrier Communications

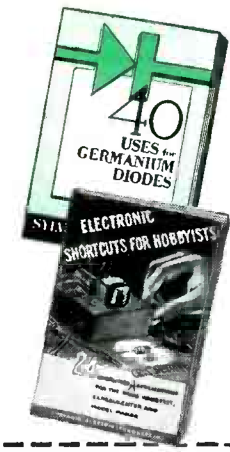
1N71 VARISTOR—The 1N71 consists of 4 matched low impedance diodes each of which, with +1 volt impressed, will pass a current within one ma. of the average current of the four.

All Germanium Diodes are notable for their low forward impedance. But the 1N56 is specially engineered to make the most of this quality.

Use this diode for high efficiency circuits with low input and output impedances. Use it for relay activation, heavy current and surge applications with low impedance coils, transformers and condensers.

Try the 1N71 varistor in carrier telegraphy and telephony work. The low shunt capacitance insures high efficiency throughout the high frequency range. You will find this varistor equally efficient in low impedance modulator circuits of the carrier suppression or carrier transmission type.

Both the 1N56 Germanium Diode and 1N71 Varistor are available from your Sylvania Distributor. Ask him for copies of the two books shown below. Price of each is only 25¢, together they comprise the most complete collection of Germanium Diode applications yet published.



Sylvania Electric Products Inc.
Dept. E-2602, Emporium, Pa.

☐ *Please send me "40 Uses for Germanium Diodes." Enclosed is 25¢*

☐ *Please send me "Electronic Shortcuts for Hobbyists." Enclosed is 25¢*

Name ____________________

Street ____________________

City __________ *Zone* ______ *State* ______

SYLVANIA ELECTRIC PRODUCTS INC. 1901-1951 50th ANNIVERSARY FIVE DECADES OF PROGRESS

SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS tion in chasses, the percentage is about 50-50. Changes in design and in spare-parts orders affect this balance, require careful monitoring.

Relations between NPA and Defense Department are expected to remain harmonious so long as present even keel is maintained. But misunderstandings sometimes arise in industry circles due to conflicting definitions. NPA says an item is electronic if it has electron tubes. Munitions Board figures cover these items as well as everything else in communication and control.

Only about 45 percent of the military dollar goes into radio and radar, (25 radar to 20 radio); 55 percent goes into spare parts and such items as telegraph, telephone, teletype, wire, cable and other non-tube items.

▶ **Some Contract Lag** — Acknowledged is a lag behind schedule of about 30 percent (dollar value) of electronic production. But a large fraction of this value is not large-scale production, represents cost of services, engineering, and "excessively high" costs of prototype models of radar, sonar and test gear. Largely because engines and other components of aircraft are also behind schedule, the lag in aircraft electronic items has not yet affected delivery of aircraft in quantity. The outlook, moreover, is for a faster makeup of schedule in electronics than in other aircraft items.

▶ **Second-Quarter Prospects**—Allocations to consumer goods for the second quarter of 1952 were released by DPA same day: communications division gets 43.4 kilotons steel, 43.6 megapounds copper, 2.6 megapounds aluminum; electronics division 58.9 kilotons steel, 30.8 megapounds copper and 12.2 megapounds aluminum. NPA officials hope and expect these amounts can be maintained in third and fourth quarters. If so, 7.5 to 8 million radio sets can be produced during the year with 3.5 to 4-million tv sets, compared with 12.5 million radios and 5.2 million tv sets in 1951.

At the moment NPA knows no method of adjusting allocations to conform to seasonal consumer buying habits. Consequently, to meet the heavy business (about half the total) which traditionally appears in the last four months, manufacturers will have to put sets in inventory in the spring. NPA points out this gamble is not an unmitigated evil, since steady flow of materials through allocation channels makes for steady employment and loading on plant during the year. But manufacturers, remembering unhappy inventory experience in mid-51, may well wish they could get materials when they know the market is ready, rather than months before.

Actually, in 1951 many radio-tv manufacturers did not consume all materials allocated to them due to slack demand and misunderstanding on extension of allocation to components and materials suppliers. Now, the working of controls is better understood, and a more normal atmosphere prevails. Scare buying is not anticipated if 4 million tv sets can be built this year. Lifting the freeze should keep the market potential at present "reasonably satisfactory" level as soon as new stations take the air.

Expansion of plant is indicated in certificates of rapid tax amortization granted in 1950 and 1951; 216 certificates represented expansions valued at a total of $165 million. Completed end-product plants took 77 of these for $90 million, tube plants 51 for $49 million, components 60 for $23 million, remainder miscellaneous.

▶ **Future Outlook** — The future health of the electronics industry is bound up in analysis revealed for first time at the meeting: the backlog of military electronic production now amounts to 20 months at the 1952 going rate of production, and a further 10 months of production contracts remains to be let on currently available funds. With 30 months military work ahead, and a near-normal year in radio-tv production, the outlook can only be labelled—good.

HIDE-AND-SPEAK MIKE

Miniature radio transmitter used in Hollywood movie studios operates on 50-megacycles. Using a four-foot antenna, which winds around the body, the 2-tube unit is hidden in the clothes of the actor. A receiver located elsewhere on the set picks up the actor's words, feeds them to a magnetic-tape recorder

New Index of Electronics Output

Manhour and productivity barometer reading to be published monthly (see page 8).

BEGINNING with this issue, a new index of the overall output of the electronics industry will be published monthly in ELECTRONICS for the guidance of businessmen in this field. The monthly service, developed by the editors and the McGraw-Hill Economics Department, covers the production of radio and television receivers, commercial radio and television equipment, military radio and radar equipment, electronic equipment and components, and communications equipment. It will appear regularly on the 'Figures of the Month' page (p 8).

The output index is computed from monthly figures collected by the Bureau of Labor Statistics on the number of production workers employed in the electronic fields named above, and the average weekly hours worked. The index figure is the product of these numbers, adjusted for average increase in productivity, which is taken as 8 percent per year. The average of the monthly indexes for 1947 is taken as 100 percent. On this basis, the current index based on the

INDUSTRY REPORT ➔

Ceroc T

HIGH-TEMPERATURE MAGNET WIRE

A most important aid in the miniaturization of small transformers, reactors, relays, and other copper-wound components of electronic equipment and aircraft! That's the rapidly spreading story about CEROC T, the new and important development in magnet wire.

The first and only magnet wire to operate safely at a continuous temperature of 250°C., Sprague CEROC T wire has considerably higher current ratings than conventional magnet wires of equivalent AWG size. Consequently, you can use smaller sizes of CEROC T to achieve a considerable saving in the physical dimensions and weight of small electric apparatus.

Or if it is necessary to "beef up" equipment already designed to fit a certain space, you can switch to CEROC T windings for a marked increase in electrical rating.

CEROC T Magnet Wire is made by an exclusive, patented Sprague process for applying its insulation of inorganic ceramic and Teflon. It has excellent solvent and abrasion resistance and high dielectric strength. Complete specifications are yours for the asking in Engineering Bulletin 402F.

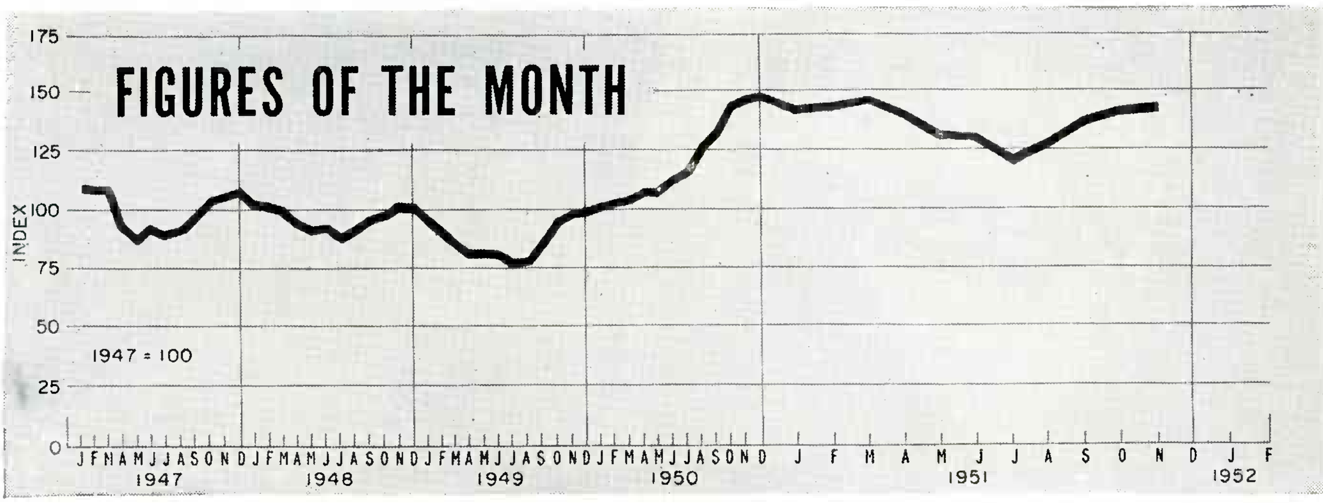
UP TO 200°C.—CEROC 200 — This ceramic-silicon coated wire is your best choice for operating temperatures up to 200°C. Write for Bulletins 401 and 403B.

SPRAGUE®

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

SPRAGUE ELECTRIC COMPANY
NORTH ADAMS, MASSACHUSETTS

See Us at the I.R.E. Show—Booths 27-28



Electronics Output Index (above):

	Year Ago	Previous Month	Latest Month
	146.6	142.8	144.0-e
	Nov '50	Oct '51	Nov '51

RECEIVER PRODUCTION

(Source: RTMA)	Year Ago Nov '50	Previous Month Oct '51	Latest Month Nov '51
Television sets	738,800	411,867	415,332
Home Radio sets	721,500	513,609	477,734
Portable sets	50,400	94,053	64,111
Auto sets	443,700	267,061	206,069

RECEIVER SALES

(Source: Licensee figures)	Oct '50	Sept '51	Oct '51
Television sets, units	898,638	490,520	608,274
Electric radio sets, units	672,937	435,917	540,915
Battery sets, units	89,919	75,169	65,703
Auto sets, units	396,730	319,816	265,215
Television sets, value	$178,354,646	$78,980,657	$96,111,904
Electric radio sets, value	$18,101,307	$9,703,146	$11,517,531
Battery sets, value	$1,713,303	$1,411,362	$1,176,656
Auto sets, value	$10,654,753	$9,355,890	$8,088,701

RECEIVING TUBE SALES

(Source: RTMA)	Oct '50	Sept '51	Oct '51
Receiv. tubes, total units	40,105,611	27,946,193	34,137,519
Receiving tubes, new sets	32,305,648	16,176,604	21,103,669
Rec. tubes, replacement	6,699,448	7,363,721	9,615,159
Receiving tubes gov't	182,177	1,568,880	1,567,190
Receiving tubes, export	918,338	2,836,988	1,851,501
Picture tubes, to mfrs.	848,387	294,951	455,636

TV AUDIENCE

(Source: NBC Research Dept.)	Dec '50	Nov '51	Dec '51
Sets in Use — total	9,845,300	14,555,800	15,176,200
Sets in Use—netw'k conn.	8,337,500	13,777,700	14,363,700
Sets in Use — New York	1,935,000	2,630,000	2,720,000
Sets in Use—Los Angeles	764,000	1,045,000	1,065,000
Sets in Use — Chicago	765,000	1,020,000	1,060,000

BROADCAST STATIONS

(Source: FCC)	Dec '50	Nov '51	Dec '51
TV Stations on Air	107	108	103
TV Stns CPs—not on air	2	0	0
TV Stns—Applications	374	463	475
AM Stations on Air	2232	2321	2408
AM Stns CPs—not on air	119	85	77
AM Stns—Applications	266	302	304
FM Stations on Air	676	635	650
FM Stns CPs—not on air	27	12	13
FM Stns—Applications	10	10	8

COMMUNICATION AUTHORIZATIONS

(Source: FCC)	Year Ago Nov '50	Previous Month Oct '51	Latest Month Nov '51
Aeronautical	28,802	31,989	31,415
Marine	27,945	33,309	33,700
Police, fire, etc.	8,279	9,965	9,969
Industrial	7,605	10,930	11,233
Land Transportation	3,962	4,542	5,362
Amateur	90,198	97,587	99,292
Citizens Radio	397	674	674
Disaster	0	22	28
Experimental	478	442	452
Common carrier	829	834	835

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)	Oct '50	Sept '51	Oct '51
Prod. workers, electronic	271,900	250,300	260,400-p
Prod. wkrs., radio, etc.	187,000	155,000	161,700-p
Av. wkly. earnings, elect.	$59.02	$62.84	$63.62-p
Av. wkly. earnings, radio	$57.03	$59.55	$60.39-p
Av. weekly hours, elect.	41.8	41.1	41.1-p
Av. weekly hours, radio	41.6	40.9	41.0-p

NETWORK BILLINGS

(Source: Pub. Info. Bureau)	Nov '50	Oct '51	Nov '51
AM/FM—ABC	$2,940,967	$3,158,714-r	$3,220,760
AM/FM—CBS	$6,455,478	$5,615,723-r	$5,257,454
AM/FM—MBS	$1,357,529	$1,759,468	$1,583,291
AM/FM—NBC	$5,040,404	$4,414,200-r	$4,315,646
TV—ABC	$1,243,549	$1,897,427-r	$1,911,243
TV—CBS	$2,215,744	$4,731,219-r	$4,605,506
TV—Dumont	Not avail.	$768,684-r	$847,373
TV—NBC	$3,070,010	$7,132,685-r	$6,555,205

INDUSTRIAL EQUIPMENT ORDERS

	Quarterly Figures		
(Source: NEMA)	Year Ago 3rd '50	Previous Quarter 2nd '51	Latest Quarter 3rd '51
Dielectric Heating	$300,000	$600,000	$210,000
Induction Heating	$1,100,000	$2,300,000	$1,900,000

INDUSTRIAL TUBE SALES

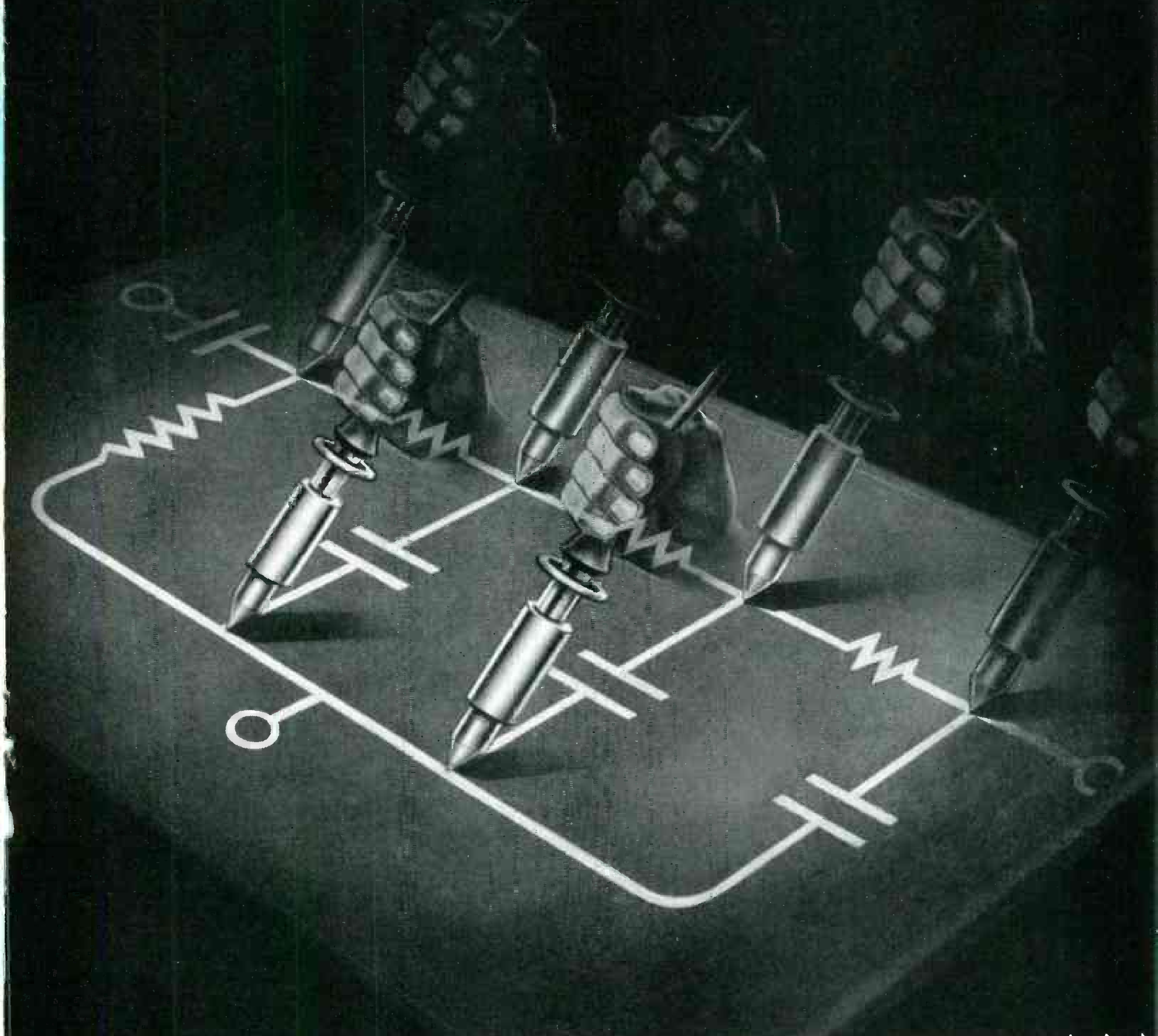
(Source: NEMA)	3rd '50	2nd '51	3rd '51
Vacuum (non-receiving)	$3,370,000	$7,750,000	$8,420,000
Gas or vapor	$1,660,000	$2,700,000	$2,620,000
Phototubes	$230,000	$360,000	$275,000
Magnetrons and velocity modulation tubes	$2,050,000	$4,130,000	$3,750,000

p—provisional; r—revised; e—estimated

INDUSTRY REPORT →

SAVE making all these expensive soldered connections

by using Centralab Printed Circuits instead!



for more information . . . see the next two pages ▶▶▶

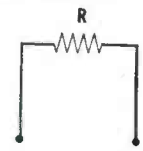
HERE ARE THE STANDARD PRINTED

PRINTED ELECTRONIC CIRCUITS

P.E.C. are complete or partial circuits (including all integral circuit connections), consisting of pure metallic silver and resistance materials fired to Centralab's famous Steatite or Ceramic X and brought out to convenient, permanently anchored leads.

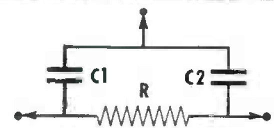
They provide miniature units of widely diversified circuits — from single resistor plates to complete speech amplifiers.

All those illustrated here are available for standard applications. Save these pages for reference. Numerous other circuit complements can be furnished for volume requirements.



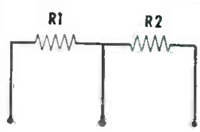
R=2 Meg

PC-2
SINGLE RESISTOR
Send for Bulletin 42-24



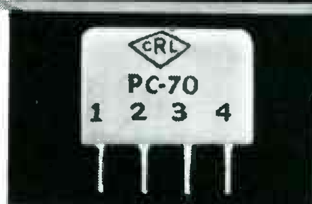
PC-52
FILPEC
Send for Bulletin 42-24

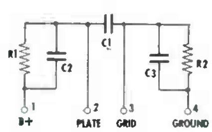
R=47K
C_1=50 mmf.
C_2=50 mmf.



R_1=500K
R_2=110K

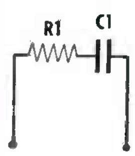
PC-21
DUAL RESISTOR
Send for Bulletin 42-24





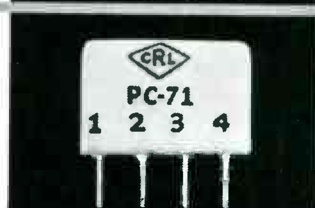
PC-70
MIDGET COUPLATE
Send for Bulletin 42-127

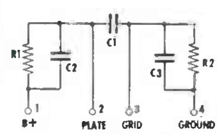
R_1=500K
R_2=500K
C_1=5000 mmf.
C_2 plus C_3=250 mmf.



R_1=240K
C_1=1000 mmf.

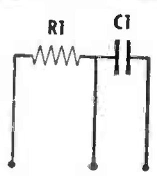
PC-30
RESISTOR-CAPACITOR
Send for Bulletin 42-24





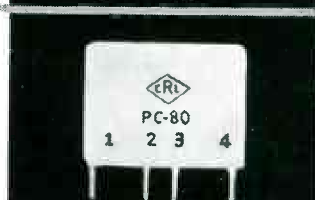
PC-71
MIDGET COUPLATE
Send for Bulletin 42-127

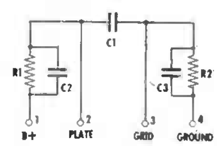
R_1=250K
R_2=500K
C_1=5000 mmf.
C_2 plus C_3=250 mmf.



R_1=1 Meg.
C_1=1000 mmf.

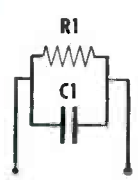
PC-33
RESISTOR-CAPACITOR
Send for Bulletin 42-24





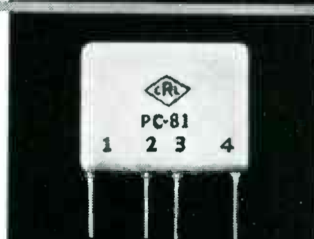
PC-80
STANDARD COUPLATE
Send for Bulletin 42-127

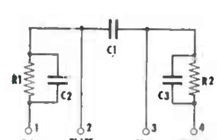
R_1=500K
R_2=500K
C_1=.01 mfd.
C_2 plus C_3=250 mmf.



R_1=100K
C_1=100 mmf.

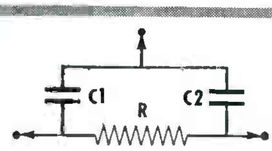
PC-36
RESISTOR-CAPACITOR
Send for Bulletin 42-24





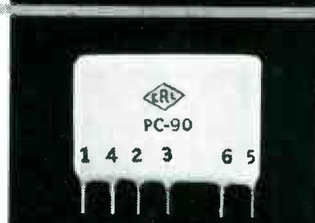
PC-81
STANDARD COUPLATE
Send for Bulletin 42-127

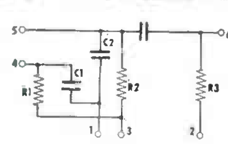
R_1=250K
R_2=500K
C_1=.01 mfd.
C_2 plus C_3=250 mmf.



PC-50
FILPEC
Send for Bulletin 42-24

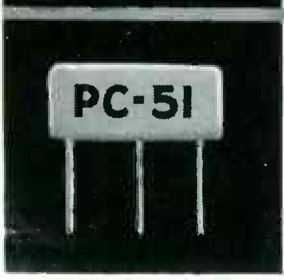
R=47K
C_1=100 mmf.
C_2=100 mmf.

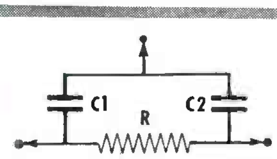




PC-90
PENTODE
Send for Bulletin 42-128

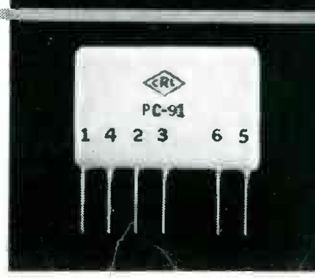
R_1=4.7 Meg.
R_2=1 Meg.
R_3=2.2 Meg
C_1=5000 mmf.
C_2=50 mmf.
C_3=2000 mmf.

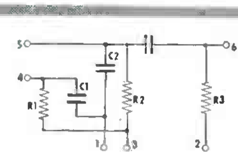




PC-51
FILPEC
Send for Bulletin 42-24

R=47K
C_1=150 mmf.
C_2=150 mmf.





PC-91
PENTODE
Send for Bulletin 42-128

R_1=4.7 Meg.
R_2=1 Meg.
R_3=2.2 Meg.
C_1=5000 mmf.
C_2=100 mmf.
C_3=5000 mmf.

October 1951 BLS figures is 142.8 percent, or 42.8 percent above the 1947 base.

To show the trend, the index is plotted from January 1947 to the present, and a new figure is added as each issue goes to press.

The index is not adjusted for seasonal variations and long-term trend. These latter adjustments may be incorporated when the necessary experience is accumulated.

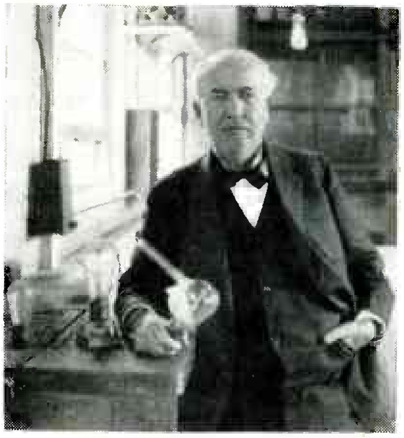
▶ **Significance Of Output**—The most significant indication of the state of health of the electronics industry is production of wealth, as measured by the output of all plants in the field. Three possible measures of output are: the number of units produced, the dollar value of shipments, and the manhours worked at a known level of productivity. Physical output figures are hard to come by; most military production figures are classified. Dollar values are not a good index of production activity because price changes are frequent, and are almost impossible to follow statistically. So manhours was chosen as the basis of the Electronics Output Index.

Output is closely geared to manhours worked, provided that productivity is taken into account. The data on manhours are accurate, taken from the broadest available industrial basis, the BLS monthly report in this field. Moreover the figures are timely, usually not more than seven weeks behind ELECTRONICS' publication date. Finally, an index based on manhours is the most sensitive of all production measures. The instant a change in production is put into effect, manhours increase or decrease accordingly. Shipments and prices reflecting the change may lag many weeks or months.

▶ **Weighting of Figures**—The choice of manhours as a basis automatically provides the proper weighting for the various branches of the industry. Obviously the production of 1,000 tv sets is more important than the production of 1,000 receiving tubes, but the manhours worked in the two cases tend to reflect the difference. For example, in 1950, 67.8 percent of electronic production manhours were worked in producing radio sets and allied equipment; 17.4 percent electron tubes, 12.8 radio communication, telephone and telegraph equipment, and 2 percent other communications equipment. Changes in these categories occur, but are averaged out in the overall manhour and productivity figures. The year 1947 was chosen as the base of the index because the last complete census of manufacturers was taken in that year, and because it represents a typical post-war, pre-Korea year.

One possibility of error exists which cannot, for the time being, be recognized in the index. The BLS figures are taken from established electronic firms, doing peacetime as well as war production business. Currently many firms outside the traditional boundaries of the electronics industry, such as milling companies, sparkplug producers, etc, are accepting contracts for production of electronic war items. The production workers of such firms are not reported by the BLS under the electronics category and their contribution to the overall output is accordingly not reflected. At present the error is negligibly small but it may become larger as more such extra-industry contracts are let. The editors are maintaining close touch with NPA and DPA officials to follow this trend and will publish corrective information as it is released by the war production authorities.

EDISON'S 105TH



The 105th anniversary of Thomas Alva Edison's birth is being celebrated this month throughout the world. Edison is hailed as the founder of the science of electronics. Shown above is the inventor with diode tube in which he discovered electron conduction, basis of all subsequent electronic development

Government Actions

Vast TV Expansion Ready for FCC Nod

Applications for new stations expected to flood Commission as defreeze approaches

NEARLY a billion dollars is ready to be invested in new television broadcast stations, according to FCC Chairman Coy, waiting only the go-ahead from two agencies. First, the FCC must issue its long-awaited report on television expansion, setting up new allocations and rules for vhf and uhf stations. Second, NPA's Industrial Expansion Division must allot critical materials, particularly structural steel for buildings and towers.

The first step, lifting the freeze, has been promised regularly every six months since issuance of construction permits was discontinued in September 1948. Now, 40 months later, Pandora's Box is to be opened, but wide. On hand in the Commission offices at presstime were 476 applications for new tv stations, 27 of them for uhf. At least 1,000 additional applications were expected to follow closely on the announcement that FCC is again handing out permits. Taking the total investment in a new tv station at NARTB's average estimate of $250 thousand, 1,500 applications add up to the tidy sum of $375 million. And this is only the beginning. Two thousand stations are planned for.

▶ **Allocations Report**—Release of the FCC report is expected before March 1st, may even occur before

INDUSTRY REPORT ➔

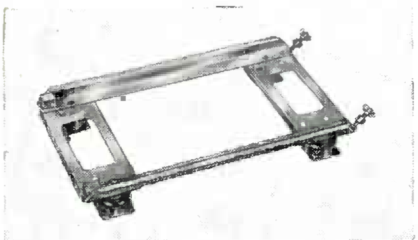
ALL-METL BARRYMOUNTS
Available for Unusual Airborne Applications

These Barrymounts give the aircraft and electronic engineer a vibration isolator designed to meet the unusual temperature and environmental conditions met in high-altitude, high-speed flight. Using no organic compounds, these mountings are not subject to temperature influences that may affect the performance of other mountings.

ALL-METL Barrymounts have wide load range with uniform performance. Natural frequency is about 7½ cycles per second; horizontal stiffness is low for maximum isolation of horizontal vibration. Transmissibility at resonance is only 4½. There is no snubber contact nor resonance carryover when vibrated at government-specified amplitudes.

Designed especially for unusual military conditions, these mountings meet the vibration requirements of JAN-C-172A, MIL-E-5272 (USAF), and MIL-T-5422 (BuAer). Ask for your free copy of Catalog 509, containing details of these mountings.

BARRY RUGGEDIZES ISOLATORS AND BASES
For Aircraft Carrier Service and Crash Landings



Barry vibration isolators and mounting bases are available in "ruggedized" construction, to withstand the severe shocks of arrested landings on aircraft carriers and in crash landings. These units are tested to meet the shock-test requirements of Specification AN-E-19, for the equipment sizes listed in JAN-C-172A.

Ruggedized mounting bases equipped with either ALL-METL or Air-damped Barrymounts can be furnished in standard JAN-C-172A sizes and in special sizes to meet customers' requirements. A conspicuous advantage of ruggedized Barry bases is the gain in strength of the base framework itself — beyond JAN requirements — achieved with very little increase in weight, for loads up to 50 pounds, by design modification of standard JAN bases. For greater loads, ruggedized Barry bases are of stainless steel instead of aluminum. Write for listing of ruggedized bases and unit mounts.

SHOCK and VIBRATION NEWS

BARRYMOUNTS FOR ASSURED CONTROL OF SHOCK AND VIBRATION

the Right answer
TO YOUR SHOCK AND VIBRATION PROBLEMS

will be found in this complete family of Barrymounts. From tiny, ounce-rated unit mounts . . . through ruggedized bases . . . to heavy-duty isolators for industrial machinery . . . Barrymounts meet all your needs. FREE CATALOGS give you details of dimensions, load ratings, and military specifications met by these effective vibration and shock isolators.

FOR AIRCRAFT SERVICE

Catalog 509 describes ALL-METL Barrymounts for use at extreme temperatures. Catalog 502-A covers Air-damped unit mounts and bases.

FOR INDUSTRIAL USES

Catalog 504-B describes the general line of Barrymounts rated from ⅛ ounce to 3300 pounds. Catalog 607 covers the use of Barrymounts with heavy industrial machinery.

And for SPECIAL PROBLEMS

ask the advice of our Field Engineering department, organized to apply our wide experience to your particular needs.

Address all inquiries to:

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

this issue of ELECTRONICS reaches subscribers. In the report will appear these items:

✦A geographical assignment of the 12 existing vhf channels and 70 new uhf channels to 1,250 cities and towns.

✦The engineering standards of allocation. These are expected to follow recommendations of such professional advisory bodies as JTAC and to meet with general approval of technicians.

✦A decision on the controversial issue of reserving channels for educational institutions not now financially able to apply for them.

✦Action on the proposed allocation plans submitted by Allen B. DuMont and others which will have a far-reaching effect on the competitive positions of tv networks.

Behind the report is a vast amount of work by FCC engineers and clerical staff. Already solved is the critical problem of fitting in stations in the crowded New England area, first region set up for consideration. Tentative solutions for other populous regions have also been reached, but a sharp reduction in clerical staff, following recent budget cuts, has curtailed the paperwork follow-through.

▶**Licensing Action** — Following issuance of the report, a period of about 60 days is anticipated to allow applicants to revise their applications (from uhf to vhf or vice versa, change in location, etc). During this period the Commission will probably not act on any application and all those from a given city will be placed on equal footing. A firm cutoff date is expected at the end of this filing period; broadcasters filing thereafter will probably find themselves in the second balcony.

The Commission will then take up applications and act on the merits of each. First to be settled will be the easy cases where the number of applications from a given city does not exceed the number of channels reserved for that city. These are smaller communities with limited capital and low market potential.

Next will follow a long series of competitive hearings, during which the Commission must sort out the haves from the have-nots where applications exceed facilities. Complicating this procedure will be the existence of uhf and vhf assignments in the same area, with substantial difference in coverage and, hence, competitive advantage. Of the 1,985 station assignments planned in the tentative allocation released last year, 526 are for commercial vhf, 1,250 for commercial uhf, 82 for educational vhf, and 127 for educational uhf. It is expected that this division will hold in the final allocation, with a possibility of a reduction in the educational reservations.

Two major hazards confront the industry in the competitive phase of allocation. First, any courageous or foolhardy applicant may throw the whole plan into the courts via the injunction route. Such action, which might delay competitive hearings a year or more, is not expected from established operators. But there is much new money waiting to be invested in a highly profitable business, and a disappointed applicant may dare the Commission's wrath by appeal first to the district courts and ultimately to the Supreme Court. The networks are holding their breath over this possibility because they, as well as the Commission and the public, have no stomach for further delay.

The second hazard is the shortage of hearing examiners. Only seven are now available; the Commission has already gone to Congress for funds to hire an additional seven men for this rough service.

▶**UHF and Materials**—The fate of the uhf band is cloudy at the moment. The Commission is fearful that many uhf channels may go begging, due to lack of receiving equipment, if manufacturers hold back waiting for stations to start operation. The industry is banking, therefore, on strong Commission support for the uhf applicant, even to the extent of allowing broadcasters who already own the legal limit of five vhf stations to own several additional uhf outlets.

FCC Broadcast Division Chief Curtis Plummer stands on his earlier prediction that from 50 to 80 uhf or vhf stations will be authorized in smaller non-competitive markets by the first of July, and that an equal number will be issued quarterly thereafter. It is problematical whether NPA actions on steel allotments and other materials controls would provide for new stations at this rate. Certainly if grants were issued faster shortages could take control in a big way. Even if they do, Commissioner Sterling is betting that operators will get on the air somehow, mit ersatz maybe, but on the air. He points out that uhf antennas are small and can be supported temporarily on wooden poles if need be.

So, this spring, tv is off to the races.

Markets and Sales

Lake Carriers Buying VHF Radiophones

GREAT LAKES 'bulk carriers' such as ore, coal, pig iron and limestone ships are installing very high frequency radiophones to supplement equipment now operating on overcrowded medium and high-frequency bands.

The Electronics Committee of the Lake Carriers Association, following a recommendation of the Washington consulting firm of Jansky & Bailey, is urging ship operators to buy 30 eight-channel sets working in the vicinity of 160 megacycles. Operators have already ordered 19 and installed several, will buy more if the sets pan out satisfactorily in 1952.

▶318 **Prospects**—There are 318 bulk carriers under U. S. Registry in the Great Lakes. Of these, 314 are equipped with radiophones op-

INDUSTRY REPORT →

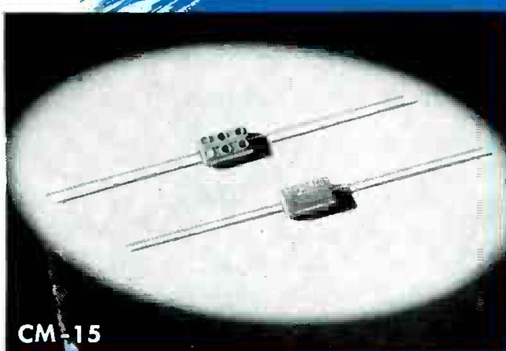
Capacity

COMES IN MANY SIZES

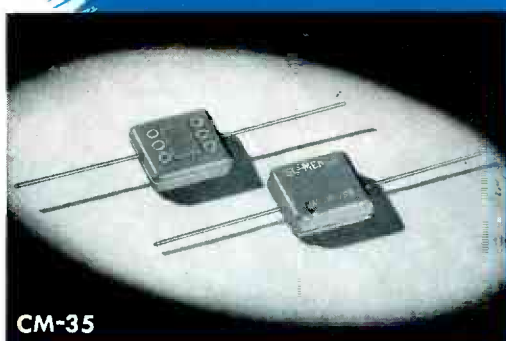
Whether you're talking in the simple terms of drinking water . . . a drink for yourself . . . the needs of a construction crew . . . or designing the latest in electronics equipment . . . capacity is important on every job. El-Menco Silvered-Mica Capacitors meet exacting requirements over a wide range . . . from the tiny CM-15 (2-525 mmf. cap.) to the mighty CM-35 (3300-10000 mmf. cap.).

The safety factor of a half-filled jug is built into every El-Menco Capacitor. Each unit is factory-tested at *double* its working voltage. You are assured of dependability in every application. El-Menco Capacitors offer peak performance for all specified military capacities and voltages.

For higher capacity values — which require extreme temperature and time stabilization — there are no substitutes for El-Menco Silvered-Mica Capacitors.



CM-15



CM-35

Write on your business letterhead for catalog and samples.

***Jobbers, Retailers, Distributors*—For information communicate direct with Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.**

El-Menco

MOLDED MICA **MICA TRIMMER**

CAPACITORS

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

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

erating in the 2, 4, 6 and 8 megacycle medium and high-frequency bands. Aside from interference caused by ships operating in close proximity to each other on these bands, the frequencies involved cause signals to travel much greater distances than are normally needed and so cause additional interference.

New and supplemental vhf radiophones are expected to cover approximately 60 miles from ship to shore and 40 miles from ship to ship. About 75 percent of all bulk-carrier communications, says the Committee, is confined to those ranges.

Printed Circuits—Past, Present and Future

'50 was a development year, '51 brought pilot-plant runs, '52 may see mass production

PRINTED CIRCUITS were the subject of intensive research and development in many plants in 1950. The work had progressed far enough by 1951 to warrant pilot-plant runs. The year 1952 will see the beginning of mass production, and proponents think that by 1953 printed circuits will be used in a substantial number of electrical as well as electronic products.

Military interest sparked printed-circuit research during World War II. Contrary to popular opinion, however, the Services have since then ordered cautiously, with the result that in the postwar period commercial applications have accounted for most of the modest volume. The market is now in the process of reversing, with military contracts constituting over half the business on the books.

▶ **Broad Field**—The words 'printed circuits' cover many processes and in several instances are a misnomer. There are numerous ways of reducing labor and material costs involved in the use of individual wires and soldered joints in electrical and electronic apparatus. Conductive liquids or powders containing metal such as silver can be deposited in required patterns on plastic or ceramic insulation by 'silk screen' methods commonly used in the manufacture of nameplates. Similar 'wiring' can be printed by means of more or less conventional presses. Insulating materials can be electroplated with metals such as copper, and part of the metal chemically etched away by photo-engraving. Or sheets of metal can be stamped or laminated firmly into plastics and unwanted areas mechanically cut out by means of dies.

In general, silk screening and printing methods are used where only a small amount of electric current must be carried and extreme compactness is the paramount need. Stamping and lamination are more commonly found in heavier-duty electrical equipment. Several mechanized-wiring techniques are used in the fabrication of component parts, as in the internal connections of a multicontact rotary switch. Some parts such as resistors and capacitors may be printed right along with wiring. Subassemblies such as amplifiers involving printed or stamped wiring and components may form part of large units otherwise wired by conventional means. Dip soldering is frequently used for interconnection of such units. On the other hand, some relatively simple devices such as hearing aids may utilize mechanized-wiring exclusively.

▶ **Typical Users**—Avion Instrument Corp. thinks it will produce $25,000 worth of printed or stamped circuits in 1952.

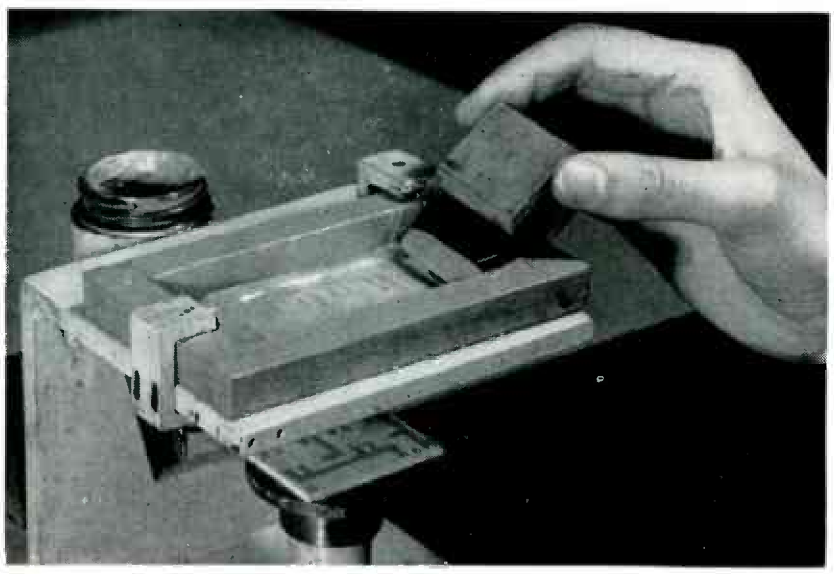
Centralab, reporting "a substantial increase in orders" for 1952, thinks '53 will be "the big year", speculates that printed-circuit business may stack up in about this order of importance for most manufacturers: ordnance items including guided missiles, communications equipment and radar, computers, tv subassemblies and other electronic items.

Decimeter, Inc., using copper-laminated wiring in a two-tube television preamplifier for the past two years, hopes to have the technique approved for use in connection with a government contract.

Elm Laboratories has spent $10,000 developing a lamination process, is now in production on a pocket-size test instrument, also has a military contract, hopes to get its investment back in '52.

Emeloid expects a 10-time increase this year in orders for both component parts and subassemblies using mechanized-wiring techniques, has commitments that seem to insure it.

Erie Resistor, so far supplying printed circuitry largely for hearing aids, says tv manufacturers are finally taking a more serious look at the technique and that this forecasts a sharp increase in



Printed-circuit technique, in elemental form; silk-screen process

INDUSTRY REPORT →

type of business.

.klin Airloop did $400,000 of stamped wiring business 951, says "the prospect for 1952 oks particularly bright in that Sylvania has signed a non-exclusive license agreement."

Mallory, working on a powdered-metal technique, "expects to bring out at least one important new product for the general consumer this year", has a high-priority miliary contract that appears to lend itself to printed wiring.

Photocircuits Corp. did $50,000 worth of business, on pilot run and production orders, in 1951. The company thinks sales will increase from five to tenfold this year, covering telemetering devices, computers, decoding machines, tv tuners, classified ordnance items and hearing aids.

Plastics & Electronics has orders for printed circuits used in subminiature servo amplifiers and a subminiature transceiver, is making 150,000 voltage dividers each of which replaces 22 conventional resistors. In addition, the firm also expects to produce a four-tube subminiature broadcast receiver.

M. J. Sears is working on a method of turning out mechanized wiring on a continuous-strip basis, expects $30,000 worth of business this year.

F. W. Sickles is developing major television components using printed-circuit techniques.

Stupakoff is getting ready for production of integrators, multipliers and amplifiers for both military and commercial use.

U. S. Gasket is moving out of the development stage.

▶ **Promising Volume**—No accurate estimate of the total volume of printed-circuit business is possible at this time for two major reasons: Many manufacturers of electronic equipment other than those spot-checked are using the technique to some extent in their own production rather than for resale or are 'not talking'; and an increasing percentage of the volume covers applications which are of necessity classified.

It is known only that business currently available is substantial, and growing more so every day.

Germanium - Threat or Promise to Electronics Industry?

Semiconductor devices will eventually replace many vacuum tubes—but try to buy a transistor today!

GERMANIUM, basis of transistors and new power rectifiers, is the enigma of the electronics industry. The material itself is a puzzler. Combining the properties of a conductor like copper and an insulator like glass, its importance in electronics resides in its ability to carry strong current under the control of a weak one.

This ability to amplify was once a virtual monopoly of the vacuum tube; by passing electrons through a vacuum or gas-filled space it is possible to exercise control over them. Now the same trick has been turned in a solid material. This not only eliminates the need for the vacuum, a costly if imponderable material, but makes possible the transistor, an amplifier having great mechanical strength, long (possibly indefinite) life, and high efficiency.

R. M. Burns of the Bell Laboratories, a pioneer in germanium electronics, predicted this month to the Society of the Chemical Industry that a new industry will grow from this material, rivalling the chemical industry in size. This is a big prediction, but one to be taken seriously since Bell Labs people are noted for conservatism in all things, let alone public utterances.

▶ **Transistors, Tomorrow**—But all this is in the future. Technicians have to be well connected to get samples today. ELECTRONICS called six manufacturers known to be working on commercial forms of the transistor, asking for order-placing information, got the following replies: Western Electric, none available, all going to military; General Electric, limited supply to equipment manufacturers only; Raytheon, did have model CK-703 available for $18, now discontinued in favor of model CK-716 expected to be available next month; Sylvania, not on market, still in engineering stage; Westinghouse, not available commercially; RCA, not available. The new day may be dawning, but it's still pretty dark in the channels of trade.

▶ **Old Material**—Discovered in 1886, germanium found few uses (manufacturing special optical glass and treating anemia) until electronic technicians found it was a rectifier, that is, would change alternating current into pulsating direct current. But it had strong competitors in silicon and selenium in the rectifier field. Then Bardeen and Brattain of Bell Labs produced the first germanium transistor in 1948, and in 1950 the same group produced an improved form, the junction transistor. The latter unit is the 'hot item' that promises to revolutionize electronics.

One of the rare metals, a by-product of lead refining, germanium has been quoted for years at about $200 per pound. The demand

INDUSTRY REPORT→

COAST-TO-COAST COLOR SURGERY

Closed-circuit tv transmission in color of an operation taking place in Los Angeles, Calif., was viewed by a group of doctors in New York recently. The operating surgeon, shown at left center with glasses, operated to remove an arterial constriction in the heart of the patient

PLASTICON "P" Capacitors—

utilize polystyrene as the solid dielectric—especially suitable for these applications:

- computors
- calculators
- saw-tooth oscillators
- RC circuits
- electronic controls
- integrating circuits

Plasticon Type "P" Capacitors have gained wide acceptance for a variety of applications in addition to those listed above.

If you require the following characteristics, specify Plasticon "P" Capacitors:

Electrical characteristics at 25°C ambient temperature:

- high resistance 10^{11} ohms/mfd or 10^{11} ohms max.
- low power factor 0.05% or less
- low dielectric absorption 0.05%
- Q is practically constant from DC to 100 Kc

Other features:

- voltage ranges available 100, 400 and 1000V
- capacitance range 0.001 to 25 mfd
- capacitance tolerance 10% standard—also available 5%, 2% and 1%
- temperature range —60°C to +90°C
- temperature coefficient approx. 150 PPM/°C negative

Large values of capacitance are housed in CP 70 style containers. Soldered-in glass insulators assure hermetic sealing. Small values of capacitance are housed in our popular glassmike style containers.

OUR SPECIALTY is engineering capacitors to exacting requirements.

We invite your inquiries.

MANUFACTURERS
Glassmike Capacitors
Plasticon Capacitors
HiVolt Power Supplies
Pulse Forming Networks

All Phones: **AMbassador 2-3727**

CP

Condenser Products Company

7517 North Clark Street • Chicago 26, Illinois

for it is still so small that the price of the raw product has not changed materially (present quotation $180 per pound). The amount of germanium used even in the larger rectifier units is so small that raw material cost is almost negligible. Special refining methods, carried out in the manufacture of the transistor or rectifier, account for bulk of the material cost.

▶ **New Process**—Until recent months, transistors and germanium rectifiers were made from a slab cut into strips with a saw. Despite great caution in processing, it proved well nigh impossible to produce a uniform product. Consequently the early point-contact transistors were difficult to produce to the tolerances commonly met by vacuum tubes. Then the production of single-crystal germanium was tried, by withdrawing material slowly from a melt just on the point of freezing. Tests showed that this material was highly uniform. Moreover specific impurities, necessary to produce the rectifying and amplifying action, could be thereby introduced with great precision. Out of this technique came the junction transistor, and the germanium power rectifier.

At the moment the germanium power rectifier has the center of the commercial stage. As a rectifier in tv sets, and elsewhere where commercial alternating current must be changed to direct current, it promises to displace immediately the traditional vacuum tube rectifier and the less efficient selenium rectifier.

▶ **Today's Market**—Even in the heavy-current industrial field, the promise is nearly a reality. In theory an area the size of your little fingernail (one square centimeter) of single-crystal germanium will rectify 1,000 amperes, and 300 amperes has actually been carried in practical tests. This puts the germanium rectifier in the heavy-duty class, quite possibly a competitor to the thyratron and ignitron in such large scale applications as resistance welding control.

The long-term future is with the junction transistor, which will put electronics into local telephone exchanges and other large-scale equipment where electron tubes have never been used because of limited life and costly consumption of power. It will radically reduce the size of computers, and so simplify maintenance that such brain-savers may someday be commonplace in many business offices. But don't try to buy a transistor today.

Industry Activities

JETEC Holds First General Conference

Committees discuss tube standardization but individual engineers seem preoccupied with television

FIRST GENERAL CONFERENCE OF JETEC, the joint electron tube engineering council of the Radio-Television Manufacturers Association and the National Electrical Manufacturers Association, attracted 120 tycoons from the tube business to Absecon New Jersey's swank Seaview Country Club.

Topic officially discussed by 11 committees was standardization of tubes, work in progress ranging all the way from type designations to packaging. Unofficially, there was much talk about tubes for television.

▶ **Tube Trends**—Engineers buttonholed at the conference seemed preoccupied with the development of television-picture-tube glass faceplates having cylindrical cross sections. It appears that as picture-tube sizes increase conventional spherical-cross-section faceplates become annoyingly susceptible to reflections from room lights above, below or off at the sides of the screen. Cylindrical-cross-section faceplates reduce side reflections. Television picture tubes having smaller-diameter necks are evidently also under development. Easier vertical and horizontal deflection of the pencil-pointed electron beam forming the lines of the picture in large-screen sets is, we were told, the objective.

Receiving-tube engineers encountered at the JETEC meeting were in many cases thinking about radio-frequency amplifier types they hoped would be suitable for use as the first tube in tuners designed for the ultra-high-frequency television band. Here the problem appears to be one of obtaining high

MEETINGS

MARCH 3–6: IRE National Convention, Waldorf-Astoria Hotel and Grand Palace, New York, N. Y.

MARCH 30: Sixth Annual NARTB Broadcast Engineering Conference, and 30th Annual Convention of NARTB, Stevens Hotel, Chicago, Ill.

APR. 7–9: Radio Component Show, Grosvenor House, Park Lane, London, W1, England.

MAY 5–7: Second Government-Industry Conference, sponsored by RTMA, NEMA, AIEE, at National Bureau of Standards, Washington, D. C.

MAY 5–16: British Industries Fair, Earls Court and Olympia, London, England, and Castle Bromwich, Birmingham, England.

MAY 13: RADIO CLUB of America, Room 502, Engineering Societies Building, New York, N. Y.

MAY 16–17: Fourth Southwest IRE Conference and Radio Engineering Show, Rice Hotel, Houston, Tex.

MAY 19–22: 1952 Electronics Parts Shows, Exhibition Hall, Stevens Hotel, Chicago, Ill.

JUNE 23–27: AIEE Summer General Meeting, Hotel Nicole, Minneapolis, Minn.

AUG. 12–15: 1952 APCO Conference, Hotel Whitcomb, San Francisco, Calif.

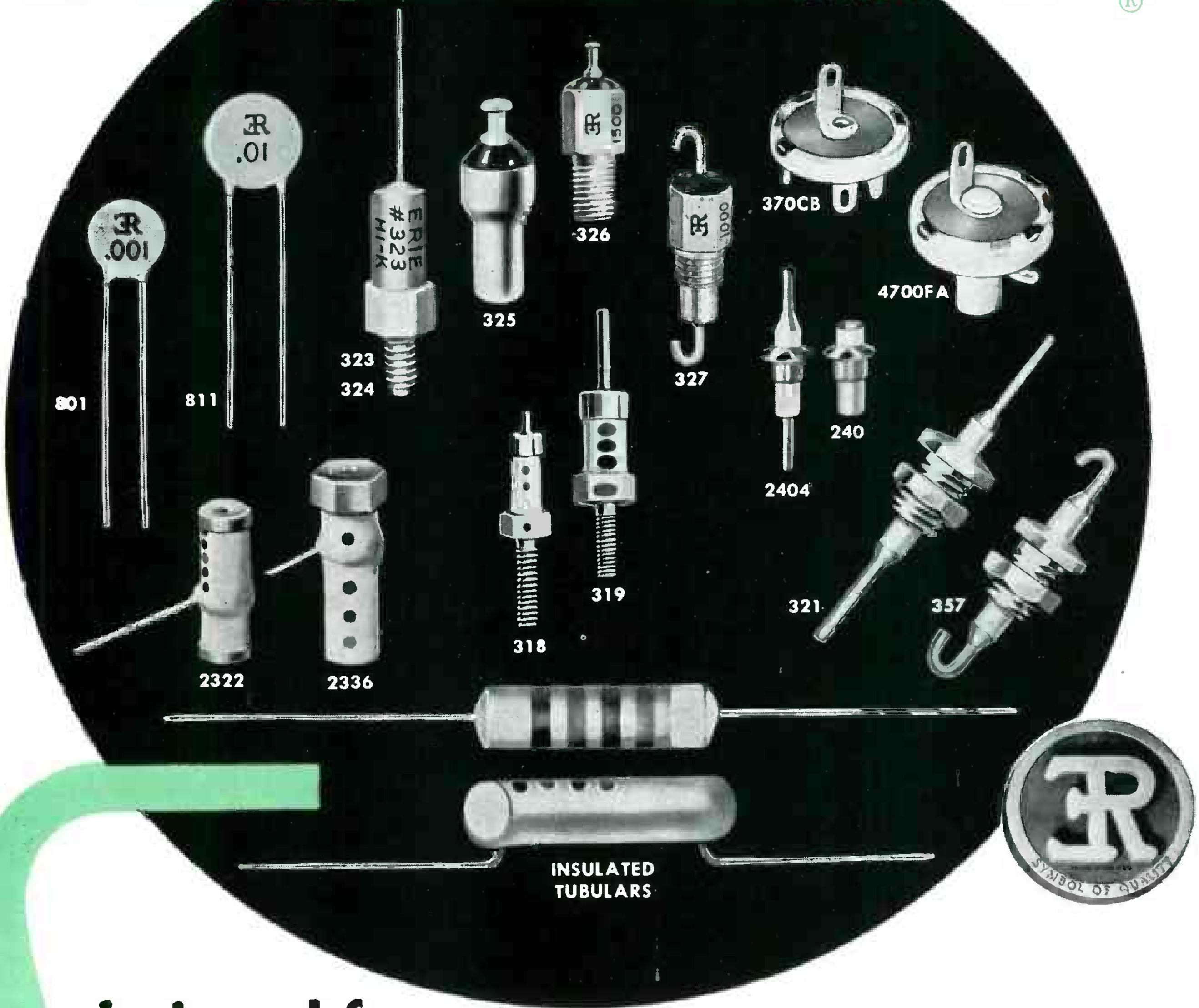
AUG. 27–29: Western Electronic Show and Conference, Municipal Auditorium, Long Beach, Calif.

SEPT. 8–12: National Instrument Conference and Exhibit, Cleveland, Ohio.

OCT. 20–22: Radio Fall Meeting, RTMA Engineering Department, Hotel Syracuse, Syracuse, N. Y.

INDUSTRY REPORT →

18 BY-PASS ERIE CERAMICONS®



designed for MINIATURIZATION, RUGGEDIZATION

Erie Ceramicons fulfill all the requisites for efficient by-passing—compact design, low inductance, and conservative 500 volt D. C. rating. Erie Resistor offers the most complete line of ceramic by-pass units available. Each design has been thoroughly proven in domestic and military equipment.

Sixteen popular styles in ceramic capacitors are shown above. Feed-Thru's are supplied in values up to 2000 mmf, Stand-Off units up to 5000 mmf, Tubular and Disc units up to .01 mfd. Also shown above are two Silver Button Micas representing the 370 series for values up to 1000 mmf and the 4700 series for values up to 6000 mmf. Write for samples to meet your specific requirements.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND . . . TORONTO, CANADA

gain without introducing serious noise within the tube itself.

Power-tube engineers in several plants are concentrating on types that generate the final output power for 1 to 5-kilowatt uhf television transmitters.

TV Antenna Tested By Helicopter

HELICOPTERS have been used to determine the best location for television station towers with some success. Now there are indications that the versatile aircraft may prove equally useful in facilitating adjustment of tv transmitting antennas for best coverage after they are installed.

When WJZ-TV moved to New York's Empire State Building and at the same time increased power, the expected increase in signal strength was achieved in all but a few locations. One of these was nearby Long Island's north shore. Engineer John Preston boarded a helicopter and circled the antenna about 1½ miles out, carrying signal-strength-measuring equipment in his lap. A 'dip' in signal strength was noted in the direction of Long Island.

The antenna was adjusted and Preston went up again. This time the 'dip' was gone, and reports from the former weak-signal area later confirmed the improved coverage.

The helicopter test, incidentally, took ten minutes to run. Similar tests at ground level would have required weeks.

TV Labor Costs Drop

Man-hours down 27 percent per set in latest plant survey

COSTS GO DOWN as production goes up. Nowhere is this better illustrated than in a report covering the radio and television business just released by the Department of Labor.

The Department's Bureau of Labor Statistics questioned 22 plants late last year, now comes up with the fact that factory man-hours required for the production of a typical television set declined 27 percent in 1949 . . . the latest full year for which figures are available . . . as against 1948, while man-hours required for the fabrication of an average radio set increased 2 percent.

▶ **Production Time**—Time required for the production of equipment in the period covered by the BLS survey ranged from 1½ man-hours on a table radio to 20½ man-hours on a combination tv-radio-phonograph.

Women comprised 50 percent of the work force in the radio-tv manufacturing business in September; they represented 27 percent of the work force in *all* manufacturing plants in that month.

Production workers engaged in the manufacture of radio and related products, in plants reporting, totalled 112,700 in 1949 as against 123,000 during the previous year.

▶ **Detailed Report**—Additional details regarding productivity are available in a report entitled "Trends in Man-Hours Expended Per Unit . . . Television and Radio Sets," available from the United States Department of Labor, Bureau of Labor Statistics, Washington, D. C., or its nearest regional office.

Fighter Planes Using New Lightweight Radar

A SMALL automatic radar unit that feeds information directly into a computing gunsight is now being installed in Air Force, Navy and Marine Corps fighter planes throughout the world.

This lightweight device eliminates guesswork on the part of the pilot. The radar is so accurate, it is reported, that inexperienced pilots, during aerial gunnery practice, have consistently downed towed targets with their first bursts.

Many types of fighter aircraft now incorporate the radar at the time of manufacture; others are scheduled to have it in the near future.

Now being produced on an assembly-line basis, the device is the most widely used radar in the world today, according to General Electric's Electronic Division.

Major General H. M. McClelland (left) inspects new gunsight radar

Predict Distant A-Blasts

Trays On Roof Used In Radiation Count

TRAYS perched on the roof of 70 Columbus Avenue, (Atomic Energy Commission Building) New York City, or others in strategically located parts of the country, could tell the story of a Russian atomic explosion.

The AEC has set up radiation monitoring and warning systems, using 50 U. S. Weather Bureau stations throughout the country.

▶ **Labs Test Samples**—After collecting samples of particles in the air, the weather bureaus forward them to a laboratory located near them, in New York City, Rochester, N. Y.; Upton, N. Y.; Oak Ridge, Tennessee; Richland, Wash. and Los Angeles, California.

From dust and liquid samplings, the laboratories test for atomic radiation. Information is provided concerning location at which the sampling was taken, direction and speed of winds, and whether previous samples have come from that direction. The Commission says, in guarded language, that they are able to predict the location from which the collected

INDUSTRY REPORT →

YES: here's an inorganic electrical insulation that is superior in every respect and yet costs less than any comparable cordage . . . the characteristics speak for themselves:

			DIAMETER	YARDS PER LB.	TENSILE STRENGTH
• exceptional high tensile strength • resistance to moisture, oils, corrosive fumes, acids, alkalis	TREATED	EC9-1-U	.009"	3,620	15
		EC9-2-U	.026"	702	80
		EC9-3-U	.034"	418	135
		EC9-4-U	.052"	209	220
		EC9-5-U	.076"	103	330
		EC9-6-U	.083"	87	420
		EC9-7-U	.095"	65	510
		EC9-8-U	.119"	43	725
		EC9-10-U	.149"	28	940
• will not rot, stretch or shrink • not affected by fungus	UNTREATED	EC9-1-N	.0105"	3,240	14
		EC9-2-N	.032"	638	62
		EC9-3-N	.039"	387	105
		EC9-4-N	.062"	193	180
		EC9-5-N	.084"	98	295
		EC9-6-N	.094"	84	340
		EC9-7-N	.110"	61	440
		EC9-8-N	.128"	42	540
		EC9-10-N	.165"	27	750

Manufacturers of electrical apparatus and appliances, repair and maintenance departments and rewind shops will find MIRAGLAS* CORDS ideal wherever a high quality binder twine or high strength tension member is required for: banding field and armature coils . . . wrapping string bands on small armatures . . . protecting front of commutator V-ring . . . reset strings . . . tying slot insulation . . . binding on V-ring extension . . . filling in winding coils . . . lashing ends of coils in large motors and generators—and when wax-treated for assembling and tying wire harnesses, etc.

• *MIRAGLAS* CORDS are made by plying fine, strong, flexible fiberglas (filaments of glass). Available either treated or untreated. Treatments: oil, neoprene or wax.*

For MIRAGLAS* CORDS as for all other ELECTRICAL INSULATIONS you can depend upon MITCHELL-RAND "Electrical Insulation Headquarters" since 1889.

Write to MITCHELL-RAND for free samples and descriptive data.

MITCHELL-RAND · Electrical Insulation Headquarters · SINCE 1889

MITCHELL-RAND INSULATION CO., INC.

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

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATING VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING samples had started as well as an approximate time and date.

▶ **Results and Equipment**—AEC discussed one result of the latest Nevada test, with relation to New York City. They revealed that radiation reaching that city amounted to 1/300th of that used for an average chest x-ray, for a 24-hour period.

Electronic equipment used in the sampling tests, being conducted daily, is supplied the weather bureaus and laboratories by AEC. This insures that all stations are working with the same type of equipment. No new devices have been developed for these tests. Instead, modified versions of standard commercial equipment are being used.

Did AEC pick up dust samplings 'on the winds' from Russia last year? Corbin Allerdyce, the Commission's Public Information Officer in New York, ducked the answer by saying "at the present time, such types of question cannot be answered."

Radio Stations Test Plan To Fool Enemy Bombers

Use Air Force planes in 19-state 'air attack'

EASTERN AIR DEFENSE FORCE planes and 400 broadcasting stations conduct exercises this month in 19 states to test a method of staying on the air for direction of civil defense units during an enemy air attack.

A similar exercise, conducted in November, was worked out by the Federal Communications Commission and put into operation after preliminary tests in the western states. The current exercises will be the largest yet attempted.

▶ **Objective Of Plan**—The plan, discussed last year in ELECTRONICS (p 94, August 1951), is based on the 'synchronous sequential' method of transmission.

Synchronous sequential operation requires that each station of a cluster or group carrying the same program operate intermittently. As the first station leaves the air, another immediately comes on. Ideally, the sequence in which the stations follow one another is varied.

The change in transmitters causes the radio compass of enemy planes to fluctuate erratically. If they attempt to 'home' on a particular station it will be off the air before they can successfully do so. Another station at some unknown place, in a different direction, will take its place.

▶ **Method Used In Test**—The 400 stations selected for the exercise are those which ordinarily go off the air between midnight and 1 A. M. They will be ordered to return to the air on a common frequency at a specified time selected in advance of the test.

From 1:30 A. M. to 5:00 A. M., each of the stations will broadcast for one minute or less, after which the program will be passed on to the next station of the group.

▶ **Progress Reported**—The results will not be revealed, since they fall under military security classification. When queried concerning the previous test, Major General Frederic H. Smith, Jr., commanding general, Eastern Air Defense Force, and director of these quarterly exercises, commented, "We've come a long way but still have a long way to go."

Business Briefs

▶ **Next 5 Years** should see a vastly improved supply of copper, extremely important in the electronics field. So says Cornelius F. Kelley, Anaconda Copper Mining Company. He believes that the government's "propaganda" campaign urging the substitution of aluminum for copper is unnecessary if scheduled major projects are carried out.

Kelley predicts an increase of 40 percent in the copper supply by '56, with imports from friendly foreign sources plus stepped-up U. S. production. At that time, he says, there should be at least 125,000 tons produced per month, in comparison with present production levels of 90,000 tons.

One reason for the copper shortage, Kelley feels, is sub-normal scrap intake.

▶ **Bids Are Being Accepted** for the construction of a $2 million storage and repair building for electronic equipment at the Naval Station, San Diego, California.

The 11th Naval District Public Works Office reports that construction will be started this year under supervision of Navy civil engineers.

▶ **Extra Compensation** to electronic engineers for longer-than-normal hours has been approved by the Salary Stabilization Board. The engineers will be allowed to receive extra pay comparable with that paid to production workers for extra work.

▶ **No Public TV In Japan** likely in 1952, State Department representative in Tokyo says, quashing a rumor prevalent in trade circles that technical, regulatory and financial obstacles prevent commercial licensing of tv at this time. Four tv license applications pending . . . one experimental station operating.

▶ **Six Month Guarantee** on cathode-ray picture tubes has been set up for receiver manufacturers by DuMont Laboratories. Guarantee starts from date of actual installation of receiver in consumer's home. Plan, which starts immediately, may set tube guarantee pattern for the industry.

▶ **2,000 Women Hold** amateur radio operators' licenses in the U. S., according to *QST*, official organ of the American Radio Relay League, which has instituted a column to serve feminine interests. The column reports stations contacted and distant countries worked by the YL's and XYL's.

104 Series
1000 V (RMS)
Flange Diameter .200
Mounting hole 1/8"
Electrode treatments
SW and L

105 Series
1500 V (RMS)
Flange diameter .250
Mounting hole 3/16"
Electrode treatments
SW and L

106 FP
1500 V (RMS)
Flange diameter 19/64"
Mounting hole 3/16"
Electrode treatment
FP only

107 Series
2000 V (RMS)
Flange diameter 5/16"
Mounting hole 15/64"
Electrode treatments
TH, HT, FP, HTL,
and FPSW

108 Series
2000 V (RMS)
Flange diameter 3/8"
Mounting hole 9/32"
Electrode treatments
TH, HT, FP, HTL,
and FPSW

Meet the FUSITE FAMILY *of* SINGLE TERMINALS

Glass to Steel for a True Fused Hermetic Seal

Protect Sensitive Electrical Components from

- DIRT
- MOISTURE
- FUMES
- CHANGING PRESSURES

109 Series
2500 V (RMS)
Flange diameter 13/32"
Mounting hole 5/16"
Electrode treatments
TH, HT, FP, HTL,
and FPSW

110 R Series
3000 V (RMS)
Flange diameter 7/16"
For exterior mounting
Electrode treatments
HTL, HT, FP, FPSW,
and FPNH

GENERAL SPECIFICATIONS

materials -- C.R. steel disc and steel electrodes. Interfused with glass.

finish -- fused electro tin plate.

voltage test -- see individual terminal.

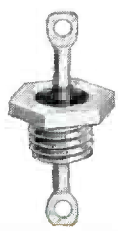
pressure test -- 12 pounds gauge.

insulation test -- 10,000 megohms after salt water immersion.

sudden thermal shock test -- dry ice to boiling water.

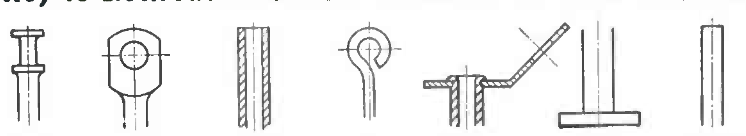
112 Series
3000 V (RMS)
Flange diameter 1/2"
Mounting hole 3/8"
Electrode treatments
HTL, HT, FP, FPSW,
and FPNH

112 R Series
3000 V (RMS)
Flange diameter 1/2"
For exterior mounting
Electrode treatments
HTL, HT, FP, FPSW,
FPNH and FP Threaded



105 TB-FP
1500 V (RMS)
Flange 3/8" hex.
Mounting hole 1/4"
28 threaded
Electrode treatment
FP only

Key to Electrode Treatment Available on These Terminals



TH TURRET HEAD	**FP** FLATTENED AND PIERCED	**HT** HOLLOW TUBE	**L** LOOPED	**HTL** HOLLOW TUBE LUG	**NH** NAIL HEAD	**SW** STRAIGHT WIRE

Write for Catalog
OF COMPLETE LINE AND ENGINEERING DETAILS -- DEPT. B

INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

THE FUSITE CORPORATION
6028 FERNVIEW AVENUE - CINCINNATI 13, OHIO

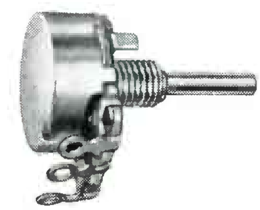
3 New Resistors

−55°C to +150°C

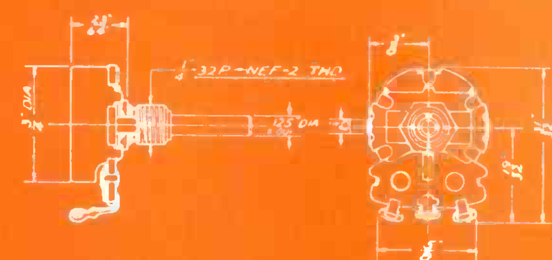
Complete aridity to saturation . . . An *unprecedented* temperature and humidity range

FOR MILITARY APPLICATIONS

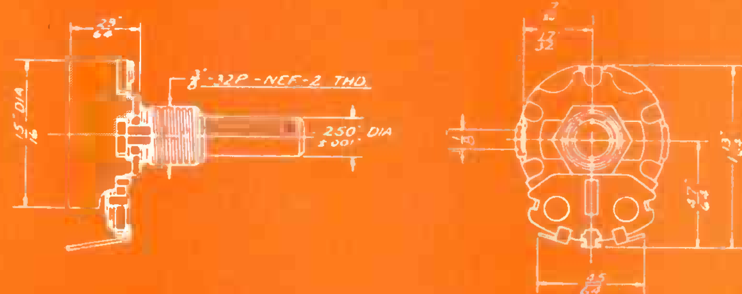
Highly recommended for use in jet and other planes, guided missiles, tanks, ships and submarines, portable or mobile equipment and all other military communications. Manufactured from specially developed materials, these absolutely unique variable resistors are now available in a *complete range of sizes*. (See chart at bottom of page.)

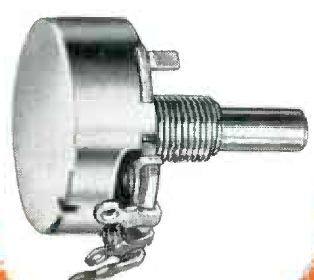


Type 65

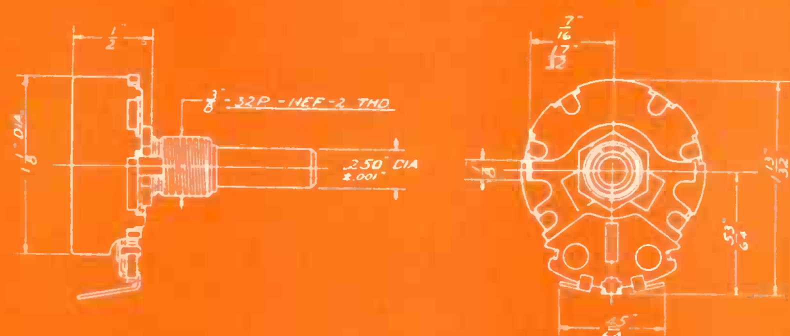


Type 90





Type 95



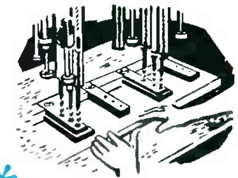
+150°C to −55°C

DIAMETER	TYPE 95 1⅛"	TYPE 90 15/16"	TYPE 65 (miniaturized) ¾"
Wattage and Voltage Rating	2 watts @ 70°C with 500 V max. across end terminals	1 watt @ 70°C with 500 V max. across end terminals	½ watt @ 70°C with 350 V max. across end terminals

Specialists in Precision Mass Production of Variable Resistors

Meets Military Specifications
JAN-R-94, Type RV-3A
CTS Type 35, 1 1/8" Diameter
Composition
JAN-R-94, Type RV-2B
CTS Type GC 45 with Switch
Composition
JAN-R-94, Type RV-3B
CTS Type GC 35 with Switch
Composition
JAN-R-94, Type RV-2A
CTS Type 45, 15/16" Diameter
Composition
JAN Type RV-4B
CTS Type FGC 95 with Switch
Composition
JAN Type RV-4A
CTS Type 95, 1 1/8" Diameter
Composition
MEETS ALL
JAN-R-19 SPECIFICATIONS
JAN Type RA 20A
JAN Type RA 20B
2 Watt (CTS Type GC-252)
JAN Type RA 25A or 30A
3 or 4 Watt (CTS Type 25)
EXCEPTIONALLY GOOD DELIVERY CYCLE
on military orders due to enormous mass production facilities . . . Please give complete details on your requirements when writing or phoning for further information.
FOUNDED 1896
CTS
CHICAGO TELEPHONE SUPPLY
Corporation
ELKHART • INDIANA
REPRESENTATIVES
Henry E. Sanders
401 North Broad Street
Philadelphia 8, Pennsylvania
Phone: Walnut 2-5369
W. S. Harmon Company
1638 So. La Cienega Blvd.
Los Angeles 35, California
Phone: Bradshaw 2-3321
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.

PUNCH IT—
Intricate parts are punched on high speed presses.



DRILL IT—
Dilecto drills fast and clean.

SAW IT—
Dilecto can be fed rapidly, without forcing.

MILL IT—
Dilecto takes higher speeds and feeds.

Versatile Dilecto...

A LAMINATED PLASTIC THAT'S EASY TO MACHINE!

Dilecto sheets, rods, and tubes have been machined into thousands of parts —some simple and some amazingly intricate. Engineers everywhere are specifying Dilecto for applications requiring a strong, low cost, high quality plastic. Here's why:

Non-metallic Dilecto remains unaffected by water, steam, oil, most chemicals, dies, solvents, acids. Silicone—glass fibre Dilecto withstands 200°C. (392°F.) continuous operating temperature. Mechanically strong, electrically superior, Dilecto is light weight and *easy to fabricate.*

Your C-D-F sales engineer can tell you about applications, grades, deliveries. Give him a call today (sales offices in principal cities)—he's a good man to know!

Write C-D-F, Newark, Del., for new . . . free plastics machining notebook.

CDF

Continental-Diamond Fibre Company

NEWARK 2, DELAWARE

SPARE PARTS BOXES

No. 1025—6
18" x 9" x 9"

No. 1025—1
12" x 6" x 6"

24 STOCK SIZES

Made to Army-Navy specifications — Jan-B-233 amendment — 2 — Mar. 10, 1950, Army No. 65-15. Navy No. 4239C, Army green, Navy grey. Immediate Delivery.

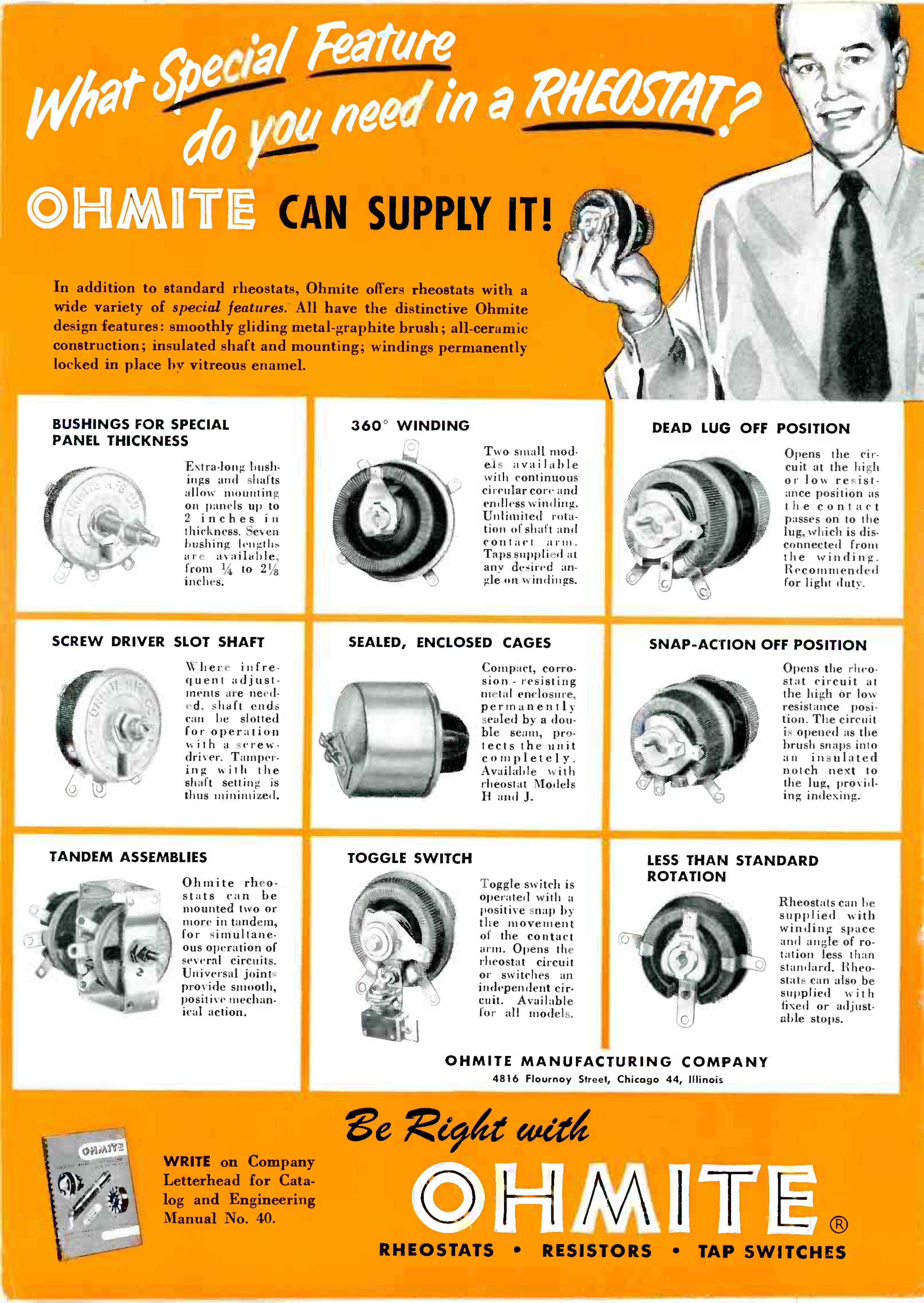
Number	Length	Width	Height	Number	Length	Width	Height
1025- 1	12	6	6	1025-13	18	18	12
1025- 2	12	9	6	1025-14	30	15	12
1025- 3	12	12	6	1025-15	24	15	12
1025- 4	12	9	9	1025-16	24	15	15
1025- 5	18	9	6	1025-17	24	18	12
1025- 6	18	9	9	1025-18	24	18	15
1025- 7	18	12	9	1025-19	24	18	18
1025- 8	18	6	6	1025-20	24	12	9
1025- 9	18	15	9	1025-21	42	9	9
1025-10	18	12	6	1025-22	36	12	9
1025-11	18	15	12	1025-23	30	15	9
1025-12	18	12	12	1025-24	42	12	9

No. 1025—14
30" x 15" x 12"
(Partitions not included)

COLE STEEL EQUIPMENT CO.

285 MADISON AVE., NEW YORK 17, N.Y.

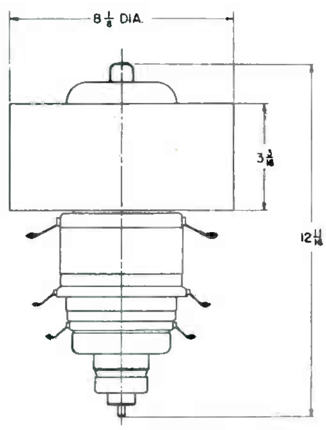
FACTORY: YORK, PA.


What Special Feature do you need in a RHEOSTAT?
OHMITE CAN SUPPLY IT!
In addition to standard rheostats, Ohmite offers rheostats with a wide variety of special features. All have the distinctive Ohmite design features: smoothly gliding metal-graphite brush; all-ceramic construction; insulated shaft and mounting; windings permanently locked in place by vitreous enamel.
BUSHINGS FOR SPECIAL PANEL THICKNESS
Extra-long bushings and shafts allow mounting on panels up to 2 inches in thickness. Seven bushing lengths are available, from 1/4 to 2 1/8 inches.
360° WINDING
Two small models available with continuous circular core and endless winding. Unlimited rotation of shaft and contact arm. Taps supplied at any desired angle on windings.
DEAD LUG OFF POSITION
Opens the circuit at the high or low resistance position as the contact passes on to the lug, which is disconnected from the winding. Recommended for light duty.
SCREW DRIVER SLOT SHAFT
Where infrequent adjustments are needed, shaft ends can be slotted for operation with a screwdriver. Tampering with the shaft setting is thus minimized.
SEALED, ENCLOSED CAGES
Compact, corrosion-resisting metal enclosure, permanently sealed by a double seam, protects the unit completely. Available with rheostat Models H and J.
SNAP-ACTION OFF POSITION
Opens the rheostat circuit at the high or low resistance position. The circuit is opened as the brush snaps into an insulated notch next to the lug, providing indexing.
TANDEM ASSEMBLIES
Ohmite rheostats can be mounted two or more in tandem, for simultaneous operation of several circuits. Universal joints provide smooth, positive mechanical action.
TOGGLE SWITCH
Toggle switch is operated with a positive snap by the movement of the contact arm. Opens the rheostat circuit or switches an independent circuit. Available for all models.
LESS THAN STANDARD ROTATION
Rheostats can be supplied with winding space and angle of rotation less than standard. Rheostats can also be supplied with fixed or adjustable stops.
OHMITE MANUFACTURING COMPANY
4816 Flournoy Street, Chicago 44, Illinois
Be Right with
OHMITE®
RHEOSTATS • RESISTORS • TAP SWITCHES
WRITE on Company Letterhead for Catalog and Engineering Manual No. 40.

NOW! AIR-COOLED FOR TV

Eimac 4X20000A

- ★ 20 Kw Peak Sync. Output
- ★ 5 Mc. Bandwidth
- ★ 216 Mc. Operation
- ★ Ceramic Envelope



Here's the companion tube to Eimac's sensational 4W20000A . . . the 4X20000A, the new powerful and practical air-cooled transmitting tetrode developed for TV on VHF. The 4X20000A incorporates all the special characteristics of the water-cooled tube including a ceramic envelope that gives greater mechanical strength and higher resistance to thermal shock. Integral contact fingers assure proper terminal contact and simplify circuit construction.

This tube's potentials are not limited to television. Write for available literature.

TYPICAL OPERATION
Class-B Linear Amplifier — Television Visual Service
(Per tube, 5-Mc. Bandwidth, 216 Mc.)
Peak Synchronizing Level

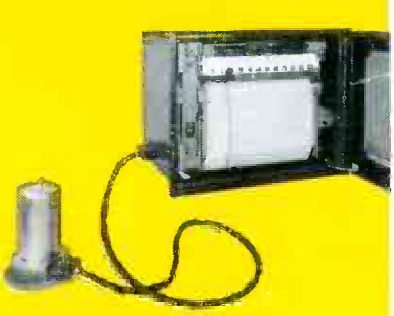
Load Impedance	400 Ohms
D-C Plate Voltage	5500 Volts
D-C Screen Voltage	1200 Volts
D-C Control Grid Voltage . . .	−240 Volts
D-C Plate Current	7.1 Amp.
D-C Screen Current (approx.) . .	500 Ma.
Peak R-F Grid Input Voltage . .	430 Volts
Plate Power Input	39.1 Kw.
Plate Dissipation	16.5 Kw.
Useful Plate Power Output . . .	20.1 Kw.

• *SEE THE 4X20000A at the March IRE Show, our regular booth No. 36*

Follow the Leaders to Eimac TUBES

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

Instruments



BROWN ELECTROMETER

For measuring and recording currents as low as 10^{-15} amperes. High accuracy provided through use of a null balance servo system and a-c amplifiers which eliminate drift common to d-c amplifiers. Used to measure and record minute currents in ionization chambers and wherever currents as low as a billionth of a microampere are encountered. The only such system that incorporates a recorder as an integral part of the circuit.

Electrical Characteristics

Full Scale Current Ranges Available: 10^{-13} amperes with 10^{11} ohm resistor, and selector switch adjustment for full scale or 10^{-12} or 10^{-11} amperes. Using other resistors, full scale current changes up to 10^{-7} amperes can be supplied with selector switch adjustment up to 10^{-5} amperes.

Input Resistor: 10^{11} ohms for most sensitive current measurement. (Also supplied in values down to 10^{5} ohms.)

System Accuracy: Approximately 1 per cent of scale.

Zero Drift: Should not exceed 0.3 millivolt per day.

System Noise: Approximately 5 microvolts.

Instrument Speed of Response: Available for either 24, 12, or 4½ seconds full scale.

Maximum Speed of Response Using 4½ Second Instrument Speed: 5 seconds for 90 per cent of change, with preamplifier located at source.

Power Supply: 115 volts, 60 cycles. Also dry cell supplied in instrument.

Power Requirements: 65 watts.

For further information, send for Data Sheet No. 10.0-4.

FUNCTION PLOTTER

Can be advantageously employed wherever there is occasion to depict graphically one variable as a function of another. It imparts speed, accuracy and efficiency to the plotting of curves.

Special Instruments

BROWN EXTENDED RANGE PRECISION INDICATOR

Ideal for facilitating the measurement of a variable where it changes throughout a wide range, and where precise evaluation and good readability are vital factors. Incorporating extended scale with automatic range changing operation, the instrument can be supplied with from two to five ranges, calibrated in emf or the specific quantity under measurement (*i.e.*, pounds or tons of force or thrust, millivoltage, temperature, etc.).

For further information, send for Data Sheet No. 10.0-3.

NARROW SPAN RECORDERS

New narrow span potentiometer circuit makes possible precise measurement of spans as low as 100 microvolts. Instruments embodying this new circuit (recorders and precision indicators) are available as self-contained units requiring no pre-amplifier unit. The instruments find ready use wherever accurate measurement of d-c potentials of the order of microvolts is required. Potentials as low as one microvolt can be precisely determined. Can be calibrated in terms of temperature, emf, etc.

For further information, send for Data Sheet No. 10.0-8.

DUPLEX TWO PEN RECORDER

Provides simultaneous measurements of practically any combination of two independent variables (voltage, current, temperature, pressure, etc.) on a single chart thereby facilitating comparisons of the two variables. Has two separate measuring systems with associated pens. Pens are entirely independent, and traverse the full eleven inches of chart width without interfering with each other. Both measuring circuits are standardized simultaneously by means of a push button. Actuation and range of the circuits may be the same or totally different.

For further information, send for Data Sheet No. 10.0-6.

NEW *ElectroniK* HIGH SPEED RECORDER

Ideal for accurately measuring and recording rapidly changing variables often found in research, engineering analyses and other technical investigations. Develops a pen speed sufficiently high to traverse its 11-inch graduated chart in one second. Full scale signals which vary as rapidly as 20 cycles per minute can be accurately recorded. Signals with a peak-to-peak amplitude of 10% of scale can be reproduced at variations up to 180 cycles per minute.

For further information, send for Data Sheet No. 10.0-7.

How Low is a HIGH VACUUM?

You can't measure a working vacuum by *pressure* alone because *time* also is a big factor in any vacuum processing operation. To provide these two essentials of high vacuum — (1) the *required low absolute pressure* (2) in the *shortest possible time* — is the job for fast, dependable Kinney High Vacuum Pumps.

Fast — Kinney High Vacuum Pumps have the ability to save processing time by speeding up the tempo of your vacuum operations.

Dependable — Kinney High Vacuum Pumps have the ability and stamina to produce the vacuum you need, whether it's measured in fractions of an inch of mercury or fractions of a micron.

Remember, there's a Kinney Pump for every vacuum requirement, from the midget 2 cu. ft. per min. pump to the new giant 1600 cu. ft. per min. model. Send coupon today for new Kinney Bulletin V-51B. KINNEY MANUFACTURING CO., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Philadelphia, Houston, New Orleans, San Francisco, Seattle, Los Angeles.

FOREIGN REPRESENTATIVES: Gen'l Engineering Co., Ltd., Radcliffe, Lancs., England • Horrocks, Roxburgh Pty., Ltd., Melbourne, C. I. Australia • W. S. Thomas & Taylor Pty., Ltd., Johannesburg, South Africa • Novelectric, Ltd., Zurich, Switzerland • C.I.R.E. Piazza Cavour 25, Rome, Italy.

KINNEY MANUFACTURING CO.
3565 WASHINGTON ST., BOSTON 30, MASS.

Please send new Bulletin V-51B. Our vacuum problem involves:

- ☐ **Vacuum exhausting**
- ☐ **Vacuum dehydration**
- ☐ **Vacuum coating**
- ☐ **Vacuum distillation**
- ☐ **Vacuum metallurgy**
- ☐ **Vacuum research**

Name .... *Company* ....

Address ....

City .... *State* ....

Kinney

VACUUM PUMPS

WTIC—HARTFORD

discovers disc recorders are still a must

Studio engineering supervisor Albert Jackson (right) along with maintenance engineer Fred Edwards (below) planned and installed WTIC's new PRESTO *disc-recording studio.*

Originally many stations across the nation thought that the advent of the tape recorder meant the eventual death of the disc. But, it didn't turn out that way! Convinced of the continuing need for disc recording and faced with an increased load of disc work, WTIC—Hartford's 50 kw station—decided to augment its disc equipment.

Having received 12 years of constant service from their PRESTO 8-A disc machines, WTIC naturally turned to PRESTO for its new equipment . . . two new 8-DG recorders, 92-B amplifiers and 160-B equalizers, along with a central console mounted between the recorders. Housed in its own studio, the new equipment turned out more than 400 recordings the first two months and is estimated to save the station $1,000 a year by cutting microgroove reference discs.

A wide range of WTIC activities, including agency program auditions, special gift records for VIP's appearing on the air, recordings of network programs originating at the station, as well as community service shows for other Connecticut stations, keep WTIC's disc equipment turning almost constantly . . . proof that disc recorders are still very much in the spin!

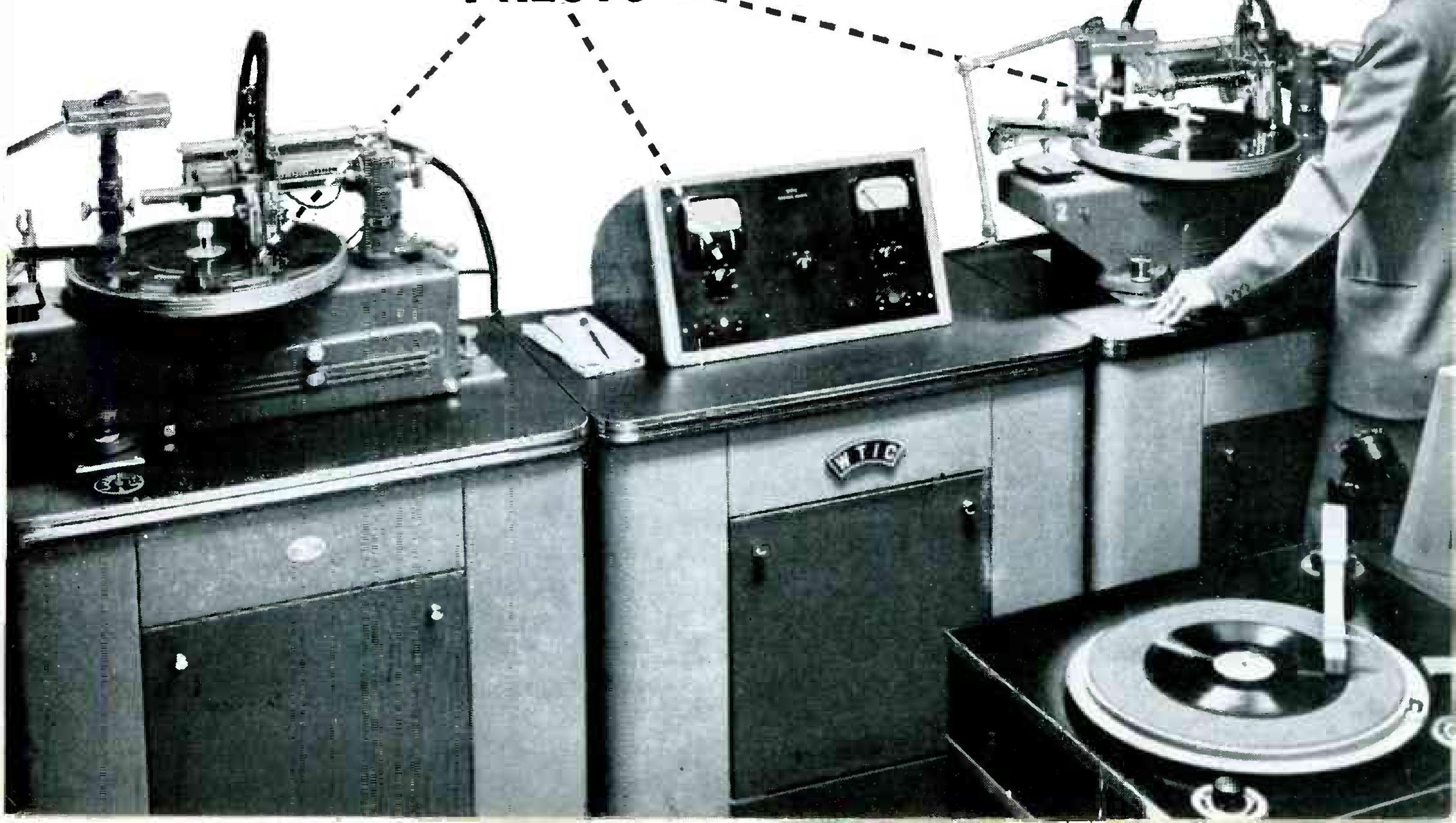
PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division:
25 Warren Street, New York 7, N. Y.

Canadian Division:
Walter P. Downs, Ltd.,
Dominion Square Bldg., Montreal

wherever you go...

there's PRESTO



SLANT YOUR REQUIREMENTS TO ICA FOR MINIATURE

SLIP RING AND COMMUTATOR ASSEMBLIES

This ICA plant—brand new inside and out—contains the most modern and complete facilities available anywhere in the world for the exclusive production of Miniature Slip-Ring and Commutator Assemblies to precision standards. It is now in full scale production to meet your requirements in the fastest possible time at the lowest possible cost.

ICA Assemblies are produoed under exclusive license by Electro Tec Corporation. They are manufactured by molding plastic blanks around the wire leads, then machining these blanks to the exact size and shape required, after which hard silver rings are electro-plated into the machined grooves. Final machining produces a one-piece assembly of extreme accuracy and free from the accumulated errors common in fabricated assemblies.

Before placing an order for assemblies of any other type, check with ICA on price and quality. Our new facilities offer exceptional advantages which should not be overlooked. Our engineering staff is at your service at all times for consultation.

TYPICAL SPECIFICATIONS:

Sizes: .045" to 24" Cylindrical or Flat

Cross-sections: .055" to .060" or More

Finish: Polish to 4 Micro-Inches or Better

Breakdown: 1000 V Hi-Pot Inter-Circuit

Ring Hardness: 60 to 70 Brinell

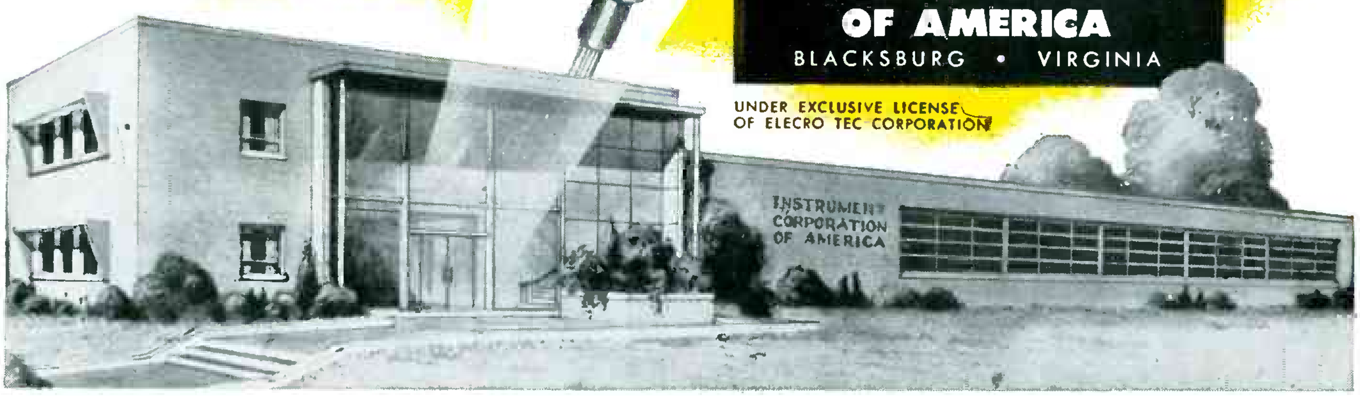
Rotation Speeds: To Over 12000 RPM

Surface Protection: Palladium and Rhodium or Gold Prevent Tarnish, Minimize Wear

INSTRUMENT CORPORATION OF AMERICA

BLACKSBURG • VIRGINIA

UNDER EXCLUSIVE LICENSE OF ELECRO TEC CORPORATION



For GAS SWITCHING TUBES TR-ATR-PRE TR *and* MICROWAVE COMPONENTS *Consult . . . Bomac*

Bomac has available an extensive line of TR, ATR, Pre TR and attenuator tubes covering all the frequency bands and power levels in use. Many types are in high level production; specialized types can be supplied on short notice.

The Bomac engineering staff includes personnel who have been associated with TR development since the inception of Microwave Radar and have made major contributions to TR development. Their accumulated experience is at your disposal.

K BAND

1B26
1B36
BL-11

X_b BAND

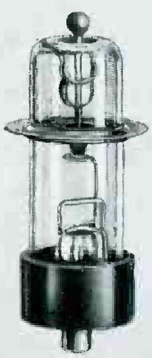
1B50
1B51

X BAND

BL-3
1B24A
1B35
1B37
1B60
724B
6038
ATR388
1B63A

S BAND

1B27	1B57
1B38	1B58
1B44	1B62
1B52	721B
1B53	5792
1B54	5793
1B55	5853
1B56	ATR387



L BAND

1B23
1B40

PRESSURIZING WINDOWS

BL105
BL106
BL107
BL112
BL114

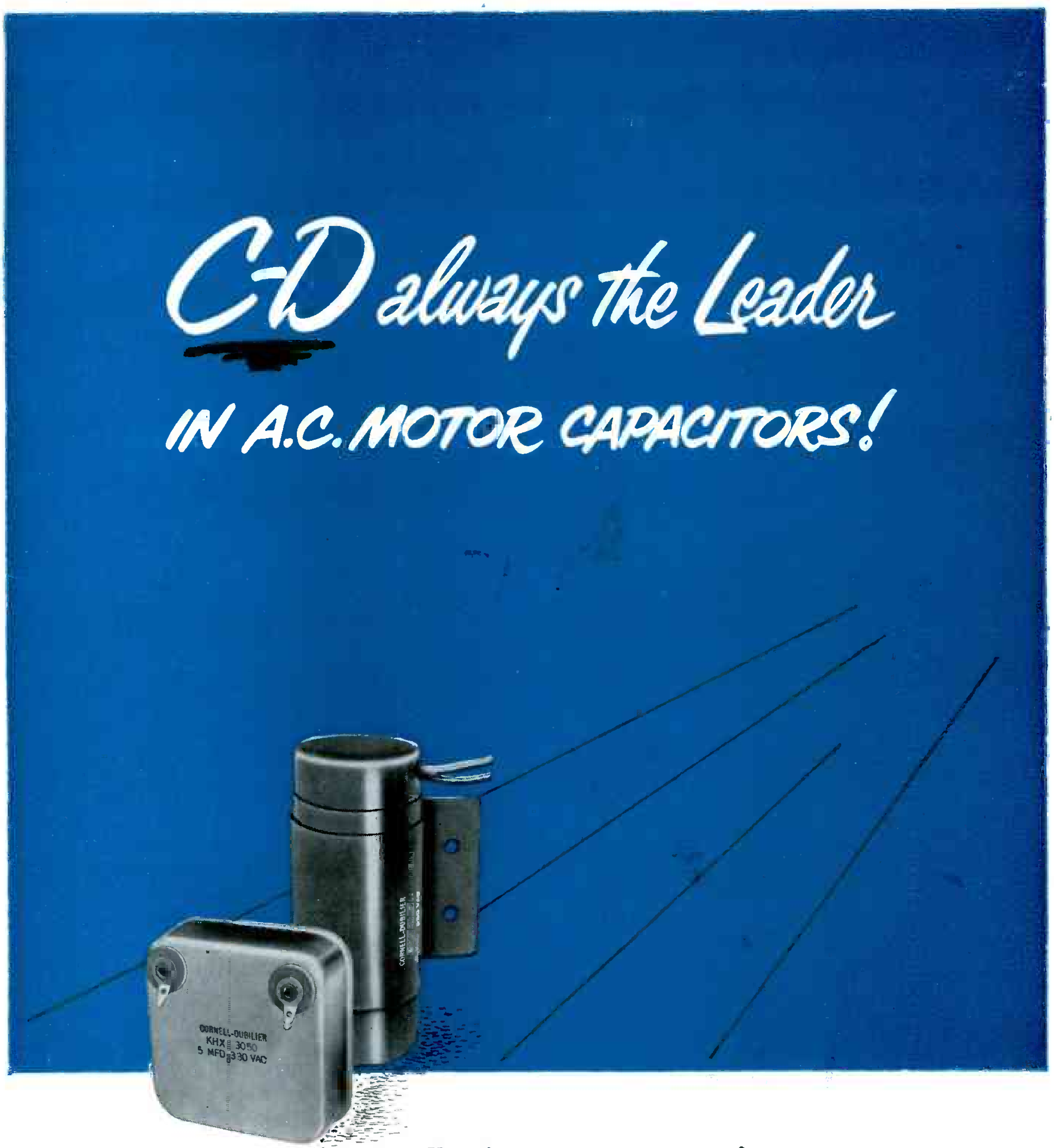
Catalog available on request. Write (on your company letterhead) Dept. C, Bomac Laboratories, Inc., Salem Road, Beverly, Massachusetts.

WE INVITE YOUR INQUIRIES REGARDING

- ENGINEERING
- DEVELOPMENT
- PRODUCTION

Bomac Laboratories, Inc.

BEVERLY · MASSACHUSETTS



Year after year, more motor manufacturers use more Cornell-Dubilier A.C. motor capacitors than any other. The reason: a great record of trouble-free service in the field! Filled with C-D's world-famous Dykanol, and conservatively rated for extra dependability. Dept. K-22, Cornell-Dubilier Electric Corp., South Plainfield, N. J.

CONSISTENTLY DEPENDABLE

CORNELL-DUBILIER

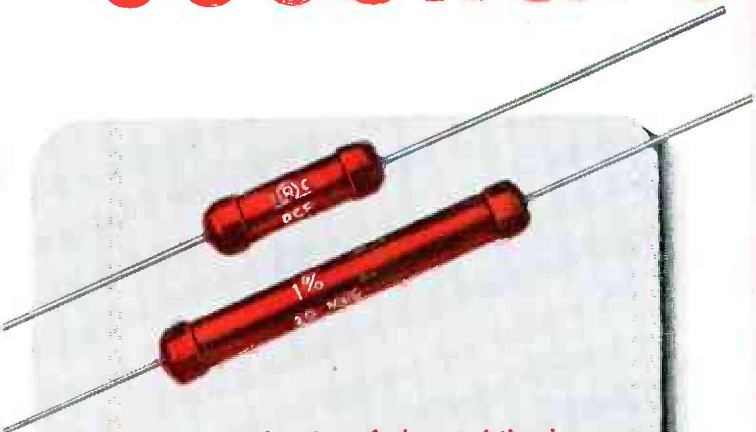
CAPACITORS

1910-1951

SUBSIDIARY

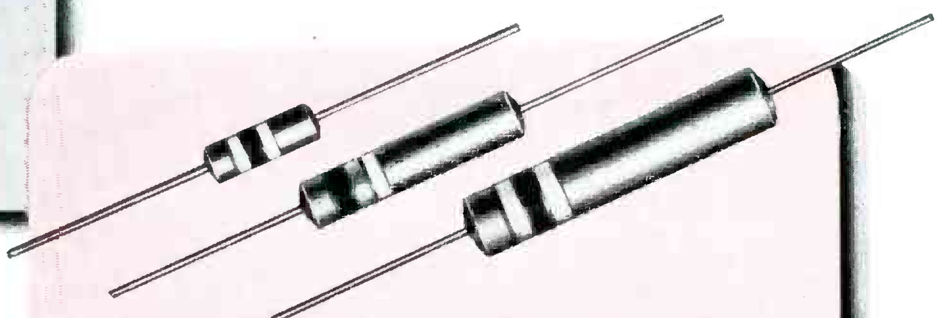
PLANTS IN SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER, AND CAMBRIDGE, MASS.; PROVIDENCE, R. I.; INDIANAPOLIS, IND.; FUQUAY SPRINGS, N. C.; AND SUBSIDIARY, THE RADIART CORP., CLEVELAND, OHIO

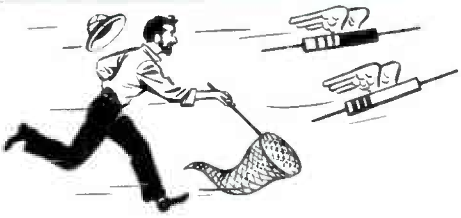
essential



Where a combination of characteristics is essential in precision applications, you'll cut costs with IRC PRECISTORS. These *deposited carbon* units solve availability problems in high frequency applications, metering and voltage divider circuits—combine accuracy and economy where carbon compositions are unsuitable and wire wounds too expensive. We make the two sizes of PRECISTORS to customers' specifications, rather than to standard RTMA values—subject, of course, to minimum and maximum values for each type. Write for complete data in Catalog Bulletin B-4.

When you need dependable small-size controls, specify IRC 15/16'' Type Q Controls. New Type Q's are rugged and compact, yet increased arc of rotation permits the same resistance ratios used in larger IRC controls. Type Q's are characterized by low noise level, unusual durability and efficiency, negligible changes in resistance even after long exposure to humidity, adaptability to a great variety of small-space applications. Complete mechanization of production and testing assures uniformity of construction and performance—and affords greater availability. Bulletin A-1 gives full details.





For exceptional stability and economy in low range applications, choose IRC Type BW Insulated Wire Wound Resistors. Uniformly wound and completely insulated, these compact units have excellent performance records in meters, analysers, low-range bridge circuits, high stability attenuators and similar applications. Type BW's are supplied in standard RTMA ranges, tolerance ±10% standard—values of 10 ohms and above in ±5%. Available also in matched or balanced pairs. Full data in Catalog Bulletin B-5.

When experiments, pilot runs or maintenance demand standard resistors *double-quick*, you'll appreciate the advantages of IRC's Industrial Service Plan. This enables you to get prompt, 'round-the-corner service from the local stocks of your IRC Distributor. Call him for your minimum-quantity requirements. If you don't know him, we'll gladly send you his name and address.

Power Resistors • Voltmeter Multipliers
Insulated Composition Resistors
Low Wattage Wire Wounds
Volume Controls • Precision Wire
Wounds • Deposited Carbon
Precistors • Ultra HF and High
Voltage Resistors • Insulated Chokes
Voltage Dividers.

IRC

Wherever the Circuit Says —⁄\/\/\—

INTERNATIONAL RESISTANCE COMPANY
401 N. Broad Street, Philadelphia 8, Pa.
In Canada: International Resistance Co., Ltd., Toronto, Licensee

INTERNATIONAL RESISTANCE COMPANY
403 N. Broad Street, Philadelphia 8, Pa.

Send me additional data on items checked below:

- ☐ Advanced BT Resistors
- ☐ Type Q Controls
- ☐ Deposited Carbon PRECISTORS
- ☐ Type BW Wire Wound Resistors
- ☐ Name and address of local IRC Distributor

NAME ______________________

TITLE ______________________

COMPANY ______________________

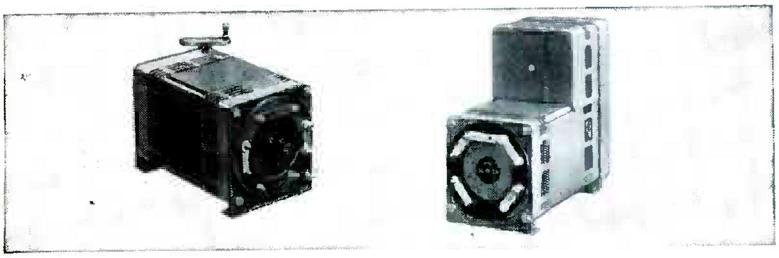
ADDRESS ______________________

CITY ______________ ZONE ______ STATE ______

DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS

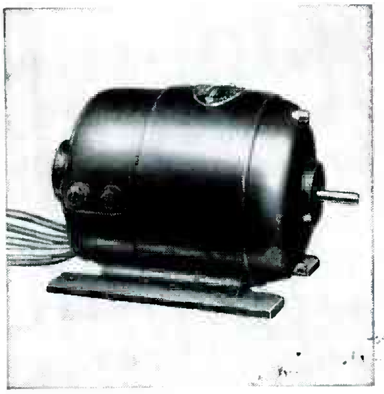
HOLD VOLTAGE STEADY—OR ADJUST IT PRECISELY—WITH G-E INDUCTROLS



For precise and dependable stepless voltage regulation or variation it's G-E inductrols. These single-phase units are available in ratings from 3 to 240 kva for circuits 600 volts and below. Motor-operated units, used with automatic control, maintain voltage within narrow limits regardless of line-voltage variation. Hand-operated models provide smooth and precise voltage adjustment for instrument calibration, rectifier control, and similar uses. Check Bulletin GEC-795.

G-E SELSYNS INDICATE POSITION—CONTROL MOTION

G-E selsyn transmitters and receivers provide automatically synchronized indication or control at one location with respect to an initial remote reference point. Built for accurate, economical, continuous service, they can be used to indicate angular or linear movement, or to control the motion of a device by controlling its actuating element. Two types are available—general purpose, for accuracy within ±5 deg; and high accuracy, ±1 deg. See Bulletin GEA-2176.



CONTROL WIRING SIMPLIFIED WITH G-E TERMINAL BOARDS

You get positive electrical connections without soldering using G-E Type EB-6 terminal boards fabricated from strong, durable molded Textolite* parts. To facilitate marking, reversible marking strips are white on one side, black on the other. Boards have 4 to 12 poles. Rated 30 amp, 600 volts. Complete details are contained in Bulletin GEA-1497.

*Reg. Trade-mark of General Electric Co.

EQUIPMENT FOR ELECTRONIC MANUFACTURERS

A partial list of the thousands of items in the complete G-E line. We'll tell you about them each month on these pages.

Components

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

Development and Production Equipment

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

General Electric Company, Section C667-18
Schenectady 5, N. Y.

Please send me the following bulletins:

Indicate: √ for reference only
X for planning an immediate project

( ) **GEA-1497** **Fabricated Terminal Boards**
( ) **GEA-2176** **Selsyns**
( ) **GEC-599** **Educational Amplistat**
( ) **GEC-784** **One-Volt-Ampere Amplistat**
( ) **GEC-790** **Forty-Volt-Ampere Amplistat**
( ) **GEC-795** **Single-Phase Inductrols**

Name ....

Company ....

Address ....

City .... **State** ....

GENERAL ELECTRIC

HOW TO HELP BRITAIN ...and Ourselves

The purpose of this editorial is to help Winston Churchill obtain the aid Britain needs

(1) to weather her present financial crisis, and

(2) to avoid a chronic recurrence of such crises.

This is not a philanthropic purpose.

Britain is our staunchest ally in the free world's continuing fight for survival. She cannot perform her role effectively if she is broke, or if she careens from one financial crisis to another.

Then, too, a nation such as ours—committed to private enterprise as a way of economic life—has a special interest in helping Winston Churchill to help Britain. His administration is relatively friendly toward private enterprise. Should he fail, he would be replaced promptly by a Socialist government more hostile than ever. And that would weaken the standing of private enterprise in the free world.

Cause of the Crisis

It is the drive of the Western World under our leadership to rearm against Russian aggression that has precipitated Britain's financial crisis. It set off a scramble for raw materials from which armaments could be made, and for many other materials that might be short in the event of war. So the prices of the things that Britain must import—mostly raw materials—have been boosted more than the prices of things she can export—mostly finished products. That leaves Britain short of funds to pay for essential imports. This difficulty increases as the necessity becomes more urgent to divert industrial effort from production for export to production for security.

The Basic Trouble

Although Britain's immediate crisis was touched off by the rearmament drive of the Western World, her basic affliction is one from which she has suffered since the end of World War II. Stated in its simplest terms, Britain does not produce enough goods to pay her own way as one of the family of free nations.

For years this deficiency in home production was made up by income from shipping and overseas investment. But Britain had to sell a large part of her foreign investments to finance her heroic part in World War II. So her income from that source has been greatly reduced. And, in spite of an increase of about a third above prewar in her own production of goods and—thanks to a continued "austerity" program—a much larger increase in her exports, Britain still is not paying her own way.

Two Ways to Solvency

Britain has two ways to restore her solvency. One is to cut down on what is consumed—the belt-tightening process. The other is to step up British production.

To surmount the present crisis, Mr. Churchill has asked for some cutting down. He probably must ask for more.

Except as a stop-gap expedient, however, more cutting down of Britain's consumption is clearly a dangerous course. That would further depress a British standard of living which, not more than half as high as ours, already is too low. Politically such a course would grease the skids for Winston Churchill's administration, even now governing by a wafer-thin parliamentary margin. Also, as *The* (London) *Economist* remarks, the "lazy expedient of cutting trade" would result in "hurting other people and forcing them to take similar action"—by cutting the market for their products.

The Only Cure

The best and, in fact, the only way to help cure Britain's economic ills is to help Britain produce more. Here the technical possibilities are encouraging. On the average, the British industrial worker produces only about 40 percent as much a year as the American worker. That is a British estimate, made by Sir Ewart Smith.

Wider use of better industrial methods and modern tools and an infusion of the competitive incentive into British industry — to replace the cartel and other restrictive practices — would go a long way to narrow this wide gap in worker productivity. This is the consensus of experts on both sides of the Atlantic.

Since 1948 the Anglo-American Council on Productivity has done much to encourage output per man-hour in Britain and to foster this doctrine with both labor and management. But much yet remains to be done.

In the United States it is increasingly suggested that before we give Britain any more economic aid we should insist that everything possible be done to exploit the technical possibilities of increased production. This emphasis on production is needed. But if we Americans were to impose upon the hard-pressed British people conditions that could be construed as an affront to a friendly and sovereign nation, we might well put into the hands of a masterful rabble-rouser such as Aneurin Bevan, the anti-American leader of the Labor Party's left wing, a campaign issue on which to maneuver himself into the Prime Ministership.

Churchill Can Insist

But Winston Churchill is not so handicapped as we should be in imposing prerequisites of further aid. As Britain's own, most honored leader he will raise no touchy questions as to Anglo-American relations if he insists that Britain have firm plans to cure her economic ills, plans sharply focussed on ways and means of increasing Britain's industrial efficiency.

By presenting a convincing plan to cure Britain's recurring crises through greater production, Mr. Churchill will greatly facilitate the process of getting the aid his country must have. He will also remove an increasingly dangerous element of dissension in Anglo-American relations — the feeling of many Americans that more aid to Britain is more money down the drain. The way to counter that feeling is to come up with a prescription for an economic cure, not a request for another economic poultice.

Technically, such a program is entirely feasible. It will perhaps be the supreme test of Winston Churchill's statesmanship to make it politically feasible as well.

In the interest of Britain, of the United States and of the whole free world, we wish him all success.

McGraw-Hill Publishing Company, Inc.

Strengthen the hand...

Today's need is for more and better production

For this reason, Ersin Multicore Solder is important to your assembly line. Helps to meet and maintain urgent production schedules. Assures consistently high soldering speed, better coverage, fewer rejects, lower labor cost.

Strengthen your product, and your reputation, with Ersin Multicore, the original 3-core thin-wall solder. Conservatively speaking, you *save dollars* on the production line by spending pennies on *Ersin Multicore Solder.*

World's Finest Cored Solder

ERSIN MULTICORE more than meets Federal Specifications

QQ-S-571-b

for SOLDER: SOFT (TIN, TIN-LEAD, AND LEAD-SILVER)

Contains only virgin metals:
Tin — 99.75% pure
Lead — 99.97% pure

- Ersin Flux is a high-grade, water white rosin, homogeneously activated and exclusive to Multicore.
- Has vigorous fluxing action.
- Possesses non-corrosive and protective features of the original rosin. Leaves nothing but pure rosin after soldering.
- Non-corrosive even after prolonged exposure to humidity.
- Reduces surface tension of molten solder — wets metals rapidly.
- Non-toxic in use. Free from objectionable odor.
- Three separate cores of flux guarantee continuity of flux stream, preventing "dry" joints.
- Total percentage of flux to solder less than in many single cored solders.
- Multicore's unique properties make perfect joints possible on difficult metals and alloys, even if oxidized

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.
Mellier House, Albemarle Street • London, W. 1, England

For better products at lower cost—

SPECIFY MYCALEX

Glass-Bonded Mica INSULATION

- MOLDS AND MACHINES TO CLOSE TOLERANCES
- MOLDABLE WITH METAL INSERTS
- CAN BE TAPPED, THREADED, SLOTTED
- AVAILABLE IN RODS, SHEETS, SPECIAL SHAPES
- MOLDED IN PRACTICALLY ANY SHAPE OR SIZE
- LOW-LOSS FROM 60 CPS TO 24,000 MCS

MYCALEX glass-bonded mica insulation is the one highly adaptable, versatile insulating material that combines every desirable characteristic required in a modern dielectric. Although far superior to lower cost dielectrics, MYCALEX offers considerable advantages over many materials costing several times as much. MYCALEX is available in various grades, each featuring specific characteristics to meet particular needs. Since proper application of the right grade of MYCALEX has resulted in simultaneous product improvement and lower cost in hundreds of instances, it's good business to check with MYCALEX before specifying sheet, rod, fabricated or molded insulation.

JAN APPROVED

MYCALEX 410 is approved fully as Grade L-4B under National Military Establishment Specification JAN-1-10, "Insulating Materials, Ceramic, Radio, Class L."

MYCALEX 400 is approved fully as Grade L-4A under National Military Establishment Specification JAN-1-10, "Insulating Materials, Ceramic, Radio, Class L."

Write for 20-Page Catalog Today!

A valuable compilation of engineering data and manufacturing information on electrical insulation that you'll surely want for your technical file. Request it today—no obligation.

CHARACTERISTICS

MYCALEX GRADE	400	410	410X
POWER FACTOR, 1 MC	0.0018	0.0015	0.012
DIELECTRIC CONSTANT, 1 MC	7.4	9.2	6.9
LOSS FACTOR, 1 MC	0.013	0.014	0.084
DIELECTRIC STRENGTH, volt/mil	500	400	400
VOLUME RESISTIVITY, ohm/cm	$2x10^{15}$	$1x10^{15}$	$5x10^{14}$
ARC RESISTANCE, seconds	300	250	250
MAX. SAFE OPER. TEMP., °C	370	350	350
WATER ABSORPTION % 24 hrs.	NIL	NIL	NIL

SINCE 1919 MYCALEX THE INSULATOR TRADE MARK REG US PAT OFF

MYCALEX CORPORATION OF AMERICA

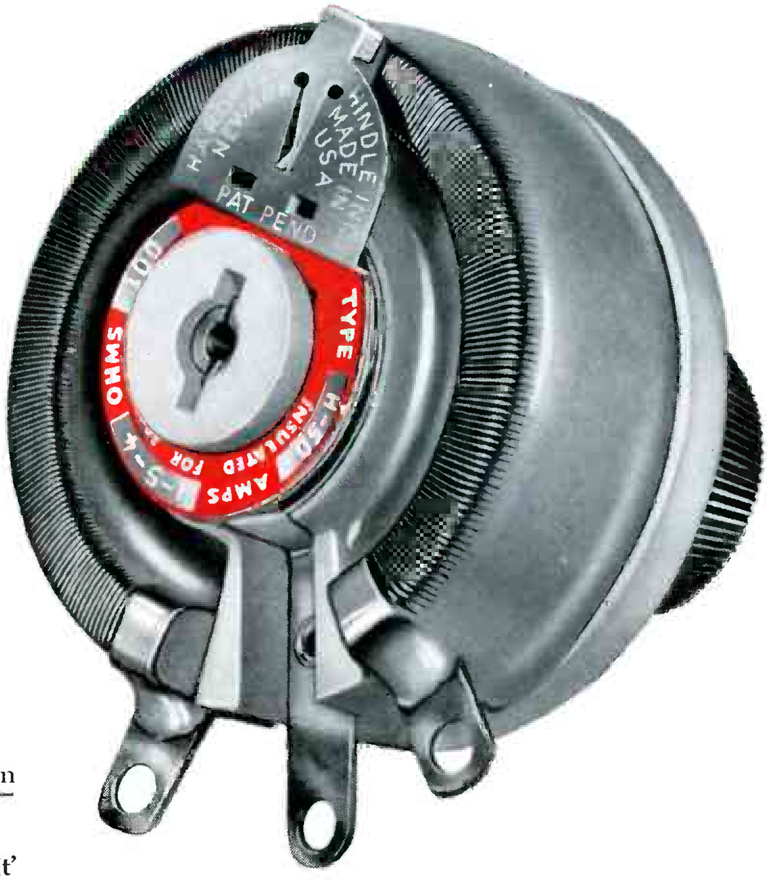
Owners of 'MYCALEX' Patents and Trade-Marks

Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 — Plant & General Offices: CLIFTON, N.J.

THIS IS IT

★ **the NEW H-50 Rheostat**

★ **another Hardwick, Hindle ten-strike!**



Instructions to our engineering department were:

"design a rheostat—completely new construction if necessary—that embodies all features essential to producing a rheostat that 'can take it' in the wide industrial field."

They did—and this is it.

1. Of course it is bonded with our new blue-gray enamel coating—thermo-shock-proof—assuring greater protection under most rugged service—under extremes of humidity and abnormal atmospheric conditions.

2. Still greater safety factor—more resistant to excess heat and shock.

3. Still higher terminal strength.

4. New trouble free construction—minimum number of parts—uniform torque, adjustable pressure, smoother electrical control, etc.

And please note; this new H-50 is designed to comply with current standards of:

(a) Military Specifications JAN-R-22.
(b) Underwriters' Laboratories.
(c) R.T.M.A.
(d) N.E.M.A.

Send today for our new bulletin, containing additional information.

HARDWICK, HINDLE, INC.

Rheostats and Resistors

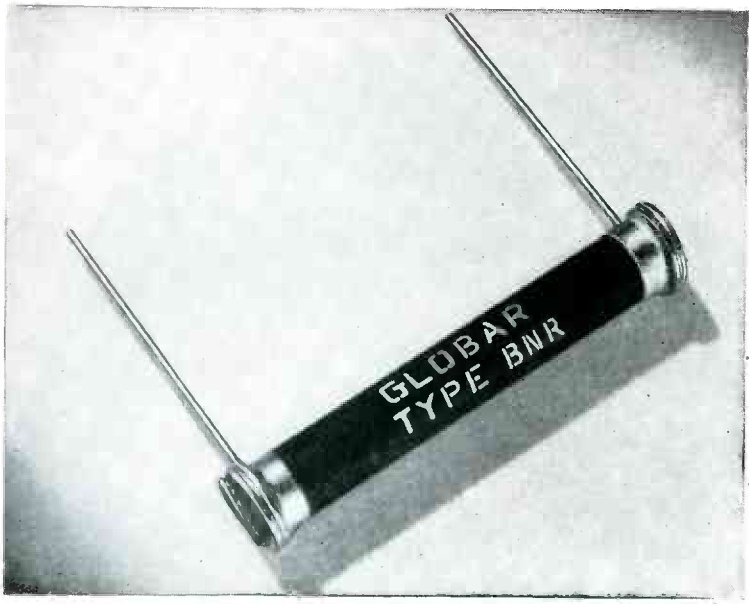
Subsidiary of

THE NATIONAL LOCK WASHER COMPANY

Established 1886 — NEWARK 5, N. J., U.S.A.

The mark of quality for more than half a century

How to use GLOBAR TYPE BNR RESISTORS to advantage



APPLICATION	RESULT
Oil burner ignition transformer	High voltage feed back into line is prevented.
Small motors	Arcing of governor contact points is greatly decreased.
Rectifier circuits	Peak voltages are limited thus stabilizing circuits.
Electronic devices	Successful use in voltage control circuits.
DC Circuits	Solenoid valve coils are protected.

● The unusual characteristics of GLOBAR type BNR ceramic resistors make them practical for a diverse number of advantageous uses. Charted here are five typical applications where these resistors are being used to advantage at present.

Our Bulletin GR-2 contains detailed engineering data which may well suggest applications in your own products. It will give you facts that will help you decide how these ceramic resistors can be of value to you. Let us send you a copy. Write Dept. E L 87-101, The Carborundum Company, GLOBAR Division, Niagara Falls, N. Y.

GLOBAR Ceramic Resistors

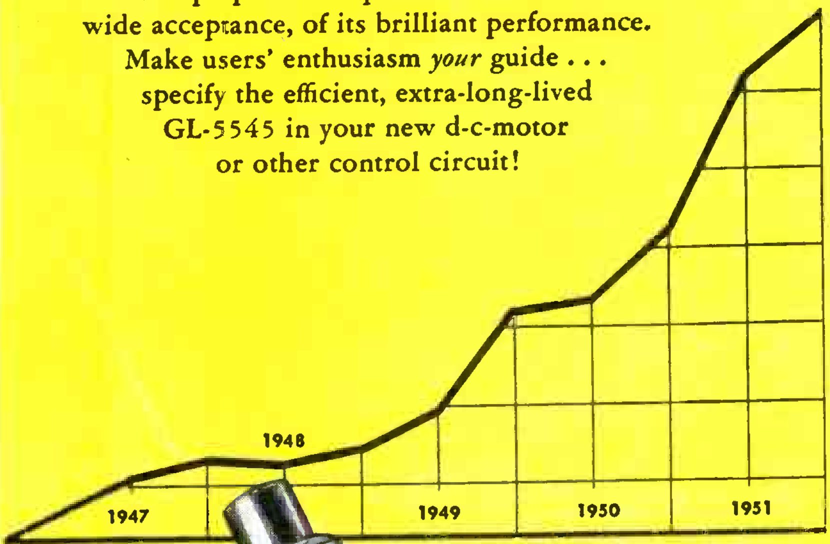
BY CARBORUNDUM
TRADE MARK

"Carborundum" and "Globar" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, N. Y.

87-101

CHOOSE THE TUBE ALL INDUSTRY IS BUYING!

GL-5545 Thyratron sales have climbed spectacularly since introduction. Their sharp up-curve is proof of the tube's wide acceptance, of its brilliant performance. Make users' enthusiasm *your* guide . . . specify the efficient, extra-long-lived GL-5545 in your new d-c-motor or other control circuit!



COMPARE! Why is the GL-5545 showing its heels to similar types? Compare this G-E control tube point-by-point with other-make thyratrons rated the same capacity:

CHARACTERISTIC	GL-5545	TUBE "A"	TUBE "B"	TUBE "C"
Avg current	6.4 amp	Same	Same	Same
Peak current	80 amp	LOWER	LOWER	LOWER
Fault current	1,120 amp	LOWER	LOWER	LOWER
Max voltage, peak forward	1,500 v	LOWER	LOWER	LOWER
Max voltage, peak inverse	1,500 v	LOWER	LOWER	LOWER
Ambient temp range	−55 to +70 C	Same	LOWER	Same
Commutation factor*	130	LOWER	LOWER	LOWER
Snubber circuit needed?	No	YES	YES	YES
Shielded grid construction?	Yes	NO	NO	NO

*Commutation factor is the product of the rate of decay of current in amperes per microsecond just before commutation, and the rate of rise of inverse voltage in volts per microsecond just after commutation.

For complete performance facts . . . for application counsel . . . wire or write *Electronics Division, General Electric Company, Schenectady 5, New York.*

GL-5545
6.4-amp THYRATRON

GENERAL ELECTRIC

163-1B1

What's in a Name?

Way back in 1922, the late Henry C. Gates, well known industrialist, decided to make the name GATES synonymous with service in the electronics field.

Today, 30 years later, it would be a rare exception to find anyone who does not know about GATES products.

One of the oldest manufacturers of electronic equipment in the world, the GATES RADIO COMPANY specializes in radio transmitting equipment of all types — AM, FM, TV, Communications, etc.

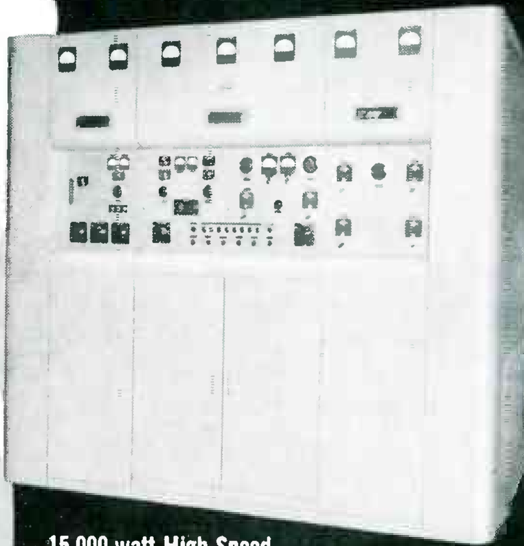
By so specializing — and through production efficiency —GATES is able to offer higher quality at more modest prices.

No job is too large or small, too complex or simple for GATES to tackle.

Because GATES itself manufactures a large number of the components that go into finished GATES equipment, designs are not assemblies built to the convenience of someone else's particular size of material.

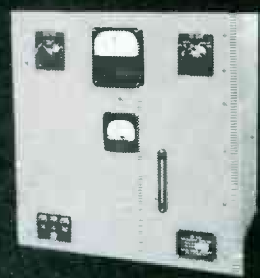
This means GATES offers "custom-built" quality and efficiency at prices that pleasantly surprise.

All of these points are of outstanding importance to you — are specific reasons for wanting your transmitting equipment to bear that familiar and trusted name — GATES.

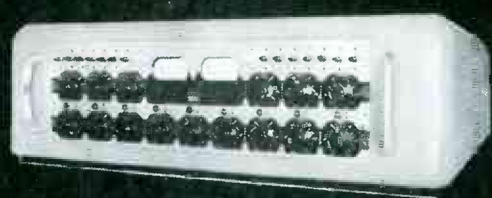


15,000 watt High Speed Telegraph Transmitter for Inter-continental service

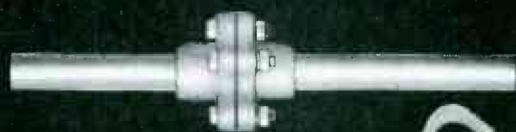
Turntable



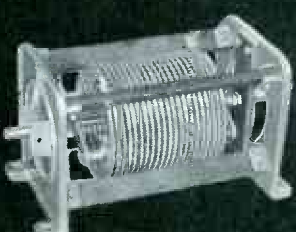
F.C.C. Approved Frequency Monitor



Dual Channel Speech Input System



GATES Supercabe Co-ax



GATES Inductor

Tube Sockets for High Powered Tubes

GATES PRODUCTS

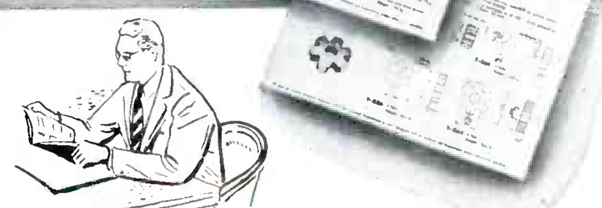
• Commercial broadcasting equipment • Commercial communications transmitting equipment • Television transmitting equipment • Frequency modulated transmitting equipment • Mobile transmitting equipment • Audio equipment including: broadcast, recording, public address • Specially designed electronic instruments including: vibration fatigue apparatus, laboratory hearing aid equipment, recording equipment • And many other items.

GATES

GATES RADIO COMPANY • MANUFACTURING ENGINEERS • QUINCY, ILLINOIS, U. S. A.

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

Canadian Marconi Company, Montreal, Quebec



WRITE FOR THIS CATALOG OF STOCK MAGNETS FOR YOUR EXPERIMENTAL NEEDS

Here's a handy reference, chock full of detailed permanent magnet information. If you are designing new products, or wish to improve present ones, this catalog will be of great value!

16% GREATER ENERGY

And, remember, all INDIANA permanent magnets described are available in INDIANA HYFLUX Alnico V—the permanent magnet material that offers an energy product averaging 5½ million BH max or more, with 5¼ million guaranteed!

Even though INDIANA HYFLUX Alnico V offers 16% greater energy product than regular Alnico V, it costs not a penny more!

INDIANA is the only manufacturer furnishing all commercial grades of permanent magnet alloys. You have a choice of cast, sintered, formed or ductile materials.

INDIANA HYFLUX ALNICO V

INDIANA engineers, with more than 30,000 successful permanent magnet applications to their credit, will be happy to help you with every permanent magnet problem.

Write—or phone—INDIANA today!
Ask for Catalog No. 11A-2

INDIANA PERMANENT MAGNETS

THE INDIANA STEEL PRODUCTS COMPANY

VALPARAISO, INDIANA • • • Sales Offices Coast to Coast

SPECIALISTS IN "PACKAGED ENERGY" SINCE 1908


MEPCO
PRECISION
WIRE WOUND
RESISTOR

FOR MAXIMUM PERFORMANCE AND LONG LIFE OF ELECTRICALLY-OPERATED EQUIPMENT

Invest in

STABILINE

Automatic VOLTAGE REGULATORS

TYPE IE51002R

TYPE IE51005

TYPE IE5101R

TYPE IE5101

Manufacturers faced with the need for increased production and lower costs are becoming extremely conscious of the importance of maintaining constant voltage to electrical apparatus. The Superior Electric Company's line of STABILINE Automatic Voltage Regulators offers equipment to suit the needs of each application. Two types are available: Type IE (Instantaneous Electronic) and Type EM (Electro-Mechanical).

STABILINE Type IE is a completely electronic unit with no moving parts . . . is used where instantaneous and extremely close correction is required. It maintains a constant output voltage regardless of line variations at no load, full load or any intermediate load. The output voltage is held to within ± 0.1 volts of nominal for wide line variations; within ± 0.15 volts of nominal for any load current change or load power factor change from lagging .5 to leading .9. Maximum waveform distortion never exceeds 3%.

Standard models are available in cabinets or for relay rack mounting in numerous ratings as listed below. In the event you have a special requirement involving other frequencies or ratings, SECO voltage control engineers will study your specific problem and make recommendations without obligation.

INSTANTANEOUS ELECTRONIC CABINET MODELS

Input Voltage Range	Output Voltage Range	Frequency In Cycles	Load Range In Amperes	Load Power Factor Range	Rated Output KVA	Type
95-135	110-120	60 ± 10%	0 - 2.2		0.25	IE51002*
195-255	220-240	60 ± 10%	0 - 1.1		0.25	IE52002*
95-135	110-120	60 ± 10%	0 - 4.5	.5 lagging	0.5	IE51005*
195-255	220-240	60 ± 10%	0 - 2.2		0.5	IE52005*
95-135	110-120	50 ± 10%	0 - 4.5		0.5	IEL51005*
195-255	220-240	50 ± 10%	0 - 2.2		0.5	IEL52005*
95-135	110-120	60 ± 10%	0 - 8.5	to	1.0	IE5101*
195-255	220-240	60 ± 10%	0 - 4.5		1.0	IE5201*
95-135	110-120	50 ± 10%	0 - 8.5		1.0	IEL5101*
195-255	220-240	50 ± 10%	0 - 4.5		1.0	IEL5201*
95-135	110-120	60 ± 10%	0 - 22.0		2.5	IE5102*
195-255	220-240	60 ± 10%	0 - 11.0	.9 leading	2.5	IE5202*
195-255	220-240	50 ± 10%	0 - 11.0		2.5	IEL5202*
95-135	110-120	60 ± 10%	0 - 43.5		5.0	IE5105
195-255	220-240	60 ± 10%	0 - 22.0		5.0	IE5205

* Also offered in rack models.

REMEMBER, STABILINE TYPE EM (ELECTRO-MECHANICAL) UNITS ARE ALSO AVAILABLE. RATINGS FROM 2 TO 100 KVA. LITERATURE ON REQUEST.

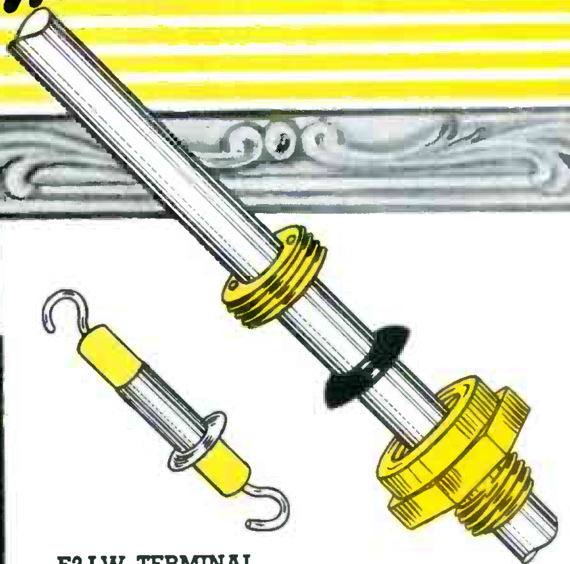
There's a STABILINE Automatic Voltage Regulator for every need. Send today for literature and specific information. Write The Superior Electric Co., 202 Thure Avenue, Bristol, Conn.

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

POWERSTAT VARIABLE TRANSFORMERS • VOLTBOX A-C POWER SUPPLIES • STABILINE VOLTAGE REGULATORS

NEO-SIL CORPORATION

Master Pieces of Hermetic Sealing —Proven to Eliminate Rejects!

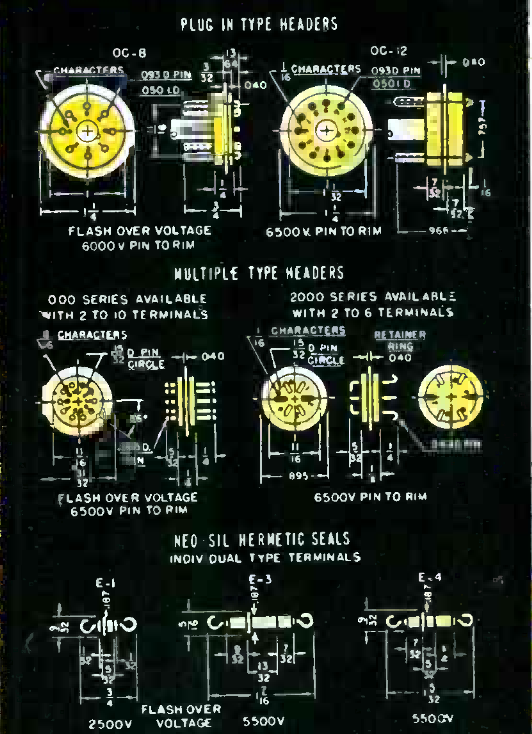


E3-LW TERMINAL

"E-Series terminals are applicable on MIL requirements and will withstand thermal shock, vibrations, mechanical strains, and excessive pressures with no impairment of the seal or other functional characteristics. E-3LW terminals are now being used at 1000 psi static oil pressure and undergo 5000 psi tests."

¼" SHAFT WATERSEAL BUSHING

"Rotary Waterseal Panel Assemblies, with GRAF-SIL Packing Glands, have an excellent five year customer history on gas filled pressurized components. They are available for ¼" shafts and for potentiometers and switch bushings."



TEST DATA

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949, on this material shows the following:

Volume Resistivity at 800 Volts d-c

Room Temperature 25°C	R.H. 30 percent
Megohm-inches	*ohm-centimeters*
1.4×10^6	3.5×10^{12}

Dielectric Constant and Dissipation Factor

Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 175° to —70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit, and 47% Relative Humidity.

"NEO-SIL's proven Hermetic sealing components will eliminate rejects resulting from breakage, strains, cracks, etc. Each NEO-SIL component is pressure checked at 25 psi — to meet military requirements and as applied to our units, NEO-SIL rubber will resist abusive temperature cycling, salt water, most acids and alkalies, and withstand high pressures and vacuums."

"In addition to the items illustrated above, NEO-SIL offers many other components, such as Hermetically Sealed Fuse Holders, Octal Type Plug In Headers, Multiple Pin Headers, Hermetically Sealed Cables, Hermetically Sealed Line Cords With Plugs For European use, Meter Gaskets, Panel Gaskets, Adapters (U.S. to Continental), Coil Forms, Crystal Contacts and other molded bakelite and NEO-SIL rubber units."

"Hermetically Sealed Fuse Holders are available for 3-AG and 4-AG fuses. These units are completely sealed from moisture with or without the cap or fuse inserted and are applicable for use on vacuum or gas filled units."

Your special problems are solicited.

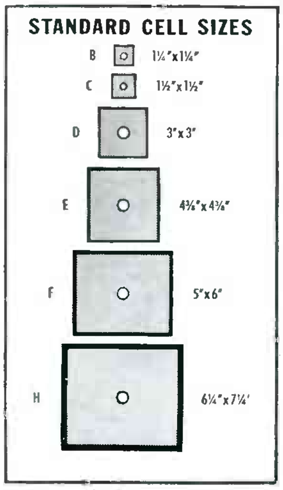
NEO-SIL CORPORATION

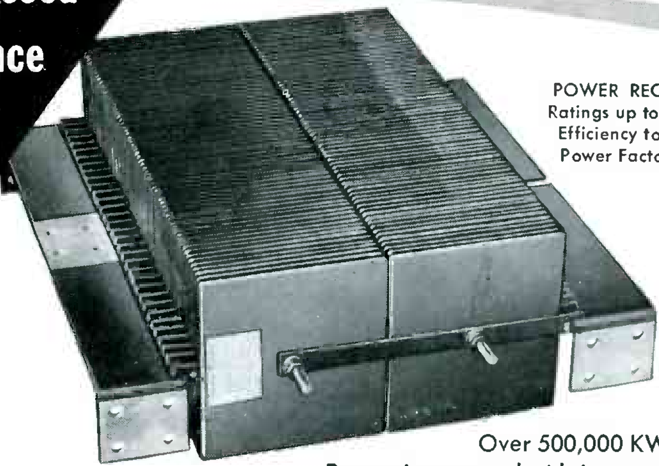
26 CORNELISON AVE., JERSEY CITY 4, N. J.

International

Selenium Rectifiers

for unsurpassed performance





POWER RECTIFIERS
Ratings up to 250 KW
Efficiency to 87%—
Power Factor 95%

Over 500,000 KW, DC Power, is operated with *International* Selenium Rectifiers. A recent month's production included Rectifiers to supply 40 microamperes, 1,000 volts, and Rectifiers with a capacity of 140,000 amperes, 14 volts. Designed and built to meet Government Specifications. Manufactured for temperatures up to 100° C ambient—100% humidity. Owned and managed by Engineers who are specialists in the design and manufacture of Selenium Rectifiers. Submit your problems for analysis and we will be glad to offer our recommendations.

Photo-Electric Cells
Self-Generating Type
Output up to 600 microamperes at 100 foot-candles illumination and 100 ohms external resistance.

Hermetically Sealed Rectifiers
Cartridge Type—up to 60 ma., 9,000 volts per cartridge.

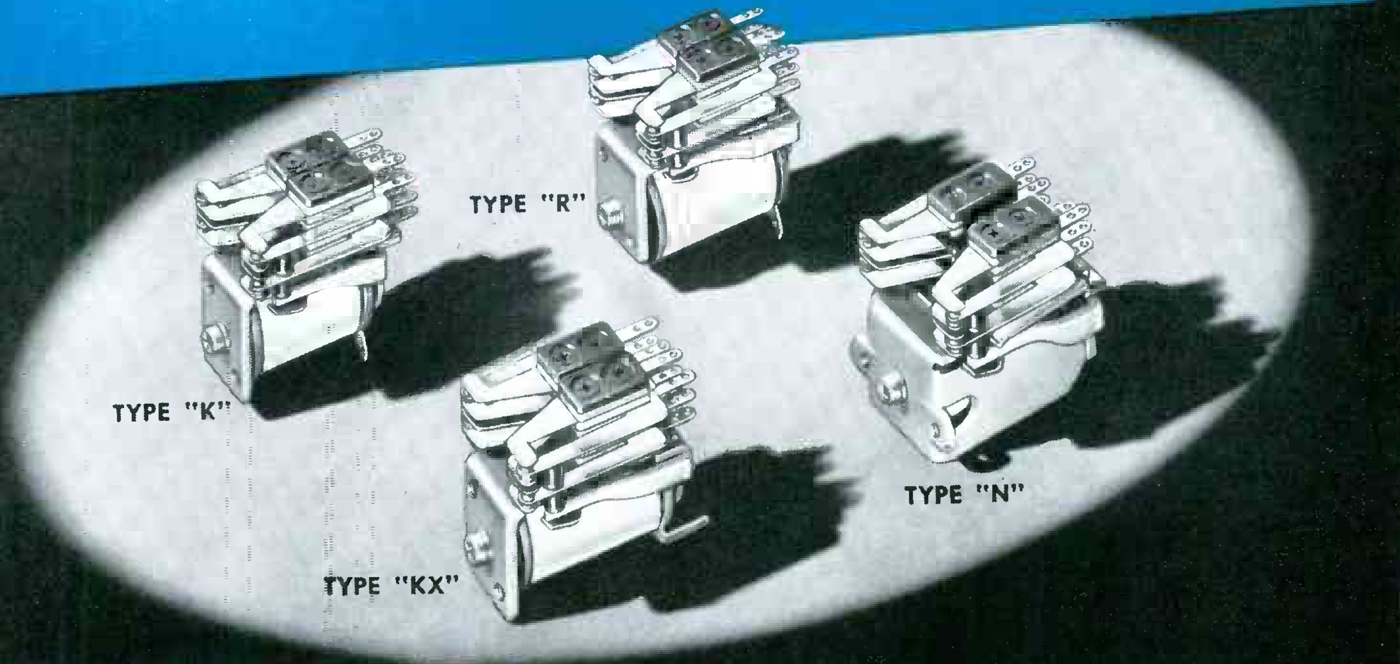
High-Voltage Rectifiers
Cartridge Type—up to 60 ma., 9,000 volts per cartridge.

Miniature Rectifiers
From 65 to 1,000 ma.

GENERAL OFFICES:
1521 E. Grand Ave.
El Segundo, Calif.
Phone El Segundo 1890

CHICAGO BRANCH OFFICE:
205 W. Wacker Dr.
Franklin 2-3889

THESE FOUR CLARE RELAYS offer designers *everything* they demand from small size, lightweight relays!



Special Features

which make these relays first choice of exacting design engineers

THE CLARE Type "K" RELAY

Fast operation—adequate contact pressure—high resistance to shock and vibration—long life—small size—1½" x 1¼" x 13/16".

THE CLARE Type "KX" RELAY

Same features as Type "K" but adds greater operating range and increased sensitivity by use of a slightly longer coil which can be safely wound to a maximum resistance of 8000 ohms. Size: 1 39/64" x 1 15/32" x 1".

THE CLARE Type "R" RELAY

Same basic features as Type "K" but adds still further sensitivity and operating range to the Type "KX" by the use of a coil which is not only longer but of increased diameter to provide even greater winding space. Size: 1 7/16" x 1 3/64" x 1".

THE CLARE Type "N" RELAY

Same basic features as Type "K" but designed for operation on extremely low power. This results from a close-coupled magnetic circuit, generous use of magnetic iron and unusually efficient coil design. Size: 1⅝" x 1⅝" x 1 5/32".

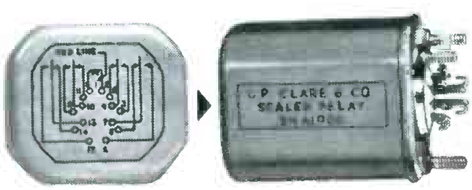
● The Clare Type "K" Relay was the first of the famous CLARE line of small, lightweight, telephone-type relays. It is still the mainstay of design engineers who must have superior relays to operate in extremely small space.

Its fast operation, adequate contact pressure, high resistance to shock and vibration, long life and complete all-around dependability have met many complex requirements.

The other three relays shown here supply all these advantages of the Type "K", but each adds certain other features to meet such specifications as a greater operating range, greater sensitivity or operation on extremely low power. All except the type "N" retain the reed armature suspension of special alloy which engineers recognize as one of the subtler reasons for the superior performance of these small CLARE Relays.

Clare sales engineers are located in principal cities to give you first hand information on the entire line of CLARE Relays . . . all of them designed to meet the most exacting relay requirements. Call them or write to C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials, Ltd., Toronto 13. Cable Address: CLARELAY.

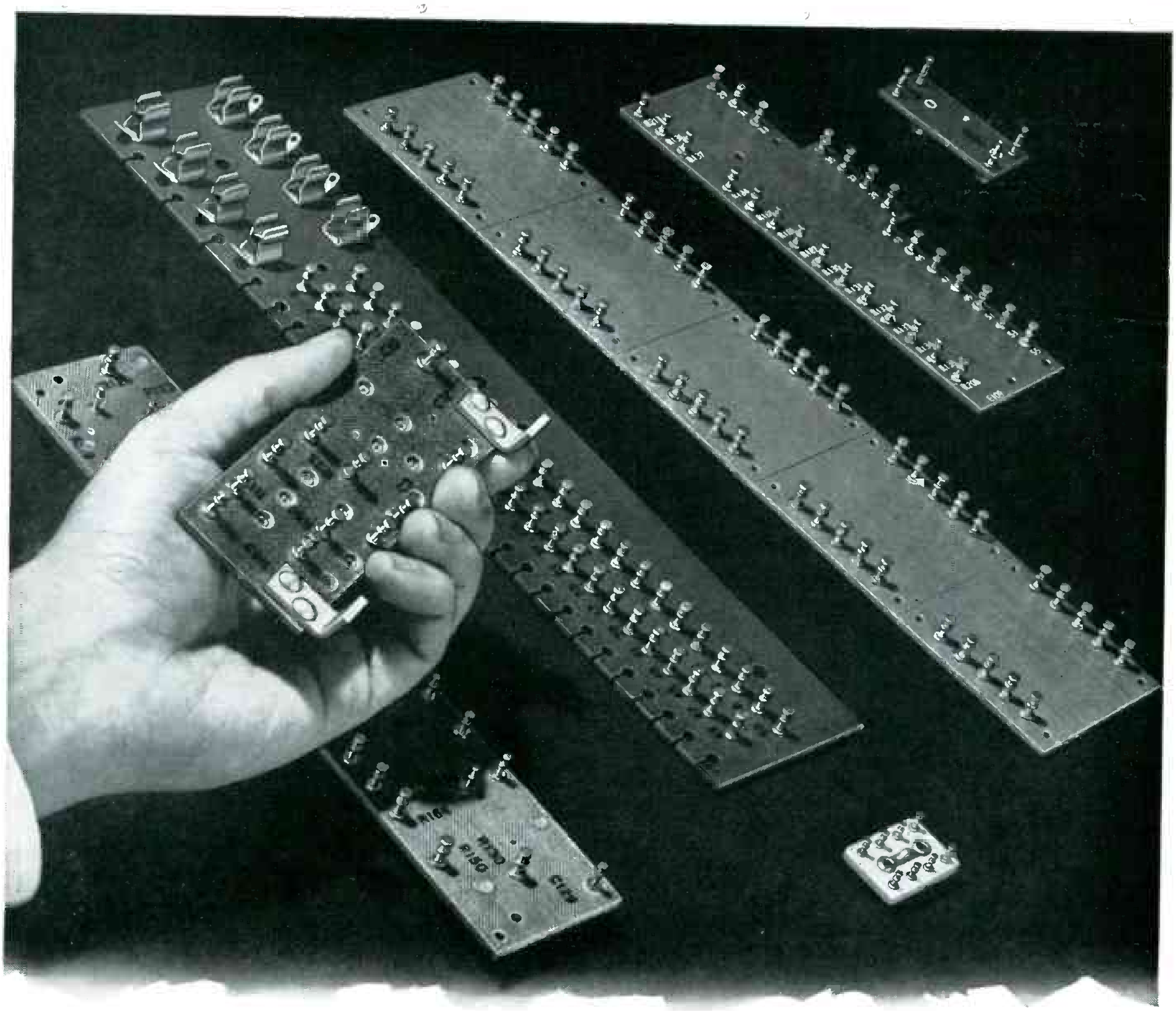
All relays available in hermetically sealed form



All of these four CLARE small relays are available enclosed in hermetically sealed steel containers. Connection diagrams are permanently imprinted on the base of the enclosure by silk screen process.

CLARE RELAYS

. . . First in the Industrial Field



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.

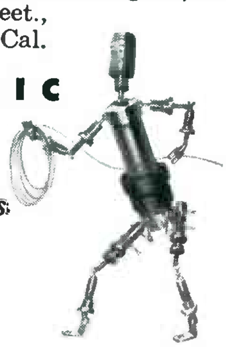
Terminals, feed-throughs, mounting hardware and all other terminal board fixtures meet all applicable government specifications.

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, 5014 Venice Blvd., Los Angeles, or 988 Market Street., San Francisco, Cal.

CAMBRIDGE THERMIONIC CORPORATION

custom or standard... the guaranteed components



See our listing in Electronics Buyers' Guide

Complete Coverage!

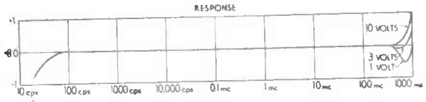
2 to 700,000,000 cps

-hp- precision voltmeters for every ac voltage measuring need!

From 2 cps to 700 mc, there's an accurate, easy-to-use *-hp-* voltmeter for any voltage measuring job. You can choose from 5 precision instruments (including a battery-operated portable unit) the dependable *-hp-* voltmeter that exactly fills your need. Each gives you familiar *-hp-* operating characteristics of high sensitivity, wide range, broad applicability, time-saving ease of operation. *-hp-* also provides a complete line of voltmeter accessories—voltage dividers, connectors, shunts and multipliers—to extend the useful range of your equipment. For complete details, see your *-hp-* sales representative or write direct.

New -hp- 410B Vacuum Tube Voltmeter

Gives same wide range and flat response performance as -hp- 410A voltmeter, but sets new standard of mechanical convenience, ease of operation, minimum bench space. Readily detachable probe leads fit in handy compartment in new, compact, streamlined case. Special diode probe design places capacity of approximately 1.3 $\mu\mu$fd across circuits under test. Shunt impedance is extremely high—10 megohms at low frequencies—thus circuits under test are not disturbed and true voltage readings are assured. New -hp- 410B provides 1 db accuracy from 20 cps to 700 mc; and may be used as a voltage indicator up to 3,000 mc. Also serves as audio or dc voltmeter or ohmmeter.



Response, -hp- 410B Voltmeter

INSTRUMENT	PRIMARY USES	FREQUENCY RANGE	VOLTAGE RANGE	INPUT IMPEDANCE	PRICE
-hp- 400A	General purpose ac measurement	10 cps to 1 mc	.005 to 300v 9 ranges	1 megohm 24 $\mu\mu$fd shunt	$185.00
-hp- 400B	Low frequency ac measurements	2 cps to 100 kc	.005 to 300v 9 ranges	10 megohms 24 $\mu\mu$fd shunt	$195.00
-hp- 400C	Wide range ac measurements High sensitivity	20 cps to 2 mc	.0001 to 300v 12 ranges	10 megohms 15 $\mu\mu$fd shunt	$200.00
-hp- 404A	Portable, battery operated	2 cps to 50 kc	.0005 to 300v 11 ranges	10 megohms 20 $\mu\mu$fd shunt	$185.00
-hp- 410B	Audio, rf, VHF measurements; dc voltages; resistances	20 cps to 700 mc	0.1 to 300v 7 ranges	10 megohms 1.3 $\mu\mu$fd shunt	$245.00

-hp- 400C Vacuum Tube Voltmeter

General purpose precision voltmeter offering wide range, high sensitivity, high stability. Quick-reading linear meter scale shows RMS volts or dbm direct from —72 dbm to +52 dbm. Broad usefulness includes direct noise or hum measurements, transmitter and receiver voltages, audio, carrier or supersonic voltages, or power gain. Also may be used as 54 db amplifier to increase signal level to oscilloscopes, recorders, power amplifiers, etc.

-hp- 404A Battery-Operated Voltmeter

Precision vacuum tube instrument for general voltage measurement where ac power is not available. Compact, portable, splash-proof—ruggedly constructed for field operations. Wide voltage range permits all types of measurements including remote broadcast line and carrier checks, strain gauge system tests, telemetering and geophysical circuit measurements, etc. In the laboratory, offers completely hum-free measurements of very low noise level.

HEWLETT-PACKARD CO.

2251A Page Mill Rd. • Palo Alto, Calif., U.S.A.

Sales representatives in principal areas

Export: Frazar & Hansen, Ltd.

San Francisco • New York • Los Angeles

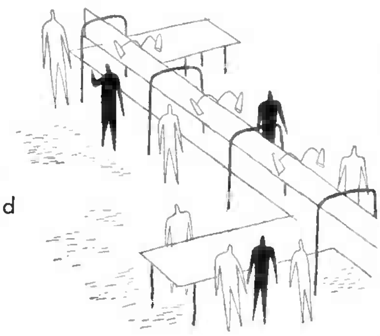
HEWLETT-PACKARD -hp- INSTRUMENTS

the truth about Dow Corning Silicones...

. . . is more fantastic than the patter of the pitchman or the spiel of the barkers that doubled in advertising and sales a generation ago. For example:

- Silicone (Class H) electrical insulation makes motors and other kinds of electrical equipment last 10 times as long as they ever did before.
- These same insulating materials are used to double the power per pound ratio in electric machines.
- Silastic,* the Dow Corning silicone rubber is used to seal hot air at 600°F., hot oil at 350-400°F., limit switches and bomb bay doors at —100°F.
- Dow Corning Silicone oils and greases make permanent lubrication a practical reality.

To many engineers and executives, such silicone facts as these still sound too good to be true. That's why we have built and assembled 16,000 pounds of demonstration units and typical applications to prove that our silicone products will do all that we claim for them. This is the first comprehensive Silicone Exposition ever assembled. Previewed in Washington, D. C. during the week of October 22nd, this exhibit will be given private showings in major industrial centers across the country.



DOW CORNING SILICONE EXPOSITION
now scheduled for

CLEVELAND
DETROIT
PHILADELPHIA
NEW YORK
BOSTON
PITTSBURGH
CHICAGO
WICHITA
FORT WORTH
LOS ANGELES

If you want to know more about this Exposition write for complete information including our new 32-page book which answers in simple words and pictures, the $64 question, "What's a Silicone?" Address Department BE-14

DOW CORNING CORPORATION
Midland, Michigan

ATLANTA
CHICAGO
CLEVELAND
DALLAS
LOS ANGELES
NEW YORK
WASHINGTON, D. C.

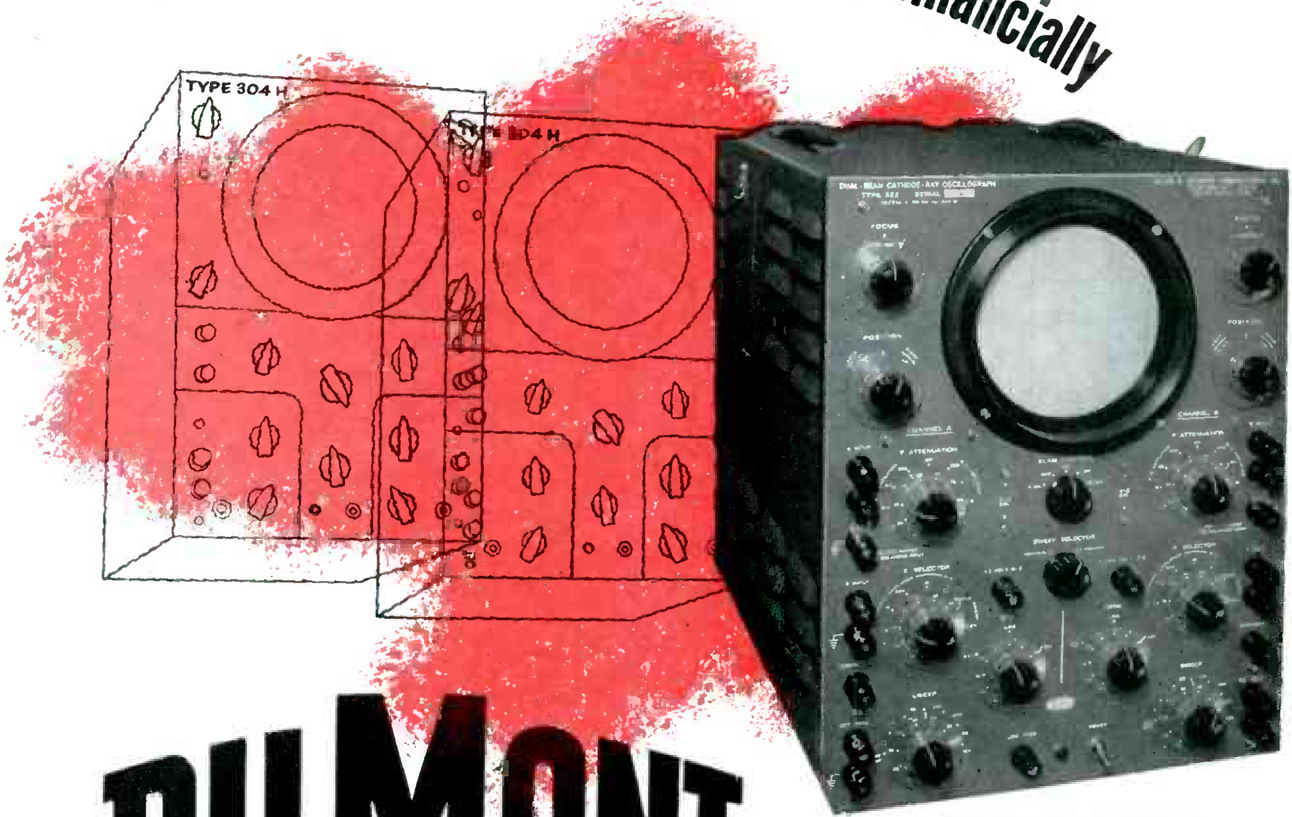
DOW CORNING SILICONES

*T.M.REG.U.S.PAT.OFF.

DOW CORNING CORPORATION MIDLAND, MICHIGAN

In CANADA: Fiberglas Canada, Ltd., Toronto • In GREAT BRITAIN: Midland Silicones, Ltd., London

A general-purpose DUAL-beam oscillograph to fit your needs technically and financially



the DU MONT

TYPE 322

Not just another specialized dual-beam oscillograph, but a brand-new type designed for general development work but rugged enough for production testing and industrial applications as well. Compactness, lightweight, ruggedness and versatility mark the Du Mont Type 322 as another milestone in cathode-ray oscillography.

FEATURES All the well-known features of the 304-H, and . . .

Thoroughly field-tested.

Individual and common time bases with driven or recurrent sweeps and sweep expansion on all sweeps.

Conventional single-ended input with stepped and vernier attenuators, or balanced input with no attenuation, on both Y-axes.

Concentric controls for easy-to-operate, compact control panel.

High-gain D-C amplifiers on both channels.

Amplitude calibration on either channel on both axes.

Illuminated scale with dimmer control.

SPECIFICATIONS

Cathode-ray Tube — Type 5SP — Dual-beam Cathode-ray Tube. Accelerating potential, 3000 volts.

Y-Deflection Sensitivity — 0.028 peak-to-peak (0.01 rms) volts/inch from D-C to 300 KC (50% down at 300 KC); A-C coupling, 10% down at 5 c.p.s.

X-Deflection Sensitivity — 0.3 peak-to-peak (0.1 rms) volts/inch from D-C to 300 KC (down 50% at 300 KC); A-C coupling down 10% at 5 c.p.s.; common, D-C to 200 KC (down 50% at 200 KC).

Linear Time Base—Recurrent and driven sweeps variable in frequency from 2 to 30,000 c.p.s. Front panel connections provided for lower frequency by adding external capacitance.

Intensity Modulation — Input impedance 0.2 megohm, paralleled by 80 $\mu\mu$f. Negative signal of 15 volts peak blanks beam at normal intensity settings.

Beam Control Switch — On front panel to turn beams on or off independently or simultaneously.

Calibrator — Regulated potentials of 50 millivolts and 1 volt peak-to-peak squarewave at power line frequency available at front panel binding posts.

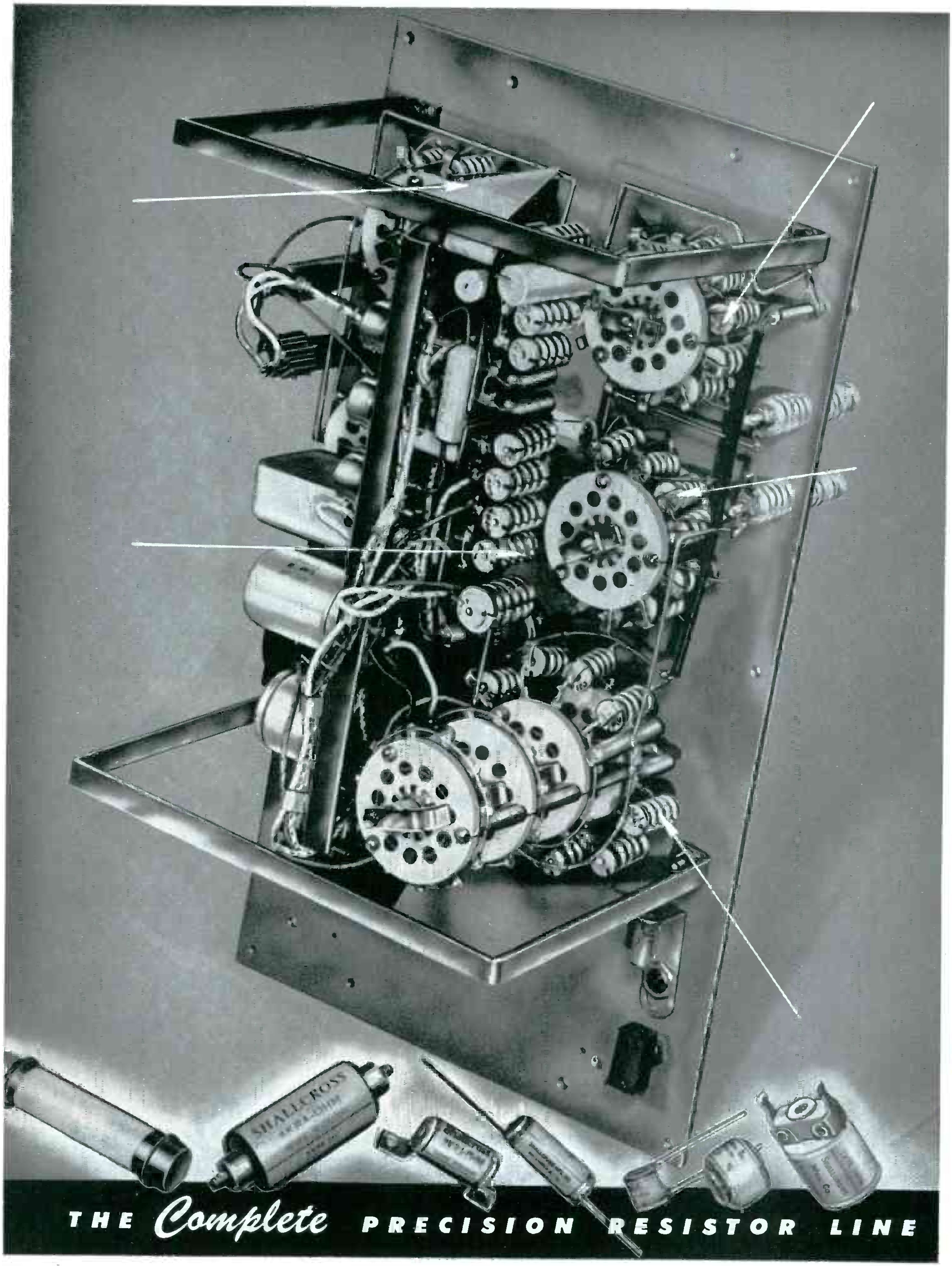
Power Source — 115/230 volts — 50-400 c.p.s. — 225 watts.

Dimensions — Height 15¾", width 12½", depth 22⅞", weight 75 lbs.

$835.00

Write for complete technical details: **Instrument Division**
Allen B. Du Mont Laboratories, Inc.
1500 Main Avenue, Clifton, N. J.


RECOGNIZED LEADERS IN SUPPLY AND SERVICE TO THE ELECTRICAL AND ELECTRONICS INDUSTRIES
RELY on REPUBLIC
FOR
ALUMINUM CONDENSER FOIL
OF UNIFORM HIGH QUALITY
Leading condenser manufacturers specify Republic aluminum condenser foil because, based on long experience, they recognize that the straight cut edges, accurate gage and uniform strength of Republic foil give maximum performance. As specialists in the production of condenser foil, Republic makes available its entire facilities for the solution of your individual problems. Your orders and inquiries will receive prompt and individual attention.
REPUBLIC FOIL & METAL MILLS
INCORPORATED
DANBURY
CONNECTICUT
BRANCH SALES OFFICES:
209 W. Jackson Blvd., Chicago 6, Ill.
666 Mission St., San Francisco 5, Calif.
REPUBLIC


SHALLCROSS
THE Complete PRECISION RESISTOR LINE

Maybe you've noticed how much of today's best equipment uses

SHALLCROSS

precision

WIRE-WOUND RESISTORS

Accuracy from ±1.0% to 0.01% as required

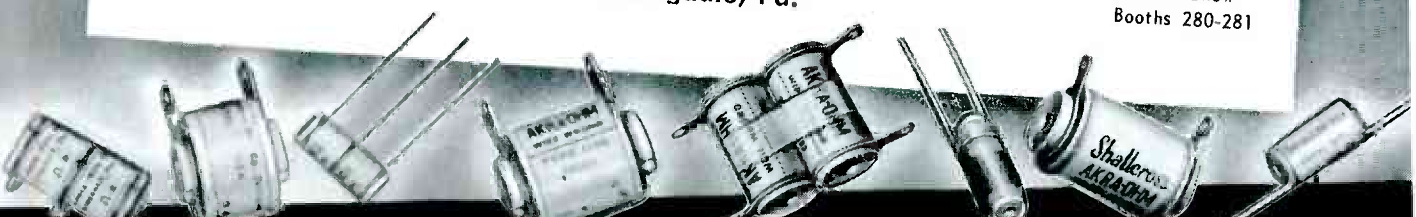
JAN R-93 types ("A" and "B" characteristics)
High-stability types
(Tolerance 0.01%; stability 0.003%)
Matched pairs and sets
Hermetically-sealed types
Low-temperature coefficient types
Predetermined time constant types

Precision power types
Miniature types
Hermetically-sealed lug-type midgets
Vertical style types
Multi-unit strip resistors
Potted types
Precision card resistors

. . . and many special types

SHALLCROSS MANUFACTURING COMPANY
Collingdale, Pa.

See Us
at the
I.R.E. Show
Booths 280-281



FOR MILITARY AND INDUSTRIAL USES

MICROWAVE POWER MEASUREMENTS

COMPLETE COVERAGE! 10 to 12,400 mc!

Instantaneous, direct readings! No adjustment during operation! No tedious computations! Complete new instrumentation for fundamental measurements of CW or pulsed power!

Instrument	Frequencies—Coaxial	Frequencies—Waveguide	Price (f.o.b. Factory)
475B Tunable Bolometer Mount	1,000 to 4,000 mc		$200.00
476A Untuned Bolometer Mount	10 to 1,000 mc		$125.00
S485A Detector Mount*		2,600 to 3,950 mc	$125.00
G485B Detector Mount †		3,950 to 5,850 mc	$95.00
J485B Detector Mount †		5,850 to 8,200 mc	$90.00
H485B Detector Mount †		7,050 to 10,000 mc	$85.00
X485B Detector Mount †		8,200 to 12,400 mc	$75.00
430B Microwave Power Meter	For use at any microwave frequency. Operates with mounts listed above.		$250.00

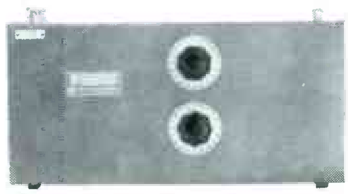
*For use with bolometer only. †For use with bolometer or crystal.

New! -hp- 430B Microwave Power Meter—measures pulsed or CW power—.02 to 10 mw

Model 430B gives you *instantaneous* rf power readings *direct* in db or mw at any frequency. (Operates with bolometer mount. Table at left shows -*hp*- mounts now available.) Measures CW power with instrument fuse or barretter as bolometer element; also measures CW or pulsed power using negative temperature coefficient thermistor at 100 or 200 ohm levels. Reads power direct .02 to 10 mw or in dbm from −20 to +10. 5 ranges selected on front panel switch. Accuracy ±5% of full scale. Higher powers may be measured by adding attenuators (-*hp*- Models 370, 380) to rf system. Directional couplers may be used to sample rf energy.

-hp- 485 Detector Mounts

For rf power measurements in wave guide systems, 2,600 to 12,400 mc (see table) in conjunction with -*hp*- 430A or 430B Power Meter and Sperry 821 barretter. Also may be used to measure relative level, or detect rf energy using a type 1N21 crystal. Semi-tuned by means of a built-in movable short.



-hp- 475B Bolometer Mount

Tunable from 1,000 to 4,000 mc for universal application, greatest convenience in making microwave power measurements. Double-stub design, coupling energy from 50 ohm coaxial systems into 100 or 200 ohm bolometers. Uses Sperry 821 barretter, thermistor or 1/100 ampere instrument fuse.

New! -hp- 476A Universal Bolometer Mount

Requires no tuning, no adjustment; measures rf power at any frequency 10 to 1,000 mc. Extremely low VSWR: Less than 1.15, 20 to 500 mc; less than 1.25, 10 to 1,000 mc. Reflected power less than 0.1 db under normal conditions. In combination with -*hp*- 430A or 430B Power Meter gives automatic, instantaneous readings from 0.02 to 10 milliwatts. Measures higher power with addition of attenuators and directional couplers. 50 ohms impedance. Has Type N connector and terminates flexible cables RG8/U, RG10/U, etc.

Get complete information! See your local -hp- representative or write to factory.

HEWLETT-PACKARD COMPANY

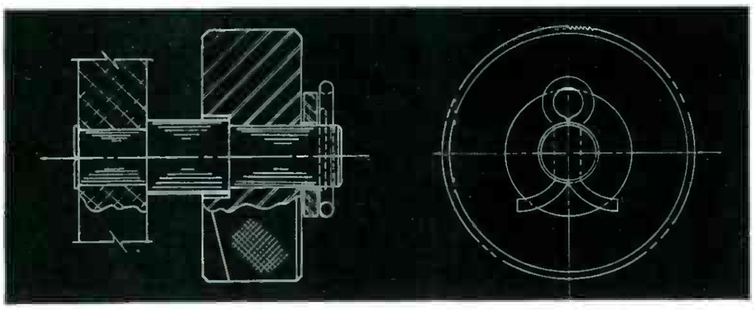
2161-A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.

Export: Frazar & Hansen, Ltd., San Francisco, New York, Los Angeles

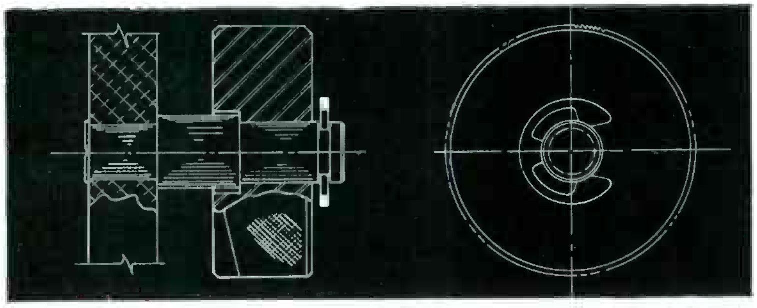
HEWLETT-PACKARD hp INSTRUMENTS

WALDES TRUARC RINGS REPLACE COTTER PINS...

SAVE 44% IN LABOR AND ASSEMBLY COSTS



COTTER PIN WAY: Flint wheel shaft in lighter assembly requires cotter pin, washer. Difficulty in drilling perfect hole causes rejects. Assembly is slow, costly.



TRUARC WAY: Waldes Truarc "E" ring fits into groove in shaft; locks assembly securely for life. Groove is quickly, easily cut... assembly is simple, speedy.

Brown & Bigelow, St. Paul, Minn., saved *$6.95 per thousand units* by incorporating Truarc Rings in the design for the REDI-FLAME compressed gas desk lighter! In spite of greater initial cost of Truarc Rings as against cotter pins, they were able to cut machining and assembly costs drastically—for an overall savings of 44%!

Redesign with Waldes Truarc Rings and you too will cut costs. Wherever you have a fastening problem...wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Truarc Ring designed to do a better job of holding parts together.

Waldes Truarc Rings are precision-engineered...quick and easy to assemble and disassemble. They can be used over and over again.

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

COMPARATIVE COSTS

Cotter Pin Way	$ Per M	Truarc Way	$ Per M
Material		*Material*	
Shaft	.48	Shaft	.35
Cotter pin	.46	Truarc ring	8.68
Washer	1.50		
	2.44		9.03
Labor		*Labor*	
Shaft	10.22	Shaft	2.27
Washer	.72		
Assembly	9.28	Assembly	4.41
	20.22		6.68
TOTAL	$22.66	TOTAL	$15.71

TOTAL SAVINGS WITH TRUARC RINGS: $6.95 or 44%

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

SEND FOR NEW BULLETINS ➡

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

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

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

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send engineering specifications and data on Waldes Truarc Retaining Ring types checked below. E024

- ☐ Bulletin #5 Self-locking ring types
- ☐ Bulletin #6 Ring types for taking up end-play
- ☐ Bulletin #7 Ring types for radial assembly
- ☐ Bulletin #8 Basic type rings
- ☐ Send me information about the Waldes Grooving Tool.

Name ____________________

Title ____________________

Company ____________________

Business Address ____________________

City __________ Zone ______ State __________ 5678

Harry M. Neben, *Chief, Electrical*
AMPHENOL *Testing Laboratory*

RECOMMENDS

Simpson Model 303
VACUUM TUBE VOLT-OHMMETER

Says Harry M. Neben: "I understand the 303 was developed to be of particular use to television service men for aligning sets in the field—so it's designed to perform a lot of test functions and is compact and easy to carry around. These same features make it quite a valuable laboratory and production tool here at Amphenol."

In the photo, Mr. Neben is using the Simpson 303 in conjunction with an Amphenol test fixture to measure insulation resistance between one wire and all other wires of a cable assembly.

SPECIFICATIONS

DC VOLTAGE: Ranges 1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe).
Input Resistance 10 megohms for all ranges.
DC Probe with one megohm isolating resistor.
Polarity reversing switch.
OHMS: Ranges 1000 (10 ohms center).
100,000 (1000 ohms center).
1 megohm (10,000 ohms center).
10 megohms (100,000 ohms center).
1000 megohms (10 megohms center).
AC VOLTAGE: Ranges 1.2 12, 60, 300, 1200.
Impedance (with cable) approx. 200 mmf. shunted by 275,000 ohms.
AF VOLTAGE: Ranges 1.2, 12, 60.
Frequency Response Flat 25 to 100,000 cycles.
DECIBELS: Ranges —20 to +3, —10 to +23, +4 to + 37, +18 to +51, +30 to +63.
Zero Power Level 1 M. W., 600 ohms.

GALVANOMETER: Zero center for FM discriminator alignment and other galvanometer applications.
R. F. VOLTAGE: (Signal tracing with Accessory High Frequency Crystal Probe).
Range 20 volts maximum.
Frequency Flat 20 KC to 100 M.C.
LINE VOLTAGE: 105-125 V. 50-60 Cycles.
SIZE: 5¼"x7"x3⅛" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6½ lbs.
STILL AT THE SAME NET PRICE: Model 303, including DCV Probe, ACV—Ohms probe and Ground Lead with Operator's Manual—**$58.75**
Accessory High Frequency Probe, **$7.50**
Accessory High Voltage Probe, **$9.95**
Also available with roll top case, Model 303RT—**$66.70**

Available through your Parts Jobbers

Simpson ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois Phone: COlumbus 1-1221
In Canada: Bach-Simpson, Ltd., London, Ont.
World's Largest Makers of Electronic Test Equipment

BURTON BROWNE ADVERTISING

CLECO
A-1 PNEUMATIC REVERSIBLE
SCREW DRIVERS

Photograph Courtesy General Radio Company, Cambridge, Mass.

This little tool is doing a great big job!

New CLECO
9-RSPC
Reversible Pneumatic Screw Driver

Larger and more powerful than the Cleco A-1. This light weight production tool is used for screw-driving and nut running on many production jobs.

Capacity ¼" machine screws or No. 14 wood screws.

Write for bulletin. P-851.

So small it is almost hidden by the man's hand, this Cleco A-1 pneumatic screw driver is increasing production of potentiometers by running No. 8 nuts *fast!*

Ideal for similar small work, the A-1 is much easier to handle than larger tools. Operator fatigue is reduced and as a result, production is increased even further.

In spite of its small size and light weight, the Cleco A-1 is a rugged production tool built for years of service. Write for bulletin S-750 or, better yet, ask us for a demonstration in your own plant.

CLECO AIR TOOLS

PNEUMATIC DALLETT EQUIPMENT ACCESSORIES

CLECO DIVISION

of the REED ROLLER BIT COMPANY, 5125 Clinton Drive, Houston 20, Texas, U.S.A.

DIVISION OFFICES

GEORGIA: Atlanta 3, 502 Peters Bldg. • **ILLINOIS:** Chicago, 5701 West Madison St. • **MASSACHUSETTS:** Worcester, 23 Enfield St.
MICHIGAN: Detroit, 2832 East Grand Blvd. • **MISSOURI:** St. Louis 3, 2322 Locust St. • **NEW JERSEY:** Newark 4, 75 Lock St.
OHIO: Cincinnati 2, 729 Temple Bar Bldg. • **PENNSYLVANIA:** Philadelphia 20, 5220 North Fifth St. . . . Pittsburgh 17, 5626 Phillips Ave.
TEXAS: Fort Worth, 1717 East Presidio • **CALIFORNIA:** Los Angeles, 1317 Esperanza St. • **MARYLAND:** Baltimore 20, 39D Oak Grove Dr.

In Canada: Cleco Pneumatic Tool Company of Canada, Ltd., 927 Millwood Road, Toronto (Leaside), Ontario

DISTRIBUTORS IN PRINCIPAL CITIES OF THE UNITED STATES AND THOUGHOUT THE WORLD

3223


TIME DELAY RELAYS
SET
CLOCK MOVEMENTS
HAYDON
AT TORRINGTON
HEADQUARTERS FOR
TIMING
INTERVAL
TIMERS
ELAPSED TIME
INDICATORS
TIMING MOTORS
HAYDON MFG CO. INC.
TORRINGTON, CONN.
MADE IN
U. S. A.
HAYDON MFG. CO. INC.

TIMING MOTORS

HAYDON* timing motors offer many advantages. Slow rotor speed allows minimum of gearing for various output shaft speeds providing quiet operation and long life. Unusually small size. Motors totally enclosed. Controlled lubrication with separate rotor and gearing lubricating systems permits selection of best method and lubricants. Operates continuously in any position. Simple to mount securely. Interchangeable design in only 2 motor series with standard speed range from 60 rpm to one revolution in 7 days. Write for Motor Catalog.

400 CYCLE MOTORS and TIMERS

FOR MILITARY APPLICATIONS

HAYDON research and engineering staffs constantly seek to develop new and build better products. One example is the HAYDON 400 cycle timing motor. This is an hysteresis type synchronous timing motor, for use as a separate motor or in many different types of timers. HAYDON personnel and plant are equipped to build motors and timers using D.C., 60 cycle or 400 cycle for military or civilian applications. Write for Engineering Bulletin No. 2 for complete information on the 400 cycle motor.

TIMING DEVICES

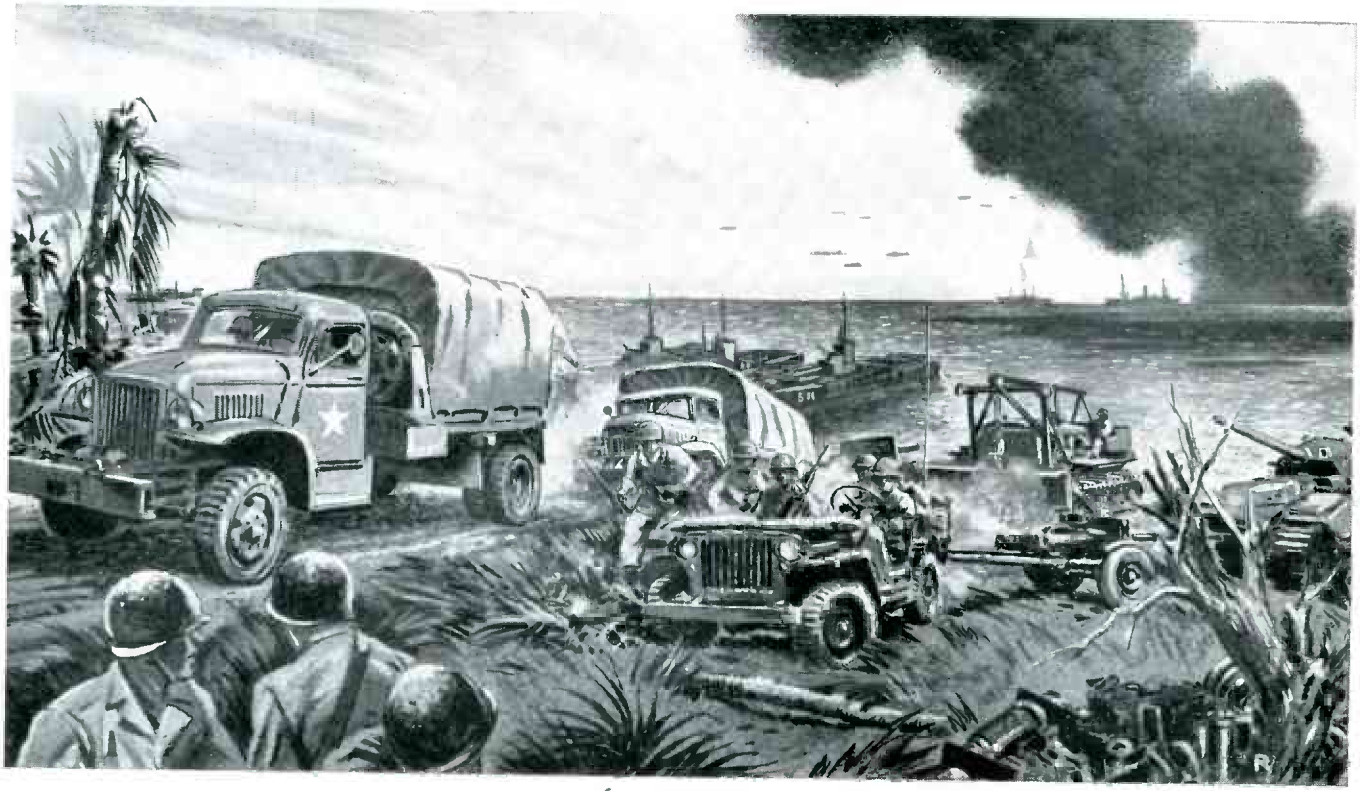
HAYDON specializes in the manufacture of timing components for standard applications and also in the design and mass production of custom-engineered timers for volume applications. The basic element of all HAYDON timers is our own rugged industrial motor described above. This means that HAYDON timing devices can be depended upon to give long, quiet operation. They are small and compact and offer designers unusual latitude in that they may be mounted and will operate without interruption in any position. Write for Device Catalog.

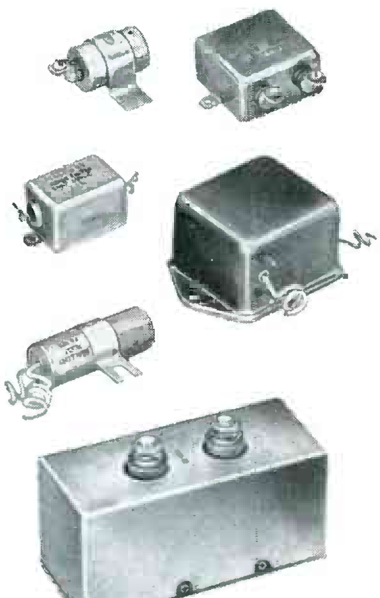
HAYDON Manufacturing Co., Inc.

SUBSIDIARY OF GENERAL TIME CORPORATION

2426 ELM STREET, TORRINGTON, CONNECTICUT

When electrical noise suppression is a problem . . .
put MALLORY'S specialized skills to work for you





Representative types of noise suppression filters and capacitors.

You can turn to Mallory with complete confidence when you need help in meeting the rigid electrical noise suppression requirements for military equipment.

Mallory personnel, facilities and experience which helped many manufacturers beat this problem during World War II are at your service today . . . ready with the filters and capacitors . . . ready, too, with application "know-how" essential to satisfactory noise suppression in your equipment.

And since the war, Mallory has worked steadily on noise suppression problems created by the ever-increasing use of electronic equipment by our Armed Forces.

Put Mallory's specialized skills and experience to work for you whenever you need standard filters and capacitors to meet Signal Corps and Ordnance specifications . . . or when you need special types for unusual uses. Call or write Mallory today.

P.R. MALLORY & CO. Inc.
MALLORY

SERVING INDUSTRY WITH
Electromechanical Products—Resistors • Switches • TV Tuners • Vibrators
Electrochemical Products—Capacitors • Rectifiers • Mercury Dry Batteries
Metallurgical Products—Contacts • Special Metals • Welding Materials

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

CROSS TALK

► **REPORT** . . . Beginning on page 4 of this issue, ELECTRONICS inaugurates a new service to its readers under the title "INDUSTRY REPORT".

The purpose of INDUSTRY REPORT is to inform our readers of significant trends in the industry, with particular emphasis on the "business end" of electronics. The style of reporting is brief, the language nontechnical; the subjects range over the whole field of electronics—industrial, business, government and commercial activity. Technical topics will be treated (in this issue, an interpretative piece on germanium, for example) but always in nontechnical language. We plan to do a bang-up job on industry statistics and have formulated a monthly index of business activity, geared to physical production which, we hope and predict, will be followed with interest by all readers of this magazine.

The philosophy behind the new service is simply stated. The industry of electronics has grown enormously since prewar years. Factory value of products has increased from $250 million in 1941 to nearly $4 billion in 1951. The core of this great production of wealth is the technical man, the reader of ELECTRONICS, if you will, who has the specialized vocabulary to read the technical material we publish. But superimposed on this technical core, is a very sizeable second group of individuals, some with business training but without formal technical background, others with engineering training, whose management responsibilities prevent their keeping up with technical details. INDUSTRY REPORT is geared for *both* groups. We hope it fills the bill, and we urgently solicit your comment and criticism.

This is an addition to our established editorial content. Nothing has been removed, in quantity or quality, from the editorial section which begins, as usual, on this page.

► **DEPARTMENTS** . . . Readers will note changes in the "back of the book" in this issue. Two departments have been combined, a new department started and a new style of departmental makeup adopted. Since 1935, our readers have grown to know *Tubes at Work* and *The Electron Art*. The distinction between these departments has become increasingly diffuse, so we have decided to combine them under the title *Electrons at Work*. This, incidentally, admits the transistor and its cousins to the Tubes At Work category and sidesteps the question of what is a transistor. Ron Jurgen will edit E at W.

The new department, *Production Techniques* is a departure to a field not heretofore covered every month. Its purpose is fully described on page 220. Comments, criticisms and contributions for PT should be sent directly to John Markus, who edits the new pages.

The makeup change will, if our mail is any indication, be greeted with shouts of joy. Effective this issue, each department now runs in consecutive pages and columns to its end before the next starts. This will avoid skipping through the back of the book, following page numbers: it will also cause certain departments to appear in unaccustomed positions. If you don't find your old friends in the regular place, consult the table of contents, page 1.

► **RELIABLE** . . . JETEC is currently engaged in a commendable effort to improve the reliability of electronic equipment through improved design of electron tubes and better understanding of their ratings. We will shortly print material germane to this program. Meanwhile we observe that this subject should not go under the name merely of "tube reliability". Circuit reliability is equally important. Tubes and circuits are so indivisibly related that it is impossible to achieve reliable operation without equal attention to both phases. Nor should JETEC feel shy about tramping on the toes of the circuit men outside its sphere of influence. This is—must be—a "tube and circuit reliability" program. And it's everybody's business.

Electronics Engineering

Medical progress depends to a great extent on progress in electronic devices that enable the research worker and clinician to measure and control physiological phenomena. Past, present and future jobs for electronics are discussed

MEDICINE, as it has been practiced through the years, cannot be considered a science. It would be more aptly termed a pseudo-science.

The present state of the practice of medicine results from the accumulation of some facts and a generous proportion of fancy. The doctor who practices successfully must still lean heavily on the art of medicine. On the other hand, the doctor who devotes his time to research must stick more closely to elaborations of the so-called "known facts and concepts." However, knowledge of many of these "facts" has been gleaned only through a pseudo-scientific approach.

Available Tools

In the clinical practice of medicine, there are two basic units on which to a large measure, our diagnoses and treatments are based. The first is the reactions of the patient in describing the history of his illness. The second is the reaction of the doctor to his findings. For most illnesses there are no mathematic-like responses on which we can rely to achieve a more scientific background for our diagnoses.

An interesting exception to this may be given in the development of the electrocardiograph. Prior to the time that this instrument was in general use, it was rather difficult to distinguish between a major and a minor heart attack.

With the introduction of the electrocardiograph, physicians were presented with a truly impersonal means of assistance. They were able to render a more accurate diagnosis, and to estimate better the prognosis of the disease.

Unfortunately there are too few examples such as this that may be cited. The x-ray, the electroencephalograph, the chemical tests, the photoelectric calculators and possibly a few others have been most helpful in minimizing the personal reaction. For the most part, the contributions which medicine requires for its advance, are still forthcoming.

Roentgenology

In the field of roentgenology, a number of important contributions are needed. Our current apparatus produces excellent visualization of bony structures. More recently we have been able to diagnose soft-tissue disturbances by using different techniques of exposure. By soft tissues we mean any of the body structures other than bone.

The tissue differential might be made so great that even minor degrees in density of structures might cause them to record differently. It is not inconceivable that even the color of internal organs may some day be recorded and used as an indication of the presence of pathologic change.

There is a tremendous need for the miniaturization of x-ray equipment. Almost everyone has been subjected at some time to an x-ray at the doctor's office. I feel sure that the large, cumbersome equipment must represent an eyesore to those engineers who are interested in a miniaturization program. A huge structure is not necessarily more efficient. Newer, smaller and better equipment must eventually be provided.

Accurate blood pressure measurements are simplified by use of electronic setup developed by University of Kansas Medical Center and the Hathaway Instrument Company. Twelve-channel recorder permits simultaneous study of pressures at various parts of the body

It would be unwise to leave this field without some thoughts on the need for additional and more varied radioactive materials. Cancer may have several causes, and there is no proof that different cancers stem from a single disease. Therefore, its solution will probably not depend on a single element. However, the wedge for medical-engineering cooperative work is progressing in a remarkable manner with newer radioactive materials.

Recently, for example, radioactive cobalt has been introduced. It is now being studied in the treatment of cancer of the uterus. Other drugs are eliminated by the body in a specific, known manner; through the skin, the kidneys or the intestinal tract. Their combination with radioactive elements may prove valuable. It would seem that we are on the verge of making interesting discoveries along this line.

Anesthesia

Some words should be expressed regarding our expectations in the field of anesthesia. At this time, to perform an operation it is necessary to render the patient unconscious with a general anesthetic or to inject a drug locally or regionally in order to establish insensibility of a specific part. General anesthesia has some obvious disadvantages. Although local anes-

Needed in MEDICINE

By HERMAN I. KANTOR

Assistant Professor of Obstetrics and Gynecology
Southwestern Medical Branch
University of Texas
Dallas, Texas

thesia is quite safe, it also presents a number of drawbacks.

We still have hopes that perhaps our imaginative engineering friends will be able to develop an apparatus to produce a temporary form of nerve paralysis.

Measuring Pain

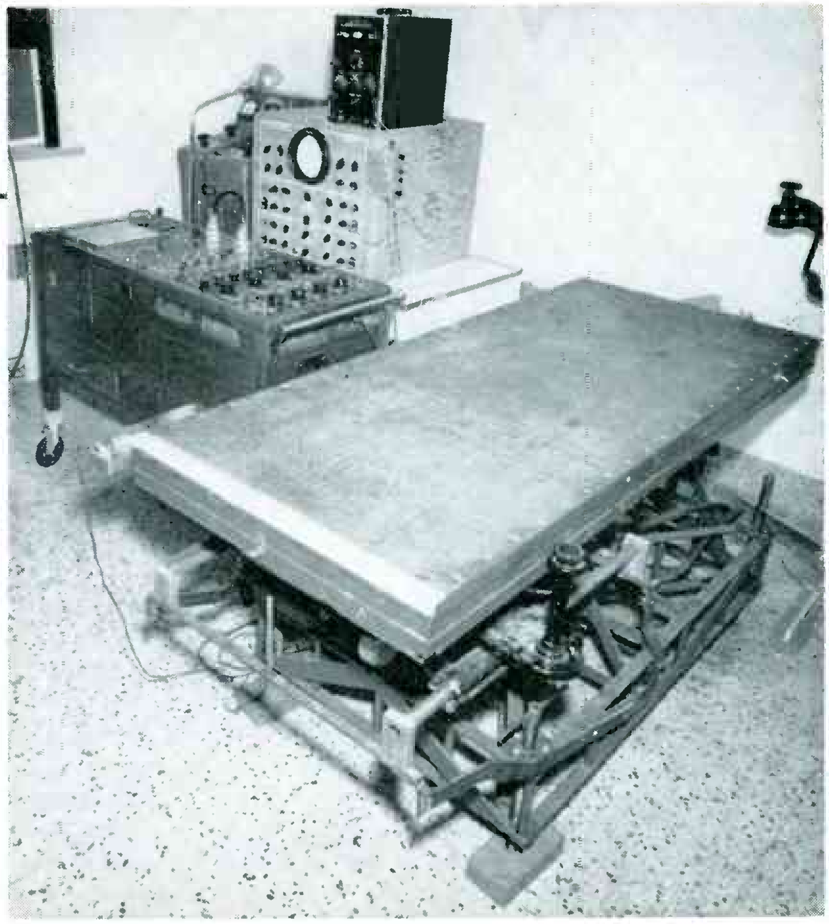
Pain is the cerebral recognition of noxious stimulation in a distal part. There are definite known pathways along which these stimuli travel. Moreover, when these pathways are blocked chemically, as with novocaine, the stimuli are no longer conveyed for cerebral response. This is the mechanism of local and regional anesthesia. It would not appear impossible that we may learn to block these same pathways electrically. With removal of the block, a normal intact nerve trunk would be left to function in its usual manner. This would truly offer the means to safe anesthesia.

There is a tremendous difference between individuals in their evaluation of the symptom of pain. One patient with a minor headache will present it as a major catastrophe. Another may minimize to unimportance the presenting symptom of a serious disease. It would seem that an apparatus for determining the degree of pain would prove most valuable to us.

Fertility

Our efforts to overcome human infertility are in urgent need of assistance. For example, it is thought that the ovaries of normal women produce a single egg in each menstrual cycle. However, we lack scientific methods of proving, first, that the egg is actually produced and, second, when in the cycle it is produced. Most of our current means for these deductions are indirect and perhaps often inaccurate. An electrical apparatus has been made to help in this problem, but the results have been questioned by many investigators. It is thought that a change in potential does occur at the time of ovulation. Undoubtedly a better recorder can be made for this purpose.

We need assistance in the better evaluation of the fertility of semen specimens, and in the treatment of some of the deficiencies found.



Extreme versatility of electronics in medicine is illustrated by the University of Kansas Medical Center ballistocardiograph table that records motion imparted to the body by the blood velocity change with each heart beat

Future Possibilities

In the foregoing discussion, the surface of the current needs of medicine has only been scratched. All branches will have their own requirements, and the potential cooperative ventures are enormous. The ophthalmologist, the laryngologist, the dermatologist—they all have problems to present; the engineers must find solutions.

Whenever a physician must depend on his senses or his judgement to measure a response, an electronic replacement is probably needed. A permanent committee in our universities to supervise medical-engineering cooperative ventures would have an almost endless task.

A more daring individual than the writer might perhaps even predict a change in future conversations. When friends meet, the prosaic "How do you feel" may become obsolete. Perhaps it may be replaced by the question "How is your electronic recording today?"

The need for a more functional and more scientific approach by medicine to its practical problems is truly great.

New Pennsylvania Turnpike

Valley Forge interchange, eastern terminus of the Pennsylvania Turnpike, is also eastern end of microwave system, as indicated by one-way set of parabolas in upper left-hand corner of photograph

PROBLEMS in proper radio coverage have always been presented by the Pennsylvania Turnpike because of the mountainous terrain through which most of it passes. There is also the necessity to keep all sections advised of constantly-changing conditions of weather, roadway, and the thousands of other problems generated in the administration of such a vast roadway system.

Complete Circuit

A microwave circuit as a through circuit with a vhf system in conjunction with it for broadcasting to mobile units and intermediate fixed stations has proved to be an excellent solution to a difficult problem. In addition, a radio-teletype circuit for handling routine matters and a second voice circuit for administration communications, form a complete comprehensive communication system stretching from Valley Forge to Pittsburgh and rapidly expanding with the roadway itself to the Ohio border.

The east circuit, which starts at the present eastern terminal at Valley Forge, uses 960-mc equipment (RCA Type CW5A). The through microwave stations carry this circuit to Everett, Pa. and the Everett Control Center. The western division microwave circuit originates at Everett and stretches to the Ohio border and the western terminus near Petersburg, Ohio, through an additional five relays. A second control point is located at the Harrisburg office, the source of administration for Turnpike affairs. The basic voice circuits are divided into eastern and western divisions at Everett to separate the traffic load for greater flexibility and ease in handling. The Teletype circuit and the administrative voice circuit is tied through from east to west.

Nine Teletype outlets are provided at the key points including the east and west terminals, the Harrisburg office, and the Everett Control Center. At each relay station (13 total) is located a vhf receiver (RCA CR9A) and a vhf transmitter (RCA Type CT12A). The receivers pick up signals originating within their individual range from a fixed station (an interchange, a maintenance building, or a police barracks) or a mobile unit, and inject this signal into the microwave circuit. Once the signal is originated into the microwave circuit it is automatically retransmitted by all of the vhf transmitters on the particular circuit (east or west).

The instant a signal originates at any given point in the system it electronically locks out the possibility of a second signal gaining con-

UHF Communications System

Microwave circuits used in conjunction with existing vhf equipment provide ultimate in dependability and efficiency of communications system. Topography along 327-mile route from outskirts of Philadelphia to Ohio border presents unique problems

By D. N. LAPP

Chief, Field Operations
Raymond Rosen Engineering Products
Philadelphia, Pennsylvania

trol until the transmission is complete. The control and lockout is accomplished by the use of subcarrier tone transmitters (Lenkurt) and tone receivers in conjunction with special switching circuits.

All vhf transmitters at the relay station operate on one frequency in the 152 to 162 mc band. All other mobile and fixed station transmitters on the Turnpike use a second frequency in the same band. Thus, a signal from a mobile unit is received at a relay station and then rebroadcast and received at the other mobile and fixed stations on the Turnpike.

The microwave relay stations use a heavy-duty fire tower (Aermotor Corp.) type construction with cabin atop. The equipment and parabolic antennas are mounted so as to provide minimum transmission-line loss. The equipment is installed in racks mounted within the cabin and 4-ft and 6-ft parabolic antennas (Andrew Corp.) feed the signal cross country.

Thirteen two-way microwave relay stations of the type shown furnish dependable communications along the route. Average hop is 24 miles

Each relay station is operated from commercial power and a stand-by 3 or 5-kw gasoline-powered generator (Kohler) is provided to take over instantly in the event of an emergency. These generator houses are located adjacent to the base of the tower at each of the relay locations.

The highest tower in the entire system is at the Ohio Gateway microwave terminal, and this is a 150-ft guyed steel tower (Stainless Inc.) with the equipment mounted in a transmitter building at the base of the tower. This tower is adjacent to the interchange and the transmitter is remotely controlled from the interchange.

Interchange Buildings

There are a total of 43 interchange and maintenance buildings across the entire Turnpike, most of which originate signals in the vhf band. All of these fixed vhf stations use (RCA CTR1A) 15-watt 152 to 162-mc f-m transmitter-receivers. These stations also use a Yagi antenna (Andrew) pointed in the direction of the nearest relay station. These antennas are mounted on 40 or 75-ft steel masts erected near the building.

Each of the transmitters is modified for a standard two-wire telephone switching circuit.

Many of the interchanges require operating points in the utility building in addition to the toll booth or booths directly adjacent to the utility building. The radio equipment is installed in the utility building on wall-mounting racks. Press-to-talk telephone type simplex operation is provided with a line amplifier and speaker at each handset location for audible monitoring. When the handset is picked up from the hanger or cradle, the speaker mutes and telephone-type transmission and reception is obtained.

All interchanges and maintenance buildings are provided with gasoline-driven emergency generators which automatically take over when the commercial power fails.

A standard mobile unit with a 30-watt f-m transmitter and receiver (RCA Type CMV4A) is used in the Turnpike equipment. These units are located in the police cars, those of the highway maintenance supervisors, and all other Turnpike vehicles requiring direct contact with the control centers of the Pennsylvania Turnpike Radio System.

To better acquaint the reader with the microwave system, it is desirable to trace a typical point-to-point transmission. This description used in conjunction with the overall system layout will give a better illustration of the manner in which typical messages originate.

Assume that a police patrol car is moving along the Turnpike near

Harrisburg, Pa. and comes upon a situation which requires assistance. The officer listens to make certain that the eastern division is not in use and then depresses his press-to-talk button to call the New Cumberland maintenance building and summon an ambulance. His 155-mc f-m transmitter signal is delivered to the receiver at the Bunches relay station and modulates the f-m transmitter at that point, in addition to transmitting the signal both east and west from Valley Forge to Everett on the microwave through circuit. All of the stations in the eastern division, in addition to the New Cumberland maintenance building, hear the signal and realize that an emergency exists. During periods like this, normal traffic stands by until the condition is properly taken care of.

Emergency Action

The New Cumberland maintenance building would receive the signal through their Yagi antenna and associated fixed station receiver. They would immediately reply and advise that the request is being complied with. In the event of an emergency where it is necessary to absolutely stop other traffic, the control operator at Harrisburg or at Everett takes command of the system and keeps the circuit clear until the emergency has passed. Standard coded signals as used by the State Police are used throughout of the entire Turnpike system.

At any point where microwave facilities are available a Teletype station can be installed. The equipment operates on a subcarrier which after being received at a microwave station and demodulated, can be placed into any standard two-wire circuit to a Teletype machine.

The Teletype printers presently in use on the Turnpike are installed at the eastern and western terminus, the Harrisburg office, and the Everett Control Center plus certain of the tunnel stations requiring this service. The tunnel stations are fed by cables which are buried under ground and come down the side of the mountain from the relay stations on top. These cables, incidentally, are from the old original radio system installed in the first Pennsylvania Turnpike system stretching from Carlisle to Irwin (116 to 119 mc, see ELECTRONICS, May 1942).

Antennas

The microwave equipment uses standard antennas of the 2, 4 and 6-ft parabola types. The size of the dish is determined on the basis of the signal required as determined by the original survey made across the state before the actual relay sites were established.

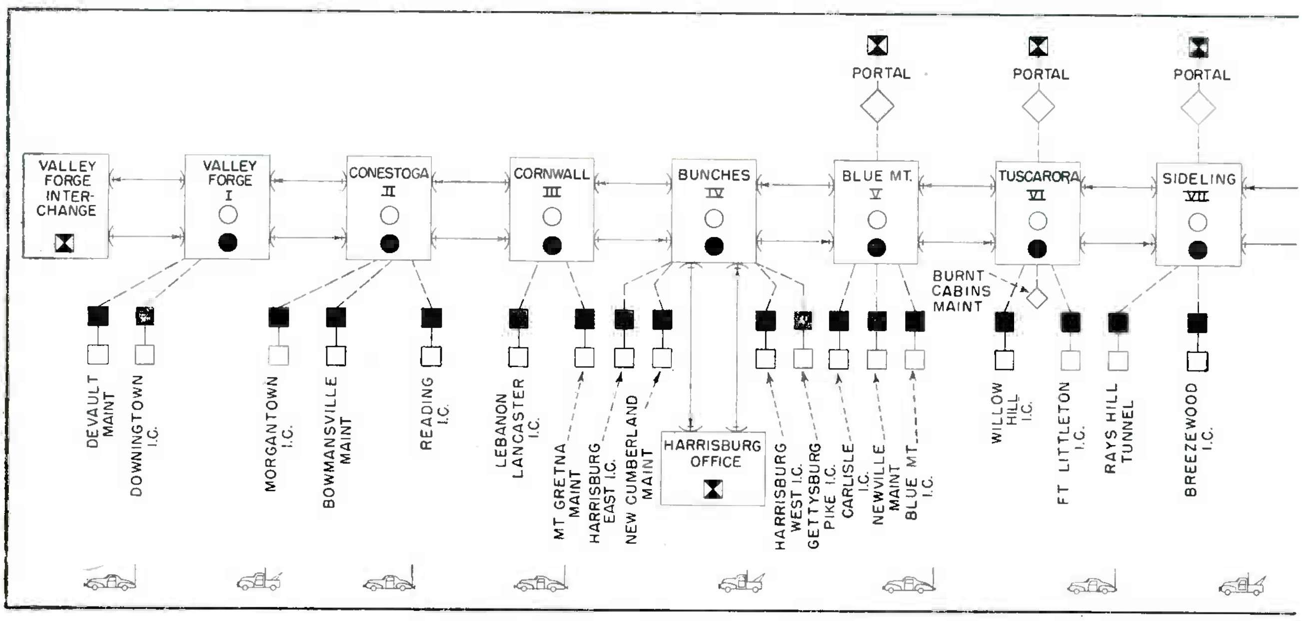
All interchanges and maintenance buildings use the Yagi-type antenna beamed at the proper relay

Emergency power stations at each relay position insure communications in the event of regular power system failure

station. In some cases a corner-reflector antenna (Andrew) is used to provide signal improvement. The fixed relay stations vhf and uhf receivers use omnidirectional (Andrew 704A2) antennas since the signals being received and transmitted are required to reach points both on and off the Turnpike right-of-way.

Survey

The Pennsylvania Turnpike System for the proper coverage from Valley Forge to the Ohio Border required a comprehensive study of topographical maps to determine the approximate locations and the length of the microwave jumps prior



System layout plan shows communications equipment used at various points along

All mobile units transmit on a common frequency (159.21 mc) and receive on a separate common frequency (155.67 mc). When a mobile operator presses his "talk" button, he automatically takes over the microwave system and his message is relayed to all appropriate stations

to the actual installation of the equipment. The maximum jump in the system is 40 miles and the average jump is 24 miles.

After the locations had been approximately determined it was necessary to conduct an actual radio survey, and on the basis of survey signals the losses were calculated and the proper tower height and antenna size was determined. From this survey the locations were pin pointed and the necessary acquisition of land, construction of roads, towers, and buildings, plus the extension of power line facilities was made.

The basic microwave system from Valley Forge to Pittsburgh was started in April 1950 and the eastern end was in test operation in October 1950. The entire system from Valley Forge to the Pittsburgh Interchange has been in operation by the Pennsylvania Turnpike since May 1951.

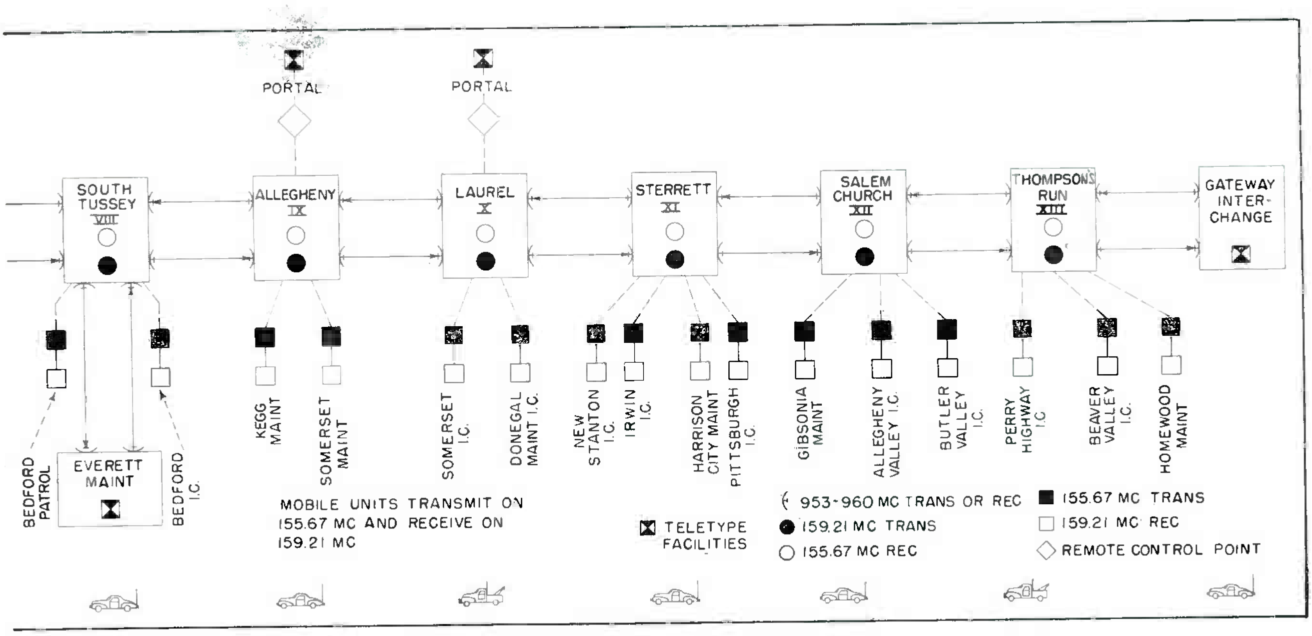
A total of 104 mobile units are in operation across the Turnpike, and the entire system is serviced on a continual basis by three men plus a supervisor. Service records for the first few months indicate few service problems and a minimum loss of microwave circuit time.

The microwave circuits to the Ohio border are being completed and will be in operation in conjunction with the opening of the roadway.

5,991 Tubes

The microwave vhf relay and terminal stations use a total of 2,202 tubes. Interchanges and maintenance buildings account for another 1,293 tubes plus 2,496 tubes in the mobile equipments. Thus, the entire system uses a grand total of 5,991 tubes. A single two-way operation requires very close to 1,000 tubes for complete operation.

This complete comprehensive system sets a pattern for radio systems to fulfill a communication need which radio alone can serve.



the 327-mile Pennsylvania Turnpike. The complete system uses almost 6,000 tubes

Principles of NTSC COMPATIBLE

By C. J. HIRSCH
Chief Engineer, Research Division

W. F. BAILEY
Supervising Engineer

B. D. LOUGHLIN
Supervising Engineer

Hazeltine Corporation
Little Neck, N. Y.

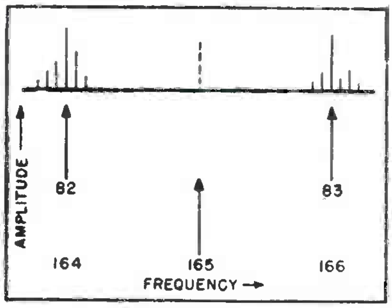
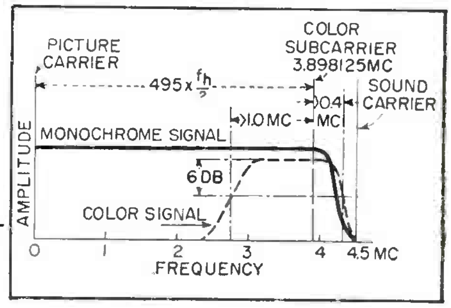


FIG. 1—Energy concentrations in tv signal. Upper numbers are harmonics of line frequency, lower numbers harmonics of half line frequency

FIG. 3—Complete video spectrum of NTSC field-test signal; f_h is the horizontal scanning frequency



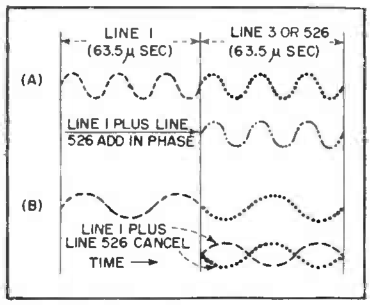


FIG. 2—Cancellation of coloring information: (A) even harmonics of half line frequency reinforce each other on successive scanning of same line; (B) odd harmonics cancel out

FIG. 4—Dot pattern corresponding to fruit in bowl, Plate *A* on ELECTRONICS front cover, when monochrome signal is absent and alternate frames are suppressed

THE SPECIFICATION of color requires three independent quantities such as the intensity of three primaries, red, green, and blue. In a color television system, this might seem to imply three separate and complete high-resolution pictures, one in each primary color. However, it is a fact that the eye can distinguish small changes in brightness (both in space and time) whereas color changes are much less easily resolved. Hence it has been shown that a color picture need not contain three times as much information as a monochrome picture.

A satisfactory color picture need contain only slightly (10 to 80 percent) more information than the same picture in monochrome[1,2,3]. To achieve this economy, color should be expressed in another set of three subjective quantities, luminance, dominant wavelength, and purity, (corresponding to brightness, hue and saturation) and the color picture should be sent as a full-resolution monochrome picture to which the minimal requisite color information is added.

In the color television method now being field tested by the NTSC[4], the information is transmitted by two simultaneous signals. One of these is called the monochrome signal and supplies all the luminance, (brightness) information. This signal is transmitted by the present FCC standards for black-and-white television and may be received by any black-and-white receiver without any change whatsoever. The other signal is called

Presented at the IRE-RTMA Radio Fall Meetings, Toronto, Oct. 1951.

COLOR TELEVISION

First public disclosure of the technical basis of NTSC field-test specifications explains choice of color subcarrier frequency, and modulation method, describes advantages of vestigial sideband color transmission, color phase alternation and constant-luminance transmission

the "color subcarrier". This signal supplies the "coloring information" which, when added electrically to the monochrome signal and supplied to a tricolor tube, reproduces the colored picture.

The signals are so formed that each picture element is reproduced in its proper color instantaneously rather than sequentially. Thus, purple is made up of a simultaneous combination of red and blue, instead of a time sequence of red and blue.

Plate *A* on the front cover of this magazine shows such a colored picture. It consists of the monochrome picture shown in Plate *C* to which the chromaticity (coloring) information shown in Plate *D* has has been added electrically. All the pictures on the cover are reproductions of photographs of actual television pictures.

Band-Sharing of Monochrome and Color Signals

The monochrome and color signals occupy the same frequency band, that is, the band normally required for the transmission of monochrome pictures. This is possible because the spectrum of a television picture consists essentially of discrete frequencies, with the energy concentrated near harmonics of line-frequency (even harmonics of half line-frequency).[2,5,6] This spectrum results because television pictures are reproduced by a periodic scanning process; each picture contains a very high amount of redundancy, and its spectrum can therefore be expressed approximately as a Fourier series.

The spectrum of the coloring signal consists also of such bunches of energy, and these are interleaved in the gaps of the monochrome spectrum at locations corresponding to odd harmonics of half-line frequency, as shown in Fig. 1.

Figure 2 shows the video spectrum of the complete color picture. It consists of a monochrome signal, made up of bundles of energy located near even harmonics of half line-frequency, and a color subcarrier, located at an odd "harmonic" of half-line frequency, whose sidebands are interleaved between those of the monochrome signal.

Black-and-white receivers display only the monochrome signal because the interleaved color signal tends to cancel itself every two frames. Reference to Fig. 3 explains how this occurs. Figure 3A shows a line whose modulation frequency occurs at an even harmonic of half line-frequency. By definition, the time period (63.5 microseconds) contains an integral number of whole cycles of the modulation. Successive lines, therefore, repeat in phase and the first line of the next frame (line 526) reinforces line 1. On the other hand, Fig. 3B shows a signal due to color information. As stated above, this signal has a frequency which is an odd harmonic of half line-frequency. By definition a line period contains an extra half cycle. This extra half cycle causes

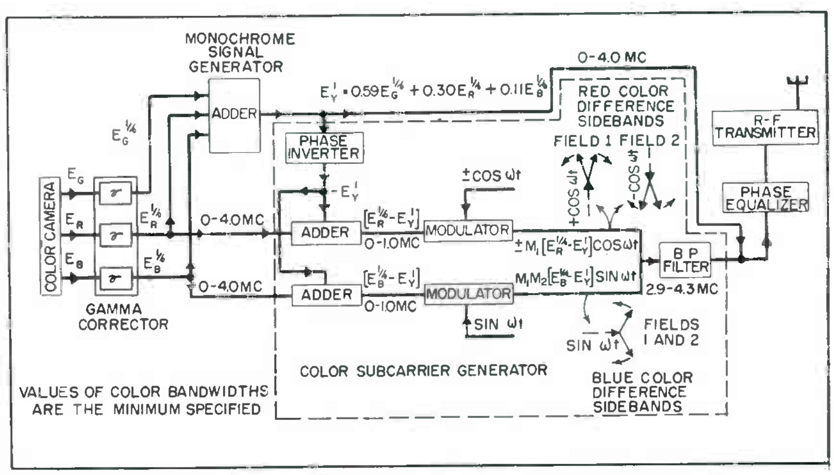


FIG. 5—Block diagram of typical equipment for generating and transmitting NTSC field-test signal

a phase reversal on successive lines and line 526 cancels the information on line 1.

The cancellation would be complete if the system were linear, and if the eye had complete retentivity from frame to frame. This is not entirely the case, because the system is only approximately linear, and the eye cancels only that part of the color modulation which it remembers from frame to frame. For this reason only a part of the amplitude of the color information cancels itself out. If the coloring signal is transmitted at too high a level, the peaks of the color subcarrier and its sidebands appear as dots in the colored parts of the transmitted picture when viewed on a monochrome receiver.

Figure 4 illustrates in exaggerated form the dot pattern corresponding to a portion of the picture

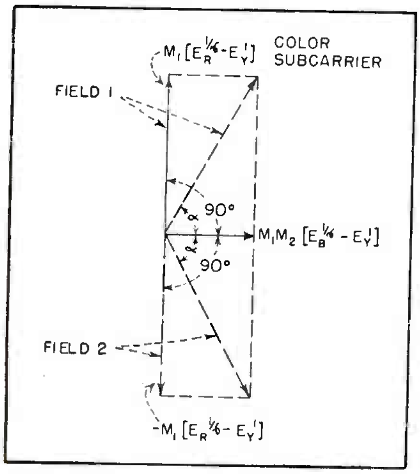


FIG. 6—Phase relations between modulation components of the color subcarrier on successive fields

in Plate *A* on the front cover. This image appears when only the color subcarrier is transmitted, and when only alternate frames are displayed, so as to make the interfering pattern most evident. This exaggerated condition never appears in practice since the monochrome component is always present for any color (except black) and because cancellation results when all frames are displayed.

To transmit the color subcarrier at high enough amplitude for adequate signal-to-noise ratio and yet make the dot pattern invisible, the

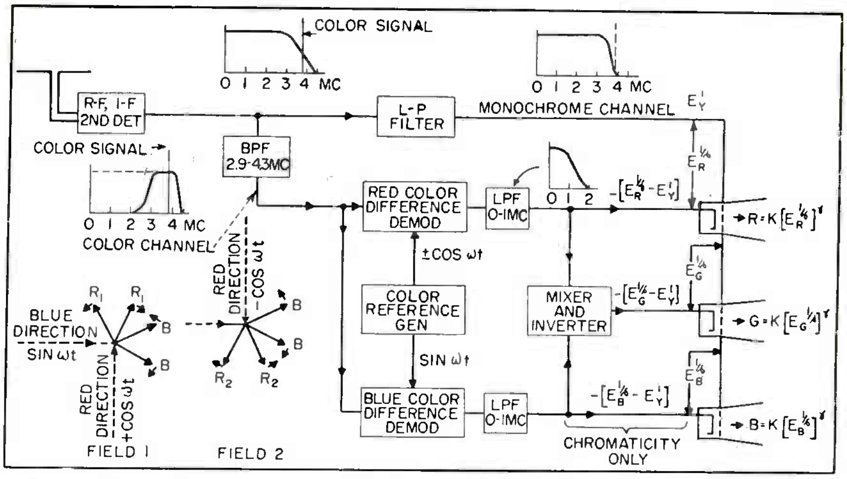


FIG. 7—Block diagram of typical equipment for receiving NTSC field test signal

frequency chosen for the subcarrier is high enough (3.898125 mc) to be attenuated considerably by existing monochrome receivers. This frequency is equal to the 495th harmonic of half line-frequency (See Fig. 2).

Monochrome Signal

The monochrome signal voltage, E_y, can be obtained directly from a camera whose output is proportional to luminance. More usually it is made up by combining voltages (E_R, E_G, and E_B related to the red, green, and blue reproducing primaries) which are derived from a three-color camera. In the latter case, the three components E_R, E_G, and E_B are combined in proportion to their contribution to the total luminance.

The luminance signal is made up as follows:

$$E_y = 0.59\,E_G + 0.30\,E_R + 0.11\,E_B \qquad (1)$$

This expression indicates that the green, red, and blue reproducing primaries* contribute respectively 59, 30, and 11 percent of the luminance of white (defined by the chromaticity coordinates $x = 0.310$; $y = 0.316$, that is, illuminant C). Note that the sum of the numerical factors in Eq. 1 is unity.

The system is so proportioned that white is produced when $E_R = E_G = E_B$. Hence for white light, substituting in Eq. 1.

$$E_y = E_R = E_G = E_B \qquad (1a)$$

* Standard reproducing primaries are red $x = 0.670$; $y = 0.330$; green $x = 0.210$; $y = 0.710$; blue $x = 0.140$; $y = 0.080$.

It is evidently desirable that the coloring information disappear when there is no color. For this reason, this information is transmitted in terms of two components ($E_R - E_y$) and ($E_B -_y$) which are called "color difference" signals.[10] From Eq. 1a ($E_R - E_y$) = 0 = ($E_B - E_y$) for white light (no (no color).

Color-Difference Signals

Since the eye is insensitive to color in fine detail, these color-difference signals are usually, but not necessarily, limited in bandwidth to 1 or 2 mc.[8]

Green, when present, is transmitted by these signals even though it does not appear explicitly. Green is, as Eq. 1 states, the main component of E_y. The color receiver recovers ($E_R - E_y$) and ($E_B - E_y$). The receiver can obtain ($E_G - E_y$) by a mixture of -0.51 ($E_R - E_y$) and -0.19 ($E_B - E_y$), as shown below.

Substituting Eq. 1 in ($E_R - E_y$) and ($E_B - E_y$) we obtain

$$\begin{aligned} & -0.51\,(E_R - E_y) - 0.19\,(E_B - E_y) \\ & = -0.51(-0.59\,E_G + 0.70\,E_R - 0.11\,E_B) - 0.19(-0.59\,E_G - 0.30E_R + 0.89\,E_B) \\ & = 0.41\,E_G - 0.30\,E_R - 0.11\,E_B \\ & = E_G - (0.59\,E_G + 0.30\,E_R + 0.11\,E_B) \\ & = E_G - E_y \end{aligned} \qquad (2)$$

The color receiver adds the luminance signal to each color-difference signal as follows:

$$(E_R - E_y) + E_y = E_R \qquad (3a)$$
$$(E_B - E_y) + E_y = E_B \qquad (3b)$$
$$(E_G - E_y) + E_y = E_G \qquad (3c)$$

The voltages E_R, E_G, and E_B are applied between the respective control grids and cathodes of a three-gun color picture tube.[7] This may be done by applying E_y to one electrode, and the color-difference signal to the other.

Gamma Correction

The foregoing discussion is oversimplified because the light output (L) of the picture tube is not directly proportional to the electrical input (E) but varies approximately as a power (γ) of this input as

$$L = K E^{\gamma} \qquad (4)$$

The voltages applied to the picture tubes must therefore be predistorted by a process called gamma correction. One way in which this may be done is by transmitting the following signals:

1. A monochrome signal made up of gamma-corrected primary voltages described as follows:

$$E_y' = 0.59\, E_G^{1/\gamma} + 0.30\, E_R^{1/\gamma} + 0.11\, E_B^{1/\gamma} \qquad (5)$$

2. The two "color-difference" components $(E_R^{1/\gamma} - E_y')$ and $(E_B^{1/\gamma} - E_y')$.

Complete Color Signal

A scheme for generating the complete color signal, shown in Fig. 5, uses individually gamma-corrected primary voltages. These are mixed to form the monochrome and color-difference signals.

A sine wave can carry two independent sets of information by modulating it in amplitude with one set and in phase with the other or, what is essentially the same thing, by splitting the sine wave into two components in quadrature and amplitude modulating each component with one set of information. Each modulation can then be recovered by heterodyning the modulated wave with a sine wave having the same frequency and phase as the carrier component carrying the desired modulation. This process is sometimes called synchronous detection and must not be confused with other forms of detection which recover the modulation envelope.

The information which is utilized to establish the reference frequency and phase at the receiver[8] is transmitted by a few cycles of the reference signal, called the color burst, on the horizontal blanking pulse following the line synchronizing pulse (see paper by R. B. Dome, this issue). Its frequency is that of the color subcarrier (3.898125 mc), and it leads the phasor representing the blue color-difference component of the modulated wave by 90 deg.

Referring to Fig. 5, we see that $(E_B^{1/\gamma} - E_y')$ is made to modulate $\sin \omega t$; while $(E_R^{1/\gamma} - E_y')$ modulates $\pm \cos \omega t$. Balanced modulators are used so that the subcarrier is suppressed on white light. The outputs of the two modulators are first combined with each other to form a single color subcarrier signal and then combined with the monochrome signal to complete the color picture signal E_m, whose equation is

$$E_m = E_y' + M_1 [\, M_2 (E_B^{1/\gamma} - E_y') \sin \omega t \pm (E_R^{1/\gamma} - E_y') \cos \omega t \,] \qquad (6)$$

In this formula, the phase reference is $\cos \omega t$ (which is that of the color synchronizing signal), M_1 determines the amplitude of the color subcarrier relative to the monochrome signal E_y', and M_2 determines the relative proportions of the two color-difference components.

The phase of the $(E_R^{1/\gamma} - E_y')$ component is reversed after each field. This is the meaning of the $\pm$ sign. This process, known as color phase alternation, allows the use of vestigial sideband operation for the color subcarrier, as described later.

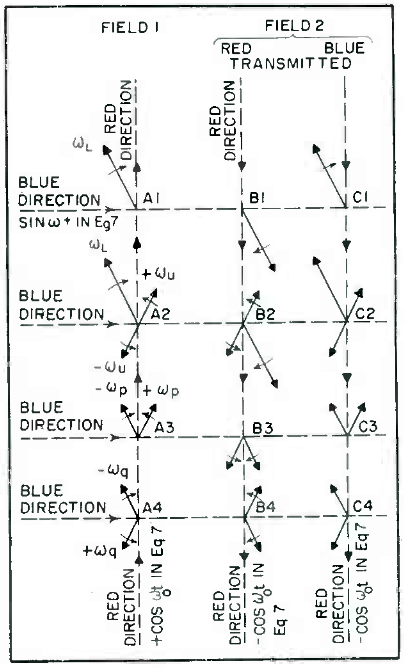


FIG. 8—Cancellation of crosstalk produced by vestigial sideband transmission: A1-4 red and blue on field 1, B1-4 red on field 2, C1-4 blue on field 2

Phase Equalizer

The relative phase of the two sets of sidebands is shown in Fig. 5, near the respective modulator output leads. The phasors representing the color subcarrier components of Eq. 6 are shown in Fig. 6. It is evident that the phase angle α of the color subcarrier with respect to the $(E_B^{1/\gamma} - E_y')$ component depends on the ratio of the two color-difference components, and therefore on the hue (dominant wavelength) of the picture. The amplitude depends on saturation (purity) since it is seen to disappear on white. The amplitude depends also on luminance since it is seen to involve absolute values of E_R, E_B, and E_y.

The complete color signal is impressed on the phase equalizer unit whose function is to modify the delay of the low-frequency portion of the monochrome signal with respect to the high-frequency portion and the color subcarrier to insure time-coincidence at the second detector of a typical receiver.[9] This is desirable because the receiver selectivity results in delaying high modulation frequencies, where the color subcarrier is located, more than low frequencies. The complete color signal then is applied to the r-f transmitter whose useful output is frequency limited in practical receivers so that vestigial sideband transmission of the color subcarrier results (See Fig. 2).

Color Receiver

Figure 7 shows a block diagram of a typical receiver. The complete color signal, monochrome plus color subcarrier, is applied to the three grids of the picture tube. This signal drives the three grids equally and produces a monochrome picture as shown in Plate C on the front cover. Some reduction of the color subcarrier in the monochrome path to the picture tube may be desirable to eliminate color desaturation due to picture tube nonlinearity. This can be accomplished by a low-pass filter located in this path.

The signal is also applied to the

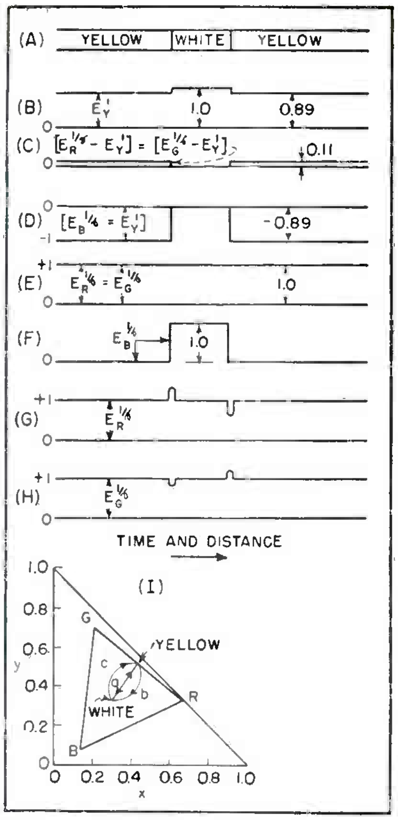


FIG. 9—Waveforms (A-H) which produce yellow-white bars shown in Plate E on front cover. At (I), *a* is the path traversed in the chromaticity diagram in going from white to yellow when using symmetrical sidebands; *b* and *c* are the paths when using vestigial sidebands

demodulators through a separate path. A bandpass filter is inserted in this circuit to attenuate the low-frequency monochrome components and sound carrier beats. The demodulation will be described first as if the signal had double sidebands. Then the correction required for the vestigial sideband transmission actually used will be described.

The color subcarrier signal applied to each demodulator consists of two sets of sidebands as shown in Fig. 7 (fields 1 and 2) with respect to the two quadrature carrier components. The phase of one of these carriers is in the $(E_B^{1/\gamma} - E_y')$ direction, and the other in the $(E_R^{1/\gamma} - E_y')$ direction. If the color subcarrier is heterodyned with a signal having the subcarrier frequency, and in phase with the $(E_B^{1/\gamma} - E_y')$ direction ($\sin \omega t$) the result, after filtering r-f terms, will consist of the $(E_B^{1/\gamma} - E_y')$ signal because the sidebands of only that signal can change the magnitude of the heterodyning signal (the sidebands of the $(E_R^{1/\gamma} - E_y')$ signal cancel in the $(E_B^{1/\gamma} - E_y')$ direction). Likewise the $(E_R^{1/\gamma} - E_y')$ signal can be recovered by heterodyning with $\pm \cos \omega t$. If, however, the heterodyning signal has a phase which is other than 0° or 90° with respect to the two color-difference components, the output will be a mixture of the two.

The following analysis may help to clarify this point. Assume that the color subcarrier is being hereodyned by a signal represented by $2 \sin (\omega t + \theta)$. Then the output E_o of the demodulator is

$$E_o = [M_1 M_2(E_B^{1/\gamma} - E_y') \sin \omega t \pm M_1(E_R^{1/\gamma} - E_Y') \cos \omega t]\, 2 \sin (\omega t + \theta) \quad (7)$$

$$= 2M_1M_2(E_B^{1/\gamma} - E_y') \sin \omega t \sin (\omega t + \theta) \pm 2M_1(E_R^{1/\gamma} - E_y') \cos \omega t \sin (\omega t + \theta) \quad (8)$$

The following trigonometric identities apply

$$\sin \omega t \sin (\omega t + \theta) = 1/2 \cos \theta - 1/2 \cos (2\omega t + \theta) \quad (9)$$

$$\text{and } \cos \omega t \sin (\omega t + \theta) = 1/2 \sin \theta + 1/2 \sin (2\omega t + \theta) \quad (10)$$

Terms having 2ω in Eq. 9 and 10 are eliminated by the lowpass filter in the demodulator output. Hence there remain

$$\sin \omega t \sin (\omega t + \theta) = 1/2 \cos \theta \quad (9a)$$

$$\cos \omega t \sin (\omega t + \theta) = 1/2 \sin \theta \quad (10a)$$

substituting, Eq. 9a and Eq. 10a in Eq. 8

$$E_o = M_1M_2(E_B^{1/\gamma} - E_y') \cos \theta \pm M_1 (E_R^{1/\gamma} - E_y') \sin \theta \quad (11)$$

$$= M_1M_2(E_B^{1/\gamma} - E_y') \text{ if } \theta = 0 \quad (12)$$

$$= \pm M_1(E_R^{1/\gamma} - E_y') \text{ if } \theta = 90° \quad (13)$$

From the above derivation we see that the receiver can separate the red and blue color difference signals by applying the signals to two synchronous demodulators, to which is also applied a reference voltage of the proper phase.

If θ equals neither 0 nor 90 deg, that is, if there is a phase shift between the color subcarrier and the reinserted reference signal, then the modulator output will contain terms from both color difference signals and color contamination results, as shown by Eq. 11. This color contamination is greatly minimized by means of color phase alternation.

The $(E_G^{1/\gamma} - E_y')$ video signal is obtained from the other two as shown in Eq. 2 and Fig. 7.

The three color-difference signals may then be applied to the respective cathodes of the color picture tube. Since the tube is operated by the cathode-grid voltage, the light output of the green gun is

$$L = K(E_G^{1/\gamma} - E_y' + E_y')^\gamma = K E_G$$

and likewise for the other guns.

Notice that all the items of information required to define a picture element in luminance (E_y'), and in chromaticity $(E_R^{1/\gamma} - E_y';\ E_G^{1/\gamma} - E_y';\ E_y';$ and $E_R^{1/\gamma} - E_y')$ are present simultaneously.

Crosstalk Due to Vestigial Sideband

Vestigial sideband modulation of the color subcarrier for high modulation frequencies is brought

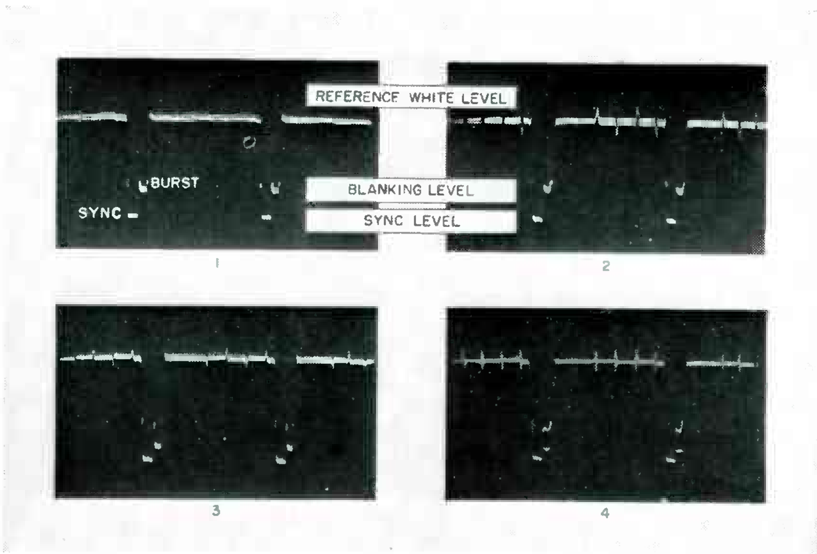


FIG. 10—Oscillograms of signal applied to red electron gun when reproducing yellow-white bars of Plate E, front cover

about by the necessity of transmitting and receiving the complete signal within a band of not more than 4.5 mc. The use of *single*-sideband modulation, as contrasted with vestigial sideband, results in the division of the power equally between amplitude and phase modulation for these modulation frequencies.

Stated in another way, single-sideband transmission results in two sets of equal sidebands, one set being in phase and the other set in quadrature with the carrier. This is shown in Fig. 8.

Fig. 8A1 represents a carrier ω_o having a lower sideband ω_L of frequency $(\omega_o - \omega_L)$. Fig. 8A2 represents the same signal except that an upper sideband $+\omega_u$ having half the amplitude of the lower sideband, has been added symmetrically about the carrier. However, another signal $-\omega_u$ equal and opposite in phase to $+\omega_u$ has also been added. This leaves the signal of Fig. 8A2 identical with that of Fig. 8A1.

The sidebands of Fig. 8A2 can now be distributed, as shown in Fig. 8A3 and 8A4 to represent modulation in phase ($+\omega_p$ and $-\omega_p$) and in quadrature ($+\omega_q$ *and* $-\omega_q$) with the carrier. Thus to red color difference signal, amplitude-modulating a carrier by means of double sidebands, will, on losing one sideband, have part of its energy transferred to a component in quadrature with the carrier, which will then appear as a spurious signal registering in the blue color difference channel.

Since observers are quite critical of the hue of the colors in large areas in reproduced pictures (faces, for instance), it is highly desirable that the sidebands for low modulation frequencies (say up to 0.4 mc) of the components of the color subcarrier be transmitted by vestigial rather than true single-sideband transmission. The slope of the overall passband in the region of the color subcarrier should be gradual enough to change from essentially zero to maximum transmission in about 0.8-mc bandwidth. This minimizes the color crosstalk in large area color which otherwise could occur as shown in Fig. 8A by using single-sideband transmission of the color subcarrier.

Color Phase Alternation[4,10]

It is desirable to use a high frequency for the color subcarrier to reduce its visibility in black-and-white receivers. This limits the frequency range over which upper-sideband transmission may be used for the color subcarrier components. However, the lower sidebands may extend for a considerable range, one or two megacycles below the color subcarrier. These unequal sidebands result in crosstalk of each component of the color subcarrier to the other one, as discussed in the previous section. While this crosstalk cannot be eliminated in the electrical signals, it may be effectively neutralized at the eye by reversing the phase rotation of the color subcarrier components after every field at the transmitter, and simultaneously making the corresponding change in the receiver demodulators.

In this process, called color phase alternation, the quadrature component which results in an excess of blue (or red) in one field also results in a deficiency of blue (or red) in the next field. This alternation between excess and deficiency occurs on adjacent lines in the picture and averages out because the eye cannot see color in fine detail.

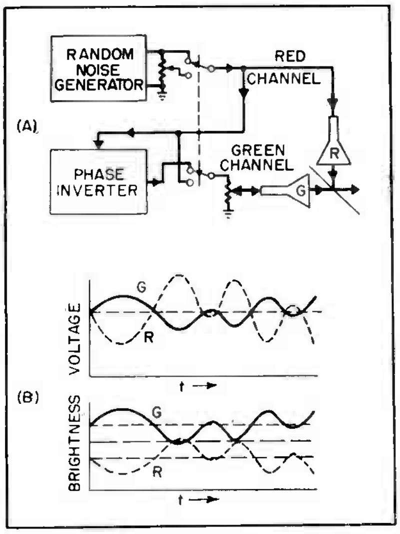


FIG. 11—Test set-up (A) for measuring annoyance of luminance noise vs color noise. Voltage fluctuations and corresponding brightness fluctuations in constant-luminance transmission are shown at (B)

The process is demonstrated in Plate *E* on the front cover which shows a yellow stripe followed by white and a return to yellow. The stripe shown at the top was obtained with double-sideband transmission and shows no contamination.

A voltage-time diagram is given in Fig. 9 for different parts of the receiver when receiving this stripe. Figure 9A shows the time-space distribution of the stripe. The luminance signal E_y' applied equally to the grids of the three guns is shown in Fig. 9B. Its amplitude is found by substituting $E_G = E_R = 1$ and $E_B = 0$ (for the yellow region) and $E_G = E_R = E_B = 1$ (for the white region) in Eq. 5. The value of E_y' is equal to $0.59 + 0.30 = 0.89$ for yellow and $0.59 + 0.30 + 0.11 = 1.0$ for white.

Figure 9C shows the amplitude of the red and green color difference signals. This is $(E_R^{1/\gamma} - E_y') = 1.0 - 0.89 = 0.11 = (E_G^{1/\gamma} - E_y')$ for the yellow area and $(E_R^{1/\gamma} - E_y') = 1.0 - 1.0 = 0 = (E_G^{1/\gamma} - E_y')$ for the white areas. Figure 9D shows the amplitude of the blue color difference signal. It is equal to $E_B^{1/\gamma} - E_y' = 0 - 0.89 = -0.89$ for the yellow areas and $1.0 - 1.0 = 0$ for the white area.

Figure 9E shows the total color signals applied to the red and green guns. It is made up of the sum of the signals of Fig. 9B and 9C and is constant at unity. Figure 9F shows the signal applied to the blue gun. It is equal to zero during the yellow stripe and to unity for the white area (because $E_R = E_G = E_B = 1$ for white).

When the picture is transmitted by vestigial sidebands, as is the case for the second row of Plate *E*, the signal cannot go directly from yellow to white and back to yellow. Instead, the color subcarrier undergoes a phase shift for one transition and an opposite phase shift for the other transition. Stated in other words, the red and blue color difference components of the subcarrier produce crosstalk on each other, and excite the red and green guns, as shown in Fig. 9G and 9H. The crosstalk introduced at the blue gun has negligible effect in this case. The shift in hue can be understood by referring to Fig. 9I which plots the hue shift on the CIE chromaticity diagram. This hue shift is seen, in the second row of Plate E, at the edge between yellow and white, which is contaminated with orange, and at the edge between white and yellow which is contaminated by green. There is no color shift in the main yellow areas because these require only low frequencies which are transmitted with nearly symmetrical sidebands.

The third row of Plate E was obtained for the same condition as those of the second row except that the phase of the red color difference component of the subcarrier was reversed. The contamination at the edges are opposite in sequence to those in the second row of Plate E.

In the fourth row of Plate E, the red color difference signal leads and lags the blue color difference signal on alternate fields so that adjacent lines in the picture have opposite color contamination with resultant visual cancellation.

Red-Gun Signal

Figure 10 is an oscillogram of the waveform of the voltage applied to the red gun when transmitting Plate E. The signal labeled (1) in Fig. 10 corresponds to the top row and was transmitted with symmetrical sidebands. No crosstalk is apparent. The signals labeled (2) and (3) were obtained when transmitting the second and third row of Plate E respectively. These signals are seen to be contaminated by an excess of red, followed by a deficiency, at the edges for one signal and with an opposite contamination for the other signal. The signal labeled (4) was photographed when transmitting several fields corresponding alternately to signals (2) and (3) of the fourth row of Plate E. The contaminations of opposite polarity are clearly seen.

Cancellation in Large Color Areas

A phase shift, between the color subcarrier and the demodulating reference signal, results in color contamination even for large areas of unchanging color where symmetrical sidebands are received[10]. This is evident from Eq. 11 above

FIG. 12—Visible effect of c-w interference when using constant-amplitude transmission. Annoyance of bars is reduced about 8 db with constant-luminance transmission

which shows, for values of θ close to zero, that some red color difference signal is added to the blue color difference signal if only the plus or the minus sign is used. Likewise some blue color difference signal is added to the red color difference signal for values of θ close to 90 deg. This equation also shows the means of cancelling this crosstalk.

The output of the blue color difference demodulator is alternately raised and lowered on successive fields by an amount equal to $M_r (E_R^{1/\gamma} - E_y') \sin \theta$. The equivalent, of course, occurs in the output of the red color difference demodulator. Since this occurs on alternate fields, and, therefore, on adjacent lines in the picture, the effect cancels out.

Plates A and B on the front cover illustrate this cancellation. Plate A was obtained with color phase alternation and 20 deg misphasing of the receiver reference signal. No difference in color values could be observed visually on reducing this phase error to zero. However, Plate B shows the two individual fields which, when interlaced, result in the picture on Plate A.

The left-hand picture of Plate B shows a counterclockwise shift in the CIE chromaticity diagram; the cup is too blue and the fruit appears less ripe than in Plate A. The right-hand picture of Plate B shows a shift in the opposite direction; the cup is too green and the fruit is more ripe. This is one case where two wrongs do make a right!

The large tolerance to phase error and the ability to use vestigial sidebands, made possible by color phase alternation, eases the design of intermediate-frequency amplifiers because less attention need be paid to the flatness of the amplitude and delay characteristics in the vicinity of the color subcarrier frequency.

Color vs Luminance Fluctuations

Studies of flicker using lights having different colors show that the eye is less sensitive to chromaticity than to luminance fluctuations. This suggests that the conversion of noise and other perturbations from luminance to color, wherever possible, might result in a reduction of their visibility[10].

To determine the relative annoyance value, the apparatus shown in Fig. 11A was set up. The background controls of the green and red tubes were adjusted to give a flat bright yellow field. The yellow color was adjusted so that the addition of a suitable blue would give a reasonable white. Then opposite-polarity noise was applied to the two picture tubes. Upon adjusting the amplitude of the noise applied to the green channel, the normal observer would find a critical balance point at which the annoyance value of the noise was reduced. This corresponded to constant luminance conditions as shown in Fig. 11B.

Similar-polarity noise at reduced amplitude was then applied, by throwing the double-throw switch, and the observer was requested to adjust for substantially the same annoyance value as that obtained under the constant luminance conditions.

Data from a small group of observers indicated that about 8 db more noise could be tolerated for the same degree of annoyance when the noise had only chromaticity fluctuations.

Constant Luminance Transmission

The monochrome channel of a color receiver is no more subject to noise or interference than a monochrome receiver of the same resolution. However, these perturbations may affect the color channel to an appreciable extent unless suitable precautions are taken[11]. The demodulators heterodyne interference, noise, and components from the luminance signal, whose frequency is close to that of the subcarrier, to a lower frequency where it becomes coarser and more visible.

Figure 12 shows the effect of c-w interference, whose frequency is 500 kc lower than the subcarrier, in a receiver built for an earlier version of the color signal. In that version, an appreciable part of the luminance was supplied by the color channel.

This receiver made use of three demodulators, having equal gains and heterodyned by three equal voltages 120 deg apart. The 500-kc luminance beat note is clearly visible in Fig. 12. This beat note varies the luminance and chromaticity.

Since the outputs of the three demodulators are equal in amplitude and differ by 120 deg in phase, the total intensity coming from the picture tube should cancel. This would be the case were it not for the fact that the eye is more sensitive to green than to red, and is least sensitive to blue. The result is that variations of equal intensities in green, red, and blue result in unequal sensations when combined by the eye, and therefore there is no cancellation. This is made clearer by reference to Fig. 13 which shows how the three guns of the picture tube are excited by the beat note as a function of time. The lower part of this figure shows how this fluctuation in time is translated to one in space as the electron beam scans. It also shows the unequal sensations of brightness evoked from green, red, and blue when equally excited. Finally it shows the total brightness fluctuation which appears in Fig. 12.

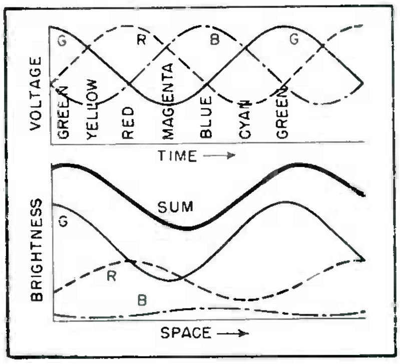


FIG. 13—Voltage and brightness waveforms for interference pattern of Fig. 12. Note that voltage variations cancel but brightness variations do not

The visibility of the interference can be greatly reduced by so proportioning the signal that the combined outputs of the demodulators result in no brightness fluctuation. When this is done, the beat note is one of chromaticity only and is greatly reduced in visibility. It is for this reason that the complete color signal is transmitted in such a manner that the monochrome signal supplies all the luminance information while the color subcarrier supplies only variations in chromaticity.

Plate *A*, the complete color picture, is made up by adding the electrical signals which produced Plate *C* to those which produced plate *D*. Plate *C* is obtained when only the monochrome channel is operative. It contains all the geometric definition present in Plate *A*. Plate *D* is produced when only the color-difference channel functions, and is responsible for all the color in Plate *A*.

Advantages of NTSC Specifications

Examination of Plate *A* shows that a system using these specifications is capable of producing color television pictures with the full resolution of which present day monochrome television is capable. In addition it can transmit all the color information that the eye can resolve. This transmission takes place within the bandwidth now allotted to black and white television.

Existing 6-mc monochrome channels are, therefore, adequate for color. Transmitters can readily be converted to color transmission. This color transmission can be received, as a monochrome picture, on any existing black and white receiver without altering the receiver in the slightest degree. Likewise monochrome transmissions can be received on color receivers. This has been accomplished by designing the system to take into account the properties of the viewer's eye, which is the actual terminal equipment of the system.

References

(1) A. V. Bedford, Mixed Highs in Color Television, *Proc. IRE*. Sept. 1950.

(2) A. V. Loughren and C. J. Hirsch, An Analysis of Color Television System, ELECTRONICS, Feb. 1951.

(3) Report of Panel 11, NTSC, p 11-114.

(4) Report of Panel Actions, Panel 13, NTSC, Panel 13-162, Oct. 23, 1951.

(5) Pierre Mertz, Television — The Scanning Process, *Proc. IRE*, Oct. 1941.

(6) U. S. Patent 1,769,920, July 8, 1930, Frank Gray.

(7) H. B. Law, A Three-Gun Shadow Mask Color Kinescope, *Proc. IRE*, Oct. 1951.

(8) Report of Panel 14, NTSC, p 14-163.

(9) R. D. Kell and G. C. Fredendall, Standardization of Transient Response, *RCA Review*, March 1949.

(10) B. D. Loughlin, Recent Improvement in Band-Shared Simultaneous Color Television, *Proc. IRE*, Oct. 1951.

(11) Improvements in Dot-Sequential Color Television, ELECTRONICS, p 154, Aug. 1950.

Bibliography

M. W. Baldwin, Subjective Sharpness of Additive Color Pictures, *Proc. IRE*, Oct. 1951.

D. G. Fink, Alternative Approaches to Color Television, *Proc. IRE*. Oct. 1951.

W. T. Wintringham, Color Television and Colorimetry, *Proc. IRE*, Oct. 1951.

NTSC Color-TV

Specification for field testing is a compromise that takes account of existing black and white transmitter and receiver characteristics. Its parameters can easily be varied somewhat as test proceeds

By R. B. DOME

Electrical Consultant
General Electric Co.
Syracuse, N. Y.

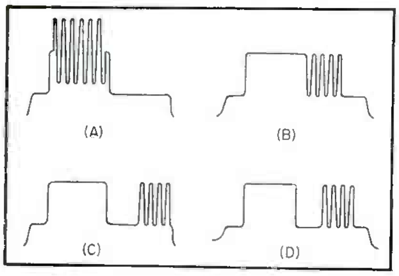


FIG. 1—Alternative positions of color-sync burst signal explained in the text

A CONTINUOUS oscillation wave of stable phase is required at the subcarrier frequency at the receiver by the NTSC color television specifications. This is necessary to perform the function of demodulation of the color information contained in the sidebands of the color subcarrier. The purpose of the color synchronizing signal is to provide information to lock the receiver local subcarrier frequency oscillation generator to a proper reference.

The color information during the picture interval is transmitted as a variable phase and variable amplitude signal of the suppressed-carrier type. Broadly speaking, the hue may be thought of as being represented by the phase of the wave while the saturation data is transmitted by the amplitude of the wave. The amplitude is chosen to be zero for the reference white of the system and since the carrier itself is suppressed, it will be found that neither the subcarrier nor any of its sidebands are transmitted during the picture interval when shades of gray corresponding to different levels of luminosity of white are being dealt with.

It is thus apparent that no use can be made of the color information itself to synchronize the receiver oscillator, and that in fact, a synchronizing signal separate and distinct from the picture signal must be employed. Since picture transmission occupies all of the time available except that of the blanking intervals, it is necessary to transmit the color subcarrier synchronizing information during the blanking intervals.

Several proposals for synchronizing signal positions in the blanking interval were made before NTSC Panel 14. All proposals chose the subcarrier frequency itself for the oscillation period of the synchronizing signal rather than a submultiple of the color subcarrier frequency such as one-half or one-third of the color subcarrier frequency.

Choice of Subcarrier

The reasoning behind this decision was that the phase relationship between the synchronizing signal and the color subcarrier during the picture interval would not tolerate the phase variation that might exist between them as the receiver tuning changed either as the result of drift in the first-detector oscillator frequency or as the result of manual manipulation of the tuning controls. In a receiver having uniform time delay throughout the video spectrum this would not matter, but practical receivers have some nonuniformity in time delay, particularly in the vicinity of cutoff where the color subcarrier is located. It should be pointed out that the phase of the local oscillations must agree with the color subcarrier information to within some ±5 to 10 degrees if hues are to be reproduced satisfactorily.

Another point of agreement in all proposals was that synchronizing data should be transmitted during every horizontal blanking interval of every picture field but not necessarily during all of the vertical blanking period.

It was agreed that synchronizing information must not be permitted to occupy any of the amplitude range of the composite television signal presently reserved for picture transmission, which means that color synchronizing signals must be kept above the black level of the picture part of the signal. If this were not done, those sets already in the hands of the public, particularly those receivers not having horizontal blanking signals added to the picture tube, would show undesirable spurious picture-tube light output on retrace and hence would not provide a satisfactory working condition.

Another point of agreement was that the synchronizing signal must not impair the operation of synchronizing systems employed in the monochrome receivers already in the hands of the public. This latter decision is basic to the precept of compatibility.

With these points having been agreed upon, the Panel considered several possible positions for the color synchronizing signal within the horizontal blanking interval. Some of these positions are shown in Fig. 1.

Figure 1A shows the subcarrier color synchronizing signal positioned on top of the normal horizontal synchronizing pulse. This

Presented at the IRE-RTMA Radio Fall Meeting, Toronto, Oct. 1951

Synchronizing Signal

method has the advantage of permitting a fairly long train of subcarrier frequency to be transmitted and also it keeps the back-porch clear of signals so that clamping is in no way interfered with. It has the disadvantage that the peak power of the transmitter must be increased to accommodate the increased overall signal amplitude.

At Fig. 1B is shown the train of subcarrier frequency occupying a position on the back porch immediately following the horizontal synchronizing pulse. This method has the advantage of permitting maximum of back-back porch for any of the methods where the color synchronizing signal is not located on top of the horizontal synchronizing pulse. It has the possible disadvantage that transmitter clamps may be confused by such a signal so as to give faulty clamping. This is particularly true for those clamping systems utilizing the trailing edge of the horizontal pulse for triggering the clamping pulse. This method, however, is worthy of some additional study.

Figure 1C shows the color synchronizing signal shifted to the right by the maximum possible amount so that no back-back porch remains. This method results in the maximum length of gap between the horizontal synchronizing pulse and the color synchronizing pulse. It has the advantage of permitting the maximum time for transmitter clamping following the cessation of the horizontal pulse but has the disadvantage in the receiver of allowing for no back-back porch so that any slightly erratic receiver gating might result in passing part of the picture information into the synchronizing channel.

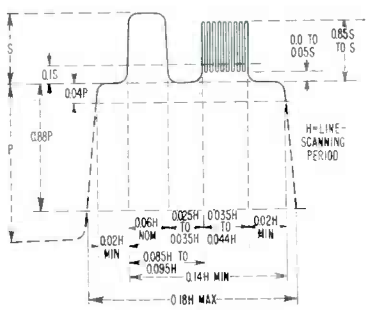
At Fig. 1D is shown a method intermediate between the second two methods. Here the color synchronizing pulse is positioned on the back porch with adequate allowance for a back-back porch but with a somewhat reduced gap between horizontal synchronizing pulse and color synchronizing pulse. It was generally believed, however, that the gap would be adequate for transmitter clamping and it is this form of color synchronizing pulse that was formally recommended for the initial field tests.

Figure 2 shows this recommended synchronizing pulse in greater detail and includes dimensions and tolerances. This pulse is shown in the form that it may be observed at the point where it is generated and not how it would appear after passing through bandwidth-limited circuits. The burst of color subcarrier frequency has a duration of some 10 cycles.

Omission of Bursts

Some discussion arose concerning the omission of bursts in the equalizing pulse and vertical pulse periods, but it was decided to omit the bursts during these intervals for initial field testing but to add them later if necessary.

The bursts may be utilized in the receiver in any of a number of ways to obtain a continuously running oscillation at the subcarrier frequency for the purposes of synchronous detection of the color information.



1. The burst frequency shall be 3.898125 mc ± 0.001% with a maximum rate of change of frequency not to exceed ⅓ cycle per second per second. The horizontal scanning frequency shall be 2/495 times the burst frequency. Burst follows each horizontal pulse but is omitted following the equalizing pulses and during the broad vertical pulses.
2. Vertical blanking 0.07 to 0.08 *V*

FIG. 2—Waveform characteristics recommended for field test

A preliminary analysis has been made of the requirements of the continuous wave insofar as phase stability is concerned and it was found that the energy contained in the burst appeared to be sufficient to provide a degree of accuracy so that horizontal scanning synchronizing stability and color data would be provided with about the same degree of immunity from disturbances arising from the presence of random noise along with the signal.

One other matter with which Panel 14 is concerned is that of the question as to whether or not there was a sufficient amount of information present in the standard television waveform to distinguish clearly between odd and even fields so that a synchronizing pulse to identify the respective fields could be derived at the receiver, especially in the presence of noise. The existing information in the waveform is the timing of horizontal pulses with respect to the vertical pulses. On one field the horizontal pulses are coincident with the leading edges of the odd-numbered blocks of the six blocks of the serrated vertical pulse. On the next field the horizontal pulses are so phased that these pulses are coincident with the leading edges of the even-numbered blocks of the six blocks of the serrated vertical pulse.

Suggestions were made regarding the inclusion of additional field-sensing synchronizing pulses so as to provide more positive field recognition at the receiver. However, for the present, it has been decided to begin field testing without such additional signals. Meanwhile a subcommittee of Panel 14 has been set up to make a study of this particular problem.

BIBLIOGRAPHY

Specifications for Color TV Field Tests, ELECTRONICS, p 126, Jan. 1952.

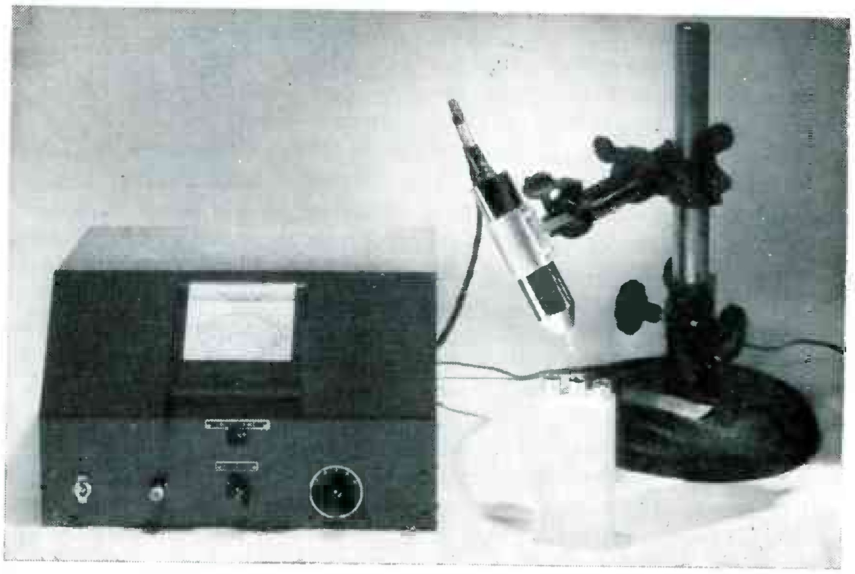
Vibrating-Plate

Viscosity indication directly on a meter with range from 0.1 to 100,000 and accuracy within ± five percent are provided. Indefinitely large volumes down to 0.5 milliliter can be handled as long as a thin flat plate can be immersed in the liquid

VISCOUS damping exerted by a liquid on a flat plate oscillating in the liquid is measured by an electromechanical transducer in the viscometer to be described.

A thin, flat plate oscillating in its own plane and immersed in a viscous liquid sets up shear waves in the liquid. The liquid exerts a retarding force against the motion of the plate.[1] This force comprises a resistive component which damps the motion and a reactive component which adds to the effective mass of the vibrating plate.

Both the resistive and reactive components are approximately proportional to $\sqrt{f\eta\rho}$ where f is the frequency of vibration, η is the coefficient of viscosity and ρ is the density of the liquid. If the damping force acting on the plate can be measured, the value of $\eta\rho$ can be deduced. This has been accomplished in the vibrating-plate viscometer by coupling the plate to a resonant mechanical system and comparing the amplitudes of vibration with and without the liquid damping while maintaining a constant driving force. Since the system is always operated at resonance, only the resistive component of the liquid loading need be considered.



Complete system of the vibrating-plate viscometer

Vibrating System

The vibrating plate is made of stainless steel or other suitable material 0.010-in. thick. It is essentially circular in shape, having a diameter of 0.200 in., and is mounted by means of a clamping block on the free end of a flat steel reed which is rigidly clamped at the opposite end. The reed is 0.010-in. thick, 0.200-in. wide and 0.875-in. long. It is set into vibration by an electromagnetic driving system of which it forms a part. The remainder of the driving system comprises an L-shaped pole piece carrying a coil form and coil, an air gap between the pole piece and the free end of the reed and a steel block on which both the reed and the pole piece are supported. Vibratory motion of the reed causes the plate to execute linear oscillations in its own plane.

A ceramic barium-titanate block is mounted on each side of the steel reed for the purpose of measuring the amplitude of vibration of the reed. The rather remarkable electrical properties of barium titanate[2,3] and its use in mechanoelectrical transducers[4,5] have been discussed at length elsewhere. It is sufficient to say that motion of the reed causes a flexing of the barium titanate which, in turn, generates a piezoelectric voltage at electrodes on the surface of the barium titanate. This voltage is proportional to the amplitude of vibration.

While a vibrating system of this type has a theoretically infinite number of resonances or modes of vibration, only the two lowest modes were found to be useful for the viscometer. The lower of these two resonances occurred in the neighborhood of 80 cycles, and the higher near 800 cycles. The 80-cycle resonance gave slightly greater sensitivity but the low-frequency vibrations were transmitted throughout the supporting structure of the viscometer so that the internal mechanical damping, and hence the amplitude of vibration of the reed, was influenced by the manner and the location in which the instrument was held. This made it difficult to secure completely reproducible measurements of viscosity. Troubles of this sort were not serious at 800 cycles, so the higher resonance was chosen for the design of the present device.

Several electrical accessories are necessary for the operation of the vibrating-plate viscometer. These include a d-c source for polarization of the electromagnetic driving system; an a-c source variable in fre-

Viscometer

By J. G. WOODWARD
Radio Corporation of America
RCA Laboratories Division
Princeton, N. J.

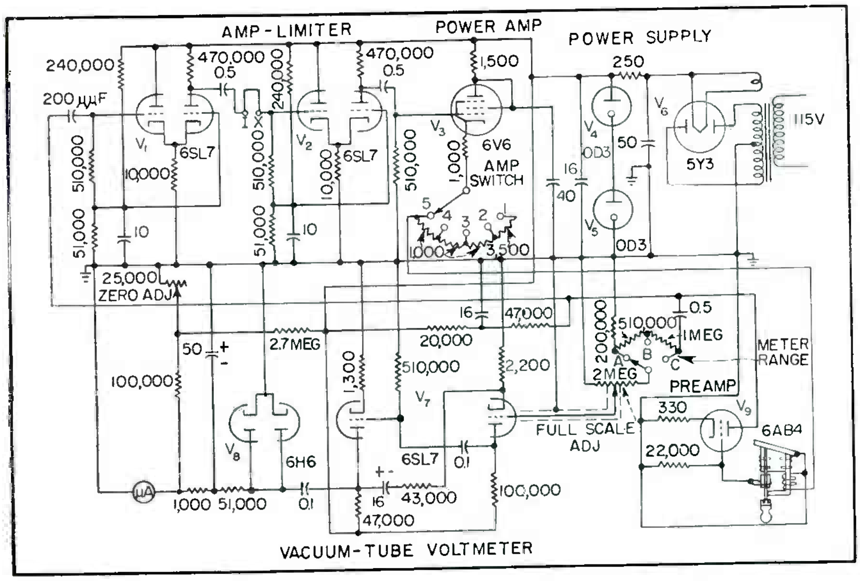


FIG. 1—Circuit diagram of the electromechanical viscometer

quency in the neighborhood of 800 cycles for driving the vibrating system and a vtvm for measuring the voltage generated by the barium-titanate blocks. The a-c must be variable in frequency because the resonant frequency is slightly different for different liquids, depending on the value of $\eta\rho$, and the system must always be operated at resonance.

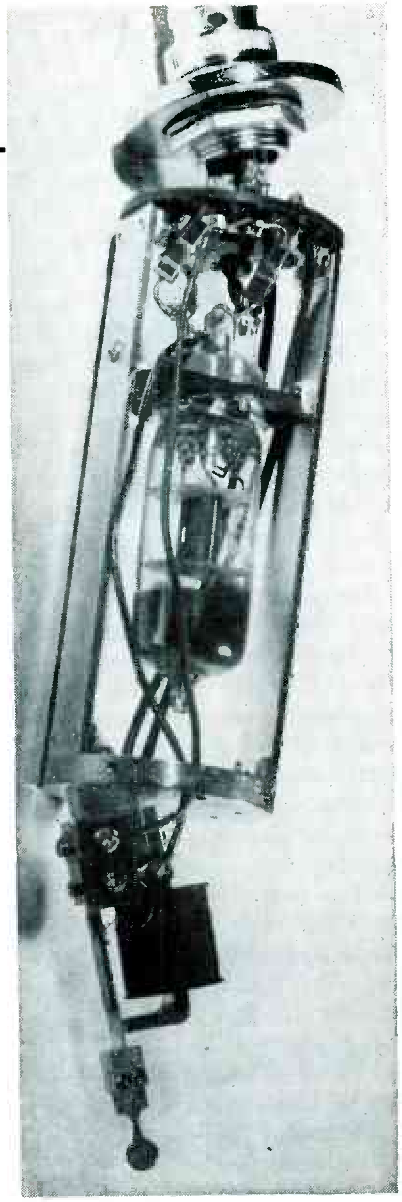
Circuit Operation

Since it would be inconvenient to manually adjust the frequency each time a viscosity measurement is made, a circuit has been devised which automatically drives the vibrating system at the proper resonance regardless of the frequency required. In addition, the driving current is automatically maintained at a constant magnitude regardless of the load on the vibrating plate. The circuit also provides the polarizing current and includes the vtvm. The circuit diagram is shown in Fig. 1.

The sinusoidal voltage generated by the barium titanate as a result of vibration of the reed is amplified by the preamplifier stage, V_9. The voltage is further amplified and also converted into square waves by the stages of V_1 and V_2. When the square-wave alternating voltage is applied to the grid of V_3, the cathode current of this tube consists of a direct current upon which a square-wave alternating current is superimposed.

The coil of the electromagnetic driving system is connected in the cathode circuit of V_3, so the direct current is the polarizing current and the alternating current is the driving current of the vibrating system. This constitutes a complete feedback loop wherein motion of the reed generates a voltage which is amplified and returned to the driving system to furnish driving power and the system is self-oscillating.

Since the driving system is electromagnetic and the generating sys-



Probe unit with outer case removed

tem is piezoelectric, the driving current in the coil and the voltage generated by the barium titanate are 90 degrees out of phase at the resonance of the vibrating system. To have the frequency of oscillation coincide with the resonant frequency of the mechanical system, the 90-deg phase discrepancy must be corrected. This is done electrically by the simple R-C network comprising the capacitance of the barium-titanate blocks and the grid resistor of V_9. This R-C network alone can give a maximum phase shift of 90 deg. Actually, due to other phase shifts in the circuit, a total compensation somewhat greater than 90 deg is required and the necessary additional amount is provided by the R-C network in the grid circuit of V_1.

With these phase corrections, the system oscillates at the mechanical resonance of the vibrating system near 800 cycles. Only when the vibrating plate is immersed in liquids of extremely high viscosity, 2,000 centipoises or greater, is the viscous damping so great as to prevent proper self-oscillation of the system. When it is desired to make viscosity measurements of highly viscous materials, therefore, an external oscillator must be used. This oscillator may be connected to terminals *I* and ground, shown in the circuit diagram, after removing the jumper between *I* and *X*.

The need for maintaining a constant driving force independent of the loading of the vibrating plate was mentioned previously. This requirement is met by converting the sinusoidal voltage from V_1 into a square-wave driving current whose amplitude depends only on circuit parameters and not upon the amplitude of motion of the reed. The magnitude of the driving current, along with the polarizing current, can be altered when desired by putting additional resistance in the cathode circuit of V_3 by means of the 5-position amplitude switch. The current through the driver coil can be measured by connecting a milliammeter between special terminals not shown.

A portion of the alternating voltage from V_6 is further amplified by V_7 and applied to the diode rectifier V_8. Approximately 17 db of negative feedback around the two-stage amplifier of V_7 makes this portion of the circuit highly stable. The diode circuit and the microammeter form a conventional peak-reading vtvm. The level of the signal applied to the diode, and hence the meter deflection, can be altered by means of the METER RANGE switch and the FULL SCALE ADJ. potentiometer.

The remainder of the circuit of Fig. 1 constitutes a power supply. The two OD3 regulator tubes, V_4 and V_5, maintain a constant B+ for relatively large changes in line voltage.

Calibration and Use

After a warm-up period of a few minutes duration, the instrument is readied for use by adjusting the gain of the vtvm circuit to give full-scale deflection of the meter with the reed and plate vibrating in air. Then, when the plate is immersed in a liquid, the meter reading is less than full scale and depends on the value of $\eta\rho$ of the liquid. By using a number of different liquids having known values of $\eta\rho$ a calibration chart for the instrument can be made. This calibration can be transferred to the face of the meter to permit direct indications of $\eta\rho$. In this calibration, η is in centipoises

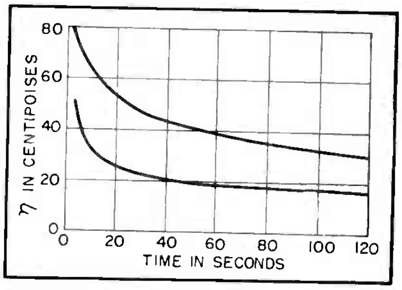


FIG. 2—Coefficient of viscosity as a function of time following immersion of the vibrating plate in thixotropic ferrite suspensions

and ρ is in grams per cubic centimeter. Increased precision is made possible by constructing the calibrated meter scale in three ranges corresponding to the three positions of METER RANGE switch shown in Fig. 1.

Performance

The vibrating-plate viscometer is capable of significant measurements from $\eta\rho = 0.1$ to $\eta\rho = 100{,}000$. This range encompasses acetone and alcohol at one end and cup grease and petrolatum at the other. Accuracies within ±5 percent are possible. Higher precision can sometimes be obtained if only relative measurements between similar liquids are desired. Liquid samples having volumes as small as 0.5 milliliter may be used if they are held in a container shaped to give ample clearance for the vibrating plate. Indefinitely large volumes may be used as long as they offer a free surface into which the vibrating plate can be immersed.

Since the vibrating-plate viscometer gives a practically instantaneous meter indication, a measurement of viscosity may be made in a matter of seconds. On the other hand, the instrument may be used to give a continuous indication as the viscosity of a liquid sample changes with time.

If desired, the rectified output of the diode which drives the indicating meter may be fed to an auxiliary amplifier and used to operate a recording galvanometer. As an example, a curve was automatically and continuously recorded in this way for a congealing gelatin solution whose viscosity changed from 10 to 200 centipoises over a period of 65 minutes.

The results of one application of the viscometer are presented in Fig. 2. The materials under test in this case were two ferrite suspensions such as are used in the slip casting of powdered-iron transformer cores. These suspensions are thixotropic, which means that their viscosities can be temporarily altered by stirring or shaking. Thus, any attempt to measure the viscosity causes the viscosity to change even while the measurement is being made. This is true regardless of the type of viscometer used.

Figure 2 shows how the viscosities of these two suspensions change with time following immersion of the vibrating plate. It is observed that after a sufficient time an equilibrium is reached and the viscosity becomes constant at some value depending on the size and the amplitude of vibration of the plate. Since only a comparison of the two suspensions was required in this experiment, the final values of viscosity gave a satisfactory result.

These examples illustrate some of the possibilities of the vibrating-plate viscometer. Others could be cited, but that is beyond the scope of the present article. It is apparent that in the vibrating-plate viscometer the application of electronic and electromechanical principles has once more afforded a new approach to an old field of measurement.

REFERENCES

(1) Lord Rayleigh, "Theory of Sound," MacMillan and Co., London, 2, p 317, 1929.
(2) A. von Hippel, Ferroelectricity, Domain Structure and Phase Transitions of Barium Titanate, *Rev. Mod. Phys.*, 22, p 221, 1950.
(3) G. N. Howatt, J. W. Crownover and A. I. Dranetz, New Synthetic Piezoelectric Material, ELECTRONICS, p 97, Dec. 1948.
(4) H. W. Koren, Application of Activated Ceramics to Transducers, *Jour. Acous. Soc. Am.*, 21, p 198, 1949.
(5) L. Grant Hector and H. W. Koren, Ceramic Phonograph Pickup, ELECTRONICS, p 94, Dec. 1948.

Inexpensive Square-Wave Generator

A cathode-controlled multivibrator employing three tube envelopes gives square waves from 50 cps to 1 mc with only 2-percent tilt in the negative half. An additional circuit is described in which a pair of pentodes replaces cathode resistors to produce square waves

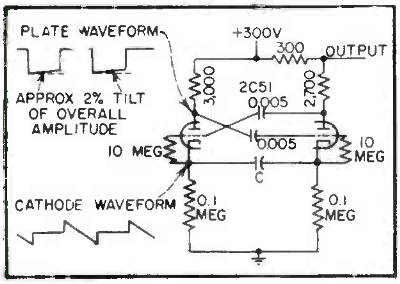


FIG. 1—Single-tube (double-triode) square-wave oscillator circuit

By G. W. GRAY

RCA Laboratories Division
Princeton, N. J.

In recent years there have been many articles in the literature concerning the use of square-wave techniques for testing amplifier circuits; however, no simple and inexpensive circuit for producing good-quality square waves is shown.

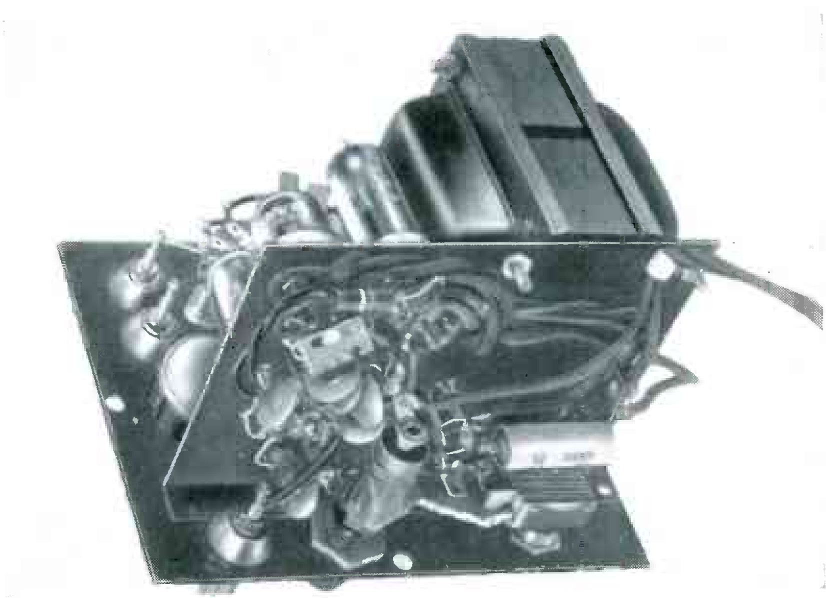
In producing such a generator it would appear that the use of clipper stages following a sine-wave oscillator is ruled out, since clipping at the bandwidth required for television testing requires several stages with carefully adjusted peaking coils and biasing. Thus a multivibrator-type square-wave generator is indicated. However, ordinary multivibrators show some serious shortcomings, the most serious of which is the grid current they draw.

This grid current is required since it is by rapidly charging a capacitor with grid current and then slowly letting it discharge that the frequency of oscillation is determined. Since the grid current is produced during the switching action it slows down the speed of operation of the circuit just the same as shunt capacitance to ground would do. In other words, it matters very little whether current must be put into a shunt capacitance to cause a voltage change or whether a series capacitance must be charged with grid current. Thus, it is difficult to design ordinary multivibrators with fast enough switching actions to produce square waves suitable for testing television-type amplifiers.

Another effect of such grid current is the production of overshoot on the negative-going portion of the square wave at the plate. It is caused by grid current flow as the conducting tube momentarily draws more than zero bias current when its grid is driven positive. This overshoot must then be removed by a clipping stage since it appears much like the square-wave response of certain types of overcompensated amplifiers. A further shortcoming of conventional multivibrators is that to change the frequency and keep the square wave symmetrical it is necessary to change two capacitors in the circuit. The switching problem is cumbersome because neither side of the capacitors is customarily grounded.

Cathode-controlled Multivibrator

A cathode-controlled multivibrator circuit has been developed that overcomes these difficulties. In the circuit shown in Fig. 1, each plate is coupled to the other tube's grid by a clamp circuit such that the positive peak of any recurrent waveform is clamped at zero bias. This coupling circuit must have a time constant long compared with the period of oscillation desired, but otherwise has no effect on the period. The gain from grid to plate of each tube is less than unity because, as will be shown, to pro-



Under-chassis view shows simplicity of wiring and lack of crowding. Top deck is correspondingly simple duce good-quality square waves it is necessary to have the cathode resistor considerably larger than the plate resistor.

If capacitor C between the cathodes is removed, the circuit will not oscillate because even though the phase of the feedback is regenerative the loop gain is less than unity. However, when capacitor C is added, another loop is completed as follows. If the cathode of one tube goes slightly negative, the signal is coupled to the other cathode by C, which in turn produces an amplified negative signal on its plate. This signal is coupled to the grid of the first tube, which drives the cathode even more negative. This loop may easily have enough gain to cause oscillation. In addition, the grid-plate loop aids the regeneration even though by itself it could not cause oscillation.

Figure 1 shows the plate and cathode voltage waveforms as a function of time. The grid waveform of each tube is exactly the same as that of the plate to which it is coupled since the coupling circuit has a long time constant. From these waveforms it can be seen that the period of oscillation is determined by capacitor C discharging through the cathode resistor of the cutoff tube until the cathode reaches a low enough voltage to start conducting. Now the regeneration of the circuit is such as to turn the cut-off tube on and the conducting tube off.

This switching can occur rapidly because there is no grid current drawn to slow down the switching action and there are two positive feedback loops both acting in the same direction. After the switch has occurred, the off tube is doubly cut off since its grid has been driven negative by the plate of the conducting tube and its cathode has been carried positive by capacitor C coupling the positive impulse from the cathode of the conducting tube. Capacitor C now discharges until the cathode of the cut-off tube becomes low enough to start conduction, at which time the circuit flips over and the same cycle repeats again.

As may be seen in the oscillogram of plate voltage, there is a slight amount of tilt in the negative half of the square wave. This is due to a variation in the discharge current through capacitor C as the voltage varies across the cathode resistor of the cut-off tube. Since this current must come from the cathode of the conducting tube, the variation shows up as a slope in the voltage at that point. The grid of the conducting tube is at a fixed potential so the change in cathode potential that results from the change in current from the cathode results in an even greater slope on the plate voltage.

To minimize this effect the cathode resistor should be made as large as possible compared to the cathode self-impedance of the conducting tube. The major term in the cathode self-impedance of the conducting tube is a factor $(1/g_m) + (R_L/\mu)$, where g_m is tube transconductance, μ is amplification factor of tube and R_L is impedance in plate of tube.

If the cathode resistor is made too large the g_m of the tube is lowered excessively because the plate current of the tube is reduced too much and the ratio between cathode resistor and cathode self-impedance is reduced. Optimum cathode resistor size is indicated by minimum tilt in the negative half of the square wave. With a 2C51 tube it is possible to reduce the tilt to 2 percent of the overall square-wave amplitude while with a 12AT7 tube the tilt will be 5 percent.

Frequency Control

The frequency of this cathode-controlled multivibrator as a function of capacitor C is shown in Fig. 2. With the 10-megohm resistors from grid to cathode, the time constant of the coupling circuit is only 1/20 second so that at about 60 cycles per second the curve departs from linearity. This range of linear relation between frequency and capacitance may be increased by removing the 10-megohm grid resistors since they are really not needed. Leakage through the cathode-coupling capacitors and gas current from the tube will both tend to make the grid go positive so that the circuit is effectively the same without the resistors except that the time constant is much longer. This effect is shown in Fig. 2 where, without the grid resistors, the curve extends linearly much further.

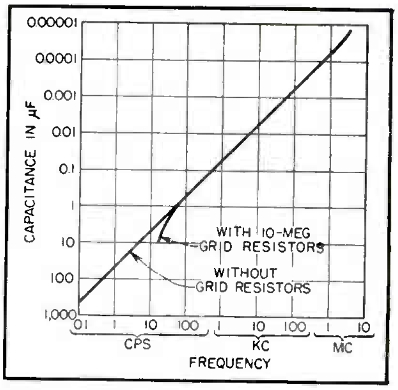


FIG. 2—Calibration of frequency versus capacitance of C in Fig. 1

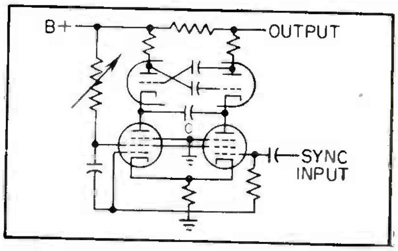


FIG. 3—Three-tube version of the square-wave oscillator in which pentodes replace cathode resistors. This circuit also provides for synchronizing

If it is necessary to have the negative half of the square wave flatter than is obtainable with the circuit of Fig. 1 the cathode resistors may be replaced by pentodes as shown in Fig. 3. With this circuit the discharging of the frequency-determining capacitor C must be a constant-current discharge since a pentode is a constant-current device. With the discharge current constant the plate current of the conducting tube is a constant and thus there is no tilt in the negative half of the output square wave.

This circuit has the additional advantages that: (1) a synchronizing pulse may be inserted on the grid of one of the pentodes; (2) changes in the plate current of the pentodes will produce small changes in frequency; (3) if the plate current of the pentodes is made unequal it is possible to make the square wave quite unsymmetrical so that the circuit becomes a pulse generator.

This cathode-controlled multivibrator circuit overcomes the difficulties inherent in more conventional circuits because no capacitor is required to change charge dur-

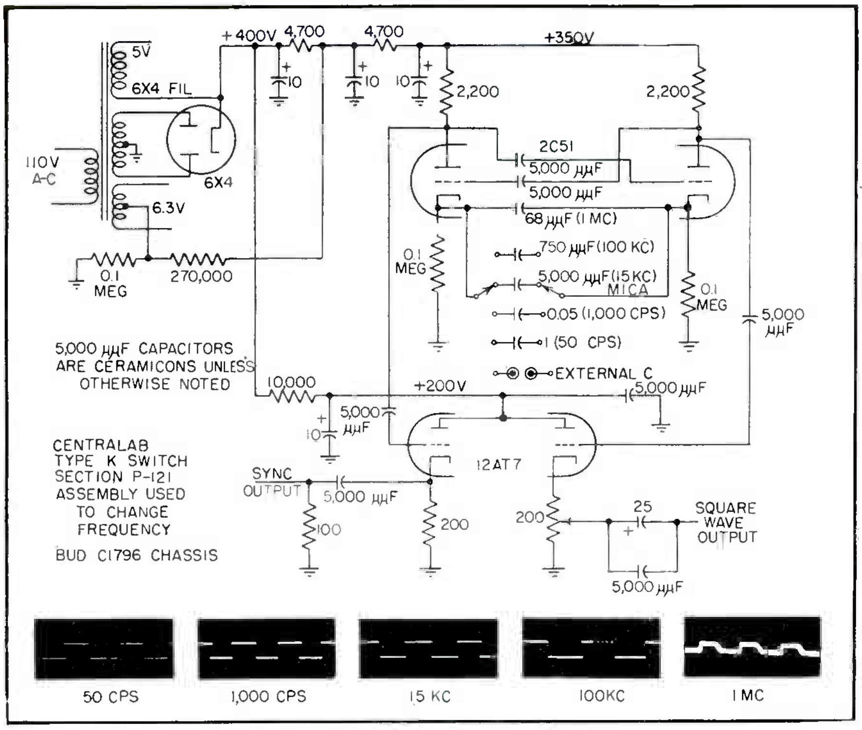


FIG. 4—Complete square-wave generator circuit and output wave forms. Balanced cathode-follower output (12AT7 tube) equalizes power supply drain and simplifies filtering

ing the switching cycle, except for the unavoidable shunt-wiring capacitances. The circuit is consequently fast in action and has no undesirable transients such as overshoot. Also the problem of changing frequency is reduced to changing one capacitor to vary the frequency range by a factor greater than ten million.

Figure 4 shows the circuit of a complete square-wave generator. In order to provide a low-impedance output at a reasonable level a cathode-follower output is used. To minimize the load changes on the power supply, two cathode followers driven out of phase are used so that the current drawn by the two is more nearly constant. This is necessary since it is virtually impossible to filter a power supply for low-frequency square waves by means of capacitors, yet for this small generator an electronically regulated supply is an unwarranted complexity. The extra output can be differentiated and is handy as a synchronizing signal that is not affected by the setting of the gain control. Although the rectifier tube, a 6X4, is nominally rated for 6.3-volt heater the power transformer used has only a 5-volt winding for the rectifier. Owing to the low-current requirement of the generator this has proved adequate.

The total power consumption for the complete generator illustrated is about 20 watts at 120 volts input, the overall size is 4 × 5 × 6 inches, the output amplitude is 3 volts across 200 ohms, and the frequency range is from about 30 cycles to 1 megacycle. Any of five predetermined frequencies is available directly by means of the switch on the front panel. Any other frequency may be obtained by connecting the proper size capacitor across the two binding posts and turning the frequency switch to the external-capacitor tap. To find the proper value of capacitor for the frequency desired a calibration chart can be attached to the front panel of the square-wave generator.

Since the calibration is so nearly linear, as given in Fig. 2, one decade of the graph may be expanded in order to obtain increased accuracy. For any other frequency range it is only necessary to multiply the capacitance scale by the inverse of the factor of ten by which the frequency scale need be multiplied.

To make the calibration chart for any particular square-wave generator, it is only necessary to measure the frequency resulting from the use of a known value capacitor. This will give one point for a graph that is logarithmic in both directions. By drawing a straight line with a slope of minus one on the graph the proper calibration will be obtained. In passing, it might be noted that this high degree of linearity between capacitance and frequency offers the possibility of making a wide-range capacitance meter with this circuit.

The oscillograms in Fig. 4 delineate the output of the circuit. The 100-kc square wave starts to show a little overshoot that is a function of the amplifier used in the oscilloscope and is not actually present in the output of the generator. This fact is borne out by the photograph of the 1-mc square wave that was made by putting the output of the square-wave generator directly on the deflection plates without using any amplification. The oscillogram was then enlarged photographically to a picture apparently in poor focus.

Nevertheless, the oscillogram serves to illustrate that no overshoot or other undesirable transients are present. Also the rise time may be measured and is approximately 0.05 microsecond, which is fast enough for testing television video amplifiers. Since the multivibrator does not change the charge on any capacitor while switching, the rise time is virtually independent of frequency instead of being some fraction of pulse duration as is the case with most multivibrators. To produce very low frequencies it is necessary to use large capacitances obtained practically only from electrolytic capacitors. Since the polarity of the voltage across the capacitor reverses, it is necessary to use two capacitors with their negative ends connected together and the two positive ends connected across the cathodes of the multivibrator.

The square-wave generator described is adequate for most purposes. The major limitation is probably the lack of means for synchronizing from some external source. If this feature is required too, it may be added by using the circuit of Fig. 3.

R-F Bursts Actuate

Technique for using simple gas diodes as radio-frequency actuated switches in storage, accumulator and other circuits of electronic computers. Bursts from pulsed r-f oscillators are applied to bands around diodes. Operating speeds up to 100,000 pps are feasible

By H. J. GEISLER

International Business Machines Corp.
Poughkeepsie, New York

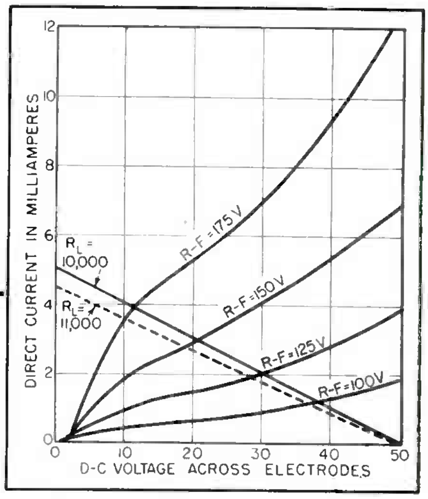


FIG. 1—Typical d-c voltage relations

THE GATE to be described is a special gas tube requiring for one of its inputs r-f energy supplied by a pulse-driven oscillator which usually is the common driver.

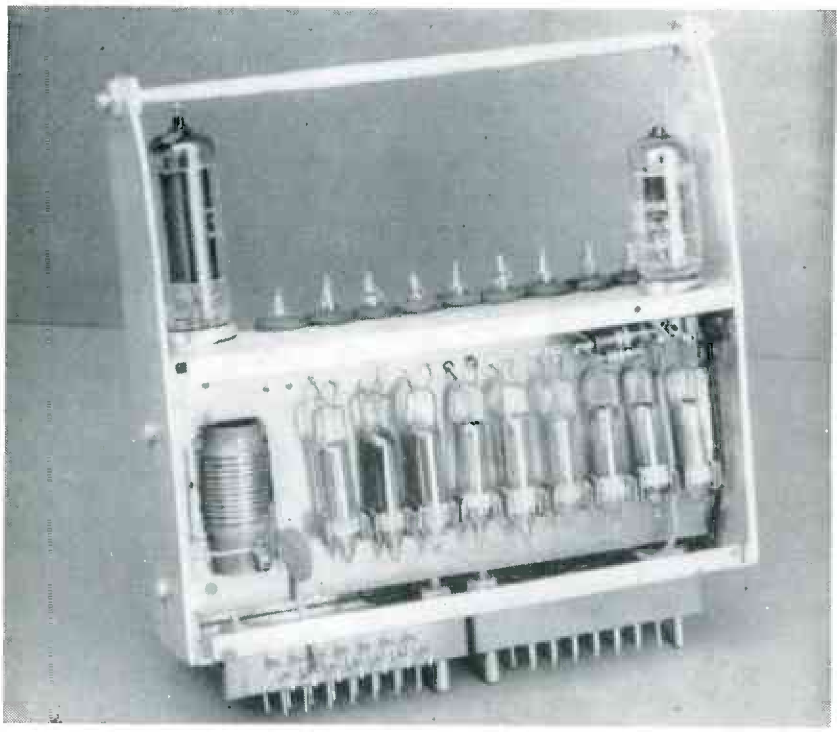
The required r-f energy to actuate the gate is coupled to the tube through the d-c electrodes and a single conducting band around the tube envelope. The cold open-circuit tube resistance is several megohms and the capacitance is less than 1 μμf between electrodes and also between the band and the electrodes.

In the IBM-36 developmental tube, approximately 100 volts peak at 15 mc ionizes the gas filling. The oscillator provides 215 volts to assure good conduction in less than one microsecond provided initial electrons are present. With no r-f voltage present, the tube will not conduct until the d-c voltage is in excess of 100 volts. This d-c striking potential is reduced as r-f excitation is increased toward 100 volts.

With 15-mc r-f energy applied to the tube, the d-c voltage-current relation is as in Fig. 1. A 10,000-ohm load line is drawn to illustrate typical output voltages that can be obtained by r-f modulation when 50 volts d-c is applied between the electrodes. Although higher d-c voltages and load resistances will develop greater output voltages, the recovery of high resistance following the r-f burst is materially slowed down.

Total tube dissipation in excess of 3 watts, when applied over long periods of time, tends to decrease the conduction and increase the ignition requirements. For 215 volts of r-f excitation and 50 volts d-c through a 10,000-ohm resistive load applied continuously for 5,000 hours, the resulting power input of approximately 0.6 watt yields less than 10-percent change in conduction and ignition characteristics. Other tube structures have been built to handle more power where larger currents are required.

Pulse discrimination of the tube is improved by removing the r-f near the end of the last pulse to be transmitted by the tube, rather than stopping the r-f burst after the last required pulse and before the first



Assembly of nine special gas diodes having their outer metal bands connected in parallel for excitation by single 6AQ5 oscillator. Note use of fuse clips for making contact with metal bands. Standard NE-2 neon indicator diodes project up through grommets

Gas-Tube Switch

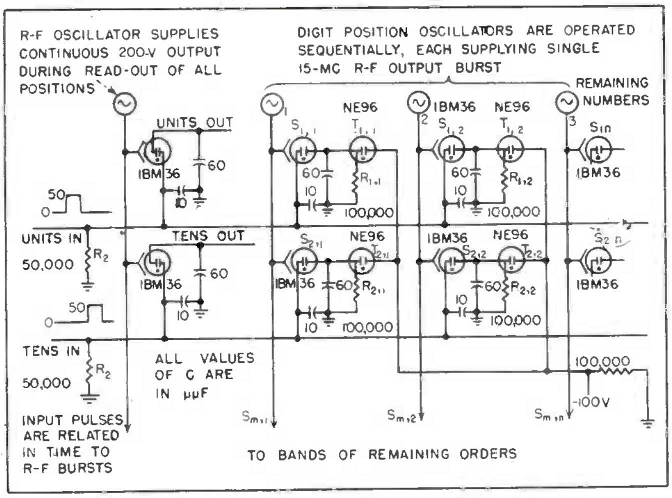


FIG. 2—Gas-tube storage system using r-f bursts to initiate switching

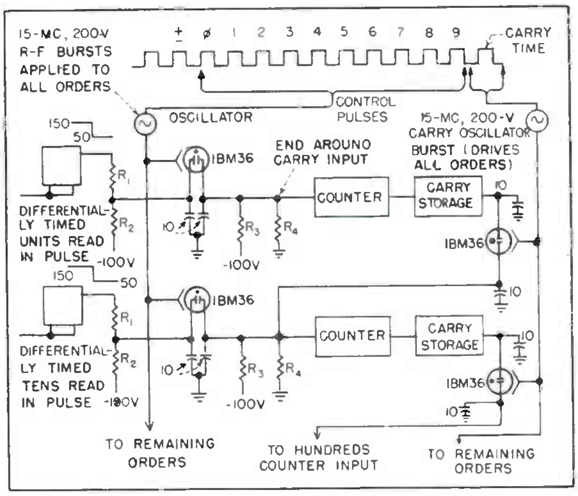


FIG. 3—Example of accumulator read-in circuit

unwanted pulse, and by keeping the circuit resistance small. Recovery to 0.5 meg under these conditions occurs in 10 μsec.

The tube has the characteristic of being ionized by an r-f burst of less than the normal ionization value when such burst occurs shortly after a burst of normal value. Whenever the second burst follows the cessation of the normal actuating burst sooner than 200 microseconds, the amplitude of the second r-f burst must be less than half the normal ionization value, if ionization is not to occur.

Computer Storage Application

Gas tubes can be used for both storage (reading in) and reading-out elements, as shown in Fig. 2. Tubes $T_{1,1}$, $T_{1,2}$ to $T_{m,n}$ are ordinary glow lamps having about 40 volts between d-c ignition and sustaining values. A portion of this voltage difference will develop across any resistor $R_{1,1}$, $R_{1,2}$ to $R_{m,n}$, where m is the order and n the number position, upon ignition of its associated glow tube. The ignition is brought about by conduction of a time-positioned pulse at the time a particular digit oscillator is turned on.

Once conducting, the glow tube remains ignited until the voltage falls below the sustaining value. One oscillator is provided to actuate all tubes of each digit position. Voltages may or may not be present across resistors R_1 to R_m at the particular time an oscillator is turned on. Only upon the simultaneous appearance of voltage across a resistor $R_{m,n}$ and an r-f burst will a particular tube $T_{m,n}$ be ignited.

During read-out, another oscillator excites a gas switch in any row R_m so that all orders are energized for the period of time required for the oscillators to sense all positions of the resistors $R_{m,n}$. This long-duration r-f burst can be held by an extra r-f actuated gas tube which acts as a holding contact on the oscillator positive drive until a pulse at "9" time turns it off. Any voltage that is found across any resistor $R_{m,n}$ of Fig. 2 is developed across the resistor R_m, whereupon the particular read-out switch passes the signal to its destination.

Accumulator Application

Another computer application for the r-f actuated gas tube is found in the accumulator read-in circuit of Fig. 3. One oscillator supplies nine r-f bursts to all columns of r-f actuated read-in switches by the usual gating methods. Resistors R_1, R_2, R_3 and R_4 are so chosen that voltage across the IBM 36 gas tube is zero unless a time-positioned signal has changed the level of the read-in storage device. The voltage level of the storage device is shown

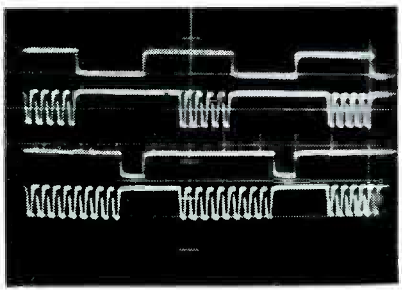


FIG. 4—Waveforms for reading in the numerals 5 and 9

to drop at the end of the fifth and ninth r-f burst in Fig. 4, indicating that after the fifth and ninth pulses the storage tube level was returned to the conditions where the voltage at the gas tube was zero. The carry signals are held in another storage element until a suitable point in the cycle is reached, at which time another oscillator simultaneously energizes another r-f actuated switch in each order, thereby passing any stored-carry signals to the input of the next-order accumulator.

R. L. Palmer, manager of the Poughkeepsie Laboratory of International Business Machines Corporation, initiated development and application of this tube in 1949. Since that time, many individuals have contributed in that direction. Credit is particularly due to A. L. Samuel, B. E. Toben and M. L. Wood for helpful suggestions during preparation of this paper.

More College Defense Research?

More than 400 qualified faculty members in 200 educational institutions are not now doing any defense research at all. Although 81 percent of the total college research time in electronics is directed towards defense, half the load is carried by only eight institutions

By JOHN I. MATTILL
Secretary
Engineering College Research Council
Cambridge, Mass.

A SURVEY by the Engineering College Research Council shows that more than 400 faculty members who are considered qualified to perform *research in electronics* are not now doing studies of *any* kind. These scientists are at 200 educational institutions throughout the United States.

And although 81 percent of the total research time in electronics under way in American colleges and universities today is directed toward defense needs, eight institutions only are now responsible for more than half of this effort. Over 150 educational institutions, with 425 faculty members qualified to undertake research, today have no *defense* research assignments.

Research In General

This summary of electronics research in educational institutions comes from an analysis of figures in a national inventory of college and university research resources completed during mid-1951 by the Council's Committee on Relations with Military Research Agencies, at the request and with the active cooperation of the Research and Development Board in the Office of the Secretary of Defense.

In all, this extensive national inventory covered the special interests and activities of faculty and graduate students in all physical and engineering sciences at 750 colleges and universities in the United States. Nearly 25,000 faculty members, and an equal number of graduate students, were reported in all fields of physical and engineering sciences. Of these 20,000 are considered by their institutions to be qualified to perform research, but only 12,700 are now active in research. An average of 27 percent of the time of faculty members reported is spent on research activities, and on a national average 52 percent of this time is already spent on defense research—studies sponsored by military agencies or their industrial contractors.

Electronics Defense Research

The Council's figures show 1,119 faculty members and full-time senior research personnel in electronics. Of there, 1,032 are judged qualified to participate in research projects, and 625 of them are now engaged in research. This effort is equivalent to that of a research staff of 387 working between 35 and 40 hours a week. Of these full-time equivalents, 314 would be engaged in defense projects for military agencies or their contractors. By this computation, electronic defense research amounts to about 81 percent of the total college and university effort in electronics in the United States today.

Junior Workers

A total of 1,107 graduate students and assistants in electronics were reported by the survey, equivalent to the full-time work of 558 junior research staff members.

More than 200 colleges and universities reported one or more staff members interested in and qualified for research in at least one field of electronics, and nearly 100 schools indicated a broad range of interests in the field.

The Unequal Load

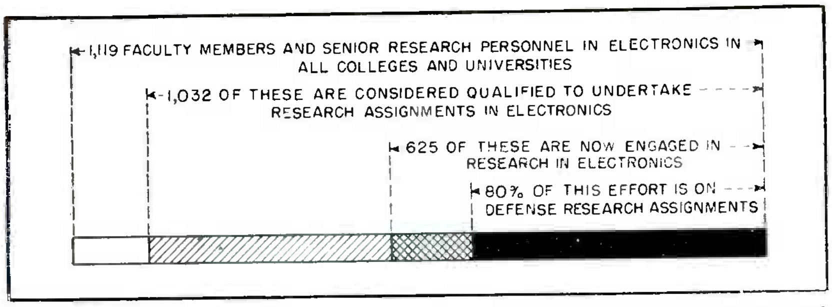
Nevertheless, the University of Michigan, New York University, University of Pennsylvania, Cornell University, Massachusetts Institute of Technology, Georgia Institute of Technology, Pennsylvania State College, and University of Florida account for more than half of the total defense research in electronics in colleges and universities, with an equivalent of 157 full-time senior research staff members.

Yet, these same eight institutions have only 259 faculty members and senior research personnel in electronics—about a quarter of those available throughout the nation. In the "big eight" nearly two-thirds of the total teaching and

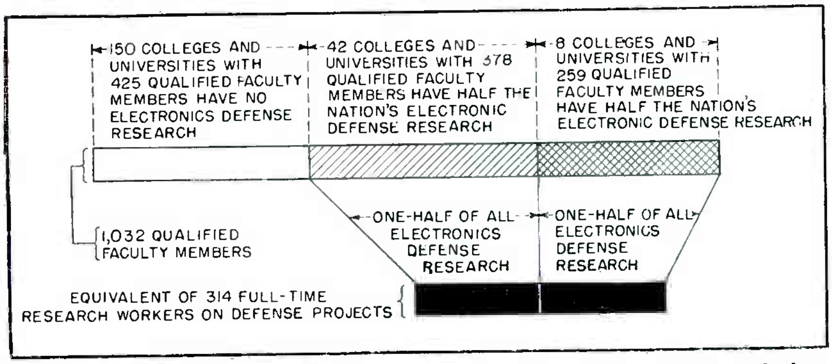
American Society for Engineering Education
Engineering College Research Council
Dr. Gerald A. Rosselot, Chairman,
Georgia Institute of Technology

Committee on Relations with Military Research Agencies

Dean A. F. Spilhaus, Chairman, University of Minnesota
Dr. A. P. Colburn, University of Delaware
Dean W. L. Everitt, University of Illinois
Prof. F. B. Farquharson, University of Washington
Prof. C. W. Good, University of Michigan
Dr. Paul E. Klopsteg, Northwestern University
Dr. James S. Owens, Ohio State University
Dr. J. R. Van Pelt, Montana School of Mines
Dr. Eric A. Walker, Pennsylvania State College



Faculty and senior research personnel reported available for work in electronics and the number of individuals actually so engaged



Qualified electronics research personnel, their disposition in the colleges, with their equivalent full-time contribution lower right

Field of Competence	Number of Institutions
Antennas and wave propagation	106
Communication theory	133
Components	62
Countermeasures	24
Electroacoustics	61
Electromagnetic waves	86
Electronic circuits and theory	201
Electronic computers	54
Electronic control equipment	125
Electron theory	108
Electron tubes	114
Microwave circuits	101
Miniature and printed circuits	19
Navigation aids and direction finding	41
Radar	97
Radio communication	147
Radio interference	57
Radiosonde	20
Speech security and scrambling	17
Television	50

Table I—Research Specialties in Electronics

research effort in electronics is devoted to defense research, compared to slightly more than one-quarter in all colleges and universities.

Of the 1,032 senior faculty and research staff members qualified to perform research in electronics in colleges and universities, only 625—a little more than half—are now engaged in any research work in that field. This leaves at least 400 faculty members not now active in research who are presumably available for research assignments. If they undertake research on only a quarter-time basis, the equivalent of 100 more full-time research scientists is added to the nation's research force, an increase of 32% in one of the most critically short areas of today's effort.

Research Potential

Widely diversified capabilities for increased service to military agencies and industry are available. In connection with the Council's inventory, institutions were asked to indicate special fields of electronics in which one or more staff members were interested and competent in research. The answers are summarized in Table I.

This list does not imply equal competence on the part of each educational institution indicated. Potential contractors and sponsors must still select with care institutions to receive contracts for specific projects. But it does indicate that vastly wider resources are available than have thus far been tapped—and there are important reasons for pressing into service less-experienced scientists who may indeed turn in a performance quite as creditable as that from the more familiar sources contractors would choose to approach first.

Special Equipment

Many research projects in electronics require specialized equipment not available at all schools. In general, however, lack of qualified personnel is the pricipal bottleneck in the current necessary expansion of research. If competent manpower is available, necessary equipment can probably be supplied to the potential research workers.

Nevertheless, a partial inventory of specialized equipment found only uncommonly at educational institutions was attempted in the belief that the availability of such equipment might be an important factor in the location of research there. Thus, such electronic equipment as computers and analyzers, correlators, electron microscopes, electrostatic generators, linear accelerators and vocoders were listed by institutions where available.

Decentralizing Research

Other, secondary benefits may result from the decentralization of assigning research to many schools not now involved. New research activities will, if properly organized, contribute to strengthening the educational programs with which they are associated. This, in turn, will assure an increasing supply of well-trained students to help fill the critical manpower needs now facing the electronics industry.

Another important gain may be realized by increasing the ratio of graduate students to full-time senior faculty and staff on research projects in those schools where graduate education is under way. This should have a similar effect of increasing the future supply of electronics manpower.

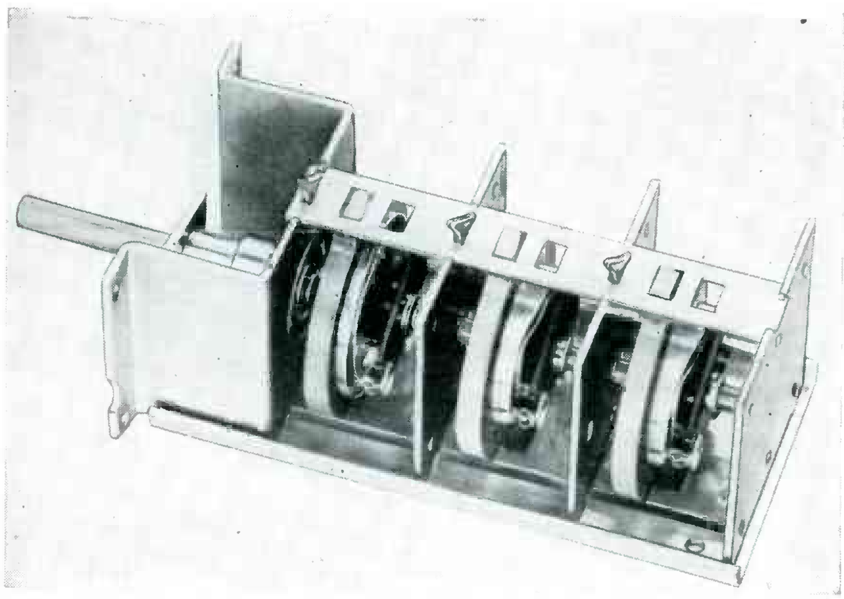
The full statistical report of the survey project, entitled "University Research Potential", identifies all schools reporting personnel, competencies, and equipment. Copies are available from the Secretary of the Engineering College Research Council at Room 7–204, 77 Massachusetts Ave., Cambridge 39, Mass., at $1.00 each.

CONCENTRIC-LINES

By EDWARD E. HARRIES and MADISON CAWEIN
Sales Manager, TV Tuner Div. *Consultant*
P. R. Mallory and Co., Inc.
Indianapolis, Indiana

Design of a tuner for the uhf television bands presents a number of problems. In addition to those involved in tuning the complete frequency range, it is necessary to consider oscillator tracking for different i-f frequencies, stray circuit parameters and their effects, and resetability of contact arrangements.

Metal strips arranged in a noninductive, concentric path are employed as dual-inductor elements in the Mallory uhf Inductuner. The edge-mounted strips provide the required inductance range in 270 degrees of rotation. The strips are pressed into molded grooves in a mica-filled phenolic base material. Terminals for each tuning element protrude from the bottom of the tuner and one, two, three, or four sections can be assembled in a single case.



Three-section tuner for tv channels 14 to 83

The preselector tuning elements are shaped differently from each other and from the oscillator tuning elements to provide good uhf tracking. Typical frequency versus dial-rotation curves for the r-f and oscillator sections with an intermediate frequency of 82 megacycles (channel 5 or 6) are shown in Fig. 1.

Best performance is obtained by using an unbalanced, 300-ohm input circuit. A split-capacitor arrangement is used for antenna coupling. A 300-ohm, balanced-input circuit is under test, but has not been finalized as yet (indicated in Fig. 4).

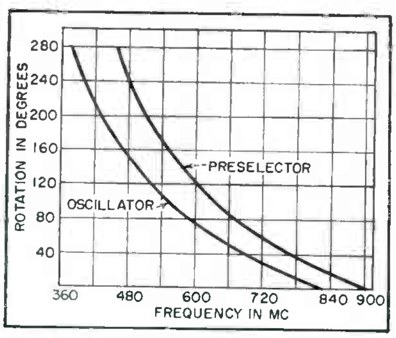


FIG. 1—Tuning curves for producing an i-f of 82 mc

The input-circuit equivalent, Fig. 2, indicates a preferred circuit arrangement for preselector tuning elements. This arrangement represents an impedance step-up from the antenna to match the tuned circuit impedance. This step-up is several fold, depending on the relative values of C_a and C_t (approximately 2.2-to-1 capacitance ratio, or 5-to-1 impedance ratio).

The tuning elements in the preselector circuit cover the tuning range of the uhf band (10-mc overtravel at each end) with an external tank capacitance of approximately 1 $\mu\mu$f. The oscillator tuning element will cover the required range for a converter (oscillator frequency below preselector frequency) with an external tank capacitance approximately equal to the grid-plate capacitance of the 6AF4, approximately 1.5 $\mu\mu$f external.

The circuit shown in Fig. 3 illustrates one preferred method of using the tuner element. As the element is relatively symmetrical in structure, both terminals may be operated in a balanced condition above ground. One advantage of this connection is the provision for placing the a-c potential of the variable inductance coil center at ground. Another advantage is that of being able to couple into the circuit, at tapped-down points, from two relatively isolated circuits, as in an antenna circuit or a mixer circuit.

The preselector tuning elements, when connected to ground as shown in Fig. 3, exhibit a suck-out resonance at approximately 370 mc. If

TUNE UHF CHANNELS

Continuous coverage of television channels 14 to 83 is provided by edge-mounted metal strips and movable shorting bars for tuning each stage of a receiver front end. Design and circuit analysis includes complete converter using the elements

Front and rear views of antenna-coupling section

a 300-ohm receiver input.

The preselector utilizes two tuning elements for double-tuned selectivity and an impedance match ahead of the mixer. Each tuning-element has spurious resonance below the band at approximately 370 megacycles. A single oscillator-tuning element, which has spurious resonance above 900 megacycles, is employed.

In this case the three tuning elements are all different. The input element provides balanced coupling to the antenna and its shape differs from that of the second preselector tuning element. Both elements are shaped to track the oscillator.

Input Coupling

The antenna-coupling means, shown in Fig. 2, represents a com-

the magnitudes of the two capacitors are unbalanced (made slightly different in opposite directions), two spurious resonances will occur at frequencies slightly lower and higher than 370 mc. If the value of each C should be decreased to 1.2 $\mu\mu$f, the spurious resonance will become high enough to cause a loss of gain at the low end of the uhf band.

It is advisable to provide a physical ground at G_2. In practice, grounds G_1 and G_2 can be inches apart on the chassis. The purpose of this ground is to short-circuit any low-frequency interference which may be present and to reduce oscillator radiation.

Suck-Outs

When operating the oscillator above 760 mc, it is necessary to connect the inner, concentric conductor back on itself, otherwise. an undesirable resonance (suck-out) occurs at approximately 780 mc. This suck-out will reduce or kill the oscillator output above 760 megacycles in some types of oscillator circuits.

A wide-strip, oscillator tuning element is available for applications above 760 megacycles. In these elements, the suck-out occurs above 900 mc.

A 3-section tuner is used in the converter circuit of Fig. 4 to provide coverage of channels 14 to 83. The oscillator operates on the low side of the carrier to prevent inversion of the video and audio carriers, and thus enables the converter to be used with a conventional vhf receiver.

The circuit consists of a preselector, crystal mixer and oscillator, followed by an i-f stage. The input impedance is 300 ohms nominal, shown as a balanced line, and the output impedance is 75 to 300 ohms. The gain of this converter is approximately 1.0 when used with the 300-ohm output connection and

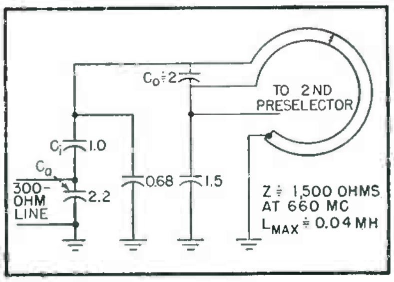


FIG. 2—Equivalent input circuit employing impedance step-up from antenna

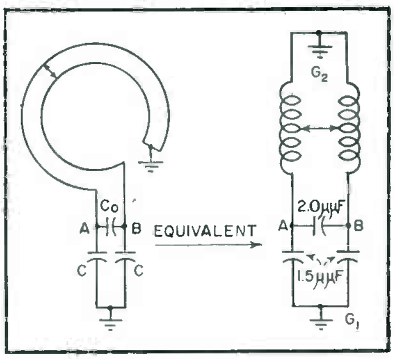


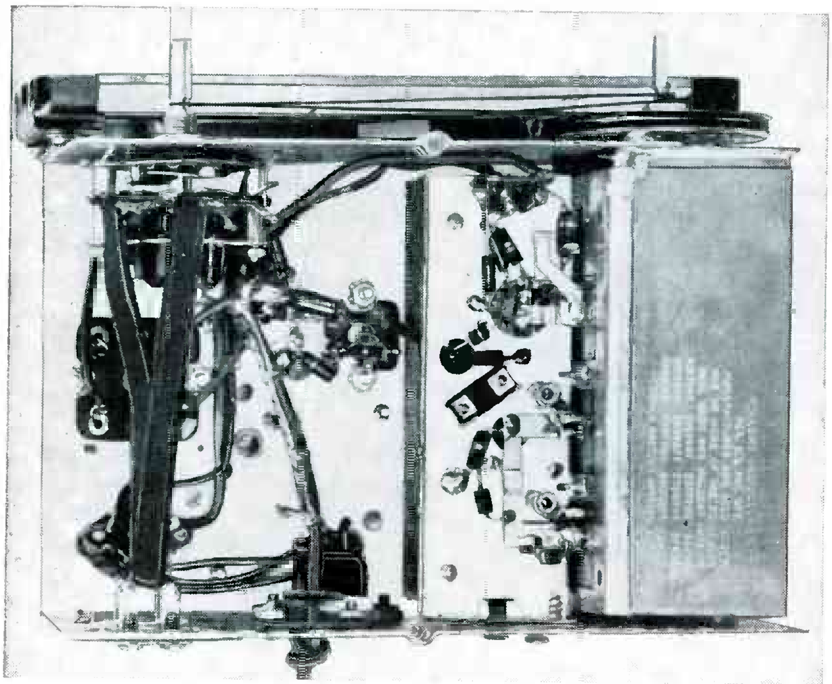
FIG. 3—Preselector circuit showing balanced condition

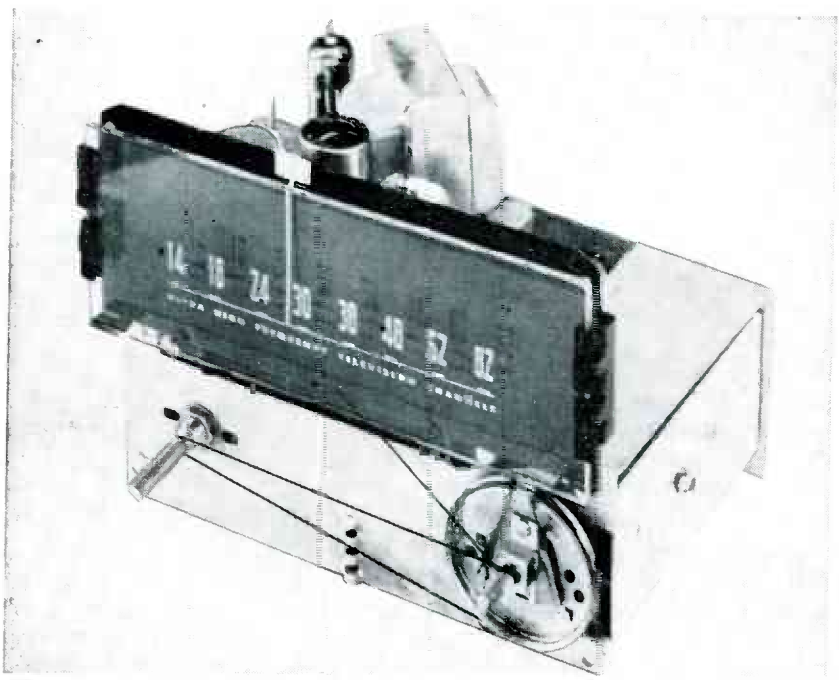
promise between energy transfer (from various types of antennas or lines), alignment problems, oscillator radiation and noise figure.

The band-pass coupling arrangement of Fig. 4 can be represented by C_1 and L_1, and contains an automatic adjustment of bandwidth across the range of the converter. When properly aligned, it is possible to maintain tv channel bandwidths in the uhf range at approximately 10 to 14 megacycles. The coupling between circuits provided is

$$k = \frac{1}{3 + (1 - r^2)\, C/C_1}$$

The symbol, $r = f/f_1$, is the ratio of selector resonance to the resonance of L_1C_1. The value of C_1 should be adjusted for a bandwidth of 12 mc at 700 megacycles, while L_1 is a few centimeters long and probably has an inductance of about 30 millimicrohenries. Probably C_1 is of the order of $\frac{1}{3}\mu\mu$f. Thus, C_1L_1 resonates near 1,500 megacycles, and k increases at high frequencies to compensate partially for increased power factor, thus keeping peak separation (which is equal to $f\sqrt{k^2 - p^2}$) relatively constant.


Bottom view of converter chassis shows critical wiring arrangement necessary for low-inductance leads at these frequencies



Complete converter covers the range from 470 to 890 mc

In the mixer circuit shown in Fig. 4, the input coupling circuit resonates at approximately 350 mc. This circuit may exhibit a second resonance near 900 megacycles.

The resistance component of the mixer impedance is estimated to be 1,000 ohms, based on injection of approximately 1 mw of oscillator power. Thus, the Q of the mixer circuit is probably somewhat less than 10 at 900 mc.

The oscillator tuning section covers a range from 378 to 828 mc for an i-f of 82 mc.

Oscillator Analysis

The oscillator equivalent circuit is shown as a reactance network in Fig. 5. The circulating current in the tank circuit, composed of the reactance arms of the network produces out-of-phase potentials between grid and plate.

The cathode is tapped in near a null-point of the network due to approximate balance between total C_p and C_g, and R_p and R_g. Consequently, the reaction of the cathode and heater circuits on the oscillator tank circuit is minimized. Value R_p is made up of plate resistance in parallel with isolating resistance. The grid leak, in parallel with the transit-time conductance constitutes R_g, which changes with frequency.

Mixer excitation is derived from coupling to the cathode through the heater-cathode capacitance of the tube (effective value of C_{hk} is 2.7 $\mu\mu$f approx for the 6AF4). Thus, the preselector circuits coupled to the mixer have a minimum reaction on the oscillator. The oscillator injection is relatively uniform across the band. The reactance of L_h increases with frequency, and tends to increase the output as the transit-time loading of the input circuit increases. This action offsets the general tendency toward reduction in oscillator voltage due to

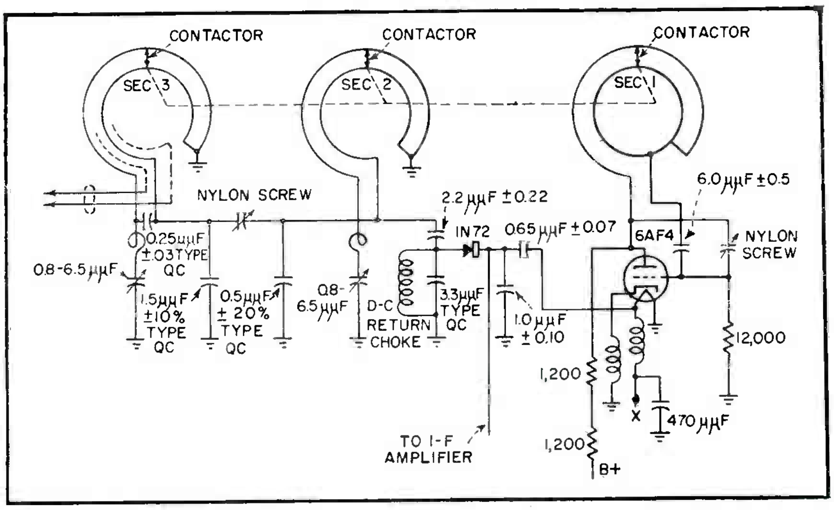


FIG. 4—Complete circuit of converter with three-circuit tuner

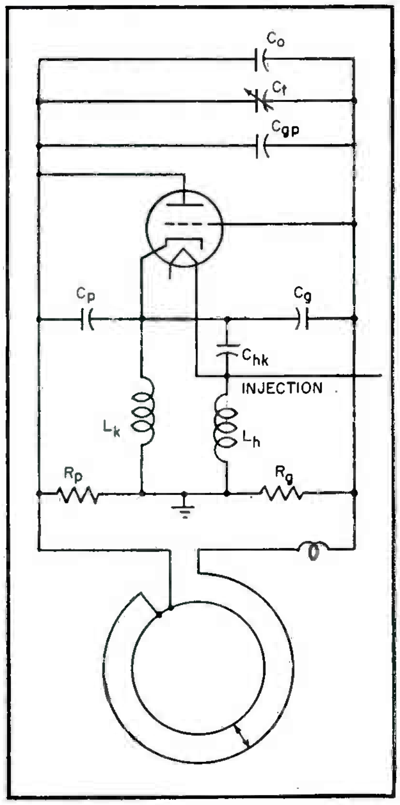


FIG. 5—Reactance network equivalent of oscillator

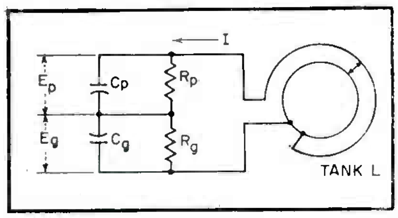


FIG. 6—Analysis of compensation for oscillator transit-time phase shift

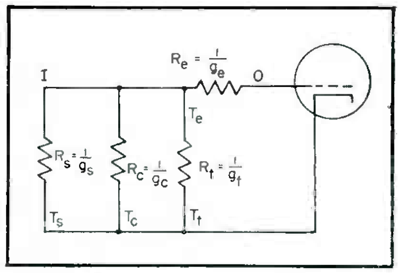


FIG. 7—Equivalent resistances and conductance of amplifier

decrease in R_g at higher frequencies, while R_p remains relatively unaffected.

Although the ideal ratio of total grid-circuit capacitance to total plate-circuit capacitance is not maintained in this network (ideal $C_g/G_p = \mu/2 = 8$), the tendency toward reduced oscillations at the higher frequencies, due to transit-time phase-shift, is offset.

Referring to Fig. 6, voltage E_p lags the tank current I by 90 degrees, and voltage E_g would lead by 90 degrees if the power factors of both C_p and C_g were small. The power factor of C_p decreases with frequency, but the power factor of C_g increases with frequency ($p = 1/RC\omega$) because R_g varies inversely with the square of frequency. Thus, E_g tends to lead by more than 90 deg as the frequency increases and reaches its maximum before it should. This phase lead offsets the increasing transit-time delay between maximum E_p and maximum E_g as the frequency increases.

The compensation of transit-time phase shift is necessary at high frequencies to maintain oscillations. This compensation will not occur for values of C_g that are comparatively greater than C_p, because the power factor of the grid circuit would then be proportionally smaller (current and voltage would be substantially 90 deg out of phase) and the grid maximum would occur too late for transference-in-time to the plate.

Oscillator drift has been minimized by the location of parts and by thermal isolation from heat contributed by the i-f and power-supply tubes. For intercarrier audio sets, the converter stabilizes during normal set warm-up time (approximately one minute). For split-audio receivers, a 3 to 5 minute warm-up may be required.

I-F Amplifier

The well-known cascode circuit is used as the i-f amplifier. This requires neutralization to maintain a good noise figure at high values of i-f frequency. The circuit arrangement takes account of the distributed tube constants. Though the circuit is inherently good, from the standpoint of noise figure, the transit-time loading of the first-tube grid represents a noise source having an effective noise-temperature ratio (to room temperature) of $t = 5$ (corresponding to $t = 1$, 2, 3, or higher for a crystal). The transit-time conductance g_t is inversely proportional to the square of the frequency up to 200 megacycles. For the 6BQ7, the transit-time loading is approximately 10,000 ohms at 82 megacycles. This constitutes a noise generator between grid and cathode.

Noise Figure

It can be shown that the principal noise sources in an amplifier are related to an input network of equivalent resistors (See Fig. 7) or conductances, whose temperatures may not be all the same. Further, the available noise power output of conductances in parallel, all at the same temperature T, is equal to KTB over a bandwidth B. This is identical to the available output from any resistor at temperature T, regardless of its magnitude.

Each resistor contributes only a portion of the total noise power. Due to the presence of the others, only a portion of KTB is available from each. This portion depends di-

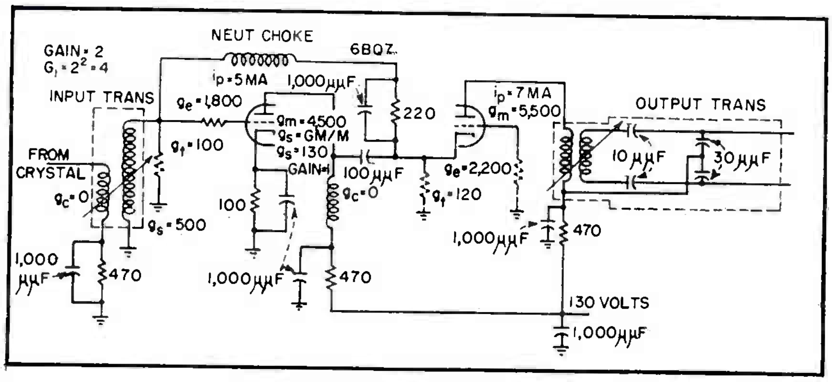


FIG. 8—Operating conditions of i-f amplifier

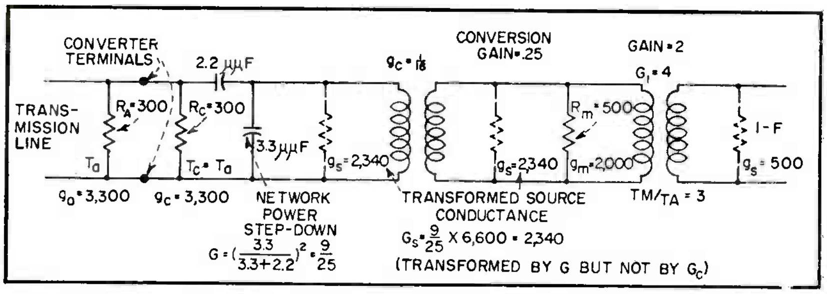


FIG. 9—Factors involved in figuring overall noise figure

rectly upon the temperature of the resistor and upon the ratio of its conductance to the total conductance. Thus, the total noise power available from the network is the sum of the noise powers available from each resistor, regardless of whether they are in series or parallel.

Noise figure for a passive network (containing noise sources) is defined as the available signal-to-noise power input divided by available signal-to-noise power output. The available noise power input from the signal source resistor R_s is attenuated by the network, but the signal impressed at I is the same as that which appears at O. Therefore, noise figure as defined in the literature (since 1944) is really the ratio of noise-power output to noise-power input.

It can be shown that the noise figure of the network is

$$F = \underbrace{\frac{g_s T_s}{g_s T_s} + \frac{g_c}{g_s}\frac{T_c}{T_s} + \frac{g_t}{g_s}\frac{T_t}{T_s}}_{\text{parallel conductances}} + \underbrace{\frac{(g_e + g_c + g_t)^2}{g_e g_s}\frac{T_e}{T_s}}_{\text{series conductances}} \qquad (1)$$

The conductance form of the noise figure equation is often more convenient than the resistance form, since transit-time conductance (g_t versus frequency) curves are usually given for vacuum tubes, and g_e (equivalent plate-current noise resistance referred to the grid circuit) usually can be taken as $g_m/2.5$ for a triode. This expression for noise figure can be extended for any number of parallel or series conductances.

In most cases, all the temperatures are equal to T_s, except T_t, which is the cathode temperature and is equal approximately to $5 \times T_s$, so Eq. 1 can be simplified.

$$F = 1 + \frac{g_c}{g_s} + \frac{5g_t}{g_s} + \frac{(g_s + g_c + g_t)^2}{g_s g_e} \qquad (2)$$

The operating diagram of the i-f amplifier is shown in Fig. 8. The noise figure of the second tube computed for Eq. 2 is 5.5. The noise figure of the first tube is 3.34. Since the gain of the first tube is 1.0, the overall noise figure of the i-f amplifier is 7.84.

The overall noise figure of the converter can be computed by reference to Fig. 9.

$$F = 1 + \frac{g_c}{g_a} + \frac{F_m - 1}{GG_c} + \frac{F_i - 1}{GG_cG_i} \qquad (3)$$

Each noise-figure contribution is referred to the input.

The i-f output circuit is a double-tuned transformer, 12 mc wide at the half-power points, with center frequency at 82 mc. The gain of the i-f amplifier is approximately 6, from input to output terminals. The output impedance is nominally 300 ohms for channels 5 and 6. Since the conversion gain is 0.25 and there is voltage step-down of 0.6 ahead of the converter, the overall gain is approximately 1.0.

Noise Figure

From the thermal noise standpoint it is not necessary for a uhf converter to have a gain greater than 1.0 so long as the converter itself is a source of considerable noise. When the noise figure is as high as 100 (20 db), the noise power output is 100 times the noise power input. Since the input and output impedances are equal (300 ohms), the noise voltage developed at the receiver input terminals is 10 times that at the antenna terminals normally.

Thus, the noise figure of the receiver becomes negligible because the receiver noise contributions are referred to a much higher source noise than in vhf reception. This means that, although there are normally only 4.2 μv of noise across the 300-ohm input of a vhf receiver, with a bandwidth of 3.5 mc, there will be 42 μv from a converter with a 20-db noise figure and unity gain.

If it is arbitrarily stated that a 2 to 1 peak signal-to-noise ratio is required for a usable picture, then the peak signal should be $2 \times 1.4 \times 4.2 = 11.76$ μv for vhf reception or 117 μv for uhf reception, using the converter. It will not help to increase the converter gain, for this will not change the signal-to-noise ratio at the antenna. Almost any television receiver will operate on 117 μv of signal. Any additional gain will merely back-down the avc, but will not change the signal-to-noise ratio. Signal-to-noise may be improved for uhf reception only by obtaining more than 117 μv of signal at the converter input, or by adding r-f amplification ahead of the mixer to improve the noise figure.

The authors appreciate the technical aid given by B. B. King and W. E. Garrigus.

Magnetic Modulators

Conversion of low-level, low-frequency or d-c signals to a-c signals capable of being amplified by conventional means is accomplished by magnetic-amplifier-type device that combines high efficiency and reliability with extreme ruggedness

By E. P. FELCH, V. E. LEGG and F. G. MERRILL

Bell Telephone Laboratories
Murray Hill, New Jersey

Amplification of small direct and subaudio a-c signals has always presented problems such as high noise and poor zero-stability. Many ingenious methods for circumventing these difficulties have been proposed and used. Most involve the conversion of the signals to be measured to a-c signals of frequencies that can be readily amplified by conventional means.

This paper describes such a method employing a magnetic modulator, or magnettor.

A magnettor is a low-level signal converter employing magnetic modulation. While magnettors fall in the general category of magnetic amplifiers, they correspond functionally to the modulators, sometimes called mixers or converters, in the electron-tube art. Their conversion efficiency, low noise level, and linearity adapt them particularly well to applications requiring low-level signal conversion for which they are ordinarily used. Their frequency response extends downward to direct current. The freedom from moving parts and critical balances common to other types of converters not only permits extended frequency response but also achieves long life and freedom from maintenance.

The principles underlying the operation of magnettors are far from new. Extensive studies of the behavior of high-permeability magnetic materials as low-level modulators have been carried out as indicated by the bibliography at the end of this article.

Principles of Operation

In its simplest form, as shown in Fig. 1, a magnettor consists of a core of magnetic material surrounded by a single winding. A pure sinusoidal current of exciting frequency f is applied to the winding and increased in value until the core is nearly saturated during a portion of every half cycle. If the voltage across the coil is analyzed, it will be found to consist of the exciting frequency and odd harmonics thereof. No even harmonics of the exciting frequency will be present, in the ideal case. However, if a direct-current signal is super-imposed on the alternating current in the winding, the second and higher even harmonics of the exciting frequency will appear across the winding.

This behavior is a consequence of the perfect symmetry of the normal *B-H* curves, which produces corresponding symmetry of the output voltage wave. This symmetry can be measurably upset by unidirectional flux which may be many orders of magnitude less than the saturation flux value.

If the amplitude of the second harmonic output voltage is compared with the d-c signal current, a linear relationship will be found to exist over a range of at least 300 to 1, or 50 db, limited by noise and by saturation at the lower and upper extremes of the range, respectively.

Polarity, Phase and Sidebands

Direct-current signal inputs of opposite polarities produce second-harmonic output voltages differing in phase by 180 degrees. In other

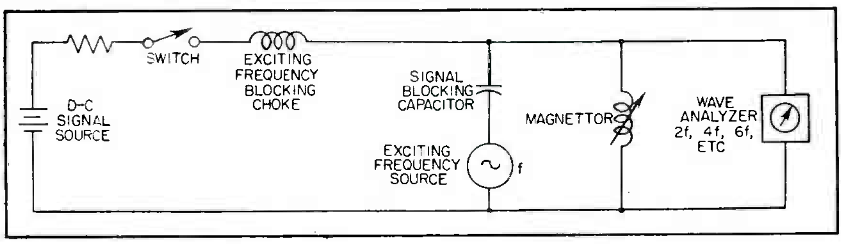


FIG. 1—Basic circuit shows magnettor (magnetic modulator) being used to convert d-c signal to proportional a-c signal capable of being amplified by conventional means

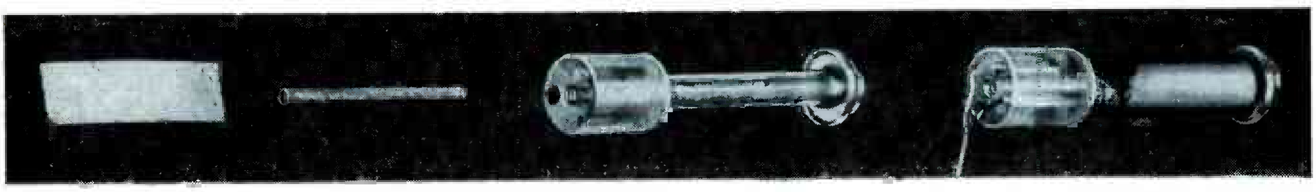


FIG. 2—Straight tubular core magnettor requires considerable shielding to eliminate spurious signals from ambient fields. Permalloy sheet at left is rolled into cylinder and placed in 2-in-long methacrylate spool

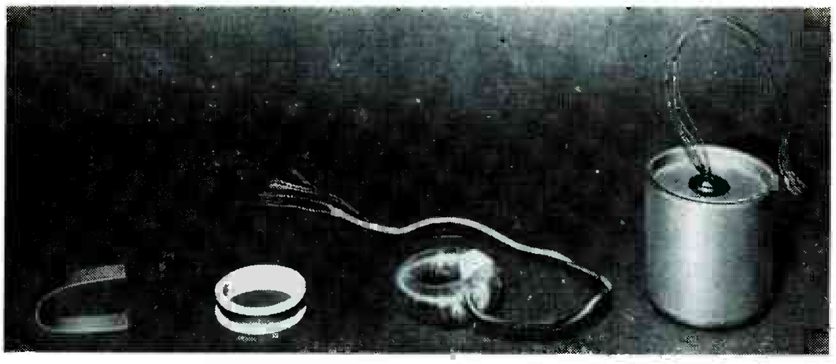


FIG. 3—Toroidal core configuration reduces shielding requirements. One-mil thick strip (left) is wound around 1¼-inch ceramic spool

words, the phase of the second-harmonic output voltage follows the polarity of the d-c input signal. This is an exceedingly useful property. By employing a phase-sensitive rectifier for reconversion of the second harmonic voltage to direct current, the polarity of the input signal may be recovered in the output. The frequency and wave shape of a-c signal inputs can be reproduced in the output provided that demodulation is accomplished in a phase-sensitive demodulator.

If a simple rectifier or demodulator is employed the input-output relationships are quite different. For direct-current signal inputs of either polarity, the rectified output is d-c of a single polarity.

For a-c signal inputs the principal demodulator output consists of the second harmonic of the a-c input signal. The magnettor output for an a-c signal input containing no d-c component comprises two sidebands of frequencies numerically equal to the sum and difference, respectively, of the second harmonic of the exciting frequency and the input signal frequency. Since there is no second harmonic generated in this case the signal frequency to sideband relationship is like that associated with suppressed-carrier modulation systems.

The degree and permanence of carrier suppression obtainable with magnettors significantly exceeds that of other types of modulators because of the almost perfect inherent symmetry of the *B-H* characteristic, upon which this balance depends. This is in contrast with the usual situation where carrier balance is a function of the identity of pairs of nonlinear circuit elements of indifferent stability.

Superposition of a d-c input signal restores the second-harmonic carrier and produces a relationship analogous to that encountered in conventional amplitude modulation.

The amplitude, phase and sideband relationships mentioned above hold for all of the higher even harmonics as well as for the second. This fact has been exploited in some magnetometers.

The performance of magnettors is dependent upon their physical design and upon the circuit in which they are used. Characteristics of principal interest include transimpedance, noise level, linearity, frequency response and input impedance. Transimpedance Z_m is a term given to the derivative of the open circuit second harmonic output voltage with respect to the input current

$$Z_m = \frac{dE_{2f}}{dI} = \frac{\mu' N^2 A f}{l} \times 10^{-7}$$

where μ' is the effective permeability (approaches permeability of core material for torodial or other closed coil structure), N the number of turns, A the cross-sectional area of the core in square centimeters, f the excitation frequency in cps and l the length of the winding in centimeters.

Core Materials

The selection of core material affects both the transimpedance and the excitation requirements. Desirable characteristics are high permeability, for maximum transimpedance; low coercive force, for minimum loss of excitation power through hysteresis; and ease of producing saturation at relatively low magnetizing forces.

These properties are combined to a highly satisfactory degree in 4-79 Molybdenum-Permalloy.

The thickness of metallic core materials affects the eddy current losses—the thinner the material, the lower the losses.

The design of the core structure influences two aspects of magnettor performance to a marked degree—transimpedance and noise level. Desirable characteristics are high μ' for maximum transimpedance, freedom from mechanical strain of the core material for minimum noise level and zero offset, and rigidity and mechanical stability for minimum noise level. Two basic core structures have been employed in the simple circuit of Fig. 1—the straight tubular type and the toroidal form.

Tubular Cores

The straight tubular core magnettor is shown in Fig. 2. These perform excellently as d-c to a-c converters, if adequate shielding is provided to eliminate spurious signals from ambient magnetic fields, such as that of the earth or of neighboring electrical machinery.

As shown in Fig. 2 this core consists of a strip of 4-79 Mo-permalloy one mil thick and ⅜ inch wide rolled into a tubule about 1/10 inch in diameter and 1½ inches long. The rolled core has barely more than one convolution. After it is annealed it is slipped over a glass tube, which is then inserted in a Lucite spool as shown.

The tubular form of core possesses a number of advantages over other straight-core structures such as flat strips and wires. Inherent rigidity and adaptability to strain-free mounting are perhaps its outstanding virtues. In any magnettor core structure strains of a permanent or a transient nature give rise to zero offset and noise, respectively.

In a straight core or, for that matter, in any core structure with a large air-gap, the effective permeability μ' is a function of the core geometry as well as of the permeability of the magnetic material itself. In a solid cylindrical core the value of μ' is particularly dependent upon the length-to-diameter ratio. It is greater for long slender cores. For tubular cores the effective diameter is not the outside diameter but it approximates more closely that of a solid cylinder containing the same amount of material, and having the same length.

It is difficult to be rigorous concerning values of μ' for cores of various dimensions. However, Table I, which is based upon experimental data, illustrates the influence of core dimensions upon the value of μ'. All of these cores were made from 4-79 Mo-permalloy tape 1 mil thick, and contained one or more convolutions to make up the areas indicated. A figure of merit is shown in the last column. This is simply the product of μ' and the area of core material, as they both appear in the formula for transimpedance.

Despite the approximate nature of these data it may be concluded therefrom that for a tubular core magnettor the transimpedance is approximately proportional to the length of the core, and is influenced to a minor degree by the amount of material in the core. Since, however, the required exciting volt-amperes is a function of the area of core material it appears advantageous to employ cores containing the minimum amount of material.

The effective output impedance of straight tubular core magnettors is affected principally by the value of μ', and secondarily by the area of the core. These effects also favor cores of smallest practicable cross-section.

Toroidal Cores

Magnettors with toroidal cores, for applications not involving measurements of the earth's field, have proven attractive from two standpoints. The problem of shielding the core from earth's field is reduced by a factor of about 1,000 compared with those having straight cores, and the transimpedance which can be realized is increased by at least an order of magnitude for structures utilizing approximately equal volumes. The latter advantage arises from the fact that the value of μ' approaches closely the permeability of the material itself and is practically independent of core dimensions. The only drawback to this is that the permeability of the material may be somewhat less stable than that of μ' for tubular cores. This provides a partial explanation for the slightly higher residual noise level observed in toroidal core magnettors.

The transimpedance and the exciting power in this case are both approximately proportional to the cross-sectional area of core material. The effective output impedance has been found to be almost proportional to core area. Hence, both the open-circuit output voltage and the output power into a matched load for a given d-c input current are linearly proportional to the core area.

Two general types of toroidal cores have been found useful. One consists of a pile-up of permalloy washers insulated from each other and enclosed in an annular box of rigid material. The box insulates the core material from mechanical strains. Another toroidal core design which lends itself well to manufacture by more or less conventional methods is illustrated in Fig. 3. The ends of the tape are spot welded and the assembly is annealed as a unit. The coil winding is applied directly to the ceramic form. The core illustrated consists of a single turn of tape. The core area may be increased as desired by applying more turns of tape. Values of μ' determined experimentally for this type of structure are in the order of 30,000.

Windings

From the standpoint of signal input the significant parameters of the winding are resistance and N/l, the turns per unit length of the winding. Minimizing resistance and maximizing N/l increase the voltage and current sensitivities, respectively. For a-c signal inputs the impedance of the winding is important, and this is proportional to N^2, the square of the number of turns. The output voltage for a given ampere turn signal input is proportional to N. However, since the effective output impedance is approximately proportional to N^2, the power output into a matched load is substantially independent of the number of turns.

Multiple Configurations

As a logical consequence of the above relationships magnettors have been constructed with multiple windings, giving the designer a wider choice of N for various functions. When separate excitation windings are employed a further advantage may be gained by pairing the magnettor with a second two-winding core structure. The excitation windings may then be connected in opposing fashion while the signal input and output windings are connected in aiding fashion. This arrangement is shown schematically

Table I—Typical Characteristics of Tubular Cores

Core Length (in.)	Core Length (cm)	Outer Diameter (cm)	Core Material Area (sq cm)	μ'	Figure of Merit ($\mu' \times$ Area)
.75	1.9	0.27	0.006	200	1.2
1.0	2.5	0.27	0.003	600	1.8
1.0	2.5	0.27	0.006	300	1.8
1.0	2.5	0.27	0.023	75	1.7
1.5	3.8	0.24	0.003	1,000	3.0
2	5.1	0.16	0.003	1,400	4.2
2	5.1	0.16	0.013	300	3.9
2	5.1	0.24	0.003	2,000	6.0
2	5.1	0.24	0.013	400	5.2
4	10.2	0.27	0.005	2,200	11
4	10.2	0.27	0.013	1,100	17
4	10.2	0.32	0.003	4,000	12
48	122	0.32	0.010	15,000	150

in Fig. 4 for magnettors illustrated in Fig. 3. It provides conjugacy between the excitation and output circuits, which relaxes filtering requirements.

The signal input and output voltages appear across the windings in the same sense. This appears to be an indissoluble relationship which necessitates a series or parallel feed arrangement of the input signal. In the circuit of Fig. 4 this is readily accomplished by employing a floating input winding in the output filter in conjunction with a capacitor shunting the input signal circuit.

Another method of accomplishing these objectives is to place the exciting windings upon the two individual cores and then place a single signal input and output winding around the two cores stacked together.

Circuit Design

Many aspects of the design of circuits employing magnettors have already been discussed earlier in this paper. The choices of excitation and output frequencies are influenced by several factors.

Favoring a higher excitation frequency are considerations of: (1) Signal bandwidth or speed of response. The wave-form of the useful output is delineated by the envelope of the excitation frequency. (2) Sensitivity and signal-to-noise ratio. The transimpedance is a linear function of the excitation frequency.

Favoring a lower excitation frequency are considerations of: (1) Unwanted winding resonances. These are particularly troublesome if a large number of winding turns are required to match a high-impedance signal source. (2) Eddy-current losses. These become significant in 1-mil 4-79 Mo-permalloy at excitation frequencies above 5 to 10 kc. (3) Availability of excitation power. This favors operation at power frequencies of 60 or 400 cps. An excitation frequency of 1,000 cps has found considerable use, representing a compromise between the conflicting factors mentioned above. For a wider signal-frequency bandwidth, 20 and 60 kc excitation frequencies have been used.

Once the choice of excitation frequency has been made the choice of output frequency remains. That is, the second, or any higher harmonic may be selected. The output voltage for the various even harmonics for a given input current and excitation frequency are substantially equal, but the equivalent output impedances increases linearly with frequency. Consequently there is little advantage to be gained from utilizing a higher harmonic than the second.

In an experiment aimed at determining qualitatively the performance at higher frequencies of the twin-core magnettor shown in Fig. 3 it was supplied with an excitation frequency of 60 kc. This required about 30 times the driving power required at 1 kc to attain adequate saturation. An audio-frequency signal of about 10 millivolts from a variable reluctance phonograph pickup together with a somewhat greater d-c voltage were introduced in the signal windings. The output spectrum was explored with a radio receiver. Carrier and audio sidebands were present at 120 kc intervals throughout the frequency range 720 to 1,440 kc. The frequency response was flat from d-c to beyond 3 kc, where the radio receiver started to cut off anyway. The quality of reproduced music was comparable with that obtained from radio stations at each output frequency. By dropping the excitation frequency to 20 kc the spectrum was filled with outputs at 40-kc intervals, with no perceptible loss in quality.

Excitation Source

The primary requirement to be met by the excitation source is that it deliver sufficient power to drive the core material close to saturation during a portion of each half cycle. The transimpedance of a magnettor increases rapidly with increasing exciting current up to a maximum and then gradually decreases. It is desirable to operate at or just beyond this maximum for several reasons. First, the influence of changes in exciting current upon transimpedance is minimized. Second, the memory effect of large-signal inputs is eliminated. Third, the dynamic range of signal amplitudes between noise and overload is approaching maximum.

It has been found advantageous to employ excitation sources having appreciably lower internal impedance than that of the magnettor.

Another important requirement is that the spurious second harmonic output voltage from the excitation source be low. While the balanced magnettor circuit reduces the transmission of second harmonic from the excitation source into the useful output circuit, it is still necessary that it be minimized. With unbalanced magnettors and those operating at extremely low signal levels, a second harmonic re-

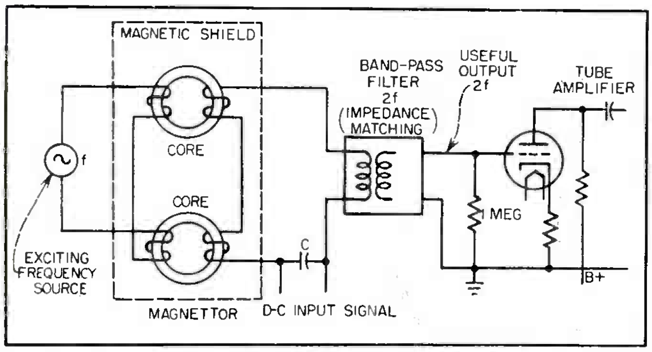


FIG. 4—Circuit shows typical use of magnettors in conjunction with vacuum tube

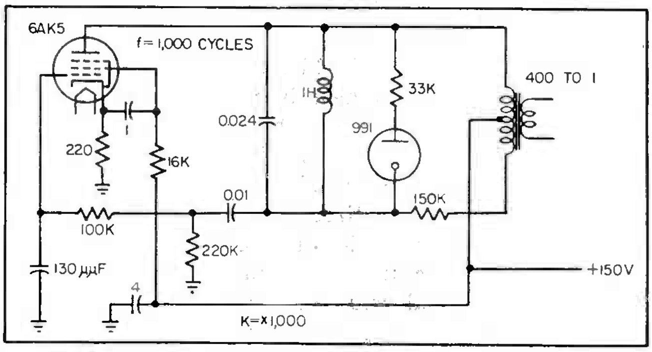


FIG. 5—Single-tube exciting oscillator has low-impedance output and excellent level stability

jection filter is necessary between the output of the excitation source and the magnettor to reduce the spurious second harmonic reaching the useful output circuit.

Good regulation or level stability of the excitation source is essential in order to realize the minimum noise from magnettors.

A single-tube oscillator combining the attributes of low output impedance (less than 10 ohms) and excellent level stability is shown in Fig. 5. The power output is around 10 milliwatts.

Output Filters

Two factors determine to a large extent the requirements for the output filter used with a magnettor. First, the bandwidth must be adequate to handle the sidebands corresponding to the highest signal input frequency. Second, the discrimination against the excitation frequency and odd harmonics thereof must be sufficient to reduce their contributions to zero offset and noise to acceptable values. The filter may also be designed to fulfill two additional functions—impedance matching to the grid of an electron tube, and providing a series or parallel feed path for the signal input current.

The simplest form of filter capable of meeting these requirements consists of a tuned circuit. For ratios of excitation frequencies of the order of 50 or greater, such simple filters or impedance-transforming pi circuits are quite adequate. For bandwidths in the order of 10 percent of the excitation frequency, band-pass structures are necessary. Care must be exercised to insure that the inductors employed in the filters do not themselves act as magnettors and impair the overall linearity. This can be avoided by using inductors having air cores or suitable magnetic cores exhibiting low modulation.

A phase modulator, as noted previously, is useful for conversion to d-c of the filtered and amplified magnettor output with output polarity corresponding to that of the input. Such a phase modulator is capable of discriminating against unwanted second harmonic voltages in quadrature with the voltages of

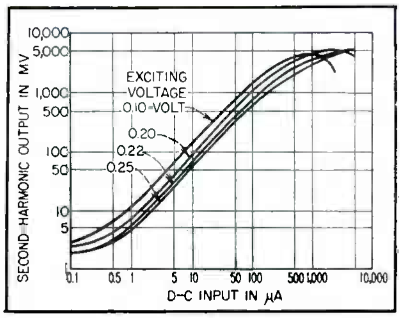


FIG. 6—Curves show linearity between d-c input and a-c output

the same frequency produced by signal inputs.

A magnettor designed for use in an automatic telephone line insulation resistance test set furnishes a practical example of the usefulness of such devices.

Insulation Tester

The requirements for this application called for the linear conversion of signal currents of 1 to 100 microamperes in the frequency range of d-c to 100 cycles. Particularly troublesome to the tube approach were the stipulations that the measuring circuit could introduce no more than 50 ohms resistance in the circuit, and that the entire signal circuit must operate off ground.

The magnettor circuit arrangement of Fig. 4 successfully meets these requirements. A twin-toroidal-core magnettor with single-turn cores, as shown in Fig. 3, is employed. Exciting windings are 200 turns each and the signal windings are 1,000 turns each. The exciting frequency of 1,000 cycles is derived from the single-tube oscillator shown in Fig. 5. The second harmonic output is selected with a filter having a pass band 200 cycles in width.

The d-c input—a-c output characteristics are shown in Fig. 6 for four values of exciting voltage. The slope is about 10 millivolts per microampere corresponding to a transimpedance including filter step-up of 10^4 ohms. The power gain in the magnettor itself is about 6 db. The zero-signal output is equivalent to an input of less than one-half microampere or about 10^{-12} watts. The linearity is excellent from 1 to 100 microamperes and the overload point is greater than 1,000 microamperes. Since the signal input impedance is 30 ohms, the zero-signal residual or offset corresponds to less than 20 microvolts. The signal-frequency response is flat within 3 db from direct current to 100 cycles.

A magnettor of the twin-core type having 70 convolutions in each core and windings similar to that mentioned above was tested with its output connected to a wave analyzer. Excitation was provided by a well-filtered 1,000-cycle oscillator. The second harmonic output into one megohm for a one-microampere signal was 70 millivolts. This corresponds to a transimpedance of 70,000 ohms. The power gain in the magnettor alone was more than 1,000, or 30 db. The zero-signal residual or offset and noise was less than one-tenth microampere or less than 10^{-12} watts. The output was linear from 0.1 up to 100 microamperes. The equivalent output impedance of the magnettor was in the order of 200,000 ohms.

Magnettors offer advantages over other techniques for signal conversion in many applications.

A great deal of exploratory work still needs to be done to realize their full potentialities. However, as a note of caution, prediction of their performance is difficult, and measurements are not easy because of the unusual and changing waveforms encountered and the number of parameters involved. It is hoped that this paper will stimulate activity in this somewhat neglected field.

BIBLIOGRAPHY

E. Peterson, U. S. Patent 1,678,163.

E. F. W. Alexanderson, U. S. Patents 1,206,643 and 1,328,473.

G. W. Elmen, U. S. Patent 1,586,885.

E. T. Burton, U. S. Patent 2,147,688 and 2,164,383.

J. M. Manley, Some General Properties of Magnetic Amplifiers, *Proc. IRE*, **39**, p 242, March 1951.

P. H. Dowling, U. S. Patent 1,739,579.

C. W. La Pierre, U. S. Patent 2,053,154.

O. W. Livingston, U. S. Patent 2,450,286.

F. C. Williams and S. W. Noble, The Fundamental Limitations of the Second Harmonic Type of Magnetic Modulator as Applied to the Amplification of Small D-C Signals, *Proc. IEE, Part II*, **97**, p 445, Aug. 1950.

W. A. Geyger, *Archiv f. Technisches Messen*, **634-4**, p T22, Feb. 1949.

Gunnar Wennerberg, A Simple Magnetic Modulator for Conversion of Milliovolt D-C Signals, *Electrical Engineering*, **70**, p 144, Feb. 1951.

E. P. Felch, W. J. Means, T. Slonczewski, L. G. Parratt, L. H. Rumbaugh and A. J. Tickner, Airborne Magnetometers for Search and Survey, *Trans. AIEE*, **66**, p 641, 1947. Abridged, *Electrical Engineering*, **66**, p 680, 1947.

E. P. Felch et al U. S. Patent 2,488,389.

Broad-Banding

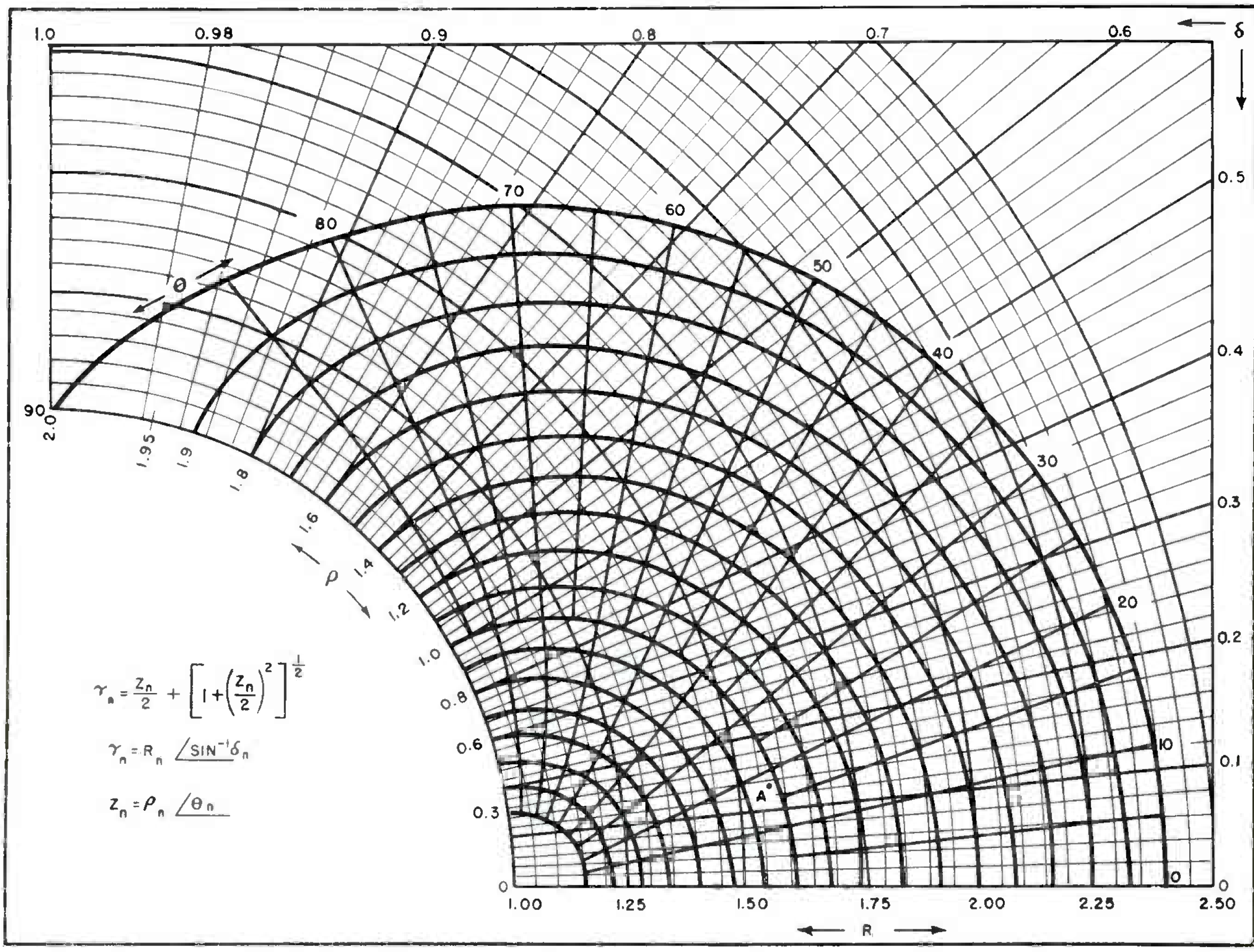


FIG. 1—Plot of Eq. 1 covering the range of ρ_n from 0.3 to 2.0 and θ_n from 0 to 90 degrees. Values of θ_n from 90 to 180 degrees are geometrically symmetrical

By ROLAND C. WITTENBERG

Airborne Instruments Laboratory, Inc. Mineola, N. Y.

INCREASING developments in electronics, such as radar and television, require numerous applications of wide-band i-f amplifiers.

This article with the aid of nomographs and charts, simplifies the design calculations of two types of stagger-tuned i-f amplifiers, that is, the Butterworth (or maximally flat) response and the Tschebycheff (or equal-ripple) response. Provisions are made for bandwidths up to twice the center frequency and for two-pole to six-pole staggers.

The usual method of design is to calculate the equivalent low-pass poles (or resonant frequencies and their damping factors) and then transform these poles to their desired band-pass values by

$$\gamma_n = Z_n/2 + [1 + (Z_n/2)^2]^{\frac{1}{2}} \qquad (1)$$

where

$Z_n = \rho_n \angle \theta_n$ (2)

$\gamma_n = R_n \angle \sin^{-1} \delta_n$ (3)

$R_n = f_n/f_o$ (4)

$2\delta_n = B_n/f_n$ = damping factor of band-pass pole (5)

ρ_n = magnitude of low-pass pole

θ_n = phase angle of low-pass pole

f_n = frequency of nth pole (or stage)

B_n = bandwidth of nth pole

Equation 1 is plotted in Figure 1. This chart covers a range of ρ_n from 0.3 to 2.0 and θ_n from 0 to 90 degrees. For values of ρ_n less than 0.3, the approximations (Eq. 20 and 21) for Equation 1 result in more accurate values. The values of θ_n from 90 to 180 degrees are not necessary because of the geometric symmetry exhibited by the band-pass poles for both the Butterworth and Tschebycheff type of stagger. This fact is used to reduce the number of calculations. For N poles:

$R_{N+1-n} = 1/R_n$ (6)

$\delta_{N+1-n} = \delta_n$ (7)

where n is a particular stage of an N-uple stagger, $n = 1$ is the highest frequency of the N-uple, and $n = N$ is the lowest frequency of the N-uple. Another saving is for the case where N is odd. The center pole (ρ_c, θ_c) is always at 90 degrees ($R_c = 1.00$) and δ_c is equal to $\rho_c/2$.

To use the chart in Figure 1, the

by Stagger Tuning

Simplified design calculations use nomographs and tables to compute either Butterworth or Tschebycheff-response stagger-tuned i-f amplifiers. Resultant wide-band circuits for radar and television have practicable conformations, and employ noncritical components

low-pass equivalent pole is calculated in a vector form ($\rho_n \angle \theta_n$). Then simply go into the chart to the point representing this vector and read off the corresponding values of R_n and δ_n. The actual frequencies and bandwidths can then be found from Eq. 4 and 5.

The following definitions are for both the Butterworth and the Tschebycheff type of stagger.

f_u = upper frequency of pass band
f_L = lower frequency of pass band
$f_o = (f_u f_L)^{\frac{1}{2}}$ = center frequency (geometric) (8)
$\alpha = (f_u - f_L)/f_o$ (9)

The first type of design is the Butterworth or maximally flat stagger. It has the response shown in Fig. 2. The normalized gain (G_o), as a function of frequency, is of the form

$$G_o = 1/(1 + x^{2n})^{\frac{1}{2}} \quad (10)$$

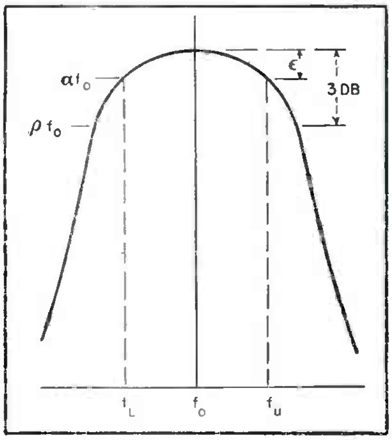


FIG. 2—Response of a circuit with Butterworth or maximally flat stagger

where

$$x = \frac{1}{\alpha}\left[\frac{f}{f_o} - \frac{f_o}{f}\right] \quad (11)$$

Equation 11 is for the usual case where the amplitude response is down 3 db at $f = f_u$ and $f = f_L$. However, if it is desired to have the response down only ϵ db at f_u and f_L, then α must be increased by a factor $1/y$. Symbol y represents the bandwidth reduction factor and depends only upon N and ϵ. It may be found from the nomograph in Fig. 3. Eq. 11 then becomes

$$x = \frac{y}{\alpha}\left[\frac{f}{f_o} - \frac{f_o}{f}\right] \quad (12)$$

The mean stage gain of a Butterworth staggered amplifier is

$$G = 20 \log \left[\frac{g_m}{2\pi f_o C} \frac{y}{\alpha}\right] \quad (13)$$

where g_m = the tube transconductance

C = the total shunt capacitance

For the Butterworth case

$$\rho_1 = \frac{\alpha}{y} = \rho_2 = \rho_n \quad (14)$$

$$\theta_n = \frac{2_n - 1}{N}\,(90) \text{ degrees} \quad (15)$$

The required values of θ_n are listed in Table I for values of N from 2 to 6.

Butterworth Method

An example of a Butterworth design will be given to clarify the design procedure.

A quintuple stagger-tuned amplifier is required to have a pass band flat within 0.2 db from 20 to 40 megacycles.

$N = 5$
$\epsilon = 0.2$ db
$f_u = 40$ megacycles
$f_L = 20$ megacycles
$f_o = (f_u f_L)^{\frac{1}{2}} = (20 \times 40)^{\frac{1}{2}} = 28.3$ mc
$\alpha = (f_u - f_L)/f_o = (40 - 20)/28.3 = 0.707$
$y = 0.73$ (from Fig. 3)

Therefore $\rho_1 = \alpha/y = 0.707/0.73 = 0.969$

$\rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_5 = 0.969$

From Table I, $\theta_1 = 18°$, $\theta_2 = 54°$, $\theta_3 = 90°$

R_1 and δ_1 can be found from Fig. 1 at point (A) where $\rho_1 = 0.969$ and $\theta_1 = 18$ degrees.

$R_1 = 1.56$ $\delta_1 = 0.135$

Similarly $R_2 = 1.35$ $\delta_2 = 0.370$

ρ_3 is the center pole of an odd N-uple, therefore

$R_3 = 1.00$, and

$$\delta_3 = \frac{\rho_3}{2} = \frac{0.969}{2} = 0.485$$

By symmetry (Eq. 6 and 7)

$R_4 = 1/R_2 = 1/1.35 = 0.742$
$\delta_4 = \delta_2 = 0.370$
$R_5 = 1/R_1 = 1/1.56 = 0.641$
$\delta_5 = \delta_1 = 0.135$

The actual frequencies and bandwidths are found from Eq. 4 and 5

$f_1 = R_1 \times f_o = (1.56)(28.3) = 44.2$ megacycles
$B_1 = 2\,\delta_1 f_1 = 2\,(0.135)\times(44.2) = 11.9$ megacycles

Similarly

$f_2 = 38.2$ mc, $B_2 = 14.1$ mc
$f_3 = 28.3$ mc, $B_3 = 27.4$ mc
$f_4 = 21.0$ mc, $B_4 = 7.8$ mc
$f_5 = 18.1$ mc, $B_5 = 4.9$ mc

POLES

The frequency response of an electrical network can be expressed as the ratio of two polynomials. The roots of the numerator polynomials are called zeros and those in the denominator are called poles. These roots are useful tools in that they completely describe the response of the network. Therefore, knowing these roots, the response of the network can be readily determined. Or, if a given type of response is desired, the response may be broken down into its individual roots (or poles). For a stagger-tuned amplifier each pole can be represented by a single tuned circuit. If the pole is written as a vector quantity, its magnitude represents the resonant frequency and its phase angle is a measure of the damping in the tuned circuit

Assuming 6AK5's are used

$g_m = 5{,}000\ \mu$mhos
$C = 11.0\ \mu\mu$f

The mean stage gain may be calculated from Eq. 13

$$G = 20 \log \left[\frac{(5{,}000 \times 10^{-6})\ (0.73)}{(2\pi)\ (28.3 \times 10^{6})\ (11 \times 10^{-12})\ (0.707)}\right]$$
$$G = 8.4 \text{ db}$$

Since all the tubes are the same, the total gain is five times the mean stage gain or 42 db.

Equal Ripple Method

The Tschebycheff or equal ripple response is calculated by a method similar to that used for the Butterworth response. The gain versus frequency response for this type of design is shown in Fig. 4. The gain variation over the pass band is $\pm\ \varepsilon/2$ or a total of ε db. The number of bumps in the response corresponds to the degree of the stagger.

Since the degree of staggering and the desired gain tolerance are known, the value of sinh β and tanh β can be found from Fig. 5. Now ρ_n can be calculated from the following equation

$$\rho_n = \alpha\ [(\cos \varphi_n)^2 + (\sinh \beta)^2]^{\frac{1}{2}} \qquad (16)$$

Cos φ_n is listed in Table II. (φ_n is the equivalent of θ_n in Table I). The value of θ_n can be found from Fig. 6 using tan ϕ_n from Table II and tanh β.

The center pole of an odd N-uple is simply

$$\rho_c = \alpha \sinh \beta \qquad (17)$$
$$\theta_c = 90 \text{ degrees}$$

With these values of ρ_n and θ_n, the actual frequencies and bandwidths can be calculated in the same manner as for the Butterworth stagger.

The mean stage gain for the Tschebycheff stagger is

$$G_n = 20 \log \left[\frac{g_m}{2\pi f_o C \rho_n}\right] + \frac{1}{2N}\ (-1)^N \epsilon \qquad (18)$$

The total gain is simply the sum of the mean stage gains and for a design using the same tubes throughout (g_m and C are the same for all stages) the total gain becomes

$$G = 20 N \log \left[\frac{g_m}{2\pi f_o C}\right] + 20 \log \left[\frac{1}{(\rho_1)\ (\rho_2)\ .\ .\ .\ (\rho_N)^{\frac{1}{2}}}\right] + (-1)^N \frac{\epsilon}{2} \qquad (19)$$

Where $\rho_{N+1-n} = \rho_n$

As an example of a Tschebycheff design the bandwidth, gain tolerance, and degree of staggering will be chosen the same as for the Butterworth example.

$N = 5$
$\epsilon = 0.2$ db
$f_u = 40$ mc
$f_L = 20$ mc
$f_o = 28.3$ mc
$\alpha = 0.707$

From Fig. 5 for $N = 5$ and $\varepsilon = 0.2$ db

sinh $\beta = 0.46$ tanh $\beta = 0.42$

From Table II for $N = 5$ and $n = 1$

$\cos \varphi_1 = 0.951$, $\tan \varphi_1 = 0.325$

ρ_1 can be found by Eq. 16

$$\rho_1 = \alpha\ [(\cos \varphi_1)^2 + (\sinh \beta)^2]^{\frac{1}{2}}$$
$$= 0.707\ [(0.951)^2 + (0.46)^2]^{\frac{1}{2}}$$
$$\rho_1 = 0.747$$

θ_1 can be found from Fig. 6 using tan ϕ_1 and tanh β

$\theta_1 = 7.7$ degrees

Similarly $\rho_2 = 0.528$ and $\theta_2 = 30$ degrees

ρ_3 is the center pole of an odd N-uple, therefore

$$\rho_3 = \alpha \sinh \beta = (0.707)\ (0.46) = 0.325$$
$$\theta_3 = 90 \text{ degrees}$$

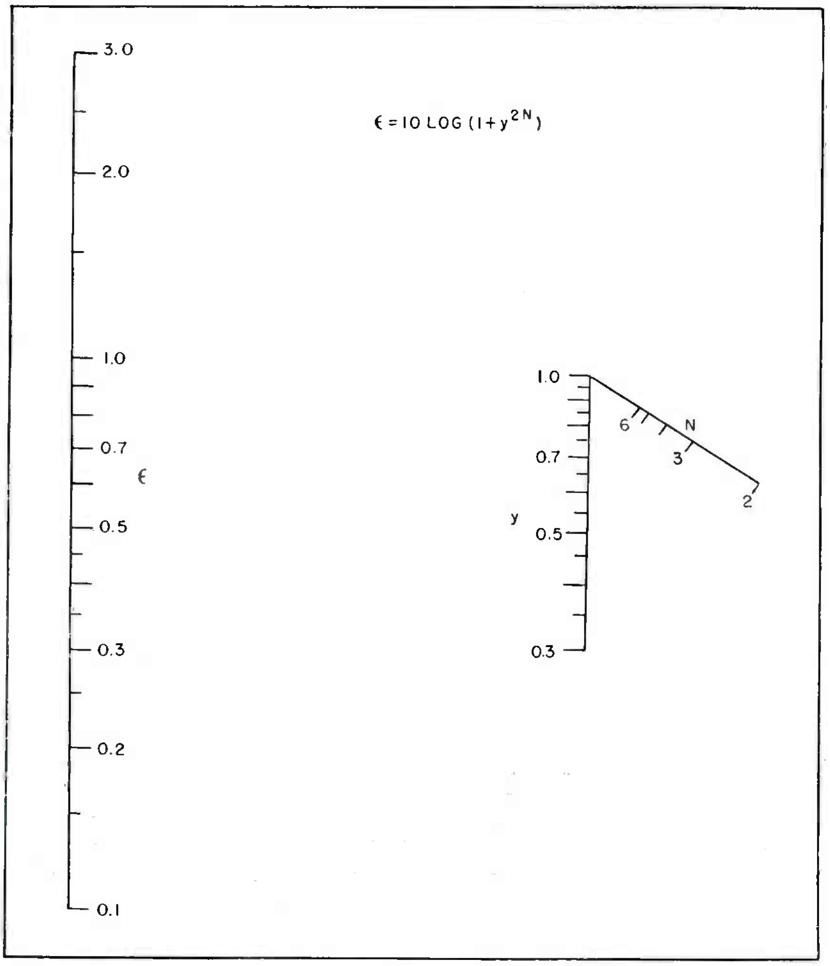


FIG. 3—Nomograph for finding bandwidth-reduction factor y that depends upon the number of poles N and attenuation ϵ for the upper and lower pass-band frequencies

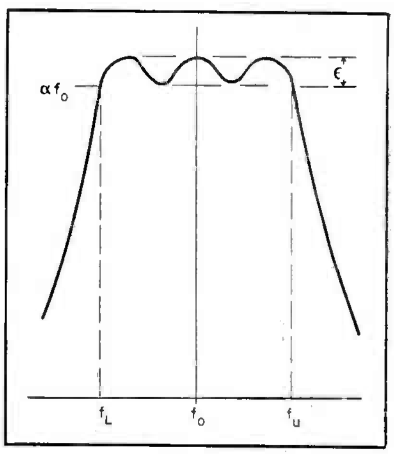


FIG. 4—Gain-frequency response for a Tschebycheff or equal-ripple stagger

Table I—Phase Angle of Low-Pass Pole

N	θ_n Degrees		
	$n = 1$	$n = 2$	$n = 3$
2	45.0	——	——
3	30.0	90.0	——
4	22.5	67.5	——
5	18.0	54.0	90.0
6	15.0	45.0	75.0

Table II—Tan ρ_n Used to Find Φ_n from Fig. 6

N	$n = 1$		$n = 2$		$n = 3$	
	Cos φ_1	Tan φ_1	Cos φ_2	Tan φ_2	Cos φ_3	Tan φ_3
2	0.707	1.00	——	——	——	——
3	0.866	0.577	0	——	——	——
4	0.924	0.414	0.383	2.41	——	——
5	0.951	0.325	0.588	1.38	0	——
6	0.966	0.268	0.707	1.00	0.259	3.73

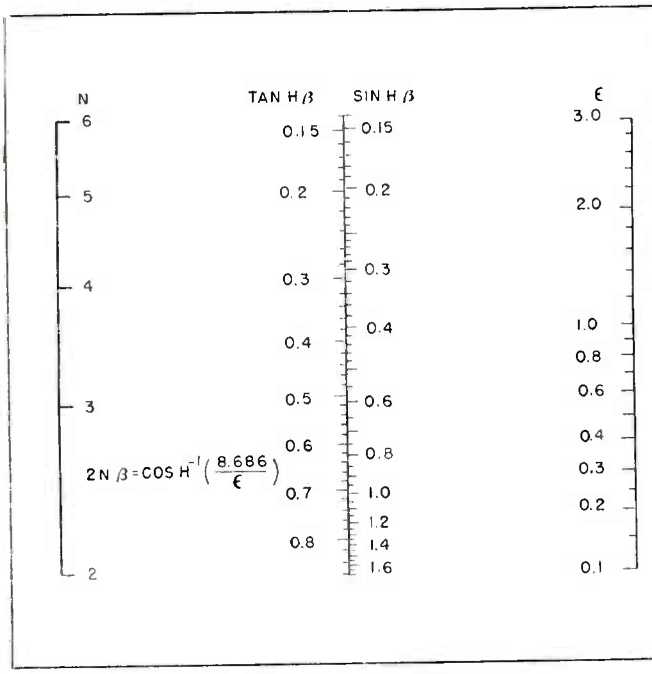


FIG. 5—Intermediate-computation nomograph used to find sinh β and tanh β by the Tschebycheff-stagger technique

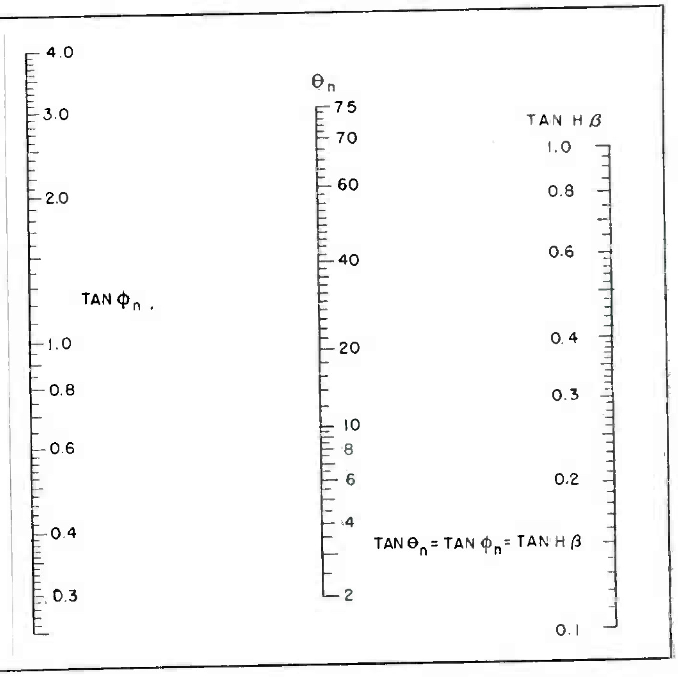


FIG. 6—Determine ϕ_1 from values in Table II and Fig. 5. The value for ρ_1 using the equal-ripple stagger, is found by Eq. 16

Now R_n and δ_n can be found from Fig. 1

$R_1 = 1.43$, $\delta_1 = 0.050$
$R_2 = 1.26$, $\delta_2 = 0.125$
$R_3 = 1.00$, $\delta_3 = \rho_3/2 = 0.163$

By symmetry (Eq. 6 and 7)

$R_4 = 1/R_2 = 1/1.26 = 0.79$,
$\delta_4 = \delta_2 = 0.125$
$R_5 = 1/R_1 = 1/1.43 = 0.70$,
$\delta_5 = \delta_1 = 0.050$

The actual frequencies are found the same way as for the Butterworth response.

$f_1 = R_1 f_o = (1.43)(28.3) = 40.4$ mc
$B_1 = 2\delta_1 f_1 = (2)(0.050)(40.4) = 4.04$ mc

Similarly $f_2 = 35.6$ mc, $B_2 = 8.9$ mc
$f_3 = 28.3$ mc, $B_3 = 9.2$ mc
$f_4 = 22.4$ mc, $B_4 = 5.6$ mc
$f_5 = 19.8$ mc, $B_5 = 1.98$ mc

Using 6AK5's, as in the Butterworth example, the total gain by Eq. 19 is

$$G = (20)(5)\log\left[\frac{5{,}000 \times 10^{-6}}{(2\pi)(28.3 \times 10^{6})(11 \times 10^{-12})}\right] + 20\log\left[\frac{1}{(0.747)(0.528)(0.325)(0.528)(0.747)}\right] + (-1)^5\frac{0.2}{2}$$

$G = 40.7 + 25.9 - 0.1 = 66.5$ db

Cascading Butterworth or Tschebycheff N-uples

If a given stagger (Butterworth or Tschebycheff) is cascaded m times, the gain tolerance is increased m times. Therefore, with the overall gain tolerance given, the gain tolerance ϵ used in the design of the individual stagger is equal to the overall gain tolerance divided by the degree of cascading (m).

When ρ_n is less than 0.3, R_n and δ_n cannot be found by using Fig. 1 because the lines are squeezed. However, they can be found by the approximations of Eq. 1 given below.

$$R_n = 1 + \frac{\rho_n}{2}\cos\theta_n \tag{20}$$

$$\delta_n = \frac{\rho_n}{2}\sin\theta_n \tag{21}$$

After R_n and δ_n are found as shown above, the design is continued in the same manner as if the values of R_n and δ_n were found from Fig. 1.

BIBLIOGRAPHY

S. Butterworth, On the Theory of Filter Amplifiers, *Wireless Engineer*, p 536, 1930.

Courant-Hilbert, "Methoden der Mathematischen Physik", p 75, Springer, Berlin, 1934.

W. H. Huggins, The Natural Behavior of Broadband Circuits, Air Force Cambridge Research Laboratories Report E5013, May 1948.

G. E. Valley, Jr. and H. Wallman, "Vacuum Tube Amplifiers", p 166, McGraw-Hill Book Co., New York, 1948.

H. Wallman, Stagger Tuned I-F Amplifiers Radiation Laboratory, MIT, Report 524, Cambridge, Mass.

Regulated 1,600-Ampere

By A. W. VANCE
and
C. C. SHUMARD

RCA Laboratories Division
Princeton, N. J.

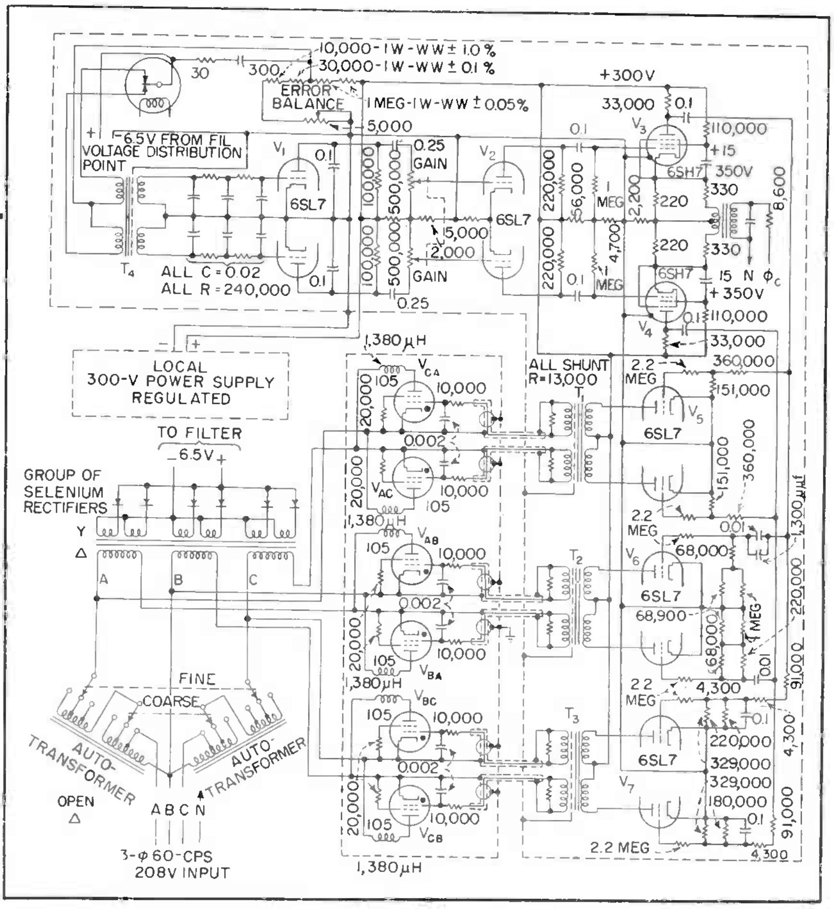


FIG. 1—Circuit used to regulate filament voltage in Project Typhoon analog-digital computer built by RCA for the U. S. Navy

THE POWER SUPPLY to be described was modified from a plating rectifier unit rated at 6 volts d-c at 2,000 amperes, to include a pair of type 105 thyratrons back-to-back in series with each primary of the three-phase transformer, with suitable apparatus for grid phase-control of these thyratrons. The banks of selenium rectifiers were corrected for three-phase full-wave operation and suitable filtering added.

To obtain phase shift for output voltage control, the error signal is chopped at a 60-cycle rate using one phase only on one d-c/a-c converter since a high degree of regulation is not considered necessary. Tube pair V_3-V_4 feeds with equal drive tubes V_5, V_6 and V_7 used as grid limiters. The circuit is so arranged that a sinusoidal voltage introduced into the cathode-to-ground circuit of pair V_3-V_4 produces a voltage across each secondary of the transformers in the output circuits of tubes V_5, V_6 and V_7 of substantially square waveform and of 40 volts amplitude. Tube V_5 operates without phase shift, tube V_6 with 60 degrees leading phase shift and tube V_7 with 60 degrees lagging phase shift.

By reversing a secondary winding of T_2 or T_3 relative to one of T_1, a secondary voltage obtained from T_2 will lag that of T_1 by 120 degrees and that obtained from T_3 will lead that of T_1 by 120 degrees. Thus, when properly related, the six secondaries of T_1, T_2 and T_3 give square waves of equal amplitude and of 60-degree separation. These voltages are of fixed phase relative to the sinusoidal voltage introduced in the cathode circuit of pair V_3-V_4.

Phase shift is now obtained by converting the error voltage, or a difference voltage, from its d-c value to a square-waveform value, filtering it to reduce the harmonics in the network preceding tube V_1, amplifying in V_1, further filtering it in the plate circuit of V_1 and amplifying the substantially sinusoidal voltage of V_2. This resultant sinusoidal voltage is then introduced into the grid-to-ground circuit of tube pair V_3-V_4.

The voltage reference used is obtained from a local regulated +300 volt supply that is itself referenced to a glow tube. The voltage is divided down to operate against the voltage obtained from the filament supply output voltage at the distribution point. Thus, the difference between the reference voltage and the filament voltage is the error voltage. This difference or error voltage is connected between the center arm of the converter contacts and the center-tap of input transformer T_4. Triple shielding on this transformer was used to reduce the magnetic pickup present due to the close proximity of the power transformers.

Figure 2 shows how the error or difference voltage controls the regulation by controlling the firing time of the thyratrons. Since all thyratrons operate identically but 60 degrees apart, only the voltages on a particular thyratron V_{AC} are shown. In the figure only the line voltage e_{AC} is drawn to scale. All phase relations are referenced to this line voltage for convenience. The tube designation V_{AC} is meant to denote that this tube conducts some time while voltage E_{AC} is positive.

For phase rotation, leg voltage *C-N* (e_{CN}) lags line voltage e_{AC} by 30 degrees and leg voltage *A-N* (e_{AN}) lags the *C-N* leg by 120 degrees. Since voltage e_{AC} is going positive, it is desired that the grid

Filament Supply

Moderate degree of regulation required for heating 6-volt filaments of some 4,000 tubes in a computer is provided. Error signal acts through chopper, amplifier and grid limiters to control firing time of thyratrons in primary legs of three-phase transformers

voltage on tube V_{AC} be negative until V_{AC} is to be triggered, at which time it should rise rapidly. Since the square-wave voltage present at the secondaries of transformer T_1 will be in phase with e_{CN}, one of these secondaries is chosen and so polarized that its voltage e_{CN} will go positive at 30 degrees. This will allow conduction of V_{AC} even earlier in the e_{AC} cycle if the output voltage is low, as will be seen.

Now, suppose a positive difference or error voltage exists. Then the polarity is chosen so that an a-c voltage e_{AN} in phase with phase A will be applied in the grid circuit of V_3-V_4. The grid-to-cathode voltage on tube pair V_3-V_4 will now be the algebraic sum of the voltages e_{CN} and e_{AN}, giving voltage e_P. The square-wave voltage e_P' will now be obtained instead of e_{CN}', so that thyratron V_{AC} will be fired 10.9 degrees later.

Actually, a sinusoidal voltage of approximately 110 volts peak to peak is maintained between the plate of V_3 or V_4 and ground. Exaggerated magnitudes of error are chosen for clarity of illustration in Fig. 2 since the principle is the same. Normal regulation occurs at much smaller error amplitude. For example, an error of 0.01 volt introduced across the converter input gives a peak-to-peak sinusoidal voltage of approximately 120 volts between the plate of V_3 or V_4 and ground with no a-c introduced into the cathodes of V_3-V_4.

Thus, if e_{AN} has a maximum amplitude A which is $+0.2\ C$ where C is the maximum amplitude of e_{CN}, the delay angle will be 10.9 degrees. Also, the resulting maximum amplitude of the resultant voltage e_P will be 0.918 C. The square-wave voltage e_P' is then produced by e_P.

Similarly, if the amplitude A is $-0.2\ C$, giving the voltage shown as $-e_{AN}$ corresponding to an error voltage representing too low an output voltage, the resultant sinusoidal voltage shown as eQ will be obtained which will lead e_{AN} by 9 degrees as will the square-wave voltage eQ' produced by eQ. Voltage eQ will then trigger thyratron V_{AC} earlier and therefore increase the output voltage.

While a definite value of line voltage E_{AC} is shown, this voltage is the principal source of variation which requires adjustment of the time of firing to obtain output voltage control. At starting, the line voltages as well as the output voltage are both low, particularly since the coarse autotransformer is used then, hence the phase shift is considerably leading so that the thyratrons are fully conducting throughout the starting period.

An a-c voltmeter is switched across the thyratron pairs to measure and allow adjustment of the regulating voltage E_r appearing across them. For the 30-degree angle shown as the mean position of

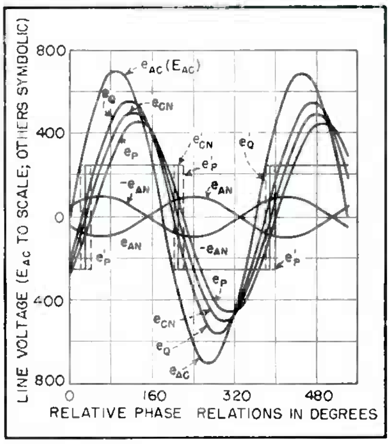


FIG. 2—Firing control curves for one of thyratrons in the circuit

operation in Fig. 2 and the rms value for E_{AC} of $700/\sqrt{2}$ volts, E_r has the value of 84 volts. Actually, for a 1,000-ampere load the measured value of E_{AC} was 495 rms volts and E_r was 70 rms volts. The triggering angle for this condition was therefore slightly less than 30 degrees. The above formula does not take into account tube drop, which is approximately 15 volts during conduction, and waveform distortion which may be appreciable.

To filter the output of the supply, a 0.25-mh reactor having a resistance of 0.1 milliohm and a nominal capacitance of one farad was used. The reactor is of the internal-gap type to minimize external field. The capacitance is considered interesting, not only because of its large value, but also because of the method of mounting the 166 individual capacitors of 6,000 microfarads each on their connecting terminals to minimize lead length. The effective capacitance was greater than one farad in the frequency range where it was desired that it be most effective, due to the inductance of the leads. Measurements at 420 cycles gave an effective capacitance of approximately 1.8 farad and a series resistance of 6.8×10^{-4} ohms.

To test the supply, long strips of Nichrome V four inches wide and 0.03 inch thick were connected in parallel as desired and cooled by fan. After some adjustment of the stabilizing network to the values of 30 ohms and 300 μf shown in series across the error voltage input circuit in Fig. 1, stable regulation was obtained for load values from 25 to 1,680 amperes. The hum level dropped slightly from 4.5 mv for the 25-ampere load to 2.5 mv at full load.

Evaluating Performance

By JULIUS GREEN

Research Division
Philco Corporation
Philadelphia, Pennsylvania

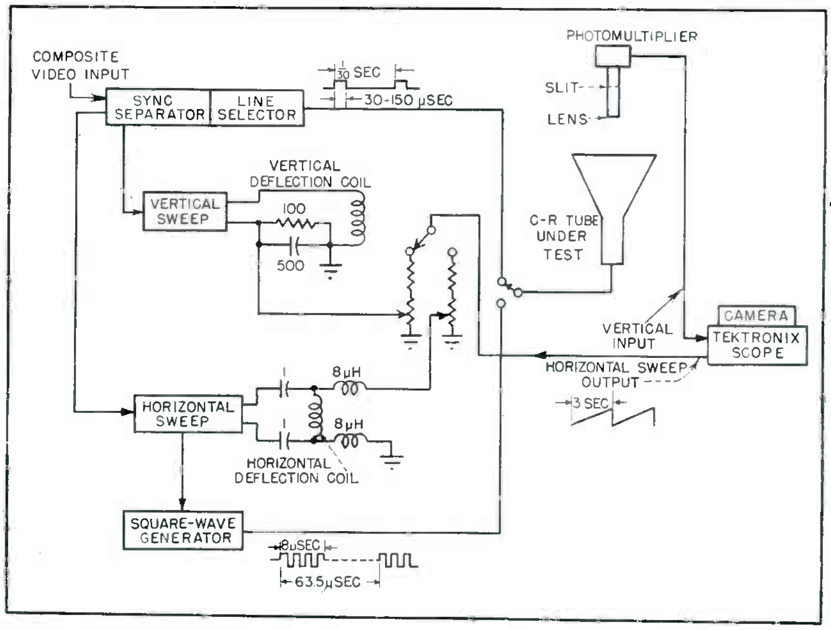


FIG. 1—Block diagram of system for measuring c-r tube spot dimensions under actual operating conditions

TELEVISION receiver performance is and should be evaluated on the basis of the qualitative, subjective judgment of the viewers. However, the engineer attempting to design a component part of the receiver should be provided with a quantitative method for evaluating the performance of each component to avoid the time-consuming, subjective method of evaluating the final picture by viewing.

The performance of the r-f, i-f, video and deflection circuits can be quantitatively evaluated by well-known and convenient methods. Unfortunately, the designer of the display tube and its associated components does not have such convenient methods. The picture brightness and the range contrast can be measured photometrically, but the detail contrast, which largely determines the picture quality, lacks a convenient quantitative method of measurement. The detail contrast is primarily determined by the cross-section of the electron beam striking the phosphor, but it is also affected by halation and diffusion of light in the phosphor. The designers of the electron gun, the focusing device and deflection yoke, and the phosphor would be helped considerably by accurate measurement of the detail contrast at various points of the tube face.

Many present methods of measurement of spot size are based on compression of raster size until the line or dot structure of the raster disappears[1], or on visual inspection using a microscope. These methods suffer from inaccuracy because a certain amount of judgment is required, and they do not take into account the effects of the diffusion disk of the spot and halation on the picture quality.

This paper will describe a method of measurement and an experimental equipment which has been built and used by the Philco Research Division to measure spot size and detail contrast.

Object of Measurements

Since the spot size is of premier importance in determining picture quality, measurement of its dimensions, or its effect, is of primary importance. By spot is meant the spot of light as viewed from the front of the picture tube face. Since the spot may be round only at the center of the tube face, becoming el-

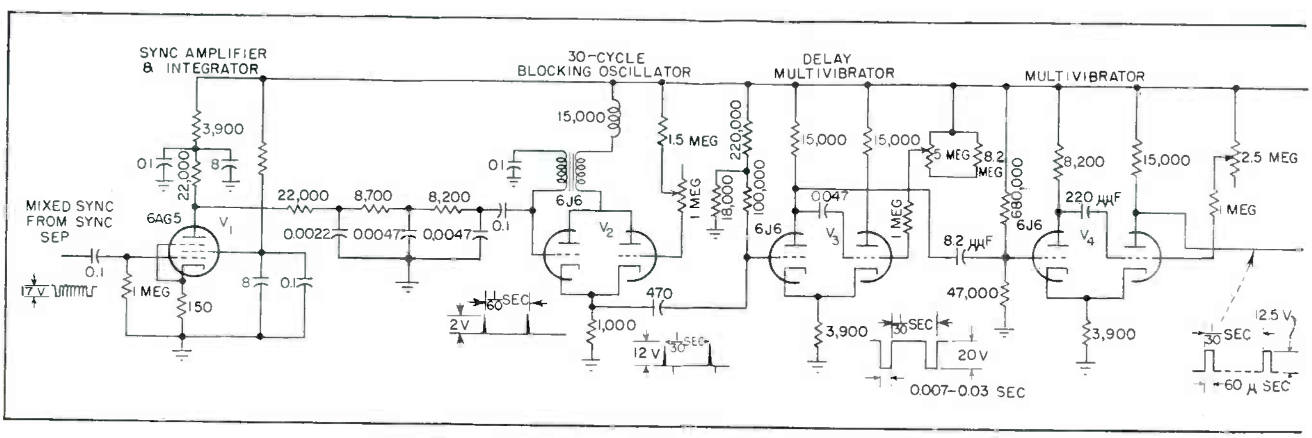


FIG. 2—Line selector unblanks c-r tube to show one line or two adjacent lines for measuring

# of TV Picture Tubes

Accurate measurements of spot dimensions are made under operating conditions for quantitative evaluation of phosphors, electron guns, focus devices and deflection yokes. System makes allowances for effects of diffusion disk of spot and halation

liptical at the edges, at least two dimensions should be specified.

The vertical dimension of the spot, and the distribution of light intensity across it, determine to a large extent the effect of the raster structure on the vertical definition of the picture. This is measured by the subject equipment by erasing all but one line of a horizontal standard monochrome television raster, to eliminate the interfering effects of the adjacent lines, and scanning the line at right angles to its length with a small light-measuring aperture, thus obtaining a plot of light intensity against vertical distance across the line.

The horizontal dimension of the spot primarily determines the horizontal definition of the picture. It would therefore be desirable to measure the distribution of light intensity across the width of the spot. In the subject equipment however, it has proved technically simpler to measure the horizontal definition directly, thus measuring the effect of the horizontal size of the spot rather than the size itself. This is accomplished by applying to the crt grid a signal from a gated square-wave generator such that when the tube is deflected in the standard manner, a series of vertical bars of light of variable fineness is produced on the face of the tube. This pattern is then scanned at right angles to the bars by a small light-measuring aperture, producing a plot of light intensity versus distance across the bars. From data taken in this manner, the drop in contrast, or the loss of definition, as the bar pattern becomes finer, is easily obtained.

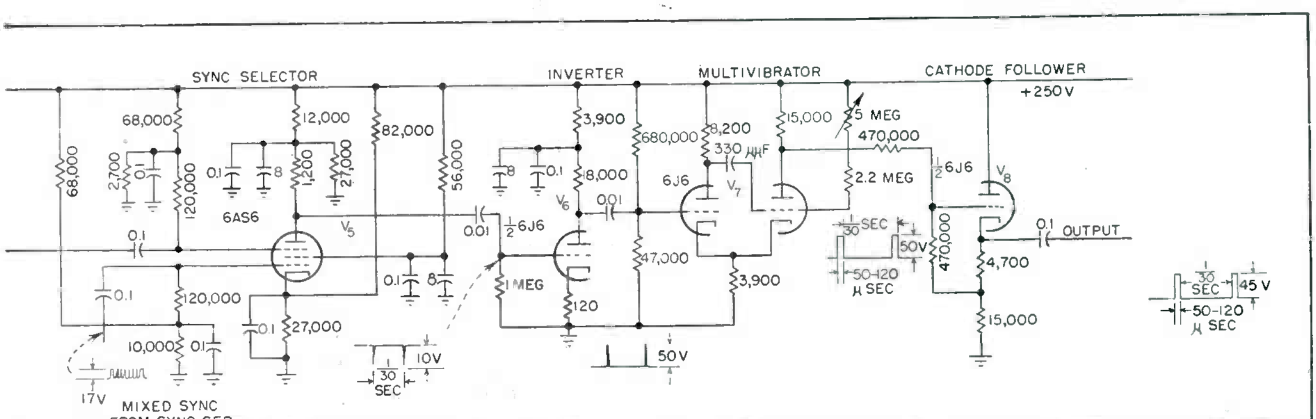
Equipment Used

The block diagram of the complete equipment is given in Fig. 1. Inasmuch as most of the equipment built was of standard design, circuit diagrams will be given only for the more novel parts of the system. As shown, provision is made for application of low-frequency voltage to either the horizontal or the vertical deflection coils, causing the entire raster to move slowly either horizontally or vertically.

Mixed sync from the sync separator is fed to the line selector whose circuit is given in Fig. 2. After amplification and integration by V_1, the resultant vertical sync triggers a 30-cps blocking oscillator V_2. The positive cathode pulse triggers the cathode-coupled multivibrator V_3, whose on time can be varied from 10 milliseconds to 1/30 second. The pulse obtained by differentiation from the trailing edge of this pulse triggers a 60-μsec cathode-coupled multivibrator V_4. This signal is applied to the suppressor of the gate tube V_5, and selects any one horizontal sync pulse from the composite sync applied to the grid.

The selected sync pulse is inverted and amplified by V_6 and triggers V_7, a cathode-coupled multivibrator whose on time is variable from 50 to 120 microseconds. The resulting positive pulse is fed to the cathode follower V_8 and is the output of the circuit.

When this pulse is applied to the c-r tube biased below cutoff and deflected in standard television fashion, the result on the face of the tube is one or two lines of either field of the scan, which may be positioned at any spot on the raster by varying the on-time



vertical spot dimension and for making positive focus adjustments

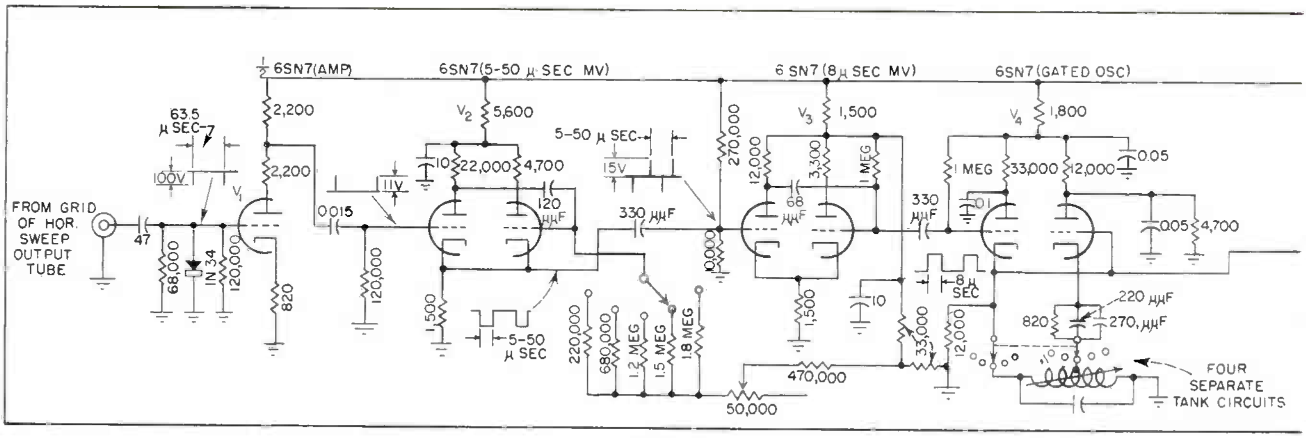


FIG. 3—Square-wave generator output applied to c-r tube grid produces

of the delay multivibrator V_3.

The same result may be achieved without V_5, V_6 and V_7 but this part of the circuit materially increases stability.

Square-Wave Generator

The square-wave generator is keyed by pulses derived from the grid of the horizontal sweep output tube as shown by the circuit of Fig. 3. The 1N34 crystal diode shorts out the positive part of the waveform as shown. After inversion by V_1, the pulse triggers multivibrator V_2, which produces on its cathode a negative pulse that can be varied in width from 5 to 50 μsec. The differentiated trailing edge of this pulse triggers the 8-μsec multivibrator V_3. The negative output pulse is fed to gated oscillator V_4.

This circuit is essentially a Hartley oscillator with a normally conducting triode across the tuned circuit whose low resistance prevents oscillation. When the damping triode is cut off by the 8-μsec pulse, oscillation takes place. The 8-μsec burst of oscillation is fed via buffer amplifier V_5 to clipper tubes V_6 and V_7. These tubes have positive bias on the grids, to offset the self-bias developed by the excessive drive and maintain proper clipping action. The output of V_7, a burst of square waves, is amplified by the video amplifier, V_8, V_9 and V_{10}.

If the output of the amplifier is applied to the grid of a normally deflected c-r tube, the result will be a series of vertical bars. Four switchable tank circuits are provided for the gated oscillator, so that its frequency can be varied from 1 to 5.65 mc thus varying the fineness of the bars. By changing the on time of V_2, the bars can be moved to any horizontal position on the raster.

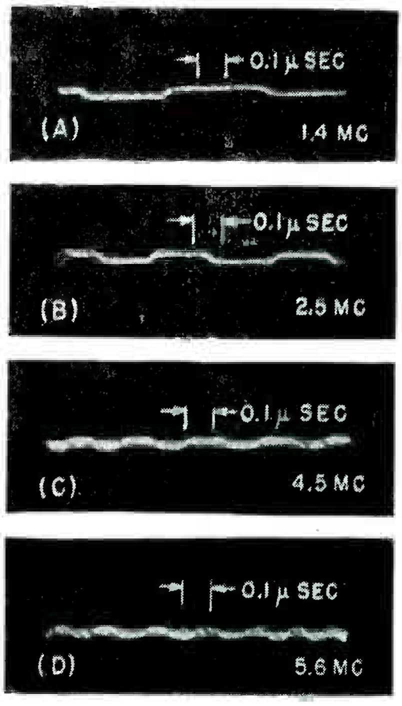


FIG. 4—Oscillograms of square-wave generator output

Figure 4 shows the output waveforms taken with a low-capacitance probe connected directly to the deflection plates of an oscilloscope.

Optical System

The optical system consists essentially of a microscope objective lens, a slit of adjustable width and an eyepiece. The distance from lens to slit and from slit to eyepiece are variable. The assembly is mounted on a microscope stand and may be rotated 90 deg about an axis parallel to the optical axis of the system. By varying the lens-slit separation, the magnification may be varied from approximately 3 to 6.

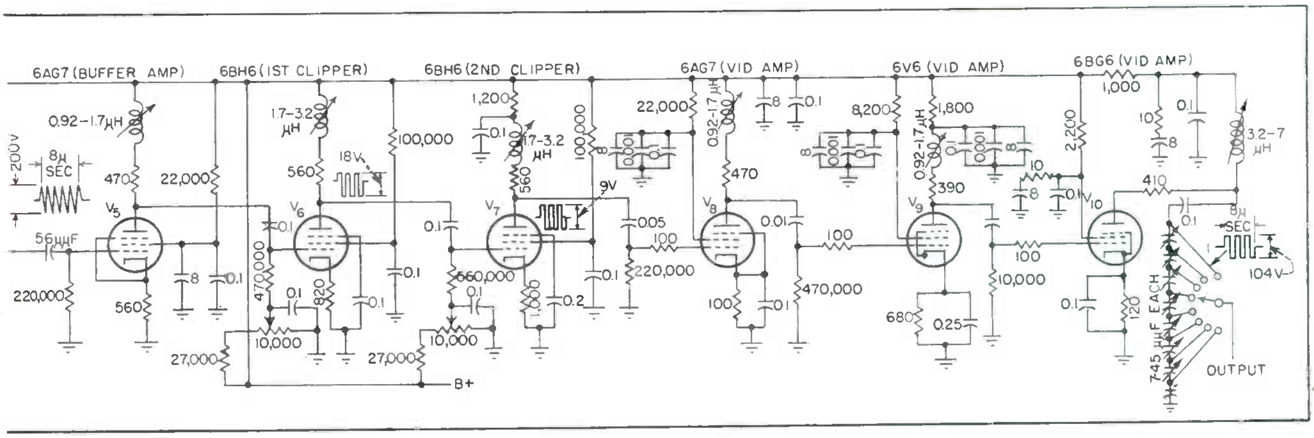
The eyepiece is used to focus the optical system on the phosphor of the c-r tube being investigated. It is then replaced by a 931A photomultiplier, in a light-tight housing, for measurements. The area viewed by the photomultiplier is rectangular in shape. In most measurements, the slit width is set so that the smaller dimension of area is theoretically 0.0004 inch. Actually due to light scattering at the lens surfaces, it is approximately 0.0008 inch.

Line-Width Measurement

In making line-width measurements, the optical system is aligned so that the slit is parallel to the lines of the raster and an enlarged image of the phosphor is focused on the slit.

The sweep output terminal of a Tektronix 512 oscilloscope provides a waveform identical with the horizontal deflection of the oscilloscope. This is applied to the vertical deflection coil of the tube under test, thus causing the entire raster to move vertically in sawtooth fashion, in synchronism and correspondence with the horizontal deflection of the oscilloscope spot, at a ⅓-cps rate. The line selector is used to blank out all of the raster but the one line viewed by the optical system. The photomultiplier output is connected to the vertical deflection amplifier of the oscilloscope.

Figure 5 clarifies the line-width measurement technique. The dotted



vertical bars of adjustable fineness for determining horizontal dimension of spot

rectangles indicate the successive relative positions of the inspection aperture and the raster line at the times when the deflected spot is writing the raster line. The number of looks per 3-second scan of the line is usually much greater than shown. It can be seen that the line is effectively scanned by the slit aperture and the envelope of the pattern on the oscilloscope is a plot of light intensity vertically across the line, with light intensity as ordinate and distance as abscissa. The pattern may then be photographed using a 3-sec time exposure. To improve the presentation, the base line of the oscilloscope, which would otherwise be very bright, is erased by applying the amplified photomultiplier signal to the cathode of the oscilloscope crt.

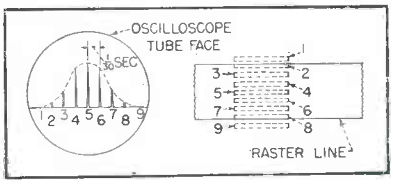


FIG. 5—Simplified representation of line-width measuring technique

The base line is restored to the photograph by another exposure with no photomultiplier output.

Calibration

To calibrate the photograph with respect to distance, a companion photograph of two lines is taken under identical conditions. The distance between the peaks is then 1/245 of the raster height, for a standard television raster.

Figure 6 shows the results obtained with a four-inch tube usually used in flying-spot scanners and projection television. From these photographs, the line width, or vertical spot dimension is easily obtained.

The critical nature of the focus adjustment is well illustrated by Fig. 6. It was found in the course of the work that it was necessary to adjust the focus current using the pattern on the oscilloscope as the criterion. The long persistence of the scope P-7 phosphor helps this adjustment.

Measurements have shown that the spot does not have the usually assumed ϵ^{-x^2} distribution of intensity. The distribution usually is more nearly the form

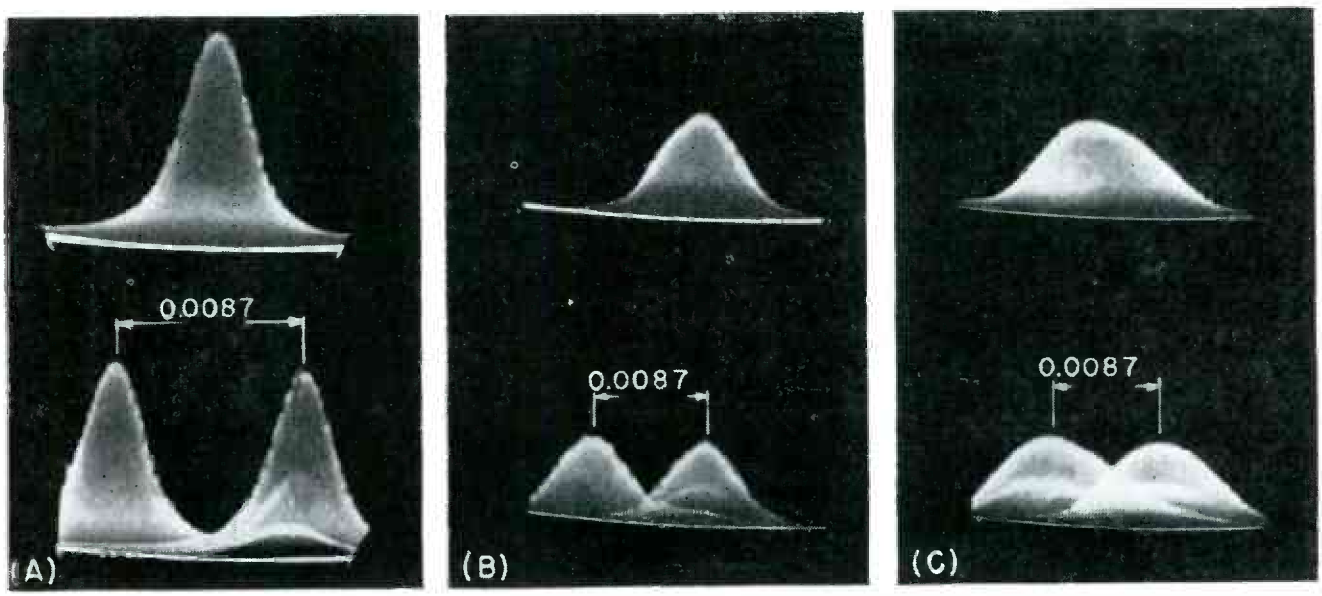


FIG. 6—Oscillograms showing vertical distribution of light intensity for a single line and for two adjacent lines on a TP-400A projection tube. Focus currents are A, 39 ma; B, 38 ma, and C, 40 ma. Comparison shows importance of correct focus current

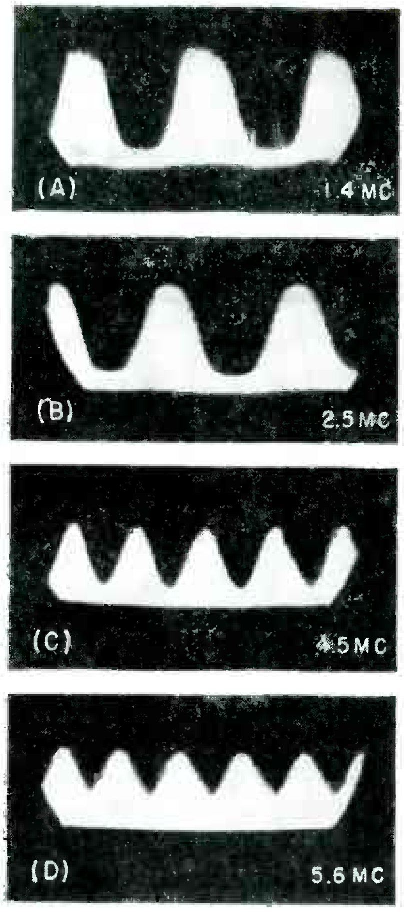


FIG. 7—Oscillograms show horizontal resolution resulting from square wave of four frequencies being applied to grid of a 16WP4 picture tube. At low frequencies, output is approximately square, but at 5.6 mc, considerable rounding off has occurred

$$A\epsilon^{-(K_1 x)^2} + B\epsilon^{-(K_2 x)^2}$$

where A and K_1 are respectively several times larger than B and K_2. It is not clear whether the tails indicated are due to the electron beam distribution or to light diffusion in the phosphor.

Contrast Measurements

In measuring contrast versus line number, the square-wave generator output is applied to the grid of the c-r tube under test. The optical system is focused on the phosphor as before with the slit now parallel to the vertical bars. The oscilloscope sweep output terminal is connected to the horizontal deflection coil of the tube under test causing the raster to move horizontally in a sawtooth fashion past the optical system. The result is a plot of light intensity versus horizontal distance. A typical result is shown in Fig. 7.

Aperture Theory

In understanding the origin and significance of these measurements, a brief simplified summary of aperture theory is helpful. Consider an illuminated pattern of black and white bars viewed by reflected light. Let us move a small square inspection aperture over and at right angles to these bars, and plot the total light flux from the pattern passing through the aperture versus time (Fig. 8). If the aperture is infinitesimally small compared to the bars, the resultant plot is almost exactly the brightness of the bars versus distance. As the bars become finer and comparable to aperture width, the plot becomes a poorer reproduction of the pattern. It can readily be seen that the effect of any aperture on the reproduction of the pattern can be summarized by a curve of $\psi_{max} - \psi_{min}$ versus δ/A or, normalizing, a curve of $\frac{\psi_{max} - \psi_{min}}{(\psi_{max} - \psi_{min})_o}$ versus δ/A where $(\psi_{max} - \psi_{min})_o$ is the difference in peak flux obtained for bars very large compared to the aperture. Furthermore, these curves can be calculated for various shaped apertures with nonuniform transmission[2].

Bar Patterns

The same concepts can be applied to a bar pattern painted on a surface by an aperture turned on and off in square-wave fashion and moved across the surface, provided that conditions are such that the surface integrates: that is, the brightness of a point on the surface is proportional to the time integral of the painting flux which has hit it. Since it is a fair assumption that a commercial television c-r tube satisfies this condition, it should then be possible to specify the size and shape of the painting aperture, the light spot, by obtaining the

$$\frac{B_{max} - B_{min}}{(B_{max} - B_{min})_o}$$

curve where B is the brightness of the phosphor and the subscript o refers to the condition where the bars are much larger than the light spot. It should be noted, however, that this curve describes completely the effect of the light spot on the square-wave information to be painted on the face of the tube.

Furthermore, this curve, which, after Schade, we call the amplitude response curve, is comparable to a frequency response curve which would be obtained by inserting at the input of a video amplifier a square wave of fundamental frequency f and measuring the peak-to-peak voltage output as f is increased: that is, the square-wave frequency response of the amplifier. In this way, physical apertures and amplifiers have similar effects on signal information passed through them.

Typical Case

To illustrate, consider the subject system. For simplicity, we shall employ square apertures of uniform transmission. The square wave emerges from the square-wave generator with a rise time of approximately 0.03 μsec. The spot on a 16-inch standard television tube with a 13.7-inch wide raster, moves horizontally at a rate of 0.24-inch per μsec or 0.0072-inch in 0.03 μsec. We can, therefore, consider the square-wave generator as a square aperture of 0.0072-inch width through which we have passed the ideal square wave before applying it to the c-r tube.

Since the aperture or light spot of the usual 16-inch tube is several times larger than 0.0072 inch, the effect of the square-wave generator aperture is negligible by comparison.

Similarly, the effect of the optical system aperture, approximately 0.0008-inch wide, is negligible, and the predominant deterioration of the pattern obtained and photographed on the face of the oscilloscope is due to the light spot of the c-r tube under test. The situation is exactly analogous to taking the frequency response of several cascaded low-band-pass amplifiers where the frequency response obtained is that of the amplifier with the band pass much narrower than the others.

The data of Fig. 7 were taken with the square-wave generator output adjusted so that the cathode current of the c-r tube under test was driven from the indicated peak value to zero. Since the bars of Fig. 7A are much wider than any reasonable value for the spot size, one would expect B_{min} to be zero. This is obviously not the case. Halation maintains the minimum brightness value and thus lowers the detail contrast regardless of the spot size[3].

As illustrated in Fig. 7B, C and D, however, the square wave begins to lose its shape due to the spot size and the contrast also decreases due to spot size. The likeness of the tube to a low-band-pass filter is indicated by the fact that only the fundamental component of the higher frequency square waves is reproduced.

The amplitude response curves from the data of Fig. 7 are shown in Fig. 9. The abscissa here is the number of vertical black or white bars which could be placed on the full raster of the tube; that is, the line number equals the horizontal sweep time, 53.5 μsec, multiplied by twice the square-wave fundamental frequency. Because of the halation and the nonlinear input grid characteristics, the horizontal spot size and shape cannot be inferred from these curves. However, they are in themselves of value in that they completely describe the effect of the tube under test on square-wave patterns of various fineness.

The gated square-wave signal, suitably attenuated, can be inserted at the video amplifier input of a television receiver, thus ascertaining the effect of the video amplifier on the final pattern reproduction, or it can be used to modulate signal generators for insertion in the receiver r-f or i-f sections. By comparing the various results obtained, one could evaluate the effect of the various sections on the definition of the final picture.

It should also be noted that a gated sine wave signal could be used instead of the square wave signal for all these tests.

The effects of astigmatism or edge defocusing on the picture can be evaluated by measuring the line width and the amplitude response curve at various points on the c-r tube and comparing to the results obtained at the center.

Conclusions

This method provides a permanent quantitative record of the filter characteristics of a c-r tube assembly. It can be used to determine the effect of changes in the design of the electron gun, focus device, deflection yoke or phosphor on some of

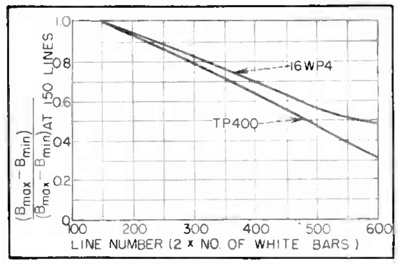


FIG. 9—Measured amplitude response curves obtained with equipment described

the dominant factors which influence television picture quality.

It should be noted that any c-r tube testing setup can be adapted to take these measurements. A line selector, a gated square or sine-wave generator, a modified microscope and a Tektronix Model 512 oscilloscope with a suitable camera are the only additional equipment needed. The stability of the deflection circuits must be very good to prevent considerable error in the measurements.

Acknowledgements

The construction of the apparatus was originally suggested by H. A. Affel, Jr. Among those who contributed to the design and construction are A. Cavalieri, H. B. Collins, Jr. and G. Turin.

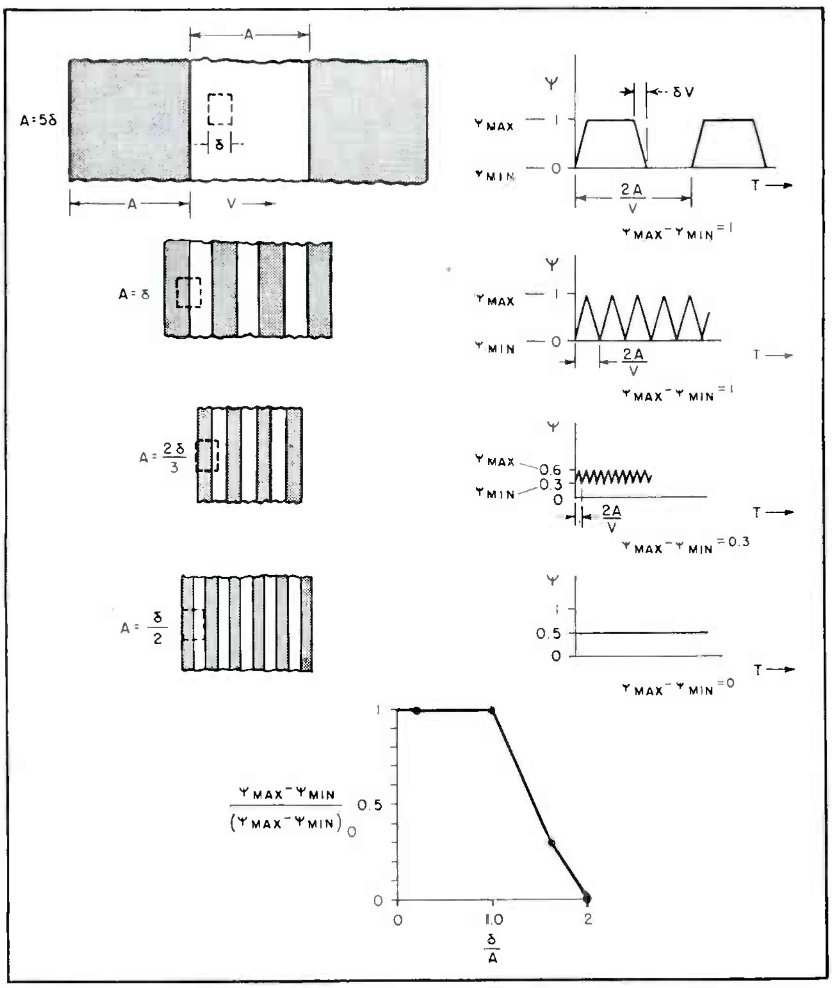


FIG. 8—Aperture method of studying picture quality

References

(1) Soller, Starr, Valley, "Cathode Ray Tube Displays," Vol. 22, Radiation Laboratory Series, McGraw-Hill Book Co., Inc., N. Y.

(2) O. H. Shade, Electro-Optical Specifications for Television Systems, *RCA Review*, p 245, June 1948.

(3) R. R. Law, Contrast in Kinescopes, *Proc. IRE*, p 511, Aug. 1939.

Microwave Antenna

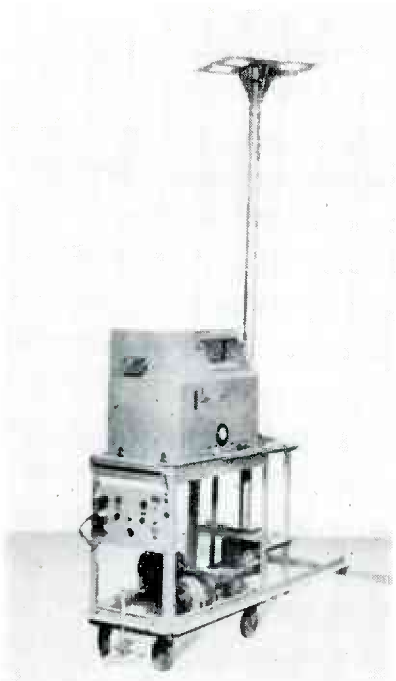


FIG. 1—Antenna sits on rotating platform which turns with recording drum

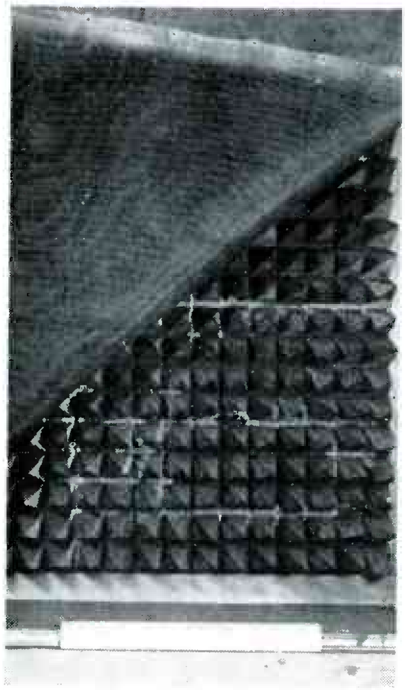


FIG. 2—Special absorbing screen eliminates reflections

By JOHN W. TILEY

Research Division
Philco Corporation
Philadelphia, Pennsylvania

TO OVERCOME the inherent time-consuming process of recording antenna patterns manually, without requiring unnecessarily expensive equipment, a compact, automatic antenna pattern recorder has been developed. The instrument is shown in Fig. 1.

Careful mechanical and electrical design has made it possible to record satisfactorily a complete 180-degree curve in two minutes, a speed which is adequate for present applications. Transmitter power level changes or frequency drifts are not likely to be appreciable in a two-minute period. Provisions are also made for minimizing energy radiated from surrounding objects.

Location of Equipment

In determining a suitable location for the transmitting antenna, reflecting surfaces must be avoided. Since the receiving antenna is to be tested, the transmitter is fixed, but the location is usually such that a portion of its energy is reflected and thus arrives at the receiving antenna at a small angle. In this

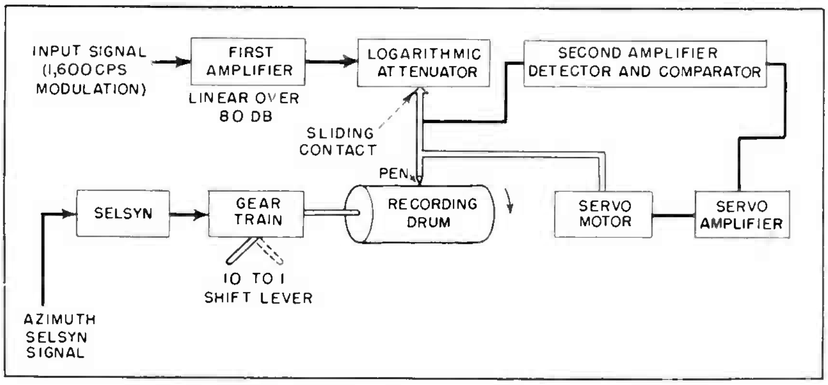


FIG. 3—Block diagram shows pen-drive servo system

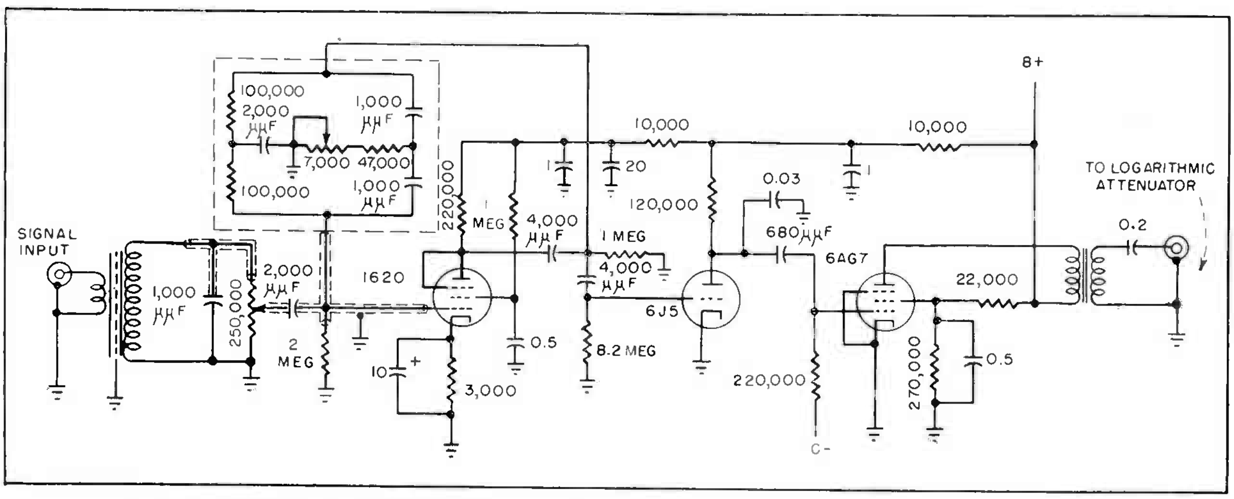


FIG. 4—First amplifier receives signal from bolometer detector and passes it to logarithmic attenuator

Pattern Plotter

Furnishing a complete pattern in two minutes, this automatic instrument turns antenna platform and recording drum in synchronism, while detector-amplifier-servo system drives recording pen in accordance with variations in received energy. Special absorbing surface eliminates interfering reflections

case it would be impossible to achieve accurate antenna gain measurements since the standing waves due to the sum of the two different beams add up to different energy levels in the receiving area as the plane of the antenna is changed. The actual effect on the antenna pattern would be to render the results below the major lobe inaccurate, the degree of inaccuracy being dependent on the power level and direction of such extraneous radiation.

To increase the accuracy of the results, an r-f probe is used to determine the energy levels over the receiving area. Where standing waves of any appreciable magnitude exist, the transmitting antenna must be changed. Probing is done in the absence of the receiving antenna to eliminate this cause of field distortion.[1]

When approximate tests of antenna patterns are made in the laboratory, greater freedom from reflection has been made possible by the development of a black absorbing surface.[2] This unit is able to absorb energies from 3,000 mc to at least 30,000 mc. The vswr of an antenna looking into this surface is approximately 1.05 to 1 over the above frequency range with the protective plastic screen in place.

A portion of the absorbing screen is shown in Fig. 2. The screen consists of 1½-inch square pyramids 6 inches high which are cast from a mixture of lamp black and plaster of paris in sections 18 by 3 inches and assembled in a wood frame six feet square. During measurements the screen is placed behind the receiving antenna being tested so that energy passing the test antenna will not be reflected back and cause erroneous results.

Servo System

Recording of the antenna pattern is accomplished by means of the electromechanical system shown in Fig. 3. It consists essentially of a first (bolometer) amplifier which receives a signal from the bolometer detector and passes it through the logarithmic attenuator into the second (potentiometer) amplifier where the signal level is increased so that it may be detected.

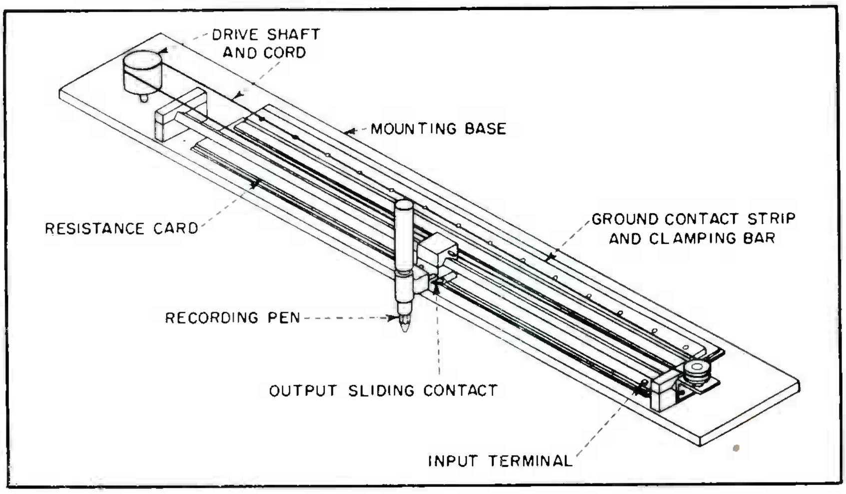


FIG. 5—Attenuator is calibrated within 0.1 db over the top 30 db of the full 40-db range

After detection the signal is applied through a bridge to the servo amplifier, amplified and applied to the servo motor which is connected through a string drive to the recording pen and logarithmic attenuator, thus completing the circuit. All time constants throughout the system must be fast with respect to the mechanical time constant of the servo motor since it is the motor which determines the speed of recording.

The first amplifier, shown schematically in Fig. 4, must have an output range of greater than 80 db. This is necessary as the square-law detector output voltage is proportional to the r-f input power, thus requiring the amplifier to have twice the range that is recorded. To achieve this range, power supply ripple or line noise feed-through must be minimized. The input transformer must be located in an area free from a-c magnetic fields; grid bias voltages must be kept free from a-c from the power supply or from other amplifiers; and suitable shields must be inserted where necessary.

The first amplifier uses a twin-T feedback network, but differs from the ordinary bolometer amplifier in that moderate output power is required to drive the 600-ohm logarithmic attenuator. The pass band of the twin-T must be wide enough to allow transmission of the sharp peaks or valleys in the pattern.

Attenuator

The logarithmic attenuator, shown in Fig. 5, has a low impedance so that stray pickup and drift may be minimized. It consists of a resistance card with a bar attached along one side and a pickup probe that slides along the other side parallel to the bar. The input terminal is attached to a point in line with the pickup probe path. Adjusting fingers are provided at points along the bar so errors due to slight nonlinearity of the first amplifier, variations of resistance in the card and other minor sources may be reduced.

When a signal generator and an accurate attenuator are used as a calibrating means, it is possible to adjust the accuracy of the attenuator over the top 30 db of the complete 40-db range within 0.1 db; the accuracy of the lower ten db is usually limited by local noise. When the maximum signal is applied the actual attenuation will be 80 db.

Second Amplifier

The main function of the second amplifier (Fig. 6) is to increase the signal to a reasonable level for detection. The 1-millivolt input signal is thus amplified to a level of one or two volts before it is detected. To reduce contact noise, this is a twin-T type of feedback amplifier.

The 1N34 germanium detector is followed by half a 6SN7 used as a cathode follower as shown in Fig. 6. The d-c output level is adjusted to the input requirements of the servo amplifier by means of the network in the cathode circuit of the 6SN7. A constant d-c voltage of suitable level is provided by a voltage-dropping network.

The d-c signal is chopped in the servo amplifier at a 60-cycle rate, amplified and fed to the servo motor. Since the drive motor determines the recording speed, its speed may be reduced to record extremely sharp peaks or valleys. All time constants in the amplifier in the servo loop are small with respect to the time constant of the servo motor for this reason. The transient response of the servo system is indicated in Fig. 7, which was obtained by switching a 10-db pad in and out of the input circuit.

The power supply is regulated and filtered. A pair of 5W4's feed a pair of 6L6's controlled by a 6SL7 to provide adequate protection from a-c line voltage changes. Twenty volts a-c line change produces little change in d-c output level. Bias voltages are supplied by a separate transformer, 6 X 4 rectifier tube, and an 0A3 voltage regulator tube.

A special mechanical system for driving the turntable and drum had to be devised so that repeat errors in azimuth of not greater than 0.1 degree could be obtained. Referring to Fig. 8A, the drive energy branches at the motor in two directions, one to the turntable and the other through a pair of selsyns to the recordng drum. The drive is shown in Fig. 8B. Two pins (connected by string) move respectively in two straight parallel slots.

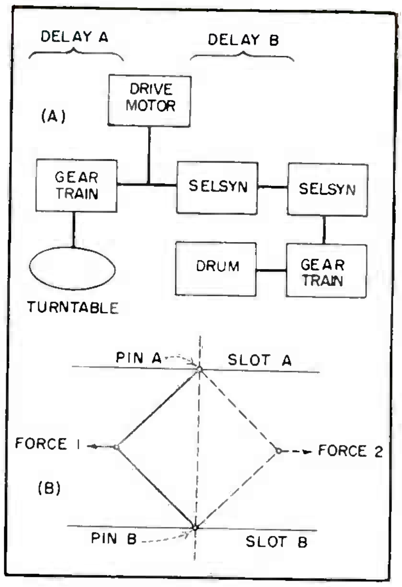


FIG. 8—Mechanical system drives turntable and drum in synchronism with azimuth error of not greater than 0.1 degree

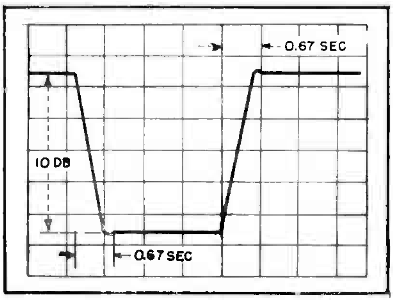


FIG. 7—Transient response curve for servo system obtained by switching 10-db pad in and out of input circuit

For purposes of illustration, the string is loose with its ends anchored in the two pins. The drive force is applied at the center of the string in a direction parallel to the slots. When the drive direction is reversed, the two pins will start in the reverse direction at a later time, but moving simultaneously. Thus in the recorder, regardless of selsyn or gear backlash, the turntable and drum always move simultaneously. The two requirements of this mechanical system are the use of good quality gears and good mechanical design. A backlash adjustment is provided on one set of gears for fine adjustment of tracking.

Conclusions

Many plots have been made with the automatic antenna recorder, and the results have been very satisfactory. Thus, by a thorough consideration of extraneous radiation and a well-designed recorder, it is now possible to make accurate antenna plots in both the field and laboratory without the laborious and time consuming process of manual recording.

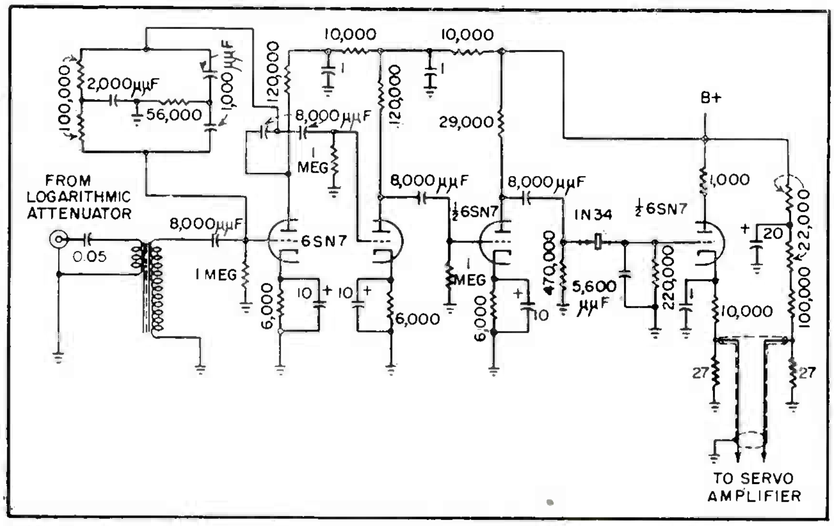


FIG. 6—Second amplifier takes signal from logarithmic attenuator and applies it to conventional servo amplifier

REFERENCES

(1) Samuel Silver, "Microwave Antenna Theory and Design", Vol. 12, Rad. Lab. Series, McGraw-Hill Book Co., Inc., New York.
(2) U. S. Patent No. 2,464,006.


STANDARD ELECTRONIC COMPONENTS
For the past quarter of a century CINCH Components have filled the requirements developed by the rapid changes in the Electronics industry. Today, judged by demand and performance, CINCH is producing the STANDARD metal plastic assembly.
Consult Cinch
Cinch components are available at leading Electronic jobbers—everywhere
Cinch
ELECTRONIC COMPONENTS
CINCH MANUFACTURING CORPORATION
1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

Atmospheric Absorption Chart

Varying absorption of microwaves, millimeter waves and infrared rays by the atmosphere is analyzed and charted for region from 0.001 mm to 10 cm. Absorption peaks should be avoided when designing radar and communication equipment

By ARNOLD SHOSTAK
Electronics Branch, Office of Naval Research
Washington, D. C.

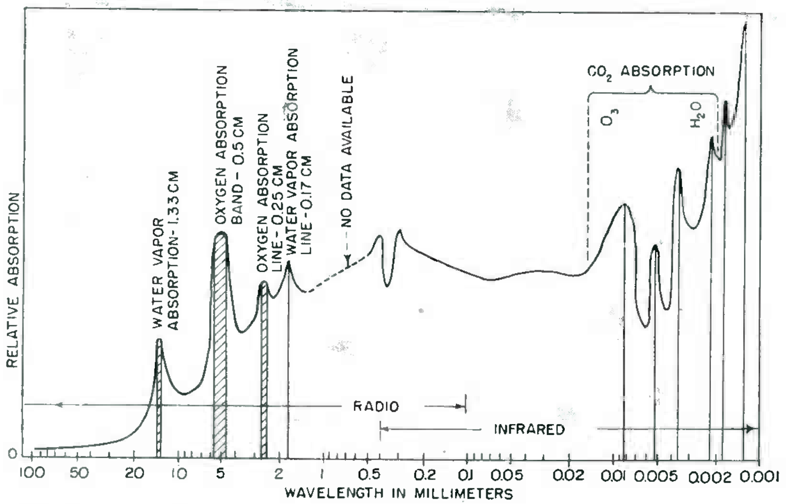
FACTORS affecting the amount of absorption experienced by a propagated electromagnetic wave include: path length, water vapor content and oxygen content of the air. The combined effects of these factors are shown in the accompanying chart.

The drop in 4-cm waves is about 0.01 db per kilometer, whereas in the oxygen absorption band around 5 mm the drop may be as high as 10 db per km. The infrared waves from 1 to 500 microns (0.001 to 0.5 mm) usually sustain complete absorption in the first 15 meters, with ensuing attenuation due to scattering.

Water exists in the atmosphere both in the form of rain drops and in the form of vapor. The amount of water per unit volume is dependent on temperature. Rain drops, as a function of their diameter and the wavelength of the propagated wave, mostly result in scattering of the wave energy. Water vapor, on the other hand, is made up of H_2O molecules which have a permanent electric dipole moment. This moment interacts with the electric vector of the impinging electromagnetic field, with resultant energy absorption. The water vapor absorption band in the region of 1.33 cm is due to this type of interaction. Carbon dioxide also has a permanent electric dipole moment that causes absorption.

Oxygen does not have a permanent electric dipole moment; it does, however, possess a permanent magnetic moment. This moment interacts with the magnetic vector of the electromagnetic wave to cause absorption, principally around 5 mm.

Most of the factors governing absorption of electromagnetic waves are thus manifested in the very short wavelength regions, from 0.001 mm to about 20 mm. Waves above 3 cm are attenuated by scattering, especially in rainstorms, but the relative effect is usually small compared to absorption in the smaller wavelength regions. In the infrared, violent oscillations in the plot of wavelength versus absorption are noted, principally due to the closely-spaced energy levels of the various molecules of the gases making up the atmosphere. Infrared transmission at sea-level is limited to very short ranges and must exploit the wavelengths of low absorption indicated in the chart. As may be noted, these bands of low absorption, called windows, are of very narrow width, compelling the use of very selective generators and receivers for successful transmission of electromagnetic energy over significant distances at these wavelengths.



Relative atmospheric absorption at sea level and temperature of 20 deg C

ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

Automatic Currency-Selector Unit

By Paul J. Selgin

Chief, Engineering Electronics Section
National Bureau of Standards
Washington, D. C.

Automatic vending and change-making devices perform a necessary function and an increasingly important one in view of personnel shortages. Usefulness of such equipment has been limited by the inability to handle paper currency. The device to be described is capable of accepting paper currency with a relatively good margin of safety.

Requirements

The requirements of a suitable paper selector are as follows: Operation must not depend on exact placement of the bill. By having a receptacle or slot exactly fitted to the dimensions of the bill, approximate positioning without effort or attention on the part of the operator may be obtained. The operating cycle must be short, preferably less than five seconds. The machine must be simple, dependable and require a minimum of service. Last, the machine must be relatively inexpensive.

The unit finally evolved, called the Nomoscope, is essentially a camera. It is used as a camera initially, before it is put into normal operation, to produce a partial negative. This negative is reduced in size and is an authentic copy of the document placed in the slot S of Fig. 1. After developing, the negative is put back into its holder H. In operation, another copy is placed in S. A lid (not shown) presses it down against the transparent floor of the slot, initiating the operating cycle by the closing of a switch. A light L goes on, illuminating the copy and causing its image to be projected upon the negative.

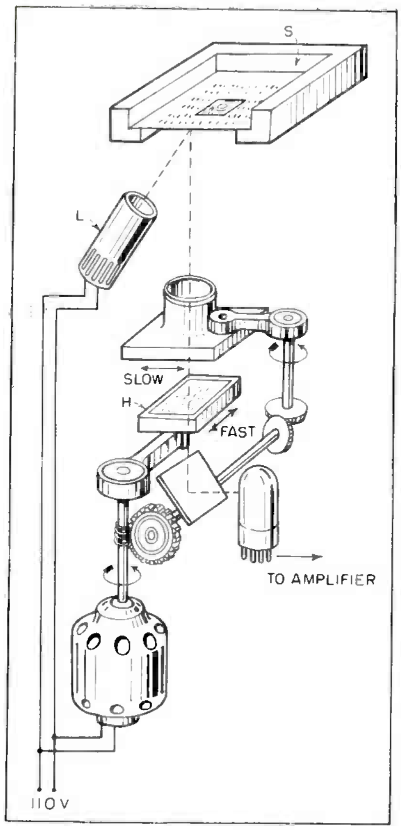
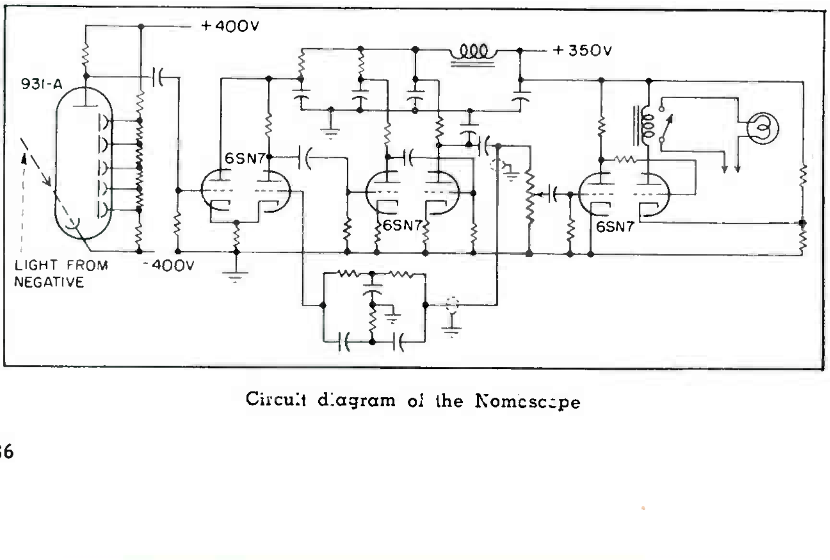


FIG. 1—Sketch of the mechanical portions of the currency selector

If both copy and image are in exactly the same position as when the negative was made, the light transmitted through the negative would be almost entirely blocked. This is true because each luminous area of the image would fall on a dark area of the negative and vice versa.

Such an exact coincidence cannot be obtained in practice. However, if both the lens and negative are oscillated at right angles to one another and at frequencies differing in the ratio of about 100 to 1, there will be times when the slow oscillation of the lens brings the image into line along one coordinate. Then the fast oscillation of the negative will take care of the other coordinate and cause the periodic occlusion of the light, at a frequency double that of the fast oscillation itself.



Circuit diagram of the Nomoscope

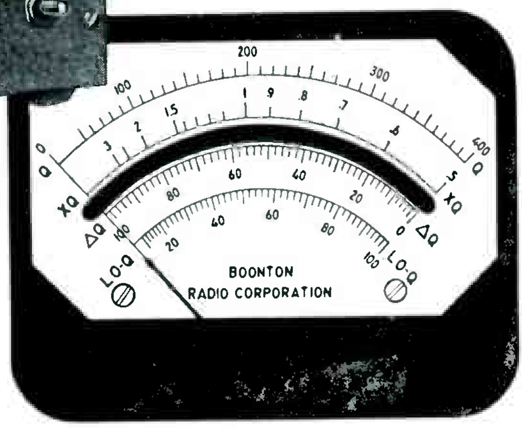
Amplifier

An amplifier tuned to the proper frequency (double the fast oscilla-

Measure Differential Q

with

The Q METER
Type 190-A



In Designing Tuned Circuits the effect on Q of adding capacitors, iron cores, or resistors must frequently be determined. The Q of the separate components is also often needed. These measurements made on Q Meters formerly available required the use of a small difference between two large Q values in various formulæ. This led to large errors. The Q Meter Type 190-A reads the difference between the Q of a reference circuit and the Q of this circuit when new components are added. The scale that indicates this *Differential Q* has a sensitivity 4 times as great as the scale which reads *Q*. The accuracy and ease with which *Differential Q* can be read is greatly improved by use of the *190-A Q Meter*.

The Q Meter Type 190-A has a "Lo Q" scale which reads Q down to a value of 5. The internal resonating capacitor is directly read and has a vernier arrangement for accurate reading of capacitance. The dial rotates approximately 10 times in covering the capacitance range. All readings are made on a single meter corrected for parallax.

SPECIFICATIONS

FREQUENCY COVERAGE: 20 mc to 260 mc. Continuously Variable in Four Ranges.

FREQUENCY ACCURACY: Calibrated to ± 1%.

RANGE OF Q MEASUREMENTS: 5 to 1200.

RANGE OF DIFFERENTIAL Q MEASUREMENTS: 0 to 100.

ACCURACY OF Q MEASUREMENTS: Circuit Q of 400 read directly on meter can be determined to accuracy of ± 5% to 100 mc and to ± 12% to 260 mc.

INTERNAL RESONATING CAPACITANCE RANGE: 7.5 mmf to 100 mmf (direct reading) calibrated in 0.1 mmf increments.

ACCURACY OF RESONATING CAPACITOR: ± 0.2 mmf to 20 mmf
± 0.3 mmf to 50 mmf
± 0.5 mmf to 100 mmf

POWER SUPPLY: 90-130 volts—60 cps (internally regulated). Power Consumption—55 watts.

(Specifications subject to change without notice)

PRICE: $625.00 F.O.B. Factory

SINGLE, EASY-TO-READ METER WITH PARALLAX CORRECTION FOR ALL FUNCTIONS

- Q indicating voltmeter: 50 to 400.
- Multiply Q scale: 0.5 to 3.0.
- A differential Q scale for accurately indicating the difference in Q between two test circuits.
- Additional accurate expanded scale for measuring low values of Q.
- A counter type resonating capacitor dial for improved setting and reading accuracy.
- Regulated power supply for increased stability and accuracy.
- Careful design to minimize instrument loading of circuit under test.

BRC **BOONTON RADIO** *Corporation*
BOONTON · N · J · U · S · A ·

tion frequency) in combination with a detector, relay and phototube will cause the energizing of the appropriate circuits when the periodic fluctuations occur, indicating identity of the copy with the original.

It should be noted that the fluctuations will be present if coincidence occurs over only part of the area, provided it is a substantial part and they will not be appreciably affected by superimposed marks. However, they will not occur if the copy "looks" like the original but is not identical to it, line for line. The fine structure of the engravings must match. These features make the principle particularly applicable to the currency selector problem since marked, torn or soiled bills will not be rejected.

F-M Detector Tuning-Indicator Circuit

By H. B. Karplus

Armour Research Foundation
Illinois Institute of Technology
Chicago, Illinois

Recommended circuits given in the manufacturers' handbooks for a 6AL7GT tuning indicator do not make full use of all its potentialities except for a discriminator squelch-detector circuit. For the ratio-detector type of discriminator, the pattern appears very similar when a station is exactly tuned as when no station is received. This is shown in Fig. 1 and 2 of the RCA 6AL7GT description.

Pattern changes similar to Fig. 3 (on the same manufacturer's data sheet) may be obtained with a ratio detector if the indicator is connected as shown in the accompanying Fig. 1. Use is made here of the large positive potential developed at the cathode of one of the detector diodes to control the current in the indicator which is normally biased almost to cut off. Excessive plate current is prevented on strong signals by a large resistor, about 1 megohm, in series with the grid. In addition, the pattern may be shifted when a station is tuned by connecting the common plate D_0 to the plate of the diode as shown in Fig. 1.

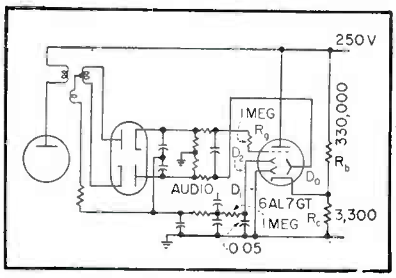


FIG. 1—Tuning eye and ratio detector

Discriminator

A positive potential may be obtained from a discriminator to control the indicator tube current, from the center point of the detector load, if the cathodes of the diodes are connected to the transformer. To obviate trouble due to heater cathode capacitances, crystal diodes are recommended as shown in the accompanying Fig. 2.

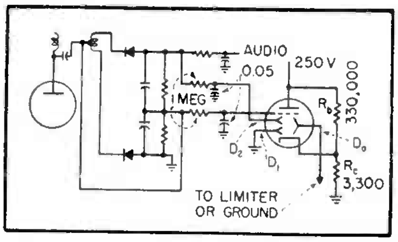


FIG. 2—6AL7 tuning eye and discriminator

In the circuits of Fig. 1 and 2, the potential divider R_bR_c may be replaced by a large cathode resistor of around 20,000 ohms, depending on plate potential. Complete extinction is then not possible and the intensification obtained on weak stations is reduced due to the feedback effect of this resistor.

The chief advantages of the circuits described are the clear distinction between exact tuning and complete detuning and also the intensity indication obtained from signals which are too weak to produce enough potential on D_2 to give a useful amount of pattern shift on the indicator.

Model Antenna Range

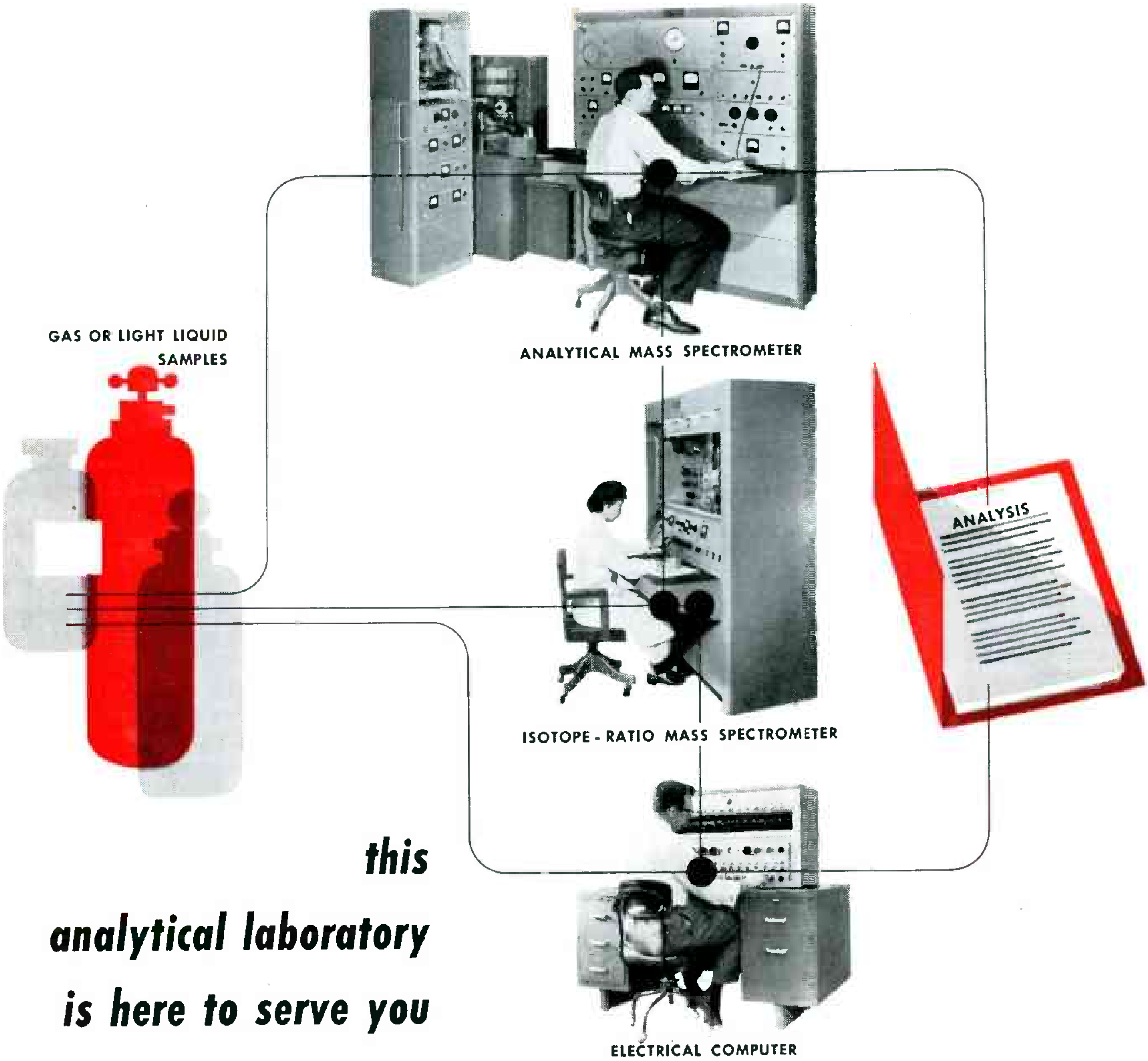
To facilitate the measurement of antenna radiation patterns in the vertical plane, a new model antenna range has been completed by the National Bureau of Standards.

As shown in Fig. 1 and 2, the antenna range consists of an inverted V-type structure which supports a test or target transmitter about 50 feet above the ground. The model antenna to be tested is placed in the center of the ground plane beneath the V frame.

Adjusting a test antenna on the antenna range. Antenna is the high-frequency model of one normally used at a much lower frequency

Current investigations are particularly concerned with the high-frequency band from 3 to 30 mc. At these frequencies, wavelength varies between 300 and 30 feet and measurements of full-sized antennas would require a site several thousand feet long. When the vertical-plane pattern is required, the problem becomes even more complex.

Techniques employed at NBS use the principle of electrodynamic similitude. As applied to an antenna, an equivalent performance is obtained from a model 1/nth as large as the prototype antenna if the operating frequency of the model is made n times the proto-



this analytical laboratory is here to serve you

Since 1949 Consolidated has operated this precision analytical service—utilizing mass spectrometry under the supervision of Consolidated's experienced staff. It serves research organizations and industry having analytical problems, but where the number of samples does not justify the purchase of an instrument.

Sample requirements are very small. Recommended containers are 100 cc for gas and 5 cc for liquid. Where isotope ratios are required, samples must be in the vapor phase. Cost of the service is low.

For further information, request Bulletin CEC-1813.

consolidated engineering corporation

analytical service

300 No. Sierra Madre Villa
Pasadena 8, California

CEC

Analytical Instruments for Science and Industry

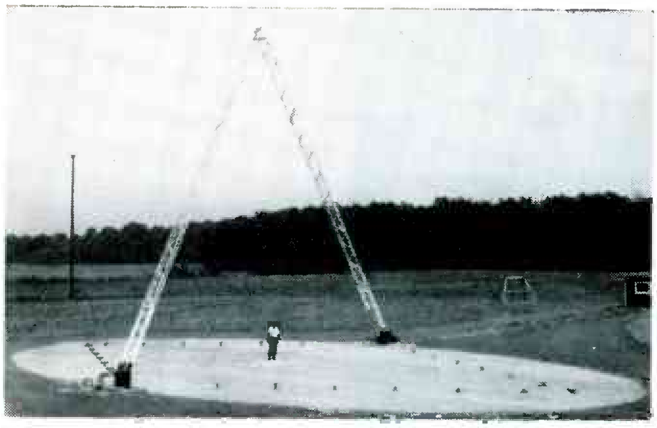


FIG. 1—Full view of the model antenna range with the target transmitter raised to the 90-deg position

FIG. 2—Checking the operating frequency of a target transmitter. Unit derives its power from wet-cell batteries

type frequency. As the model frequency is increased, the free-space wavelength is decreased proportionately. Also, the distance between the transmitting and the receiving antenna can then be reduced by the same scaling factor of n.

By using a sufficiently large scaling factor, it becomes possible to mount a target transmitter on a rigid structure, to move it over and about the model antenna under test and to obtain radiation patterns substantially the same as the true long-distance radiation patterns of a full-scale antenna.

In addition to dividing the physical dimensions of the model by the scaling factor n and multiplying the frequency by the same factor, it is necessary to multiply the conductivity of the antenna and the ground by n. In most practical h-f antennas, the copper losses are small and the conductivity effects may be ignored without introducing any serious error.

In operation, the model antenna is located at the center of the ground plane and receives energy from the target transmitter located in the V structure. The energy intercepted by the model antenna is rectified and the signal voltage is transmitted along underground cables to a recording pen attached to an automatic pattern plotter. Synchrogenerators, connected to the axis of the V frame, transmit its position to the turntable of the pattern plotter.

Low-Frequency Adapter for Audio Oscillators

By JOSEPH HOULE
Falls Church, Va.

WHEN a low-frequency signal source is occasionally needed, it is feasible to build a small adapter to extend the range of an ordinary resistance-tuned audio oscillator down to a few cycles. In the case of Hewlett-Packard and similar oscillators, those models whose lowest range extends only to 20 cps are susceptible to this conversion without disturbing their calibration on the original ranges. The adapter or range-extender is a small box with a dial, plugged in when needed.

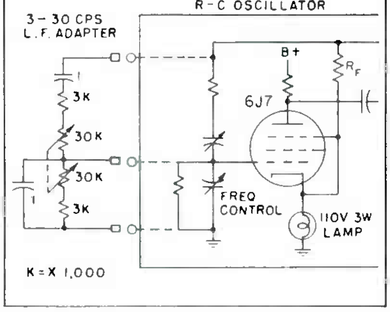


FIG. 1—Plug-in unit for adding 3 to 30-cps range to conventional R-C audio oscillator

Figure 1 shows the circuit. Pin jacks or a panel connector are installed on the oscillator, connected to the frequency-determining network as indicated. Excessive added stray capacitance should be avoided. The adapter is merely another tunable R-C network, plugged in parallel with the network in the oscillator. The range switch in the oscillator should be set on the lowest range. The impedance of the internal network is then about three orders of magnitude higher than that of the adapter; the adapter determines the frequency of oscillation. In the adapter shown, the two-gang 30,000-ohm potentiometer covers the range from 3 to 30 cps. If linear potentiometers are used, the dial scale will be crowded at the high end; tapered units are better. Composition volume controls appear to track well enough, although their permanence of calibration is questionable. Capacitance tuning is not feasible.

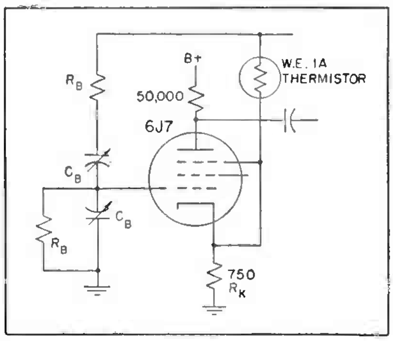


FIG. 2—Modified audio oscillator circuit using thermistor as amplitude control gives improved performance

The 110-volt, 3-watt lamp used as

CLEAN SHEETS

You can make better products from clean, smooth, flat Chase Sheet Brass and Copper. Chase sheets are free from oxide coatings, excess grease and oil. That means they are uniform in color and have a bright finish.

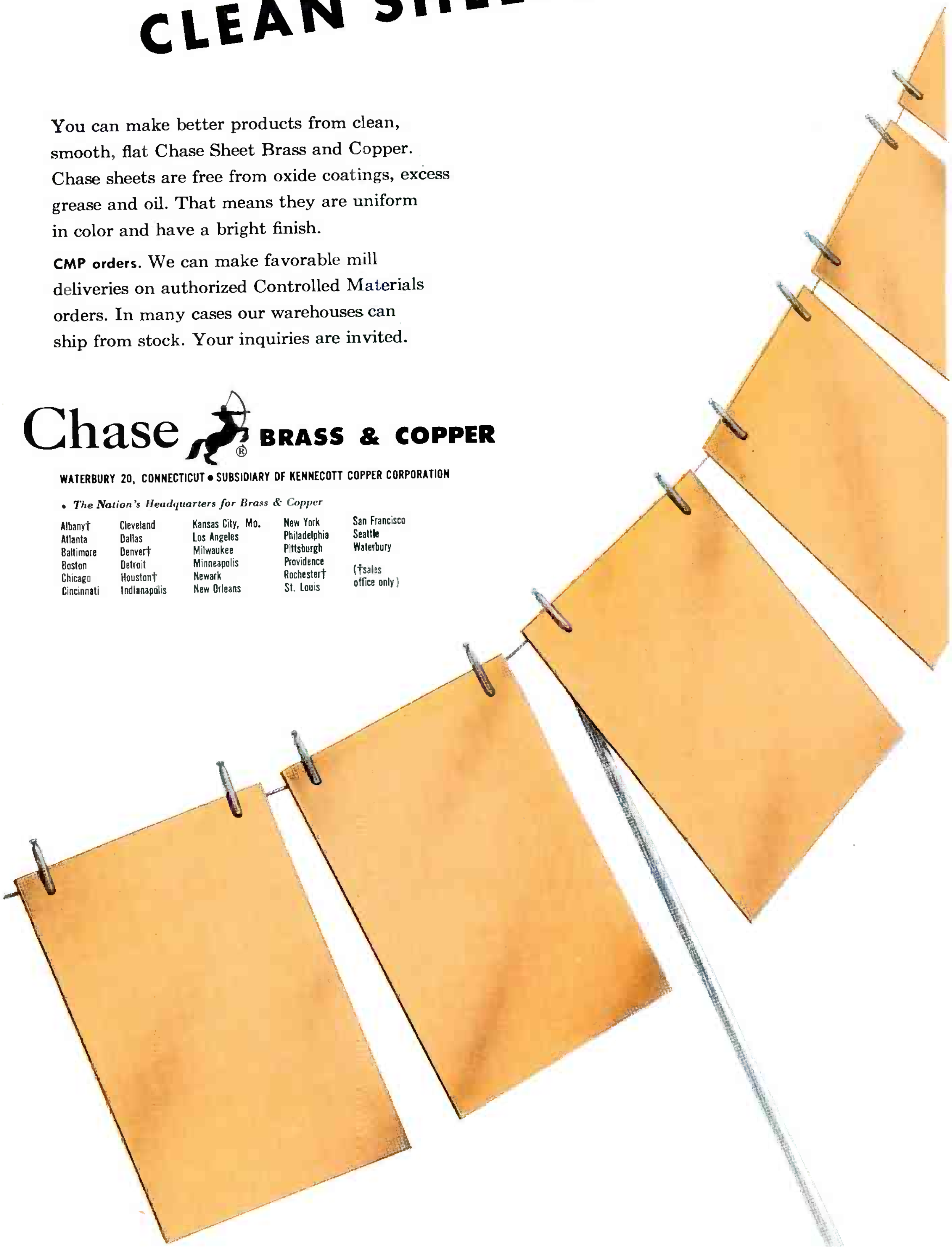
CMP orders. We can make favorable mill deliveries on authorized Controlled Materials orders. In many cases our warehouses can ship from stock. Your inquiries are invited.

Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	



the automatic amplitude control in many commercial oscillators has easy availability as its chief advantage. The lamp resistance varies but slowly with changing current, and its range of control is quite limited. Adjustment of the series resistor R_F (Fig. 1) which determines the operating point of the lamp, is rather critical and must be tailored to the individual lamp used. The thermal time constant of these lamps is long enough to give satisfactory control down to about 5 cps, but below this frequency the lamp "follows" and distortion sets in.

A thermistor works a lot better. Its time constant is longer than that of the lamp, but its resistance is so steep a function of the heating current that it controls the amplitude, in effect, more quickly than the lamp. Its correcting action is better damped, and it can correct for larger changes in gain. The Western Electric 1A thermistor has been used successfully for amplitude control of an oscillator working down to 1 cycle.[1]

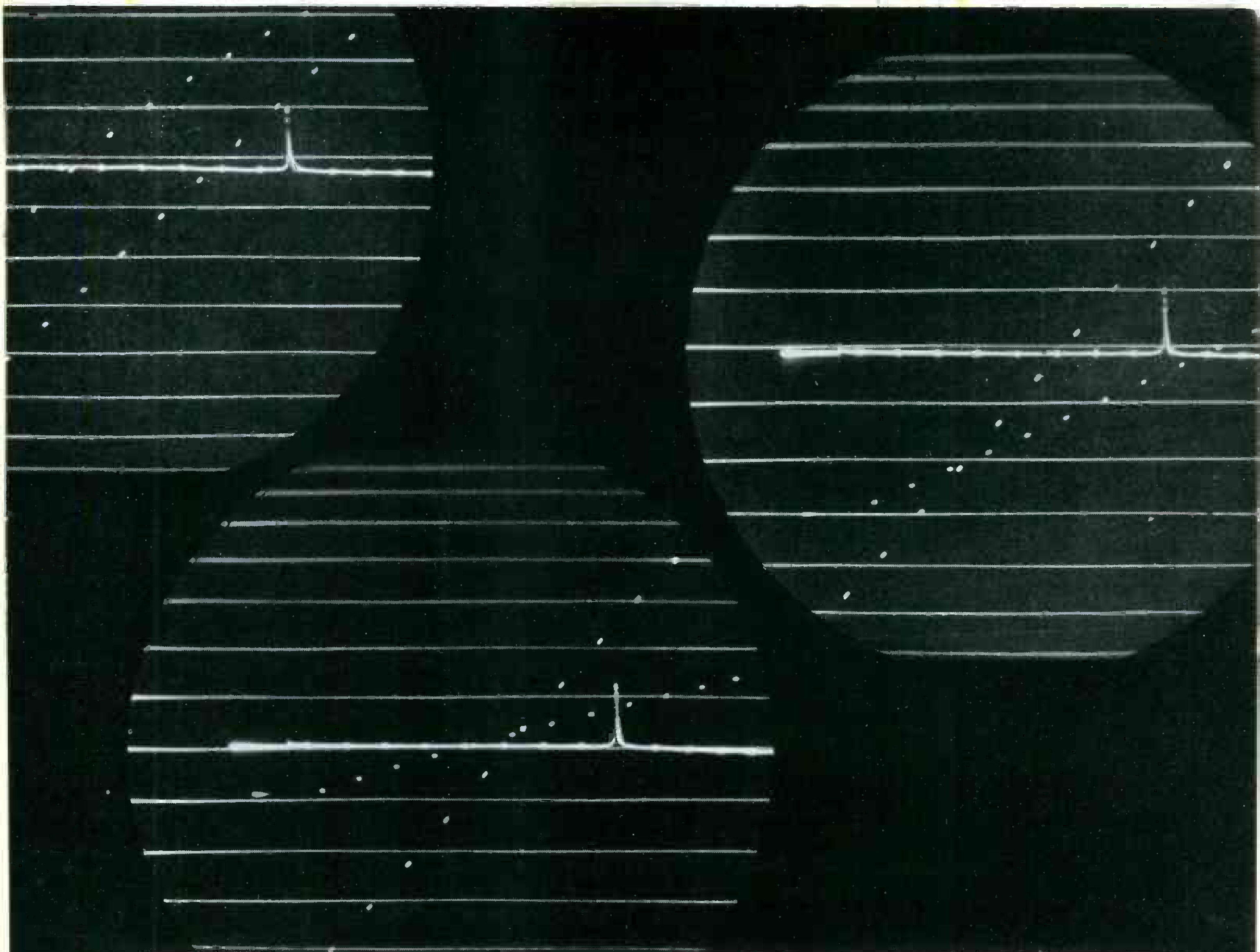
Fig. 2 shows the application of the 1A thermistor to a commercial audio oscillator (Hewlett-Packard 200C). The lamp is replaced by a 750-ohm resistor, and the series resistor R_F is replaced by the 1A thermistor. No other change is necessary, and no adjustment.

While the adapter outlined above is practical without this additional modification, the addition of the thermistor is very desirable, both because of the lower distortion at the lowest frequencies, and because the constancy of amplitude is better maintained in the face of mistracking of the ganged potentiometers.

A low-frequency source has become almost indispensable with the advent of wide application of negative feedback to audio amplifiers. Flatness over the audible frequency range is, in fact, an indication that the frequencies beyond both ends must be explored for peaks which betray an inadequate margin against oscillation.

REFERENCES

(1) Lawrence Fleming, Thermistor-Controlled Low-Frequency Oscillator, ELECTRONICS, p 97, Oct. 1946.
(2) J. A. Becker, C. B. Green, G. L. Pearson, Properties and Uses of Thermis-



PHOTOGRAPHY HELPS A COSMOTRON KEEP PROTONS IN LINE

A peak power of 21,000 KVA will create the magnetic field in the cosmotron now under construction at Brookhaven National Laboratory. The design calls for whirling protons through the field of a giant doughnut-shaped magnet, over 60 feet in diameter. At every point of the protons' path along the circular quadrants and at all times during the second while the magnetic field is rising to its top value, the configuration of this field must be the same, or the protons will collide with the walls and be lost.

This monster magnet is built of laminations of ½" steel sheets, 8 feet high, 12 in a 5.7-ton bundle, 288 bundles in all. Each bundle had to be carefully matched to its neighbors to give the utmost overall uniformity of magnetic parameters.

Photography provided a practical solution to the matching problem. The magnetic phenomena of each block were displayed on a cathode-ray oscillograph and photographed with a Kodak 35 camera. Five months and 8,000 oscillograms later (the shutter didn't fail once), a complete set of photographs like those seen here of the characteristics of each block made it possible to determine the position of each one in the magnet ring, to insure the most satisfactory magnetic field.

Quantitative records—full of detail, quickly made, available for reference whenever needed—are photography's contribution in a great many kinds of scientific and engineering jobs. Kodak makes a large variety of films and papers for them. Drop us a line, and we'll send you a complimentary copy of a new booklet that helps you make the best selection among them. Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

PHOTORECORDING . . . an important function of photography

Kodak
TRADE-MARK

bringing

Your Product

to market

is a full time job for . . . electronics

When you consider that there are more than 2,000 widely-diversified products sold to manufacturers and users of electronic equipment, the problem of bringing your product to that market — and selling it, might, at first, seem complicated. But it isn't.

Consider first how products are bought and by whom. Components and materials used in the design, testing or production of electronic equipment of all sorts are bought for engineering reasons by engineers. That this is true is obvious when one considers the extremely technical nature of the industry's products. The buying for this industry is done by men like the one shown . . . back-in-the-plant, design, development and test engineers, generally inaccessible to salesmen.

And it is their counterparts throughout industry and, of course, in communications and broadcasting who, by use of electronic equipment to solve their own design, test, production and control problems, create the markets for packaged electronic equipment.

It is for these men that ELECTRONICS is edited. Bringing them the up-to-the-minute electronic design, use and product information is ELECTRONICS' full time job. (A job it has held for over twenty years.) Because of this, they work with ELECTRONICS at their sides and refer to it more than to any other single source for the information they need in their work. It is for this reason that bringing your product to this market isn't as complicated as it might seem at first. ELECTRONICS provides a market place, the only one, in which you can reach these men who do the specifying and buying of electronics throughout industry . . . be it electronic manufacturing or general industry.

ABC ABP

electronics THE DIRECT ROUTE TO — — —

12 REGULAR ISSUES supplying latest technical information, design and product news

A McGraw-Hill Publication • 330 West 42nd St., New York 18, N. Y.

tors-Thermally Sensitive Resistors, *Electrical Engineering*, Nov. 1946.

(3) R. L. Shepherd, R. O. Wise, Frequency Stabilized Oscillator, *Proc. IRE*, 31, p 256, June 1943.

Tachometer Pickup Device

By Irving Gottlieb
Mountain View, Calif.

In industrial and laboratory instrumentation, it is often necessary to obtain electrical information pertaining to the angular velocity of a rotating mechanical member. A common way of meeting this requirement consists of an adaptation of the inductor-generator principle or an application of electromagnetic induction resulting from relative motion between a magnetic field and a solenoid.

The inductor-generator system makes use of a piece of permeable material attached to the rotating member. The magnetic properties of the material must differ appreciably from that of the rotating member in order to develop a good response in a nearby polarized solenoid.

In the second method, a segment of the rotating member is magnetized or a small permanent magnet is mounted thereon. An emf is induced in a nearby solenoid consisting of a winding on a soft iron core by virtue of the periodic approach and recession of the magnetic field. Still another application of magnetics involves the use of bismuth wire, the resistivity of which is a function of magnetomotive force.

With the first two methods, both

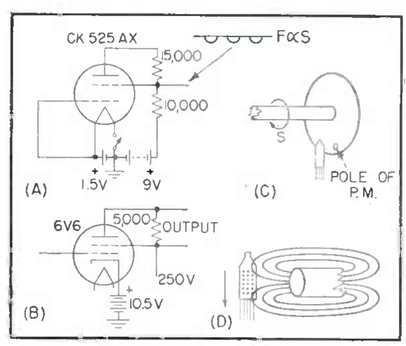
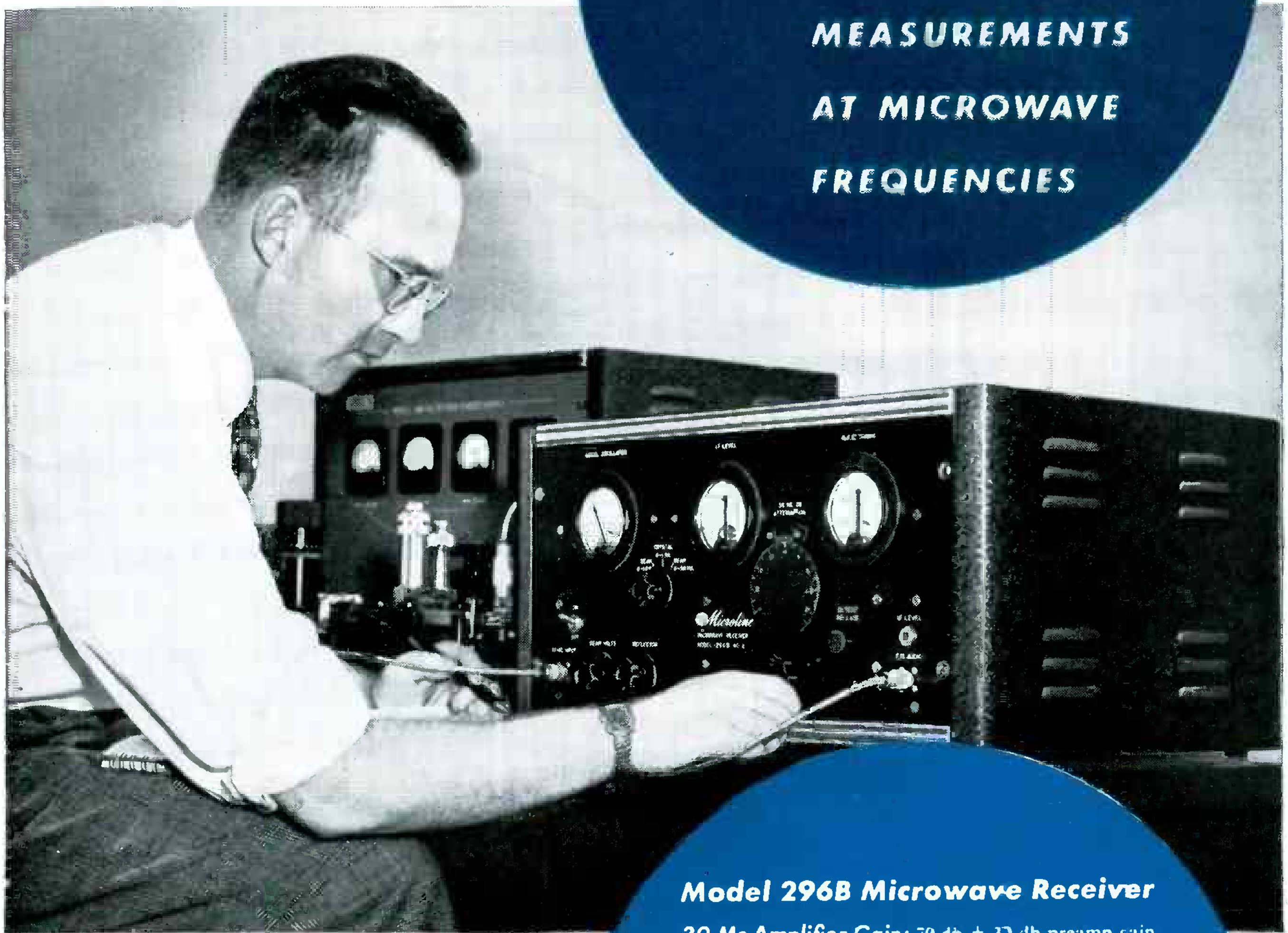


FIG. 1—Tachometer pickup device. Tachometer element circuit (A), direct-coupled amplifier (B), actual application (C) and enlarged view depicting normal component of mmf interacting with electron flow within tube (D)

The newest addition to Sperry's Microline* is Model 296B Microwave Receiver for laboratory use. This instrument is an important addition to the microwave laboratory where a good secondary standard of attenuation is required.

The versatility of Model 296B permits measurements to be made at all microwave and UHF frequencies. In addition to its use as a secondary standard of attenuation, this receiver has many other uses . . . one of the more important being antenna pattern measurements.

NEW SPERRY MICROLINE RECEIVER FOR ACCURATE MEASUREMENTS AT MICROWAVE FREQUENCIES



Model 296B consists of a 30 mc pre-amplifier, IF amplifier and precision 30 mc waveguide below cut-off attenuator. Included in the receiver is a well-regulated klystron power supply. Klystron stability is assured by self-contained, automatic frequency control circuitry.

Our Special Electronics Department will be happy to give you further information on this instrument as well as other Microline equipment.

*T. M. REG. U. S. PAT. OFF.

Model 296B Microwave Receiver

30 Mc Amplifier Gain: 70 db + 30 db preamp gain — 15 db insertion loss.

IF Bandwidth: 1.8 Mc.

Attenuator: Insertion loss 15 db; 80 db attenuation range with detent positions at 10 db steps.

Local Oscillator Power Supply: Beam supply 600 to 800 volts 50 ma, continuously variable, positive grounded. Reflector supply continuously variable from —10 to —500 volts with respect to cathode.

Accessories Supplied: One pre-amplifier, one pre-amplifier power cable, one klystron power cable, two 30 Mc IF cables.

Accessories Needed: Local Oscillator Klystron and a mixer.

SPERRY ***GYROSCOPE COMPANY***

DIVISION OF THE SPERRY CORPORATION

GREAT NECK, NEW YORK · CLEVELAND · NEW ORLEANS · BROOKLYN · LOS ANGELES · SAN FRANCISCO · SEATTLE
IN CANADA — SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

Visit our booths 57-58-59 at the Radio Engineering Show, Grand Central Palace, March 3-6.

NEW Miniature Telephone Type Relay

NEW LK RELAY

MOUNTING: End mounting for back of panel or under-chassis wiring. Interchangeable with standard "Strowger" type mounting.

COIL POWER: From 40 milliwatts to 7 watts D.C.

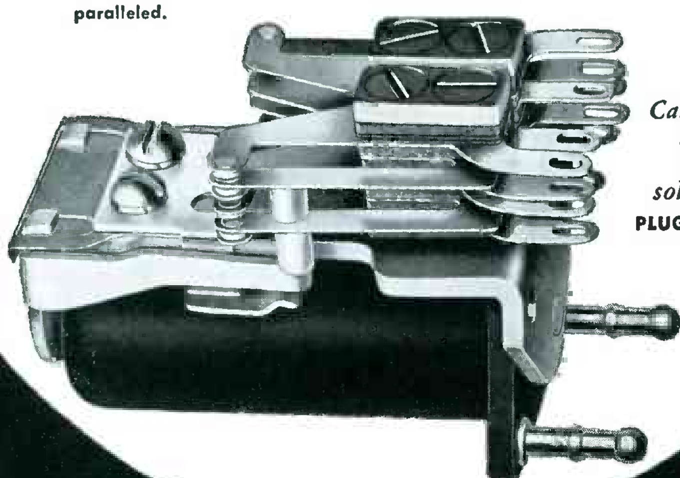
CONTACTS: Standard 2 amperes, special up to 5 amperes. 2 amperes up to 6 P.D.T. 5 ampere contacts (low voltage) up to 4 P.D.T. Special 20 ampere power contacts S.P.S.T., normally open, paralleled.

DIMENSIONS:

$1\frac{5}{8}$" HIGH, $2\frac{7}{32}$" LONG, $1\frac{3}{32}$" WIDE

These are the dimensions for the 6 pole relay.

Will meet Army and Navy aircraft specifications as a component unit.



Can be furnished hermetically sealed with solder terminals.
PLUG-IN MOUNTING-SPECIAL.

SK RELAY

MOUNTING: Front of panel mounting and wiring.

COIL POWER: From 100 milliwatts to 4.5 watts D.C.

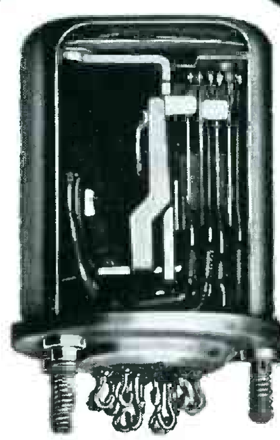
CONTACTS: Same as "LK".

DIMENSIONS: $1\frac{1}{2}$" HIGH, $1\frac{9}{16}$" LONG, $\frac{31}{32}$" WIDE.

These are the dimensions for the 4 pole relay.

Will meet Army and Navy aircraft specifications as a component unit.

CAN ALSO BE FURNISHED HERMETICALLY SEALED WITH SOLDER TERMINALS. PLUG-IN—SPECIAL.



SK, HERMETICALLY SEALED

AL-132

ALLIED CONTROL CO. INC. 2 EAST END AVE., NEW YORK 21, N. Y.

"Pennies saved . . . dollars lost"

Twice in one month, when the burglar alarm went off, the police and protective service men had swarmed down on the Benedict Laundry. Each time it had been a false alarm. Inferior insulation on the alarm switch had weakened—the shorting set off the alarm. The second "run" sent two men to the hospital—a police car crashed as it rushed to the plant.

Little items, like electrical insulation, are often a matter of pennies in original costs. Failure however, can mean much in direct and indirect losses.

Guard against product breakdown with the right electrical insulation. Outstanding in the field is BH "649", designed especially for tough jobs.

Permanently flexible and abrasion resistant it will take unusual abuse without loss of physical or dielectric properties. BH "649" can be pushed back without breakdown for ease in assembly—spread to cover knobs and terminals—bent or knotted—it will not lose its dielectric strength. Flexibility is constant under heat or cold. Tested from 15 minutes at 425-450°F, to 1500 hours at 220-230°F, and down to –45°C, there was no cracking or splitting. Chemical and oil resistance are additional features that help make it a must for high product protection.

BH "649" is one of a family of electrical insulations, each designed to meet a particular condition in service. Give us a few facts about your requirements—product, temperatures, voltages—we will gladly furnish 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. 393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

the frequency and amplitude of the emf's developed in the solenoid are proportional to the speed of rotation of the mechanical member. If a wide range of rotational speed is to be measured, the accuracy tends to be adversely affected because the indicating device and the circuitry associated therewith generally respond to the undesired, as well as the desired, parameter. As the rotational speed becomes lower, it is increasingly difficult to induce a usable emf in a solenoid of practical dimensions. A pick-up probe made from a noninductive winding of bismuth wire is free from these shortcomings but the high thermal coefficient of resistivity of this element must be considered if accuracy is to be preserved.

The New Pickup Device

The author has applied a different type of magnetic responder which delivers constant-amplitude pulses over a rotational speed range just greater than standstill to the highest to be encountered with mechanical equipment. There is no disturbance from temperature variation. The indicating apparatus is designed and calibrated to depict rotational speed as a function of frequency.

The principle and the application thereof are illustrated in Fig. 1. A subminiature tube is used as the actual pickup element. The low velocity electrons in the interelectrode space between control and screen grids are deflected in their trajectory by a magnetic field. This will be evidenced by a reduction in screen grid and plate current.

The screen grid is used as the anode whereas, the plate, operating at a lower potential, functions in the manner of the repeller electrode in a klystron. The plate imposes a retarding field to the electrons in the region between screen grid and plate. This results in a higher screen-grid current than would otherwise be the case.

For optimum sensitivity, many electrons should reach the screen grid but their velocity should be low. By making the control grid slightly positive with respect to the filament, a large number of electrons are imparted with velocities

Are you missing any of these IRON CORE ENGINEERING POSSIBILITIES?

There's no substitute for molded iron cores in a long list of applications—electrically, mechanically or economically!

Besides all regular styles for high, low and standard frequencies, Stackpole offers full facilities for the quality-controlled production of almost any needed special type. Write for Catalog RC-8 to Electronic Components Division, Stackpole Carbon Company, St. Marys, Pa.

STACKPOLE

sufficient to reach the screen grid. The same number of electrons could be made to reach the screen grid by increasing the potential of that electrode. This would, however, also result in higher electronic velocity, thereby rendering the tube less responsive to magnetic fields.

The amplitude of the pulses will depend upon the field strength normal to the plane of thermionic emission. It is easy to obtain one-half volt pulses from an alnico-V permanent magnet about a quarter of an inch from the tube. With appropriate amplification, separation distances greater than an inch might even be used. The tube should be oriented about its three axes of rotation to empirically determine the most sensitive position for the particular magnetic conditions in the actual application.

Photographing R-F Modulation Patterns

By John M. Carroll
Ensign, USNR
Washington, D. C.
(on Military Leave from ELECTRONICS)

Radiation characteristics of most communications transmitters may readily be studied from photographs taken of the transmitter's modulated r-f envelope. The photographs shown were taken with the incoming signal displayed along an f-m time-base which was varied to permit each particular signal to be visualized best.

As contrasted with the usual panoramic display of a video signal after detection, examination of the i-f envelope reveals details within the modulation envelope such as parasitic oscillation, sideband splat-

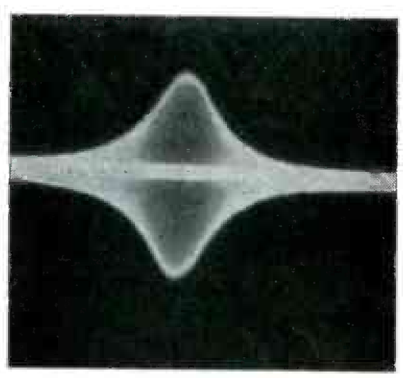
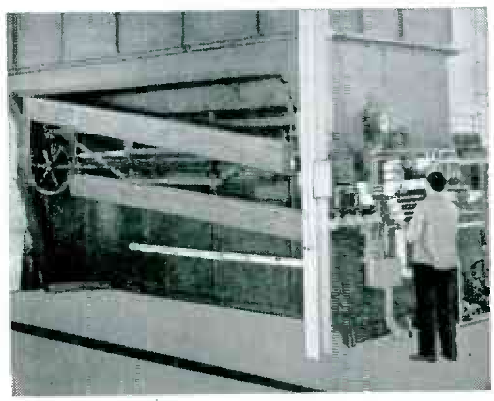


FIG. 1—Unmodulated r-f carrier

Superior Tubular Parts ...mean Superior Electronic Performance

Part of Inspection Procedure on Lockseam Nickel Cathodes as they come off the production machine. Each cathode must undergo many rigid tests before being approved.

Engineering . . laboratory equipment for all kinds of testing, including emission characteristics of nickel cathode materials.



To Guard Against contamination by processing lubricants, Superior tubing is thoroughly degreased before each annealing operation.

Superior supplies disc cathodes, cups and anodes for the famous *Rauland* "Tilted Offset" Electron Gun used in peak-performance picture tubes. This new development of Rauland permits the use of a single Ion Trap magnet, bends the electron beam only once and gives the sharpest possible beam focus. The new Indicator Ion Trap reduces adjustment time to a matter of seconds, eliminates the need for mirrors or guesswork in Ion Trap adjustment. This "Double Feature" gun is a triumph of Rauland research.

But no electronic device can be better than the components of its assembly. That's why Rauland and so many other electronics manufacturers specify Superior tubular parts.

Here at Superior we combine production know-how, research facilities and engineering experience to produce tubular parts, in many forms and metals, each designed to do tough electronics jobs better. We have specialty equipment for the high speed production of anodes, cups, cathodes, grid cylinders and many other parts for television and cathode ray gun structures. If you are not now a customer of Superior it will pay you to check on the many ways in which we can serve you. Write for information—no obligation of course. Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.

Which Is The Better For Your Product . . .

SEAMLESS . . . ? The finest tubes that can be made. Standard production is .010″ to .121″ O.D. inclusive, with wall thicknesses of .0015″ to .005″. Cathodes with larger diameters and heavier walls will be produced to customer specification.

Or LOCKSEAM* . . . ? Produced directly from thin nickel alloy strip stock, .040″ to .100″ O.D. in standard length range of 11.5 mm to 42 mm. Round, rectangular or oval, cut to specified lengths, beaded or plain.

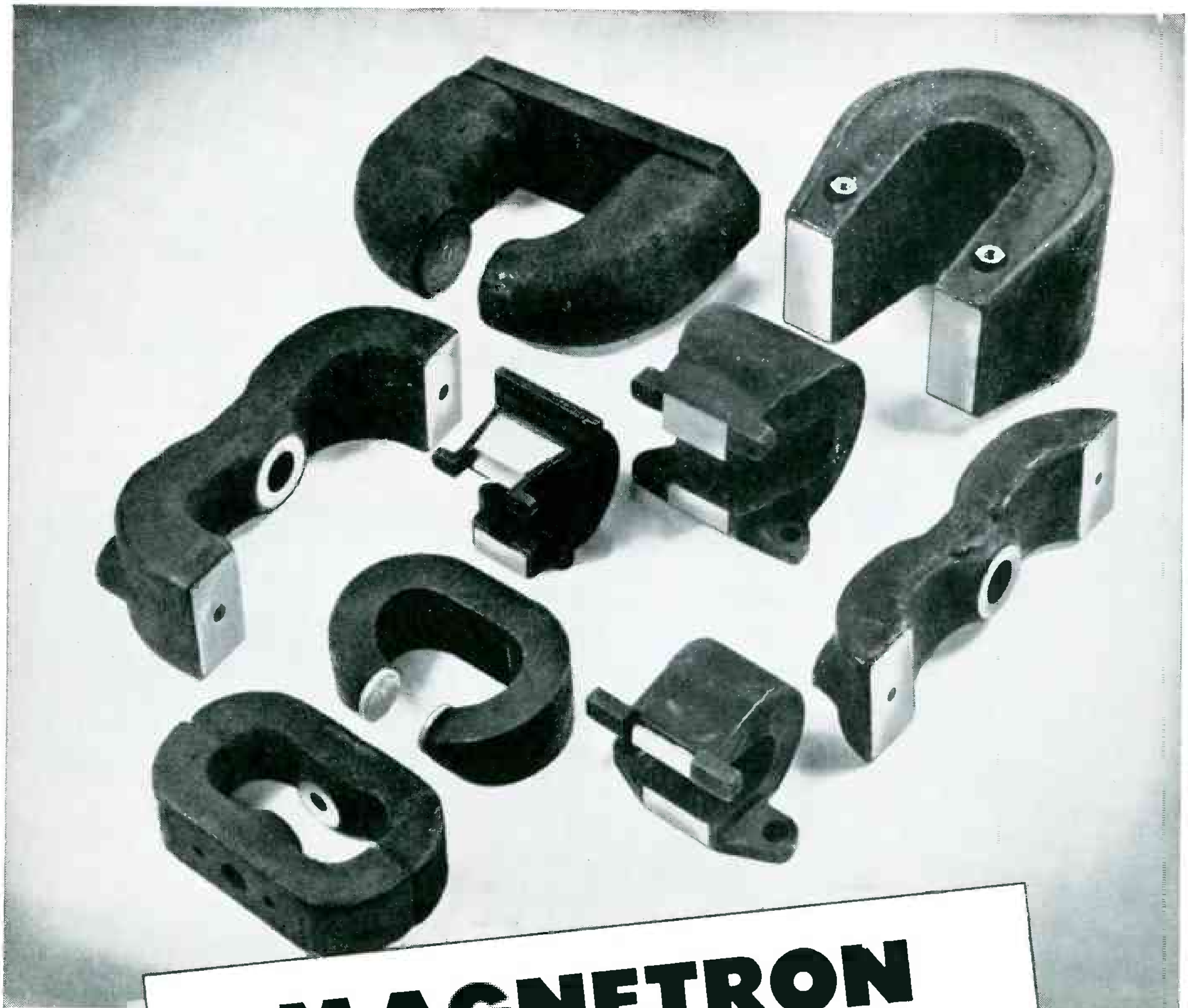
Superior

THE BIG NAME IN SMALL TUBING

All analyses .010″ to ⅝″ O.D.

Certain analyses (.035″ max. wall) Up to 1⅛″ O.D.

*MFD UNDER U. S. PATS. *SUPERIOR TUBE COMPANY • Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800*



In this panel are illustrated standard models of HELIPOT multi-turn and single-turn precision potentiometers—available in a wide range of resistances and accuracies to fulfill the needs of nearly any potentiometer application. The Beckman DUODIAL is furnished in two designs and four turns-ratios, to add to the usefulness of the HELIPOT by permitting easy and rapid reading or adjustment.

A B C

MODELS A, B, & C HELIPOTS
A—10 turns, 46" coil, 1-13/16" dia., 5 watts—resistances from 10 to 300,000 ohms.
B—15 turns, 140" coil, 3-5/16" dia., 10 watts—resistances from 50 to 500,000 ohms.
C—3 turns, 13-1/2" coil, 1-13/16" dia., 3 watts—resistances from 5 to 50,000 ohms.

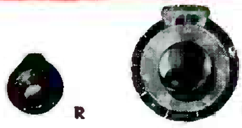
D E

MODELS D AND E HELIPOTS
Provide extreme accuracy of control and adjustment, with 9,000 and 14,400 degrees of shaft rotation.
D—25 turns, 234" coil, 3-5/16" dia., 15 watts—resistances from 100 to 750,000 ohms.
E—40 turns, 373" coil, 3-5/16" dia., 20 watts—resistances from 200 ohms to one megohm.

F G J

MODELS F, G AND J PRECISION SINGLE-TURN POTENTIOMETERS
Feature both continuous and limited mechanical rotation, with maximum effective electrical rotation. Versatility of designs permit a wide variety of special features.
F—3-5/16" dia., 5 watts, electrical rotation 359°—resistances 10 to 100,000 ohms.
G—1-5/16" dia., 2 watts, electrical rotation 356°—resistances 5 to 20,000 ohms.
J—2" dia., 5 watts, electrical rotation 357°—resistances 50 to 50,000 ohms.

LABORATORY MODEL HELIPOT
The ideal resistance unit for use in laboratory and experimental applications. Also helpful in calibrating and checking test equipment. Combines high accuracy and wide range of 10-turn HELIPOT with precision adjustability of DUODIAL. Available in eight stock resistance values from 100 to 100,000 ohms, and other values on special order.



R W

MODELS R AND W DUODIALS
Each model available in standard turns-ratios of 10, 15, 25 and 40 to 1. Inner scale indicates angular position of HELIPOT sliding contact, and outer scale the helical turn on which it is located. Can be driven from knob or shaft end.
R—2" diameter, exclusive of index.
W—4-3/4" diameter, exclusive of index. Features finger hole in knob to speed rotation.

FOR PRECISION POTENTIOMETERS come to Helipot

...world's largest manufacturer of such equipment!

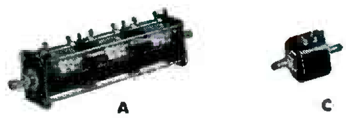
For many years The HELIPOT Corporation has been a leader in the development of advanced types of potentiometers. It pioneered the *helical* potentiometer—the potentiometer now so widely used in computer circuits, radar equipment, aviation devices and other military and industrial applications. It pioneered the DUODIAL*—the turns-indicating dial that greatly simplifies the control of multiple-turn potentiometers and other similar devices. And it has also pioneered in the development of many other unique potentiometric advancements where highest skill coupled with ability to mass-produce to close tolerances have been imperative.

In order to meet rigid government specifications on these developments—and at the same time produce them economically—HELIPOT* has perfected unique manufacturing facilities, including high speed machines capable of winding extreme lengths of resistance elements employing wire even less than .001" diameter. These winding machines are further supplemented by special testing facilities and potentiometer "know-how" unsurpassed in the industry.

So if you have a problem requiring precision potentiometers your best bet is to bring it to The HELIPOT Corporation, world's largest manufacturer of such equipment. A call or letter outlining your problem will receive immediate attention!

**Trade Marks Registered*

The versatility of the potentiometer designs illustrated above permit a wide variety of modifications and features, including double shaft extensions, ganged assemblies, the addition of a multiplicity of taps, variation of both electrical and mechanical rotation, special shafts and mounting bushings, high and low temperature operation, and close tolerances on both resistance and linearity. Examples of potentiometers modified for unusual applications are pictured at right.



A C

3-GANGED MODEL A HELIPOT AND DOUBLE SHAFT MODEL C HELIPOT
All HELIPOTS, and the Model F Potentiometer, can be furnished with shaft extensions and mounting bushings at each end to facilitate coupling to other equipment.
The Model F, and the A, B, and C HELIPOTS are available in multiple assemblies, ganged at the factory on common shafts, for the control of associated circuits.

B F

MULTITAPPED MODEL B HELIPOT AND 6-GANGED TAPPED MODEL F
This Model B Helipot contains 40 taps, placed as required at specified points on coil. The Six-Gang Model F Potentiometer contains 19 additional taps on the middle two sections. Such taps permit use of padding resistors to create desired non-linear potentiometer functions, with advantage of flexibility, in that curves can be altered as required.

THE Helipot CORPORATION, SOUTH PASADENA 2, CALIFORNIA

Field Offices: Boston, New York, Philadelphia, Rochester, Cleveland, Detroit, Chicago, St. Louis, Los Angeles and Fort Myers, Florida. Export Agents: Fratham Co., New York 18, N.Y.

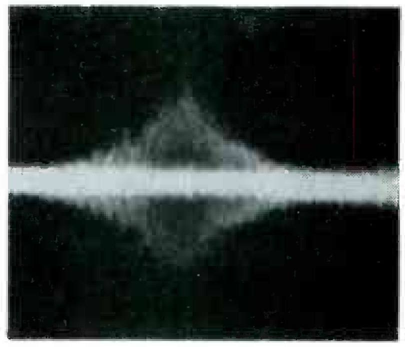


FIG. 2—Carrier with spurious modulation

ter, unwanted f-m due to oscillator instability and other spurious emission. Some of these details are lost altogether in the process of detection.

The pattern of an unmodulated carrier is shown in Fig. 1. The bandwidth is somewhat exaggerated in all such sweeping panoramic signal presentations due to the finite time, in this case 1/30 sec, taken for the f-m time-base sweep. The carrier appears to be free of undesired modulation. It produces a clear note when heterodyned with the receiver beat-frequency oscillator.

Figure 2 was also taken of a c-w carrier. However, this signal would be described as producing a rough note when heterodyned with the bfo and its spurious modulation content is readily apparent from the photograph. The appearance of broadcast music is shown in Fig. 3.

A frequency-shift keyed radiotelegraph signal is shown in Fig. 4. In this type of frequency modulation, the shift in the frequency of the r-f carrier corresponds to the 'space' and 'mark' intervals of

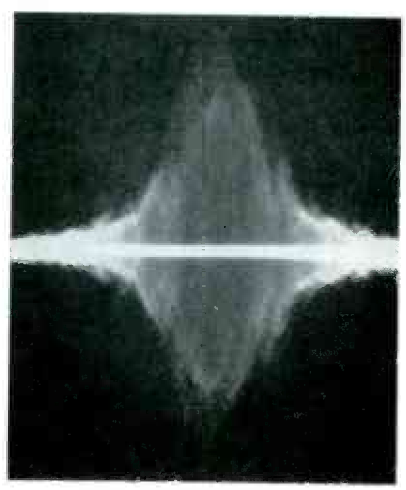
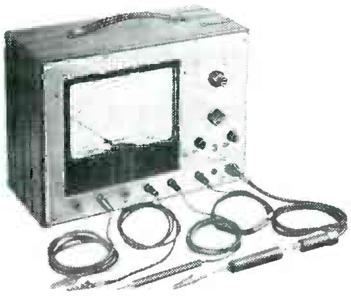


FIG. 3—Broadcast music

Announcing

The new RCA WV-87A *Master* VoltOhmyst*

$112.50 Suggested User Price



Measures . . . (Full-scale ranges)

DC VOLTAGE: 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts
PEAK-TO-PEAK VOLTAGE: 0 to 4, 14, 42, 140, 420, 1400, 4200 volts
RMS VOLTAGE: 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts
RESISTANCE: 0 to 1000 megohms in seven overlapping ranges
DC CURRENT: 0 to 0.5, 1.5, 5, 15, 50, 150, 500 milliamperes; 0 to 1.5, 15 amperes

Sold Complete—with the following Probes and Cables

- Direct Probe and Cable
- DC Probe
- Ohms Cable and Probe
- + Current Cable (Red)
- — Current Cable (Black)
- Ground (Case) Cable

Accessory Probes Available on Separate Order

- √ WG-264 Crystal-Diode Probe for measuring ac voltages at frequencies up to 250 Mc.
- √ WG-289 High-Voltage Probe, with WG-206 Multiplier Resistor, for increasing dc-voltage range to 50,000 volts and input resistance to 1100 megohms.

FEATURING an 8½" meter, the new WV-87A Master VoltOhmyst is really the master of every testing application. Its peak-to-peak scales are particularly useful for television, radar, and other types of pulse work.

The WV-87A measures dc voltages accurately in high-impedance circuits, even with ac present. It also reads rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of dc.

Like all RCA VoltOhmysts, the WV-87A features ±1% multiplier and shunt resistors, a ±2% meter movement, high-input resistance, zero-center scale adjustment for discriminator alignment, dc polarity-reversing switch, and a sturdy metal case for good rf shielding.

On direct-current measurements, extremely low-meter resistance gives an average voltage drop of only 0.3 volt for full-scale readings on all ranges. Nine overlapping ranges provide dc readings from 10 microamperes to 15 amperes.

An outstanding feature is its usefulness as a television signal tracer . . . made possible by its high ac input resistance, wide frequency range, and direct reading of peak-to-peak voltages.

The RCA WV-87A *Master* VoltOhmyst has the accuracy and stability for laboratory work. Its large, easy-to-read meter also makes it especially desirable as a permanently mounted instrument in the factory and repair shop.

For complete information on the WV-87A, see your RCA Test Equipment Distributor or write RCA, Commercial Engineering, Section BX42, Harrison, New Jersey.

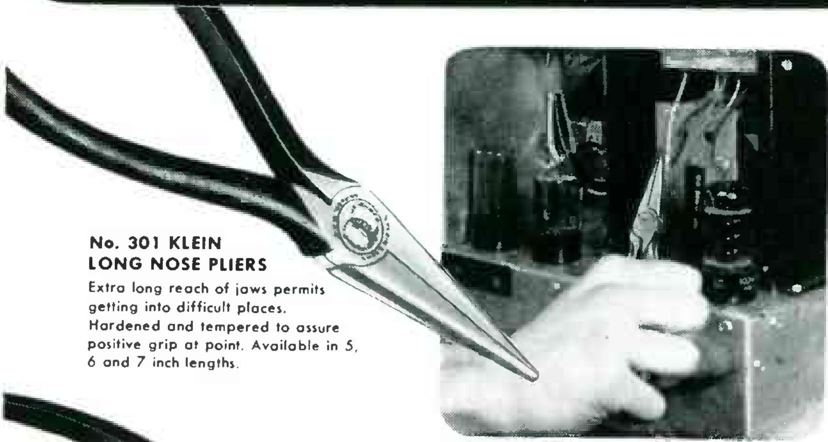
*Reg. U. S. Pat. Off.

Get complete details today from your RCA Test Equipment Distributor.

RADIO CORPORATION of AMERICA
TEST EQUIPMENT **HARRISON, N. J.**

KLEINS

Quality pliers for radio-television-amplifier work



No. 301 KLEIN LONG NOSE PLIERS
Extra long reach of jaws permits getting into difficult places. Hardened and tempered to assure positive grip at point. Available in 5, 6 and 7 inch lengths.

No. 202 KLEIN NARROW NOSE OBLIQUE CUTTING PLIERS
One of the most useful tools in your kit. Narrow head permits use in confined places. Individually honed knives meet accurately at all points and stay sharp. Available in 5 or 6 inch sizes.

• There is a Klein Plier made for every job in wiring radios, television or sound system amplifiers. Long nose pliers that assure a tight grip even in confined spaces. Keen edged cutters that stay sharp even after continued service. Flat nose pliers, duck bill pliers, curved nose pliers—many types and sizes to meet every wiring need. By having a full selection of these quality tools, you will save valuable time in any wiring work.

This Klein Pocket Tool Guide gives full information on all types and sizes of Klein Pliers. A copy will be sent without obligation.

ASK YOUR SUPPLIER
Foreign Distributor
International Standard
Electric Corp.
New York

"Since 1857"

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

ENGINEERS
DESIGNERS
PHYSICISTS

THE Aerophysics & Atomic Energy Research Division of North American Aviation, Inc., offers unparalleled opportunities in Research, Development, Design and Test work in the fields of Long Range Guided Missiles, Automatic Flight and Fire Control Equipment and Atomic Energy. Well-qualified engineers, designers and physicists urgently needed for all phases of work in

Supersonic Aerodynamics,
Preliminary Design & Analysis,
Electronics,
Electro-Mechanical Devices,
Instrumentation,
Flight Test,
Navigation Equipment,
Controls,
Servos,
Rocket Motors,
Propulsion Systems,
Thermodynamics,
Airframe Design,
Stress & Structures.

●

Salaries Commensurate with training & experience.
Excellent working conditions.
Finest facilities and equipment.
Outstanding opportunities for advancement.

Write now—Give complete resume of education, background and experience

●

PERSONNEL DEPT.
AEROPHYSICS & ATOMIC ENERGY RESEARCH DIVISION

NORTH AMERICAN AVIATION
INC.
12214 LAKEWOOD BLVD.
DOWNEY, CALIFORNIA

HI-Q* SERVES NATIONAL DEFENSE

Wherever Electronics Guide Them Home

The amazing and intricate science of electronics has provided new eyes and ears to bring our airmen straight home from anywhere . . . to sight a target many horizons beyond the span of human vision. On land and sea, electronics likewise has become a vital keystone in national defense. And wherever you find electronics, you'll find **Hi-Q** . . . Small Ceramic Disk Capacitors, for example, of both the by-pass and temperature compensating types. Tubulars, perhaps . . . Plates or the new High Voltage units. And wherever you find **Hi-Q** you'll find unerring dependability, rigid adherence to specifications and tolerances, and long life. Whether your needs are for standard or specially designed components, **Hi-Q** engineering and production keenness can meet your most exacting requirements.

Specializing in ceramic capacitors, **Hi-Q** has developed a complete line of Temperature Compensating Disk Capacitors with a capacity range from 475 mmf to .3 mmf and standard tolerances of ±5%, 10% or 20%. For applications requiring a large gradient of capacity vs. temperature **Hi-Q** Extended Temperature Compensating Disk Capacitors are available. These together with **Hi-Q** By-pass Disk Capacitors give you one source of supply for all ceramic Disk type capacitors. Write for New Engineering Bulletin on Disks.

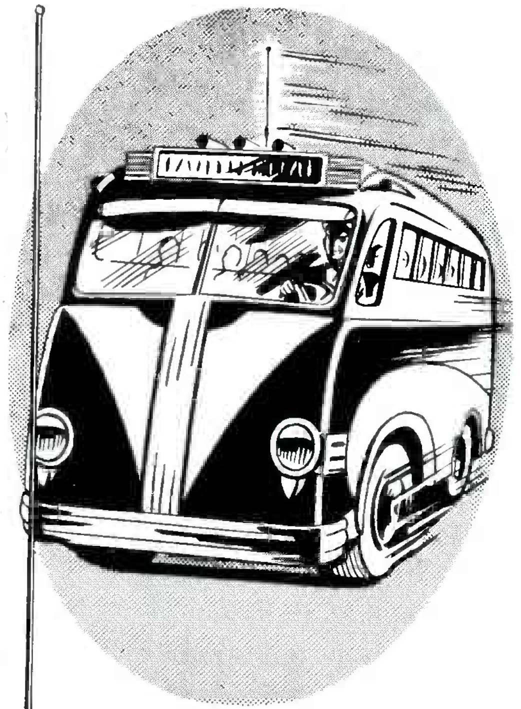
**Trade Mark Reg. U.S. Pat. Office*

Electrical Reactance Corp. **HI-Q***

OLEAN, NEW YORK

SALES OFFICES: New York, Philadelphia, Detroit, Chicago, Los Angeles
PLANTS: Olean, N.Y., Franklinville, N.Y., Jessup, Pa., Myrtle Beach, S.C.

JOBBERS — ADDRESS
740 Belleville Ave., New Bedford, Mass.



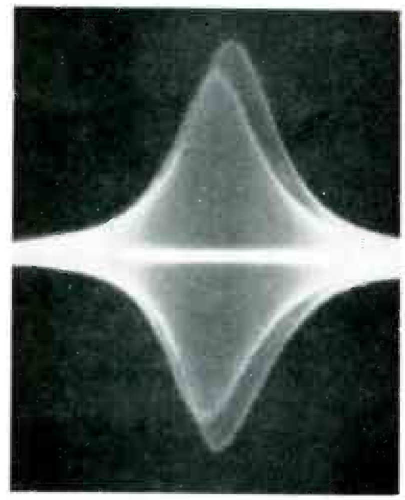


FIG. 4—Frequency-shift-keyed radiotelegraph

radio-printer code. In this case, the frequency shift is 850 cps.

The appearance of a more complex signal is shown in Fig. 5. This type of modulation is known as double single-sideband. To the left of the carrier, which is suppressed 60 db, are 12 audio tones each 170 cps apart in frequency. Each adjacent pair of tones constitutes a two-tone keyed radio-printer channel. To the right of the carrier are the lower sidebands of the narrow-band voice channel associated with the system. The 440 cps tone modulation pattern of standard frequency station WWV is shown in Fig. 6.

The signal is received on a standard communications-type receiver coupled to a panoramic intercept adapter which provides an f-m sweep to sample the signal in frequency in step with the oscilloscope time-base. Exposure for the photographs is 1/5 second at f 3.5.

The 455-kc i-f signal is taken off the plate of the receiver mixer tube. This avoids reduction in bandwidth due to receiver i-f selectivity and approaches the ideal condition for this type of work which would be a receiver with a wide-open front end. The panoramic r-f amplifier has a 180-kc passband.

The panoramic f-m oscillator is swept from 581 to 781 kc at a 30-cps rate. The panoramic i-f amplifier is sharply tuned to 226 kc. Thus, the 200-kc passband centered about 455 kc is sampled 30 times per second. A 30-cps sawtooth voltage, which also provides the

Three New Products Developed by LABORATORY for ELECTRONICS, INC.

The LFE Model 401 Oscilloscope is a high gain, wide band, versatile general purpose instrument capable of quantitative measurements of high and low speed electrical phenomena. It is perfectly suited for the precise examination of pulse wave-forms and transient phenomena, in addition to customary oscilloscope applications.

Model 401 OSCILLOSCOPE

OUTSTANDING FEATURES

- High sensitivity
- Excellent transient response
- Triggered and recurrent linear sweeps
- Continuously adjustable precision sweep delay
- Signal input line terminations
- Functionally grouped and colored control knobs

MERCURY DELAY LINES

LFE Mercury Delay Lines meet severe military requirements and are precision built under controlled conditions. Used for storage of information, comparison of two sets of information, correlations and sequential timing devices, they are the smallest, most compact lines available. Currently recognized as a foremost supplier of mercury delay lines, LFE furnishes a wide range of delays and assures quick delivery.

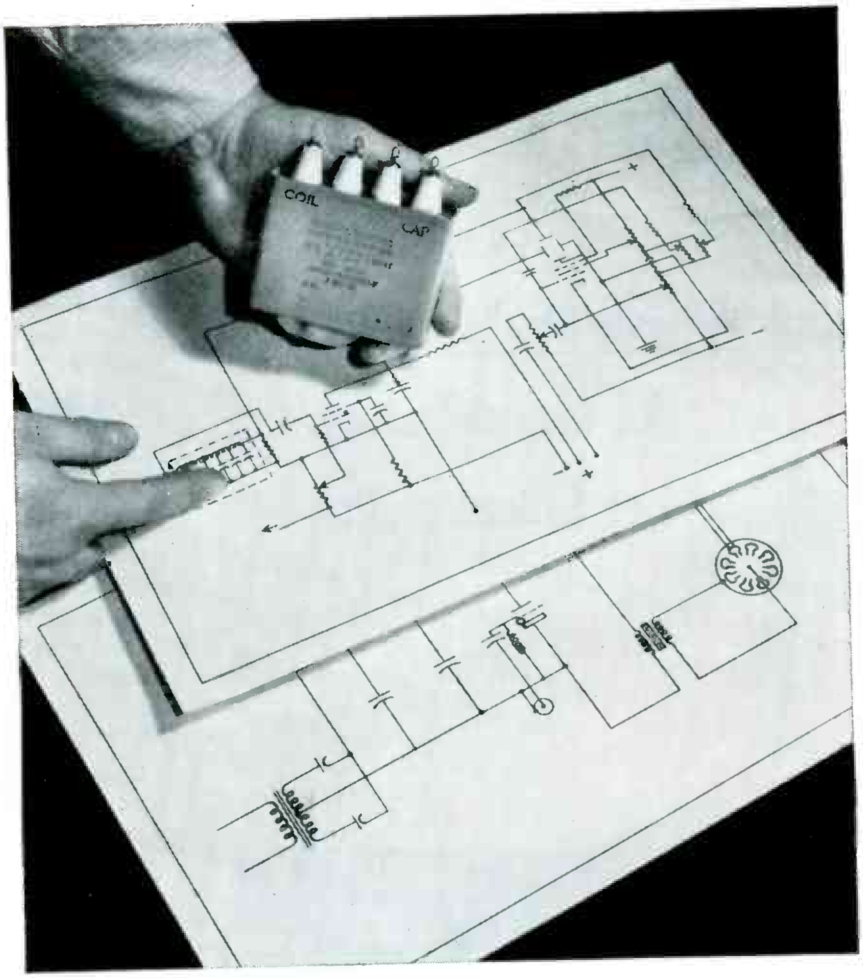
Model 101 MAGNETOMETER

The Pound Magnetometer is a device for accurately measuring magnetic field strength using the principle of nuclear resonance. Accuracy of measurement is limited only by the accuracy of the frequency measuring equipment. Because of its simplicity, accuracy and wide range, the Model 101 Magnetometer is ideal for engineering and research organizations working with magnetism.

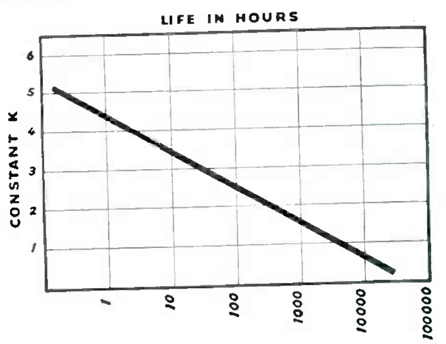
See these three new products demonstrated at the New York, I. R. E. Show, fourth floor, booth 461

LABORATORY for ELECTRONICS, INC. 43 LEON STREET BOSTON 15, MASS.

Got a really tough capacitor network problem for us?



...let our network designers help you solve it!



This curve results from actual life tests of capacitor networks under pulsing conditions in a radar modulator. Service life, for varying values of "K", starts at 2 tenths of one hour and stretches out to something over 40,000 hours (more than 4½ years of continuous operation at full-rated voltages.)

It's just one example of actual performance data G-E engineers use in designing capacitor networks for the job they must do.

Whether your problem deals with guided missiles—aircraft—land or sea radar equipments, General Electric application and design engineers can help you solve it. We've designed and built capacitor networks for every type of pulse radar equipment since the inception of radar.

Take service life for example. You can specify a service life of 10,000 hours—or just 60 seconds. And we'll deliver pulse networks to match your requirements. Here's why:

> Since 1944 General Electric has been running continuous life tests on many types of networks. We've established life limitations, under varying conditions of temperature and voltage, for all types of dielectrics, bushings, materials for coil forms and treating processes.

Let us use this store of information and experience to solve your capacitor network problems. Your inquiry addressed to your nearest Apparatus Sales Office, or to Capacitor Sales Division, General Electric Company, Hudson Falls, N. Y. will receive prompt attention.

General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC 407-308

a versatile High Vacuum "Packaged System" for leak detecting, gas filling, sealing

● DPi's 10-PORT VACUUM MANIFOLD SYSTEM is greatly improving the efficiency of processing sealed relays, small containers, and delicate mechanisms in the electronics industries.

Used specifically for leak detecting, gas filling, and sealing, it is particularly effective in checking units for microscopically small leaks. (A Consolidated Leak Detector, which is connected to the system, can sound an alarm for a leak so small that a thimbleful of air would take 30 years to get through.)

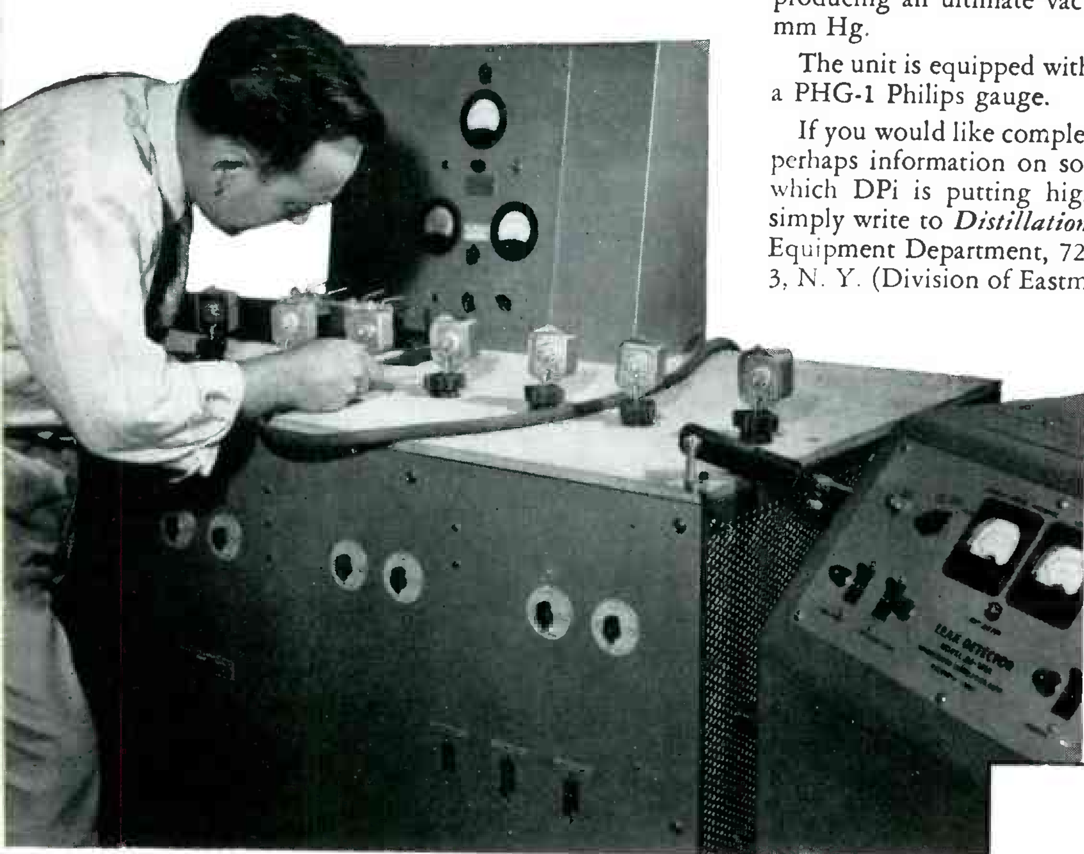
The Vacuum Manifold System is a completely contained "packaged unit," designed to operate from any 110-volt, 60-cycle line capable of handling 35 amperes.

Two mechanical pumps serve as the roughing and the backing pumps for the unit. The roughing pump evacuates the ports to a pressure within the operating range of the diffusion pump. The backing pump maintains a forepressure on the diffusion pump that is well below the required pressure for efficient diffusion pump operation. And three electrically energized solenoid valves on each port of the manifold permit continuous operation of the diffusion pump during the entire processing cycle.

This diffusion pump, DPi model MC-275, is capable of producing an ultimate vacuum of approximately 5×10^{-5} mm Hg.

The unit is equipped with a two station Pirani gauge and a PHG-1 Philips gauge.

If you would like complete technical data on this unit, or perhaps information on some of the many other ways in which DPi is putting high vacuum at industry's service, simply write to *Distillation Products Industries,* Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).



DPi's 10-Port Vacuum Manifold System in use at Barber-Colman Company, Rockford, Illinois.

DPi

high vacuum research and engineering

Also ... vitamins A and E ... distilled monoglycerides ... more than 3400 Eastman Organic Chemicals for science and industry

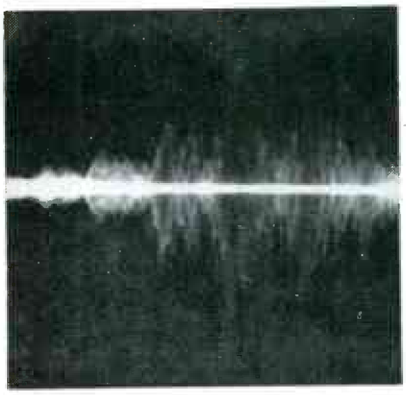


FIG. 5—Double single-sideband suppressed carrier

horizontal time base for the panoramic scope, is used to vary the transconductance of the reactor tubes across the f-m oscillator tank. The 30-cps sawtooth generator is synchronized with the power-line frequency.

The Y-axis amplifier of the oscilloscope has substantially flat video response from 20 cps to 2 mc thus permitting the modulated i-f envelope of the target signal to be visualized without distortion. Since provision is made to synchronize the internally produced X-axis sweep voltage of the oscilloscope with the power-line frequency, the f-m oscillator sweep of the panoramic adapter is easily synchronized with the horizontal time-base sweep of the oscilloscope.

With this equipment, it is possible to select a portion of the 200-kc spectrum displayed on the panoramic scope for more thorough examination. The controls on the

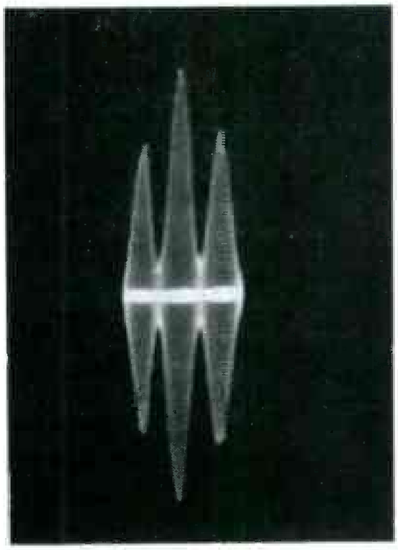


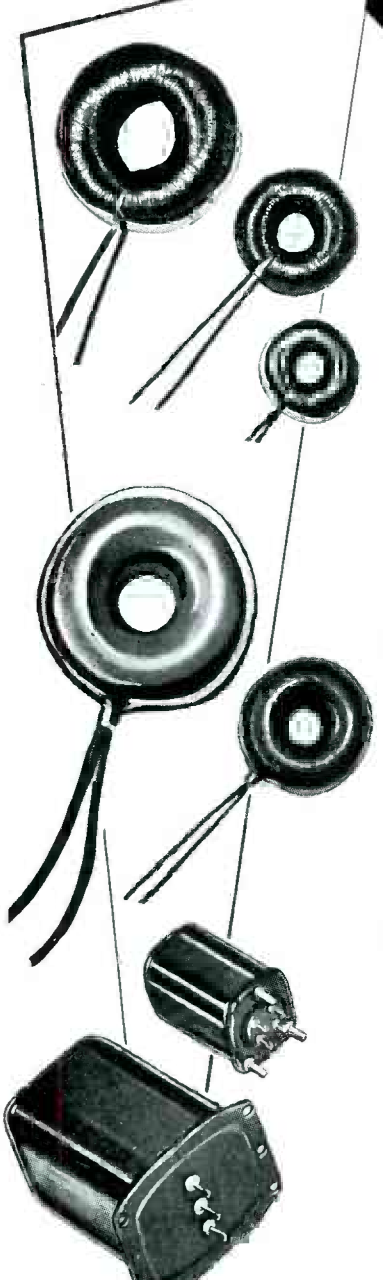
FIG. 6—Standard frequency station WWV

When You Think of

TOROIDAL COMPONENTS...

Think of

COMMUNICATION ACCESSORIES CO.



UNCASED COILS ADJUSTED TO YOUR SPECIFICATIONS

A wide variety in physical size, power capacity and frequency range is offered. Coils are wound to comply with customers' requirements and specifications. Engineering assistance and suggestions are offered without charge.

Coils may be supplied to a tolerance of plus or minus one percent, or matched to a standard inductor to a tolerance of one-tenth percent, or one turn.

Coils may be supplied with temperature coefficient of 180 parts per million per degree Centigrade, or may be supplied with 0° C. coefficient through a limited temperature range.

MOISTURE PROOF PLASTIC COATED TOROIDS

To eliminate the possibility of damage to the exposed winding during assembly, we offer toroids coated with tough thermal setting plastic coating. These coated toroids are recommended where coils are subject to high humidity and where coils must be mechanically mounted. Plastic coating is available in all types of toroidal coils.

STEEL CASED TOROIDS AND FILTERS

C.A.C. engineers, with years of experience in the design of filter networks are at your service to design or help you design the proper networks for your requirements. Where space requirements are severe, filters may be miniaturized by the use of wedding ring toroids and special capacitors. Typical filter cases are shown. However, cases may be fabricated to your specifications.

Write for our latest catalog

COMMUNICATION ACCESSORIES *Company*

HICKMAN MILLS, MISSOURI

GENERAL NETWORK ANALYSIS

Just Published!

Develops both underlying phenomena and techniques of analysis. Covers steady state in lumped networks, steady state in distributed systems, and transients in lumped networks. Gives specialized techniques such as matrices, symmetrical components, transmission-line charts, Fourier series, Fourier integral, and Laplace integral. By **Wilbur LePage** and **Samuel Seely**, both of Syracuse University. 505 pages, 561 illus., 6 x 9, $8.00.

TELEVISION PRINCIPLES

A practical treatise on the principles and theory of television transmission and reception. Emphasizes basic TV transmitter and receiver design, and such subjects as video amplifiers, cathode followers, grounded-grid amplifiers, signal-to-noise ratios in head-ends, intermediate frequency amplifiers, and detection. By **Robert B. Dome**, General Electric Co. 281 pages, 85 illus., $5.50.

FRENCH-ENGLISH SCIENCE DICTIONARY

2nd Ed. Just Published!

Conveniently translates over 43,000 scientific and technical terms pertaining to chemistry, physics, mathematics, etc., and related fields, adapting to the increasing overlapping of the sciences. Second edition supplement defines terms in aeronautics, electronics, radar, and television. By **Louis DeVries**, Iowa State College. 2nd Ed. 596 pages, $6.50.

RADIO ENGINEERING HANDBOOK

Provides quick answers to routine and special assignments in communications, broadcasting, aircraft radio, television, and related fields. Reflecting modern developments in the field, this handbook gives a complete coverage of every aspect of radio engineering—from inductance, power-supply systems, and electron tubes . . . to receiving systems, and code reception—all arranged in concise, quick-reference form. **By Keith Henney, Editor-in-Chief. 4th Ed. 1197 pages, 1038 illus., $10.00.**

SEE THESE BOOKS 10 DAYS FREE

McGraw-Hill Book Co., 330 W. 42nd St., NYC 36

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus a few cents for delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

☐ LePage & Seely—GEN. NETWORK ANAL. $8.00
☐ Dome—TELEVISION PRINCIPLES $5.50
☐ DeVries—FR. ENG. SCIENCE DICT. $6.50
☐ Henney—RADIO ENGINEERING HDBK. $10.00

(Print)
Name ....

Address ....

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

Company ....

Position L-2

This offer applies to U. S. only

Thomas A Edison Cuts Costs in Half with SPEED NUTS®

Edison specifies SPEED NUTS after cost comparisons reveal 50% savings over other militarily acceptable fastening methods.

In the very earliest design stages of their aircraft fire detection relay panel, engineers of Thomas A. Edison, Incorporated, checked various methods of attaching connectors to the panel.

Their requirements were rigid. The fastening means had to be light in weight, resist vibration loosening, provide quick and easy assembly, and be in line on cost. Tinnerman Aircraft Connector Mounting Rings proved to be the only fastener that qualified on all counts. Connectors are quickly inserted through these mounting rings and the panel.

As for cost, Tinnerman SPEED NUTS *turned in the finest record by far! Easily 50% assembly savings over acceptable military substitute fasteners were provided by faster, easier, better* SPEED NUTS. Complex or simple, solving fastening problems is Tinnerman's specialty. New booklet, "A Story of Quality", reveals how we can help you. Write for your copy. TINNERMAN PRODUCTS, INC., Dept. 12, Box 6688, Cleveland 1, Ohio. *In Canada:* Dominion Fasteners Ltd., Hamilton. *In Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales.

Cut-away view of Edison Fire Detection Relay Panel, left, shows two SPEED NUT Connector Mounting Rings in position. "U" Type SPEED NUTS, self-retained on 4 corners of ring, line up with screws driven from outside panel. Detail drawing, below, is close-up of assembly.

front panel of the panoramic adapter and the oscilloscope may be adjusted to present a portion of spectrum varying in width from 10 to 200 kc. Hence, two or more signals may be studied concurrently which may be particularly desirable in studies of adjacent carrier interference.

The views expressed in this article are the private ones of the author and are not to be construed as official nor as representing the views of the Navy Department or the Naval Service at large.

Gain-Stabilized Mixer

RETENTION OF GAIN CALIBRATION over long periods of time is an outstanding feature of a new type of feedback mixer developed by the National Bureau of Standards. This feature makes the device especially applicable to continuous radio field intensity recorders as well as to other types of frequency-selective measuring equipment.

Gain stabilization is accomplished in the mixer circuit by using the difference frequency voltage from the output of a superheterodyne as negative feedback. When a high degree of feedback is employed, the gain is approximately proportional to the ratio of two constants determined by the switching or modulating function of the mixer tube. One constant is related to the average value of amplifier transconductance and the other refers to the conversion transconductance. Variations in the constants are mainly due to tube aging but are also affected by changes in circuit impedances, oscillator and supply-voltage instability, and so on.

If both constants are changed in a similar manner by approximately the same percentage, there is little

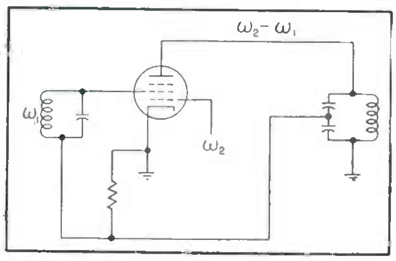
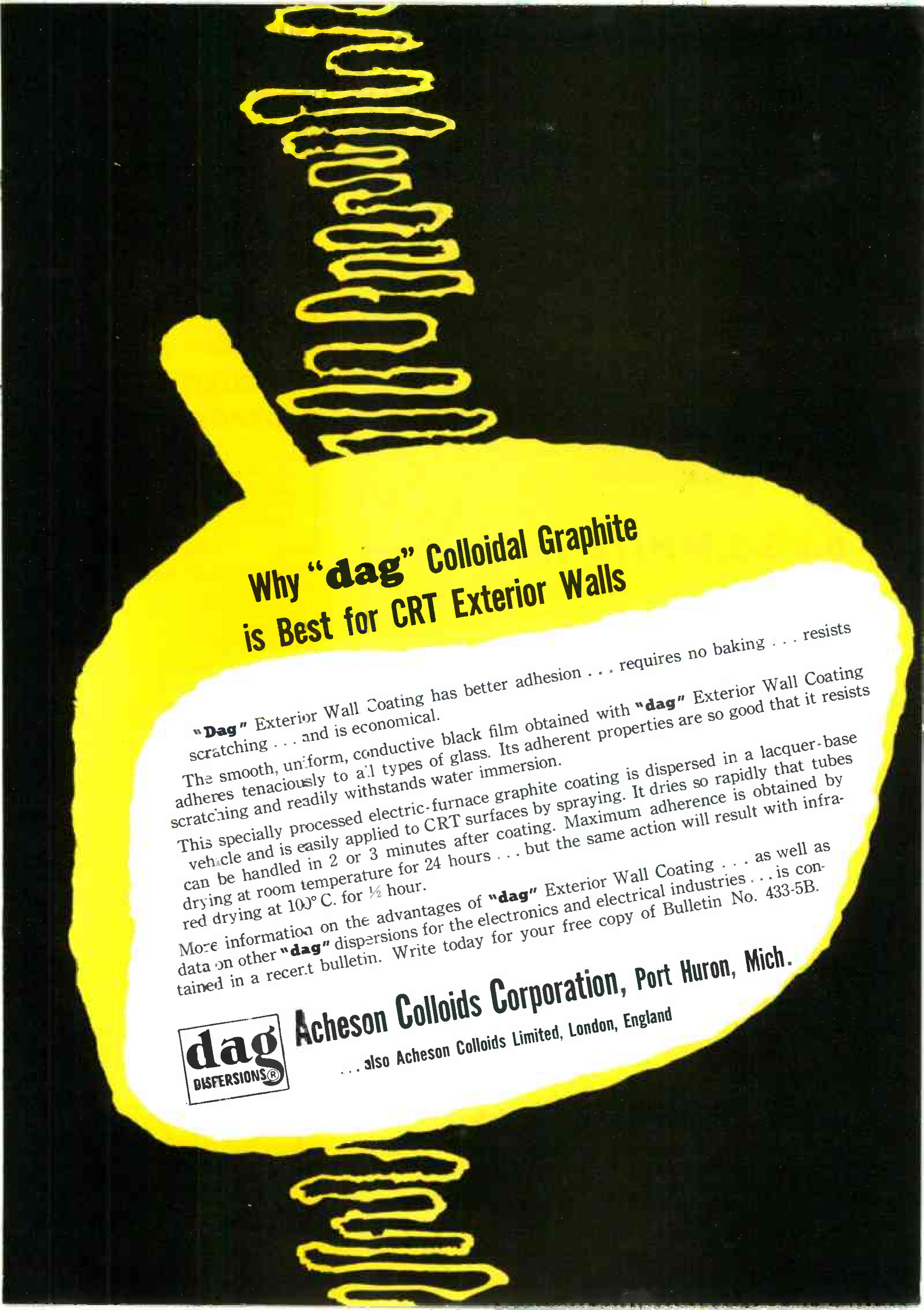


FIG. 1—Schematic diagram of a single-tube feedback mixer using the gain-stabilization principle


Why "dag" Colloidal Graphite is Best for CRT Exterior Walls
"Dag" Exterior Wall Coating has better adhesion . . . requires no baking . . . resists scratching . . . and is economical.
The smooth, uniform, conductive black film obtained with "dag" Exterior Wall Coating adheres tenaciously to all types of glass. Its adherent properties are so good that it resists scratching and readily withstands water immersion.
This specially processed electric-furnace graphite coating is dispersed in a lacquer-base vehicle and is easily applied to CRT surfaces by spraying. It dries so rapidly that tubes can be handled in 2 or 3 minutes after coating. Maximum adherence is obtained by drying at room temperature for 24 hours . . . but the same action will result with infra-red drying at 100° C. for ½ hour.
More information on the advantages of "dag" Exterior Wall Coating . . . as well as data on other "dag" dispersions for the electronics and electrical industries . . . is contained in a recent bulletin. Write today for your free copy of Bulletin No. 433-5B.
dag DISPERSIONS®
Acheson Colloids Corporation, Port Huron, Mich.
. . . also Acheson Colloids Limited, London, England

RELAYS
BY GUARDIAN

- BUSINESS MACHINES
- ALARM SYSTEMS
- AUTOMATIC CONTROLS

- POWER
- TURRET CONTROL
- GUN FIRING
- COMMUNICATIONS

FOR TANKS OR BANKS

Fast . . . accurate . . . the power, gun firing, turret control and communications in a fighting tank depend on expert industrial design and production techniques on the homefront, where speed and precision meet again in business machine "paper work". In mills, factories and in banks Guardian Relays control devices that count–compute–sort–convey–package–vend–meter and mail. Basic . . . flexible . . . government approved . . . *hermetically sealed* or open type mounted . . . Guardian Relays serve all fronts . . . will serve you well!


OCTAL PLUG

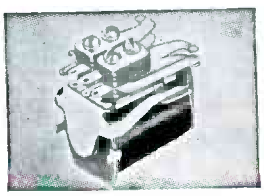

A. N. CONNECTOR


SCREW TERMINAL

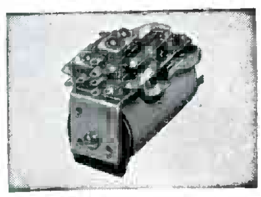

LUG HEADER


AN-3320-1 D.C.


AN-3324-1 D.C.


Series 595 D.C.


Series 610 A.C.—615 D.C.


Series 695 D.C.

Get Guardian's New HERMETICALLY SEALED RELAY CATALOG Now!

GUARDIAN ELECTRIC

1625-B W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY effect upon the gain with feedback. Such tubes as the 6SA7 and 6SB7-Y react this way.

In an experimental single-stage circuit, as shown in Fig. 1, a 6SB7-Y was employed as the mixer tube. With 26 db of feedback and a plate supply of 100 v or greater, the gain variation was less than 5 percent of that which would be experienced without feedback. In order to make substantial improvement in the gain stability, a relatively high degree of feedback is required. For this reason, a tube with a high conversion transconductance should be selected. If a relatively narrow bandwidth is desired, the tuned plate circuit should

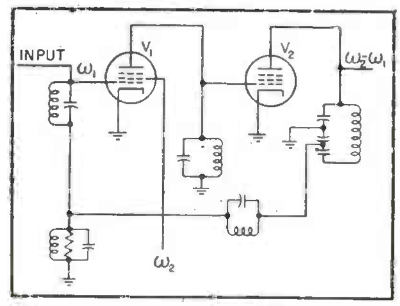


FIG. 2—Circuit using an extension of the gain stabilization principle to a mixer couple

have a high impedance and a high Q.

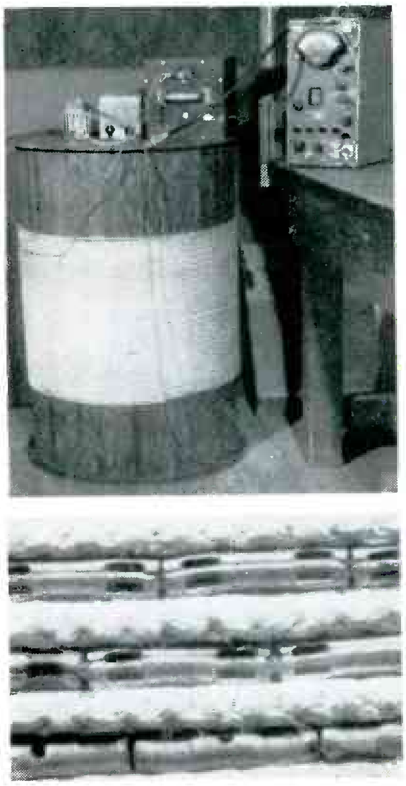
If feedback is applied over two stages, Fig. 2, using practically obtainable coils of high Q, improved flatness with a relatively narrow bandwidth will result. Feedback voltage is obtained from the capacitive voltage divider of a tuned-plate circuit and is returned to the cathode of the first stage through a parallel resonant circuit. Resulting improvement in gain stability for the mixer couple operating at 3.75 mc with 23 db of feedback is greater than that obtained in the single tube circuit.

Degeneration of both signal and oscillator voltages is appreciable when the mixer tube is operated with a fairly large cathode resistor. In order to avoid this, the phase of the feedback voltage is reversed by suitable means and the feedback applied to the signal grid of the mixer. The circuit is similar to the mixer couple described except that the feedback voltage returns to a junction between a parallel-tuned grid circuit and a grounded shunt circuit composed of R, C and L. The purpose of the grounded shunt is to furnish the correct terminating impedance for the feedback circuit as well as to provide a sufficiently low impedance at the signal frequency to bypass the grid return. This arrangement has been used to maintain a constant feedback ratio over a frequency range of 1 to 20 mc.

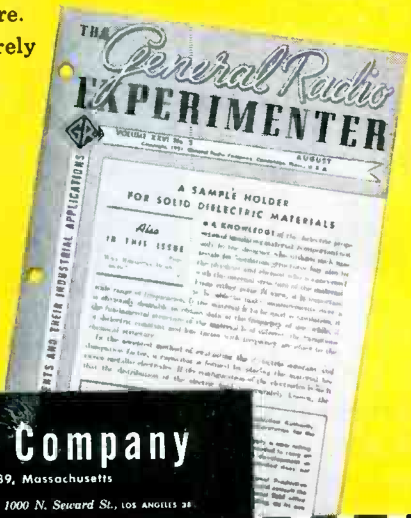
The mixer couple provides improved gain stability, increased gain bandwidth and a gain-frequency characteristic which more nearly approaches an ideally rectangular shape as compared to a cascade, synchronous, single-tuned mixer-amplifier arrangement.

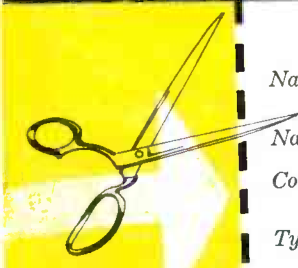
R-F Noise Test for Solderless Connectors

TO DETERMINE whether crimped solderless connectors produce noise in high-gain r-f circuits, a reel containing 7,000 connectors in series was made up by Aircraft-Marine Products Inc. of Harrisburg, Pa. After aging the reel for two years in a warehouse, it was connected as



Connectors on reel for noise test, with battery, r-f choke, variable capacitor and noise meter above. Magnified view below shows the series connectors, spaced apart by an insulating rope





D-H RADIO ALLOYS

Provide Important Parts for

DUMONT's

Selfocus Teletron

Latest development in picture tubes is the Du Mont Selfocus Teletron which provides *automatic focus at all times without the aid of external circuits or devices.* This eliminates the focusing coil or PM unit now used on standard electromagnetic-focus picture tubes, affording a substantial saving of vital materials in the manufacture of television receivers.

The Selfocus Teletron employs electrostatic focus with magnetic deflection, and this type of receiver is unique among electrostatic-focus tubes because its focusing element is operated at zero volts and is tied internally to the cathode through a resistor.

The elimination of focus circuits from the receiver is made possible largely by the focusing cylinder of the Selfocus picture tube. The unusual design of the cylinder and the precision with which it can be located in the electron gun produce increased picture quality by minimizing defects which have been inherent in conventional picture tubes. With greater control of these defects, it is possible to maintain quality uniformly from tube to tube.

Driver-Harris, who has been supplying Du Mont with alloys for cathode ray tubes for more than 10 years, supplies Stainless Steel 18-12 and special D-H Nickel No. 599 for manufacture into important parts of the electron gun of Du Mont's new Selfocus Teletron. The special requirements of this facet of the television industry are well served by the properties of these metals.

At present, strategic materials and the alloys made from them are inevitably on strict allocation. However, we shall be glad to make recommendations based upon your specific needs, and serve you to the best of our ability.

Makers of the most complete line of electric heating, resistance and electronic alloys in the world

Driver-Harris Company

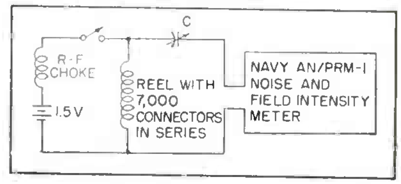
HARRISON, NEW JERSEY

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

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

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

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



Test setup for solderless connectors. The r-f choke blocks noise originating in the battery

shown to a noise meter, using a variable capacitor to tune out the inductance. Results indicated that any noise that exists either with or without direct current flowing in the connectors is less than an order of magnitude above the inherent thermal noise of the circuit.

Fast Construction of Temporary Circuits

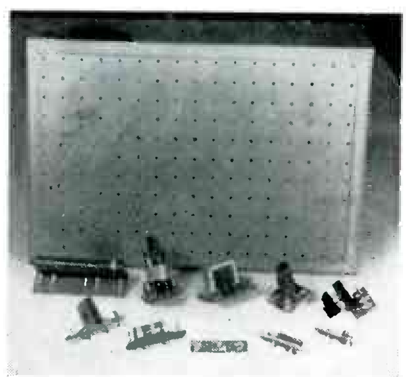
By Arthur R. Jubenville

Electrical Instructor
R. L. Simpson High School
Huntington, New York

A RECENT development in the breadboard technique has been engineered which completely eliminates the aggravating time-consuming factors as well as the unreliability and awkwardness of existing methods for temporary circuit construction.

This latest approach to temporary circuitry is unusually practical because of its design. Components are mounted on individual bases in which two retaining pins ⅛ in. in diameter are fitted. Holes for these pins are drilled throughout the base panel on 1-in. centers. This situation makes it possible to mount speedily any series of components in the desired physical and electrical relationship.

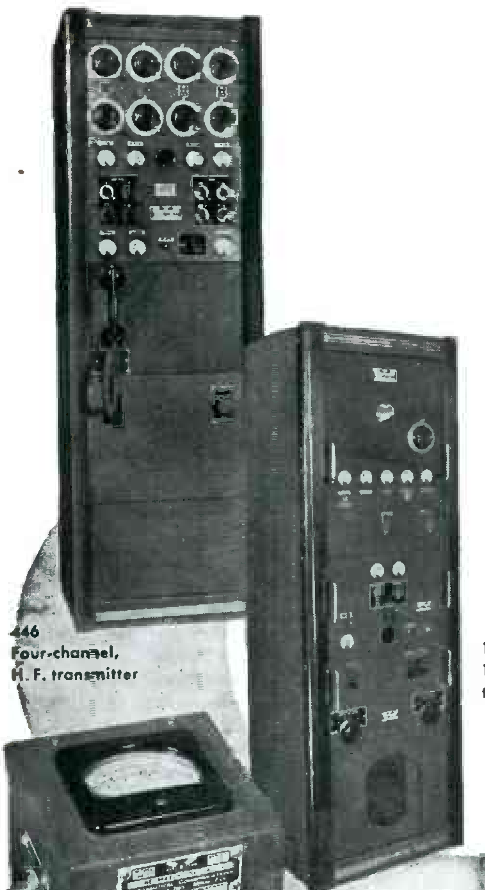
Elements of all components



Components ruggedly mounted on individual bases may be securely positioned on panel as first step in circuit construction

GREATER AEROCOM PRODUCTION!

SAME HIGH QUALITY!



Illustrated here are a few of Aerocom's high-quality products, designed and engineered for the communications industry. Other equipment manufactured: a very-high-frequency (AM) transmitter (VH 200), a dual automatic package-type radio beacon, 50, 100, and 1000-watt M. F. transmitters, an airborne H. F. transmitter, meteorological instruments, and a 50-watt H. F. (AM) transmitter — all top-quality products.

A letter is all that is needed to get technical information on any of Aerocom's equipment. All the equipment manufactured by Aerocom is ruggedly constructed and conservatively rated, assuring you long, trouble-free service.

CONSULTANTS, DESIGNERS AND MANUFACTURERS OF STANDARD OR SPECIAL METEOROLOGICAL AND COMMUNICATIONS EQUIPMENT

AER -O- COM

Reg. U. S. Pat. Off.

AERONAUTICAL COMMUNICATIONS EQUIPMENT, INC.

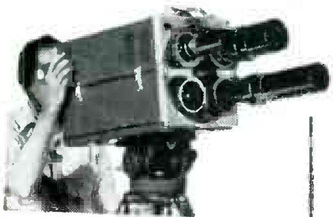
3090 Douglas Road, Miami 33, Florida

Only One Source gives you Double Duty TV!

Highest Quality Studio Programming Resources—plus

Portable Packaging for Maximum Studio-Field Flexibility!

When you invest in GPL TV *studio* equipment, you're buying *field* equipment as well. Every GPL unit provides unparalleled flexibility, light weight, easy handling, precise control. Let GPL engineer *your* station, from camera to antenna. Have *The Industry's Leading Line*—in *quality*, in *design*.



Camera Unit

Precision-built, lightweight, fast-handling. Push-button turret, remote iris control, remote focus and range selection. Easiest to service.

Camera Control Unit

Touch-identified controls. 8½" monitor tube. Split or single headphone intercom system. CRO views horizontal, vertical, and vertical sync block. Iris control.

Camera Power Unit

Rugged, dependable, compact. Matched to other units in GPL chain. Standard relay panels swing out for maintenance.

Synchronizing Generator

Affords maximum circuit reliability without operator adjustment. Binary counters and delay lines, stable master oscillator. Built-in power supply.

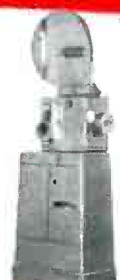
Complete TV Station Installations from Camera to Antenna

Video Switcher

Full studio flexibility anywhere. Control can view, preview, fade, dissolve, etc. Views any of 5 inputs, 2 remotes, outgoing line. Twin fade levers.

"3-2" Projector

Portable sync unit. No need for special phasing facilities. Projects rear-screen or "direct in." Ideal for remote origination of film. Relieves load on Telecine.



Professional TV Projector

Highest quality 16-mm projector designed specifically for TV. Delivers 100 foot-candles to tube. Sharp, steady pictures from 4000-foot film magazine.

Remote Control Box

Provides revolutionary remote control of camera focus, lens change, pan, tilt. Styled to match other components in the GPL TV line.

See Remote Control in Action—Booth 18-20 IRE Show.

WRITE WIRE OR PHONE FOR DETAILS

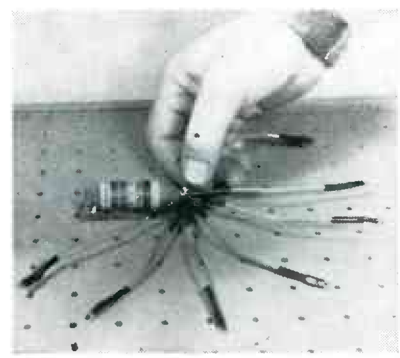
General Precision Laboratory

INCORPORATED

PLEASANTVILLE NEW YORK

TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment mounted on the bases terminate in ⅛-in. posts, which provide excellent contact with the Jiffy Clip connector used in completing the circuit. Accessibility of all terminals plus the ease and speed with which any junction may be opened or closed, permits rapid, efficient component substitution and evaluation and greatly facilitates electrical-measurement and trouble-shooting procedures.

The fact that no tools are required, with no soldering or wire preparation necessary, presents a unique situation. The operator may concentrate completely on circuit interpretation, construction and testing without being distracted and retarded by difficult and impractical mechanical connections or confusing lash-ups.



Connector is attached to post by pressing on at right angles to post or by fitting to top of post and sliding to desired position

Up to seven conductors may be connected to a given terminal as easily as one may be connected. The nature of the connector is such that accidental shorts or disconnection of jumpers is not likely, yet complicated circuits may be "undressed" completely and easily in a matter of seconds.

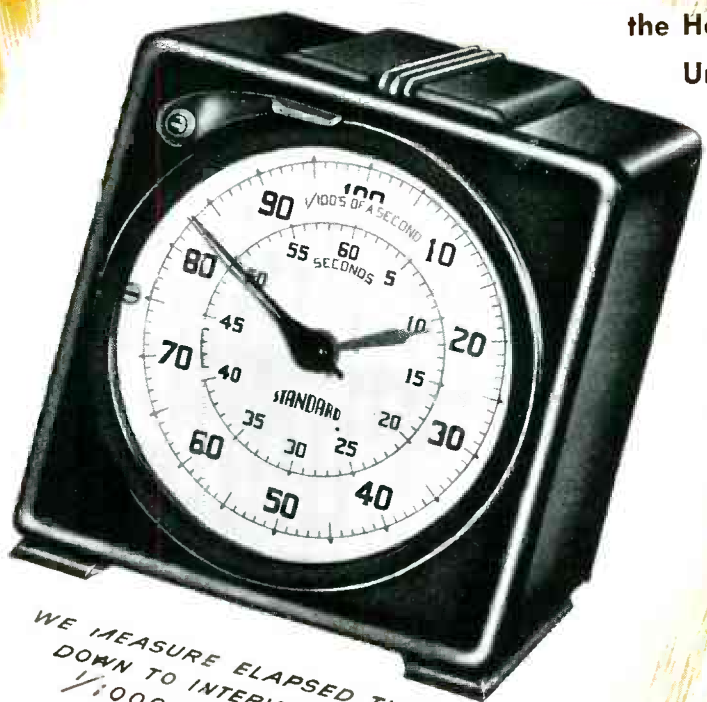
As a result of the excellent conductivity of the connector, all circuits function as normally as if soldered. Tests have proved that the conductivity of the connector compares favorably with any present method of joining wires to elements, including soldering.

The design of the Jiffy Clip makes possible the above mentioned features. The clip is fundamentally a U-shaped device, fabricated from 0.051-in. round phosphor-bronze spring wire. It has been life tested

YOU ARE LOOKING AT
THE MOST Accurate and MOST Rugged
TIME-MEASURING INSTRUMENT IN GENERAL USE
IN THE WORLD!

The STANDARD PRECISION TIMER

It's There — in the "Clutch"
the Heart of STANDARD'S
Uncanny Precision
Performance



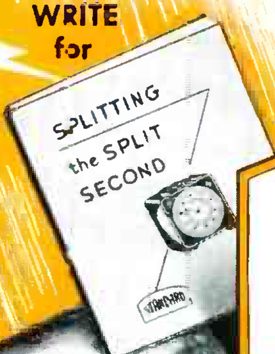
WE MEASURE ELAPSED TIME DOWN TO INTERVALS OF 1/1000th SECOND

Available in 12 Models

Manually and Electrically Operated
•
Portable Cases or Panel Mounting
•
Optional Changes to Conform to Customers' Requirements

Government
Educational Institutions
Electrical Industries
Scientific Laboratories
Aviation
Automotive
Chemical
Food
Textile
Paper
Petroleum
Hundreds of Other INDUSTRIAL Classifications

WRITE for



Let our Engineers help you with Your Special Timing Problems

ESTABLISHED 1884

STANDARD

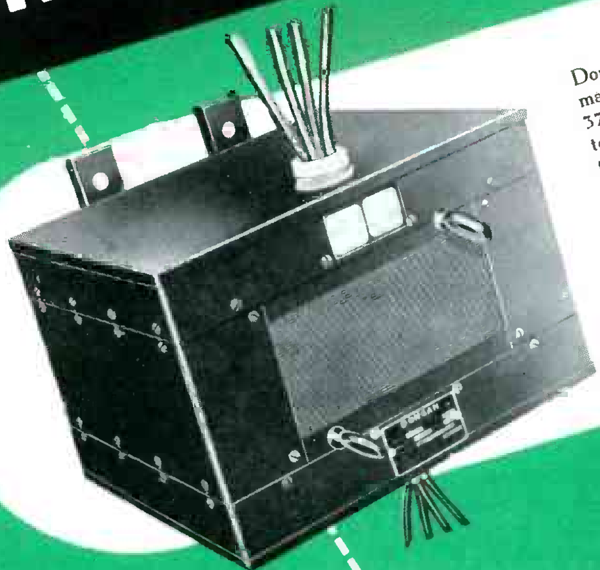
ELAPSED TIME — SIXTY-EIGHT YEARS

THE STANDARD ELECTRIC TIME COMPANY

97 Logan Street, Springfield 2, Massachusetts

TIMERS AND CHRONO-TACHOMETERS
LABORATORY PANELS
PROGRAM CLOCK SYSTEMS
PIPELINE ANALYZERS

DONGAN *Transformers* ARE INSULATED WITH NATVAR Varnished Cambric



Dongan power circuit transformers are made in capacities from .050 KVA to 37.5 KVA, single phase and from 3 KVA to 50 KVA, three phase. Single phase transformers have two primaries and two secondaries which can be connected either in series or in parallel. Dongan #35-1000, illustrated, is rated 10 KVA; primary, 460/230 volts; secondary, 230/115 volts; 50/60 cycles. Natvar varnished cambric is used as insulation between the four windings and also as an outside wrap for the entire coil assembly.

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

Dongan Electric Manufacturing Co., Detroit, has manufactured "The Dongan Line Since 1909." This line of dry-type transformers includes air cooled power circuit transformers, transformers for gas and oil burner ignition, for neon sign and cold cathode lighting, for electronics and communications equipment, and for machine tools.

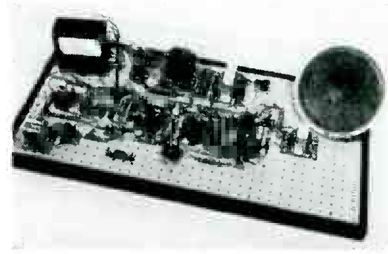
Natvar Varnished Cambric has been used as insulation for many years because of its consistently good electrical and mechanical properties.

All Natvar flexible insulations are consistently uniform no matter when or where purchased. They are available either from your own wholesaler's stock or directly from us.

THE NATIONAL VARNISHED PRODUCTS *Corporation*

Telephone Rahway 7-8800 — Cable Address NATVAR: Rahway, N. J.

201 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY



Circuit of a three-stage 15-watt phase-inversion amplifier. Construction time. 30 to 35 minutes; disassembly time. 3 to 5 minutes

to 7,000 applications to and from the post and remained effective. A notch with a radius of $\frac{1}{16}$ in., with a minimum of 2,500 circular mils area of contact is swaged into the inner side of each of the extending arms. This notch is held to a very close tolerance, resulting in a mating fit with the post that insures a maximum resistance not greater than one thousandth of an ohm. The contact area is such that up to 30 amperes may be effectively carried.

The inner portion of the ends of the arms are swage beveled to facilitate application to the post by pressure at right angles to post. The connector may also be simply fitted to the top of the post and pressed down to the desired position. Any single connector may be easily removed from a group without disturbing remaining connectors. The plastic sleeve is for insulation purposes only, the grip at the junction being maintained by the action of the phosphor-bronze spring wire.

Line-Terminated Pulse Stretcher

By L. Reiffel and G. M. Burgwald

Armour Research Foundation Illinois Institute of Technology Chicago, Illinois

The ideal pulse stretcher produces a rectangular pulse rather than the exponential decaying type. One possible technique recently described[1] utilizes the shunt charging of a lumped parameter line. This technique requires a charging diode for each section of the line and a very-low impedance charging circuit making the stretching of high-amplitude signals difficult with stretching by a factor of 25 being a practical upper limit.

It is possible to terminate

LITTON INDUSTRIES NEWS

LITTON 4J50 MAGNETRON

SNAP-ON OPERATION, LONG SHELF LIFE WITH LITTON X BAND MAGNETRONS

Two high-quality pulse magnetrons in the 9345 to 9405 mc/sec range are now being manufactured by Litton Industries. Designated 4J50 and 4J52, these magnetrons require no aging or seasoning. Special design and processing have resulted in tubes with long shelf life and snap-on operation to full power immediately after completion of the cathode warm-up period.

These tubes offer either high or medium power outputs. Litton 4J50 is a high-power magnetron providing 225 kw minimum peak at .001 duty. 4J52 is a medium power magnetron offering 65 kw minimum peak at .001 duty. Both operate at or beyond ratings.

MOLECULAR LUBRICANT PRODUCTS

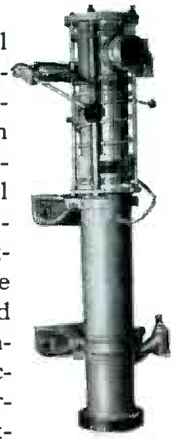
Litton Molecular Lubricant "C" has a vapor pressure of approximately 10^{-7} mm. Hg. at room temperature. In the presence of ionization it will give an indicated pressure of 10^{-6} mm. Hg. Its principal use is in vapor pumps and as a lubricant for bearing operation in vacuum.

Great care has been exercised in its refinement, and the product has a very narrow boiling range. The color and fluorescence are inherent to the material.

This oil has excellent lubricating qualities at temperatures below 100° C. and is suitable for use with anti-friction bearings operating within dynamic vacuum systems.

OIL VAPOR VACUUM PUMPS

The Litton Oil Vapor Vacuum Pumps are of all-steel construction which obviates the possibility of glass breakage and substantially increases the length of service of the equipment.



Boiler and charcoal baffles are easily demountable for cleaning purposes. Litton pumps feature replaceable external heaters, special cooling coils and demountable baffles. These pumps can be obtained in various combinations with high vacuum valve, with charcoal baffle for straight-through operation or side opening.

The Litton pump with charcoal baffle (straight-through operation) has an ultimate vacuum of 5 x 10^{-8} mm. of mercury. The speed (measured at 10^{-5} mm. of mercury) is 75 to 100 liters.

NEW LITTON PLANT ADDITION

Litton Industries has added a new **building** to its plant at San Carlos, California. 40,000 square feet of space is now used for research, manufacturing and general offices. The new building is windowless concrete-and-glass-block construction, completely air conditioned. The interior is light engineered for optimum working conditions.

Write for price and delivery information. Data subject to change without notice.

LITTON INDUSTRIES

SAN CARLOS, CALIFORNIA, U.S.A.

2370

DESIGNERS AND MANUFACTURERS of:
Glassworking Lathes and Accessories, Vertical Sealing Machines, Burner Equipment, Precision Spotwelders, Oil Vapor Vacuum Pumps, Glass Baking Ovens, Vacuum Tubes and Tube Components, Magnetrons, High Vacuum Molube Oil, Microwave Equipment.

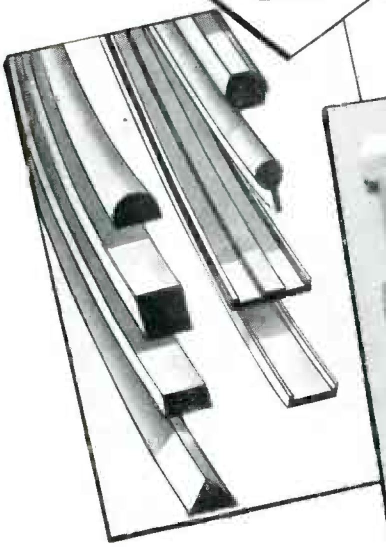
A responsible low-cost source of supply for quantity users of *precision*

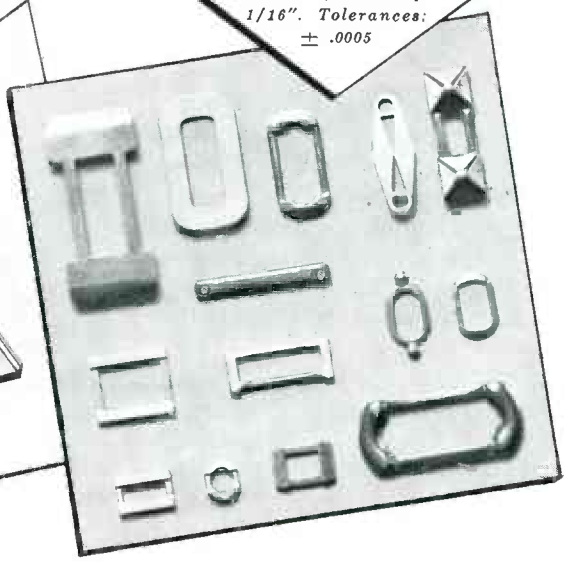
shaped wire

we produce these and any other special shapes, in all ferrous and non-ferrous metals and alloys, to customers' specifications up to 3/4" wide and 3/16" thick. Tolerances: ± .0005

stampings & piercings

any shape, any type to customers' specifications, in all ferrous and non-ferrous metals and alloys, within these dimensional limits: Over-all size—up to 1". Thickness of stock—up to 1/16". Tolerances: ± .0005





As one of the country's foremost manufacturers of fine quality jewelry chain, our plant is equipped with hundreds of high-speed wire drawing and forming machines. Many of these machines, which were designed and built by this organization from the ground up, are also capable of producing the most intricate stampings and piercings to customers' specifications.

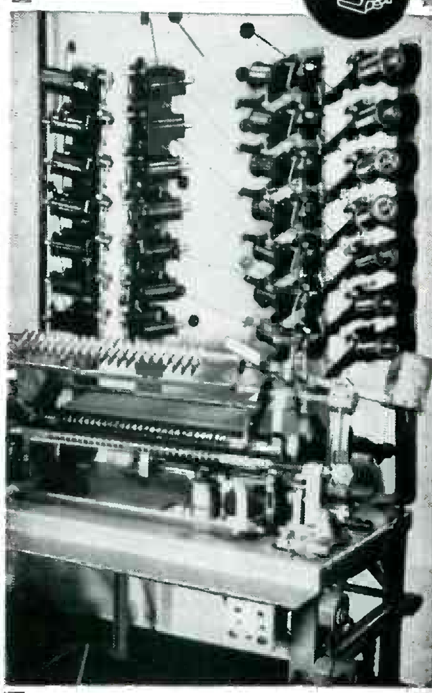
• • • Additional facilities such as an up-to-date tool shop plus complete finishing equipment — including tumbling, polishing, heat treating — assure you of on-time deliveries to meet your defense work schedules.

SEND BLUEPRINT OR SAMPLE & QUANTITY REQUIREMENT FOR COST COMPARISON & DELIVERY, OR CALL SOUTH ORANGE 2-7600.

universal chain co. inc.
92 burnett avenue, maplewood, n.j.

WIND more COILS faster

WITH YOUR PRESENT COIL-WINDING MACHINE!

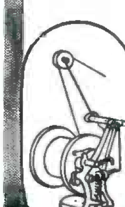


— use

PAMARCO

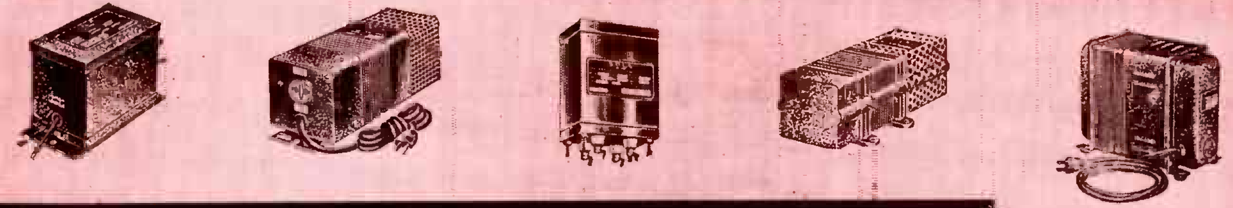
Wire DeReeling Tensions for PERFECT COILS

Installation of these inexpensive PAMARCO tensions lowers winding costs because each machine will accommodate *more* coils at *higher* winding speeds. In addition to increased production, PAMARCO tensions raise production quality. Free-running action practically eliminates wire breakage and shorted turns. Simple thumb screw setting quickly adjusts for any wire gauge. No tools or special skill are needed for operation. For complete data call or write.



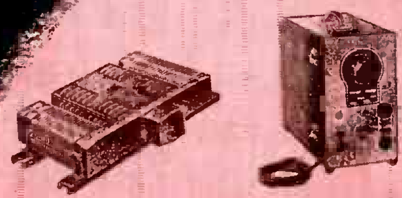
PAPER MACHINERY & RESEARCH, INC.

1014 OAK STREET
ROSELLE, NEW JERSEY

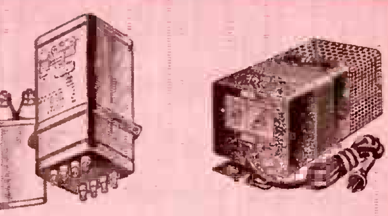


SOLA voltage regulation *for Military Components*

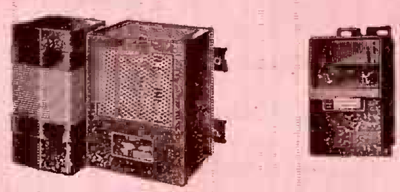
TYPICAL EXAMPLES



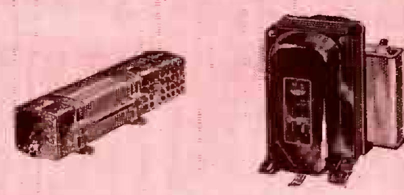
OF THE MANY REGULATING



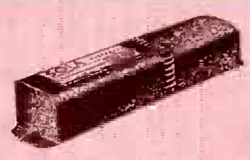
TRANSFORMER TYPES



PRODUCED BY THE



SOLA ELECTRIC CO.



Unfailing voltage control is vital to the performance of today's complex, sensitive electrical and electronic military devices. The manufacturer of such a device can insure its continuous optimum performance by "building in" a SOLA Constant Voltage Transformer to insure the proper input voltage required.

SOLA regulators are ideal for military use. They are rugged . . . completely automatic . . . instantaneous in response . . . have no moving or expandable parts . . . require no manual adjustment or maintenance . . . and are self-protecting against short circuit. The standard units will regulate secondary voltage output within ±1% regardless of continuous line voltage fluctuations as great as 30%.

In addition to line voltage regulation for 115 and 230 volt service, SOLA regulators are available in many special types such as: harmonic-neutralized units for commercial sine wave output; regulated plate and filament power supply transformers; adjustable, regulated A.C. voltage supplies; low voltage, high current filament transformers for oscillators and other large tubes.

The engineering skill and production facilities of the SOLA ELECTRIC CO., the world's largest manufacturer of constant voltage transformers, are available for defense production. SOLA regulators were purchased during World War II directly by the Signal Corps, Air Force and Navy as well as primary military contractors.

We invite your inquiries about standard and custom designed regulators, or the use of SOLA engineering and production facilities as a sub-contractor. Your request will be promptly answered.

SOLA *Constant Voltage* **TRANSFORMERS**

Transformers for: Constant Voltage • Fluorescent Lighting • Cold Cathode Lighting • Airport Lighting • Series Lighting • Luminous Tube Signs
Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • **SOLA ELECTRIC CO., 4633 W. 16th Street, Chicago 50, Illinois**

abruptly the stretching action of the circuit of Fig. 1 so that the long residual signal is eliminated and essentially a square pulse of arbitrary duration will appear across capacitor C_1. This is accomplished through use of the circuit shown in Fig. 2, wherein the delay line which may be either of the ordinary distributed or lumped-parameter type is used to control the time of application of a clamping signal to capacitor C_1. The stretched pulse duration will be equal to the time delay introduced by the line.

The capacitor C_1, which can be very small, is charged by the input pulse just as it was in Fig. 1, through diode V_1. At the same time, the input pulse begins traveling down the delay line L. The voltage on C_1 after charging is complete begins to leak off very slowly through resistor R_1. The time constant R_1C_1 can be made long so that during the time T_d equal to the delay in the line L the voltage on the capacitor has decreased, say, less than 1 percent.

At the time T_d the input pulse emerges from the line and is applied to the control grid of the clamp tube V_2 which in turn pulls all positive charge off capacitor C_1 and may charge the capacitor negatively, thus causing undershoot which may be eliminated by a second clamping diode V_3. In this manner one is able to produce an essentially rectangular pulse of amplitude equal to that of the input pulse with time duration T_d and rise and decay times about equal to the rise time of the input pulse provided this rise time is not less than approximately 10^{-8} sec.

Where time durations greater than those easily obtained by a delay line are required, the line may be replaced by a univibrator whose differentiated trailing edge may be used to trigger the clamp tube V_2.

It is interesting to note that when the pulses to be stretched are

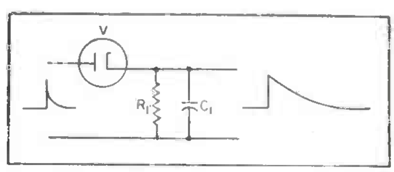
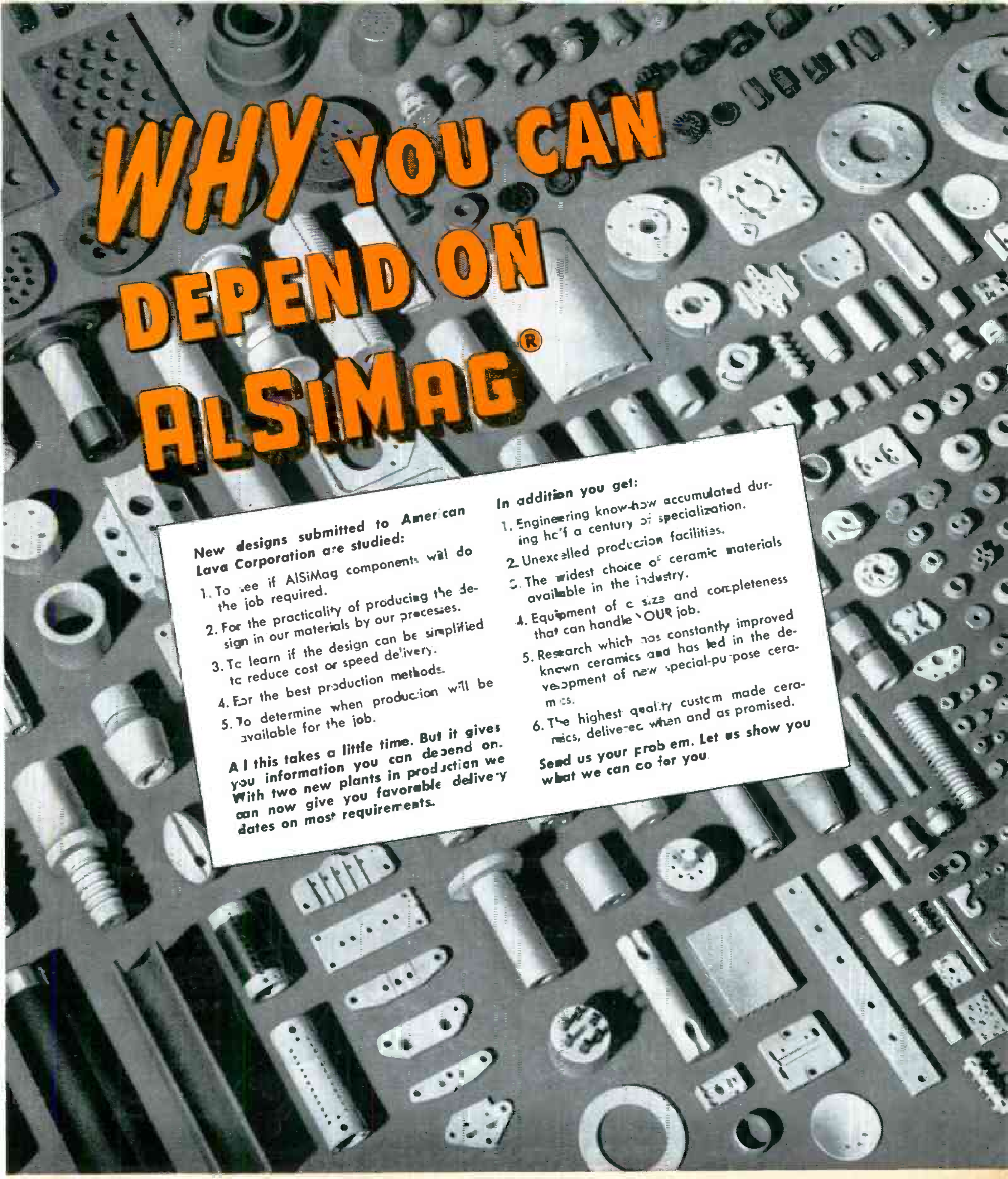


FIG. 1—Peak detector pulse stretcher



WHY YOU CAN DEPEND ON ALSIMAG®
New designs submitted to American Lava Corporation are studied:
1. To see if AlSiMag components will do the job required.
2. For the practicality of producing the design in our materials by our processes.
3. To learn if the design can be simplified to reduce cost or speed delivery.
4. For the best production methods.
5. To determine when production will be available for the job.
All this takes a little time. But it gives you information you can depend on. With two new plants in production we can now give you favorable delivery dates on most requirements.
In addition you get:
1. Engineering know-how accumulated during half a century of specialization.
2. Unexcelled production facilities.
3. The widest choice of ceramic materials available in the industry.
4. Equipment of a size and completeness that can handle YOUR job.
5. Research which has constantly improved known ceramics and has led in the development of new special-purpose ceramics.
6. The highest quality custom made ceramics, delivered when and as promised.
Send us your problem. Let us show you what we can do for you.

General Industries'
Model TR 3-Speed Phonomotor

Dependability . . .

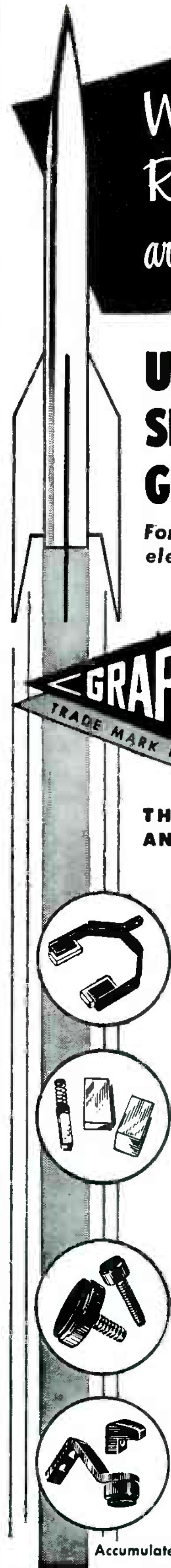
an important reason why leading manufacturers prefer General Industries' 3-Speed Phonomotors

Year after year, General Industries' *Smooth Power* Phonomotors provide trouble-free performance—backing up fine radio, television and record-changer engineering with highest quality motor design and construction.

Write for complete information, including specifications, design features and dimensions. Quantity price quotations available on request.

THE GENERAL INDUSTRIES CO.
Department MA, Elyria, Ohio

Where the Requirements are Extreme . . .



Use SILVER GRAPHALLOY

For extraordinary electrical performance

GRAPHALLOY
TRADE MARK REG. U. S. PAT. OFF.

THE SUPREME BRUSH AND CONTACT MATERIAL

for BRUSHES

- for high current density
- minimum wear
- low contact drop
- low electrical noise
- self-lubrication

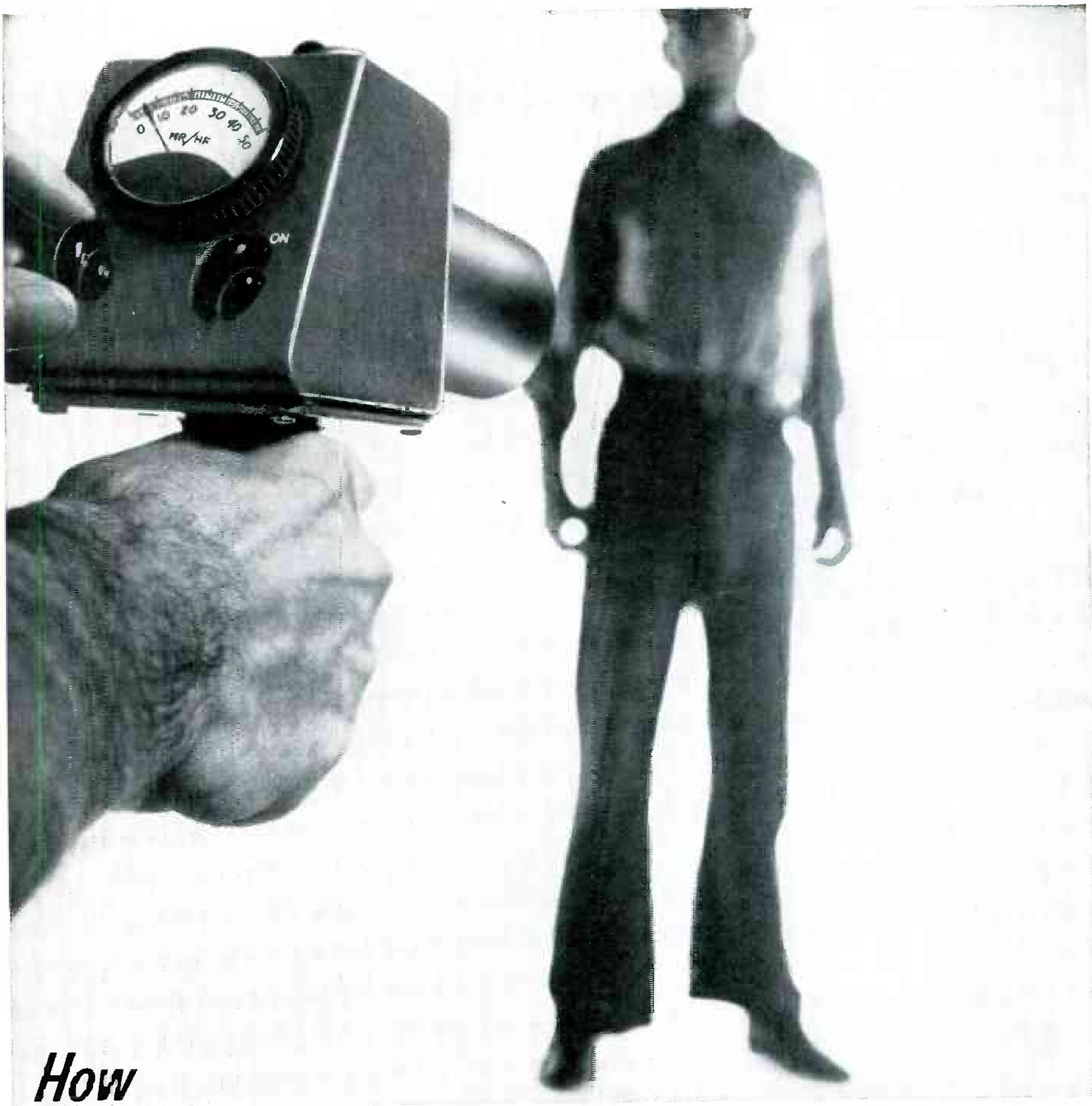
for CONTACTS

- for low resistance
- non-welding character

Graphalloy is a special silver-impregnated graphite

Accumulated design experience counts—call on us!

GRAPHITE METALLIZING CORPORATION
1055 NEPPERHAN AVENUE, YONKERS 3, NEW YORK



How to catch an atomic killer!

Today, there's a potential killer in labs and factories — radioactivity!

But atom workers are safe — thanks to the weapons of science.

Besides every precaution, workers get daily check-ups with ion-chamber "guns" and other radiation-detection instruments. They catch the killer before it strikes!

With atomic industry booming, demand for nuclear instruments is great. Delivery must be certain — and it must be *fast.*

That's why, when shipping these and other precision instruments, both shipper and receiver stamp their orders: via Air Express!

The world's fastest shipping service brings this vital equipment safe, sound and *soon* to laboratories and defense production centers everywhere.

Whatever your business, *you* can profit from regular use of Air Express. Here's why:

IT'S FASTEST — Air Express gets *top priority* of all commercial shipping services — gives the fastest, most complete door-to-door pick-up-and-delivery service in all cities and principal towns at *no extra cost.*

IT'S DEPENDABLE — Air Express provides one-carrier responsibility all the way and gets a *receipt upon delivery.*

IT'S PROFITABLE — Air Express service costs less than you think, gives you many profit-making opportunities.

For more facts, call Air Express Division of Railway Express Agency.

AIR EXPRESS

GETS THERE FIRST

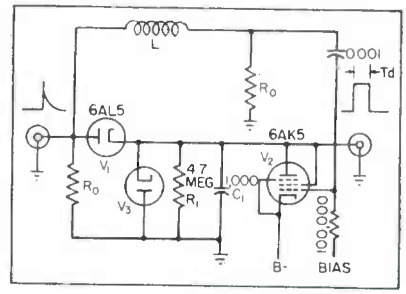


FIG. 2—Line-terminated pulse stretcher

of sufficient amplitude and a small amount of residual signal is tolerable, the plate-supply voltage for the clamp tube V_2 may be derived solely from the charge on capacitor C_1. The circuit described has proven to be both reliable and flexible in its applications and may be used to stretch pulses by as much as a factor of 1,000 in a single step since the discharging impedance can be made very large permitting fast charging of the correspondingly small stretching capacitor.

REFERENCE

(1) J. F. Craib, Improved Pulse Stretcher, ELECTRONICS, p 129, June 1951.

Control System for Induction Heaters

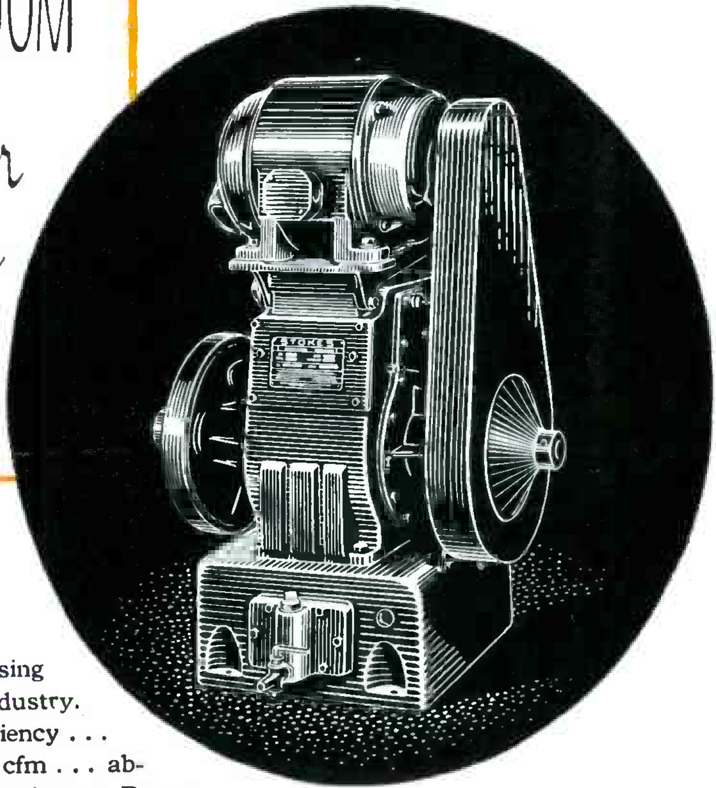
WHEN SILVER SOLDERING or brazing near rubber or plastic insulation, the operation should be completed as rapidly as possible to avoid damage to the insulation and to the parts being brazed or soldered. The control system to be described reduces the power when the desired temperature has been reached and disconnects the power when the braze is completed.

The system arrived at controls power up to 40 kw at 10 kc. Full power is first made available and then reduced to the level required to keep the temperature constant at the operating point. When the operation is completed, a detector circuit turns off the power.

Operation

The radiation from the work is compared to that of a standard lamp to control the power fed to the work by the induction heater. A photocell, see Fig. 1, is switched back and forth between the work and lamp by means of a spinning

STOKES HIGH VACUUM EQUIPMENT... *for every requirement of vacuum processing*



Stokes Microvac Pumps — basic to vacuum processing —are designed for the broadest requirements of industry. They have high volumetric and mechanical efficiency . . . capacities of 15 to 500 cfm . . . absolute pressures to 10 microns. Power consumption is low. Compact design with top-mounted motor requires minimum floor space.

There are but four moving parts including the high speed, full-opening exhaust valve of corrosion-resistant Teflon. Lubrication is completely automatic, without packing, stuffing-boxes or grease fittings. Wear is kept to a minimum, and long trouble-free service assured. Parts are precision-finished, standard and interchangeable.

Stokes is the only manufacturer of equipment for complete vacuum systems, including Microvac mechanical pumps, oil diffusion pumps, McLeod Gages and Vacuum Valves.

Consult with Stokes on the application of vacuum to rotary exhaust machines, house vacuum systems, vacuum impregnation, vacuum furnaces, vacuum metallizing, and to other applications in which vacuum deserves exploration.

Send for FREE Stokes Vacuum Calculator. This slide rule determines needed pump capacity for any job...shows Centigrade to Fahrenheit conversion. Other useful conversion tables and scales on reverse of rule.

STOKES

STOKES MAKES
Plastics Molding Presses,
Industrial Tabletting
and Powder Metal Presses,
Pharmaceutical Equipment,
Vacuum Processing Equipment,
High Vacuum Pumps and Gages,
Special Machinery

F. J. STOKES MACHINE COMPANY, 6046 TABOR ROAD, PHILADELPHIA 20, PA.

Boost feeble input signals with *Sensitrol*® ultra-sensitive relays......

How many devices do *you* know of that use an amplifier to boost a feeble input signal up to where it will operate a relay? Most of them would be more reliable . . . more compact . . . more economical—if the amplifier could be omitted.

It can be omitted! For rugged Weston Sensitrol Relays operate reliably on input signals as slight as *1 millivolt* or *½ microampere,* handle substantial wattage *at 110 volts!* They require no power for excitation.

Engineering assistance is freely offered to help you adapt these Sensitrol Relays to present products, or any new problems you may have in mind. Simply consult your nearest Weston Representative, or write Weston Electrical Instrument Corporation, 595 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAGliabue instruments.

A Type for Every Need

So sensitive that they operate direct on the output of a photo-electric cell or thermocouple, Sensitrol relays enable the instrument engineer to dispense with amplifiers, vacuum tubes and auxiliary power supplies. Single or double contacts, fixed or adjustable, manual or solenoid reset. Be sure you have a copy of Bulletin B-25-B, which gives detailed data on Sensitrol and other Weston relays.

WESTON *Instruments*

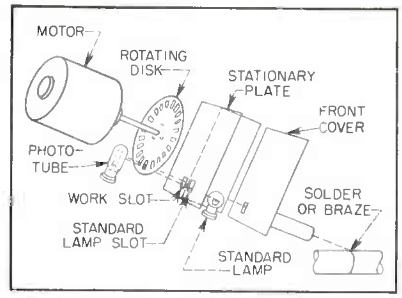


FIG. 1—Optical commutator for temperature control

slotted disk. The slots in the stationary plate are aligned with those of the disk. The lamp is behind one stationary slot and the work is behind the other. As a disk slot scans across the two stationary slots, a wave shape of the incident light on the photocell is produced.

A separate lamp, in addition to the standard lamp, radiates through another portion of the rotating disk into a second photocell. A reference wave is produced by this lamp to perform switching functions in the electrical circuit. The reference wave has a frequency of 600 cps with the disk rotating at 1,800 rpm.

Figure 2 shows a block diagram of the temperature-control system. The preamplifiers are located in the viewing unit. The control and amplifier unit also contains the circuits for the delay feature which disconnects the power when the braze is completed.

The phase-sensitive rectifier is an important part of the system. It is fed by a temperature-comparison signal and the phase-reference signal from the respective preamplifiers. The phase-sensitive rectifier rectifies these two signals and develops a d-c output voltage proportional to the magnitude and phase sense of the temperature com-

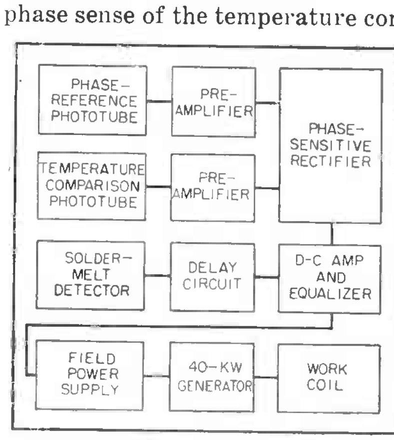
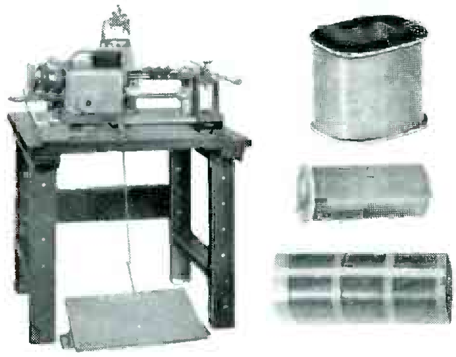


FIG. 2—Block diagram of temperature-control system

YOUR COIL CAN BE WOUND FASTER, CHEAPER, EASIER ON A GEO. STEVENS WINDER!

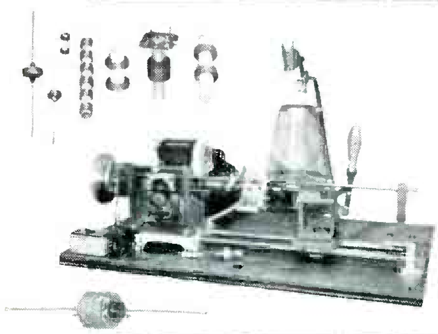
- **MORE OUTPUT . . . LOWER COSTS . . .** from EXCLUSIVE SPEED FEATURE. Variable speed motors permit speed changes without changing belts or pulleys. Coil design permitting, speeds as high as 7500 RPM are not uncommon.
- **MUCH FASTER CHANGING OF SET-UPS.**
- **MUCH LOWER ORIGINAL COST.**
- **LONG LIFE.** Most of the original Geo. Stevens Machines bought in 1936 are still operating daily at full capacity.
- **EASIEST TO OPERATE.** In one hour, any girl can learn to run a Geo. Stevens Machine.
- **MORE GEO. STEVENS** coil winding equipment is in use than all other makes combined.

SOON TO BE ANNOUNCED
NEW TORROIDAL WINDING MACHINE



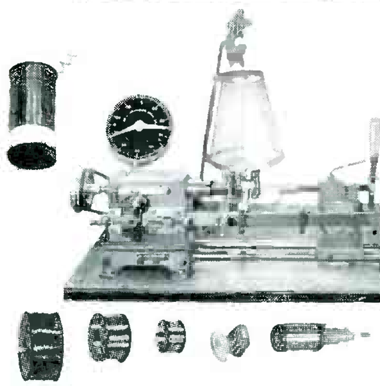
MODEL 117-A
Automatic Heavy Wire Bobbin and Transformer Winder (Screw Feed)

—especially suited for winding *heavy* wire in tight, perfectly uniform layers for one or several Bobbin and Transformer Coils for regular production, laboratory or experimental use in *military and other types of equipment where space is limited.* Also winds single layer close or space wound coils.



MODEL 120-A
Universal Automatic Winder

—winds self-supporting, lattice wound universal coils. More than 2 universal coils may be wound simultaneously. Also winds R.F. Chokes, single or Pi-wound



MODEL 112
Bobbin Winder

—winds all types of random wound Bobbin Coils; Solenoids; Repeater Coils.

NEW GEO. STEVENS CATALOG—
describes machines that wind practically every kind of coil for laboratory or production line. Write for your copy today.

World's Largest Manufacturer of Coil Winding Machines

REPRESENTATIVES

Frank Tatro
6022 No. Rogers Ave., Chicago 30, Illinois
Insulation & Wires, Inc.
2240 E. Washington Blvd., Los Angeles 21, Calif
R. F. Staff & Co.
1213 W. 3rd St., Cleveland 13, Ohio

GEO. STEVENS
MFG. CO., INC.
Pulaski Road at Peterson
Chicago 30, Illinois

MELPAR INC.

ELECTRONIC ENGINEERS

WHO WE ARE:

As a result of our recent affilation with the Westinghouse Airbrake Co., we are entering a new and accelerated expansion program directed toward permanent growth in the industrial electronics field.

WHAT WE OFFER:

To qualified, competent engineers, we offer truly permanent positions at salaries that rank among the highest in the industry. Additional compensation is paid for the extended work week.

WHERE WE ARE:

We are located just outside Washington, D. C.—away from the hustle and bustle, yet close enough for you to enjoy all the advantages the nation's capital offers. Suburban housing in northern Virginia is available only a few minutes away from where we are located.

HERE'S ALL YOU DO:

If you have experience in any of the fields listed below, you owe it to yourself to investigate career opportunities here. Of course, all replies will be strictly confidential.

- **Computers**
- **Radar Beacons**
- **Telemetering**
- **Sub-Miniaturization**
- **Microwave Receivers**
- **Microwave Transmitters**
- **Millimicrosecond Pulse Circuits**
- **Research in Underwater Sound Systems**

Send resumes to: PERSONNEL DIRECTOR

MELPAR, INC.

452-A Swann Ave., Alexandria, Va.

For Communication Circuits PRECISION *And For Networks*

TOROIDAL INDUCTORS

by FREED

Q vs FREQUENCY TYPE TI-1

Q vs FREQUENCY TYPE TI-2

Q vs FREQUENCY TYPE TI-3

Q vs FREQUENCY TYPE TI-3A

Q vs FREQUENCY TYPE TI-4

Q vs FREQUENCY TYPE TI-5

Q vs FREQUENCY TYPE TI-6

Q vs FREQUENCY TYPE TI-7

Q vs FREQUENCY TYPE TI-8

Q vs FREQUENCY TYPE TI-9

Q vs FREQUENCY TYPE TI-10

Q vs FREQUENCY TYPE TI-11

Q vs FREQUENCY TYPE TI-12

Q vs FREQUENCY TYPE TI-13

FREED TYPE	FREQUENCY
TI-1	Up to 15 KC
TI-2	Up to 75 KC
TI-3	Up to 200 KC
TI-3A	Up to 200 KC
TI-4	Up to 15 KC
TI-5	Up to 15 KC
TI-6	Up to 75 KC
TI-7	Up to 75 KC
TI-8	Up to 60 KC
TI-9	Up to 60 KC
TI-10	Up to 60 KC
TI-11	Up to 15 KC
TI-12	Up to 15 KC
TI-13	Up to 75 KC

SEND FOR NEW COMPLETE CATALOG.

FREED TRANSFORMER CO., INC.
1722B WEIRFIELD ST., (RIDGEWOOD) BROOKLYN 27, N. Y.

FREED TEST INSTRUMENTS — PRODUCTS OF EXTENSIVE RESEARCH

No. 1020 Megohmmeter

No. 1010 Comparison Bridge

No. 1030 Low Frequency "Q" Indicator

No. 1060 Vacuum Tube Voltmeter

No. 1110A Incremental Inductance Bridge

No. 1140 Null Detector

Decade Inductor 30 CPS to 300 K

parison signal. The output voltage has one polarity if the braze requires more power. To reduce the heating power, the polarity is reversed. Magnitude of the voltage is proportional to the temperature unbalance between the work and the standard lamp.

The signal is next passed through an amplifier whose gain compensates for the effect of the inductance of the 40-kw generator field. The power delivered to the braze tends to lag the application of voltage to the generator field because of this inductance.

The material in this article was abstracted from an article in the *Bell System Technical Journal* for September, 1951, entitled "Induction Heater Control System" by R. W. Ketchledge.

Multichannel Remote Control System

By H. M. Schweighofer and A. H. Wulfsberg

Engineering Division
Collins Radio Company
Cedar Rapids, Iowa

In the Design of remotely operated multichannel transmitting and receiving equipment, there is often a need for a device capable of turning a shaft to any one of a number of angular positions by remote control. The need is especially evident in the design of vhf and uhf aeronautical equipment for which frequency channels have been set up on a decimal basis.

A relatively simple mechanical device called the Autopositioner has been developed and successfully employed in a number of radio equipments for both commercial and military application. The system also shows promise in certain industrial control and indicating applications.

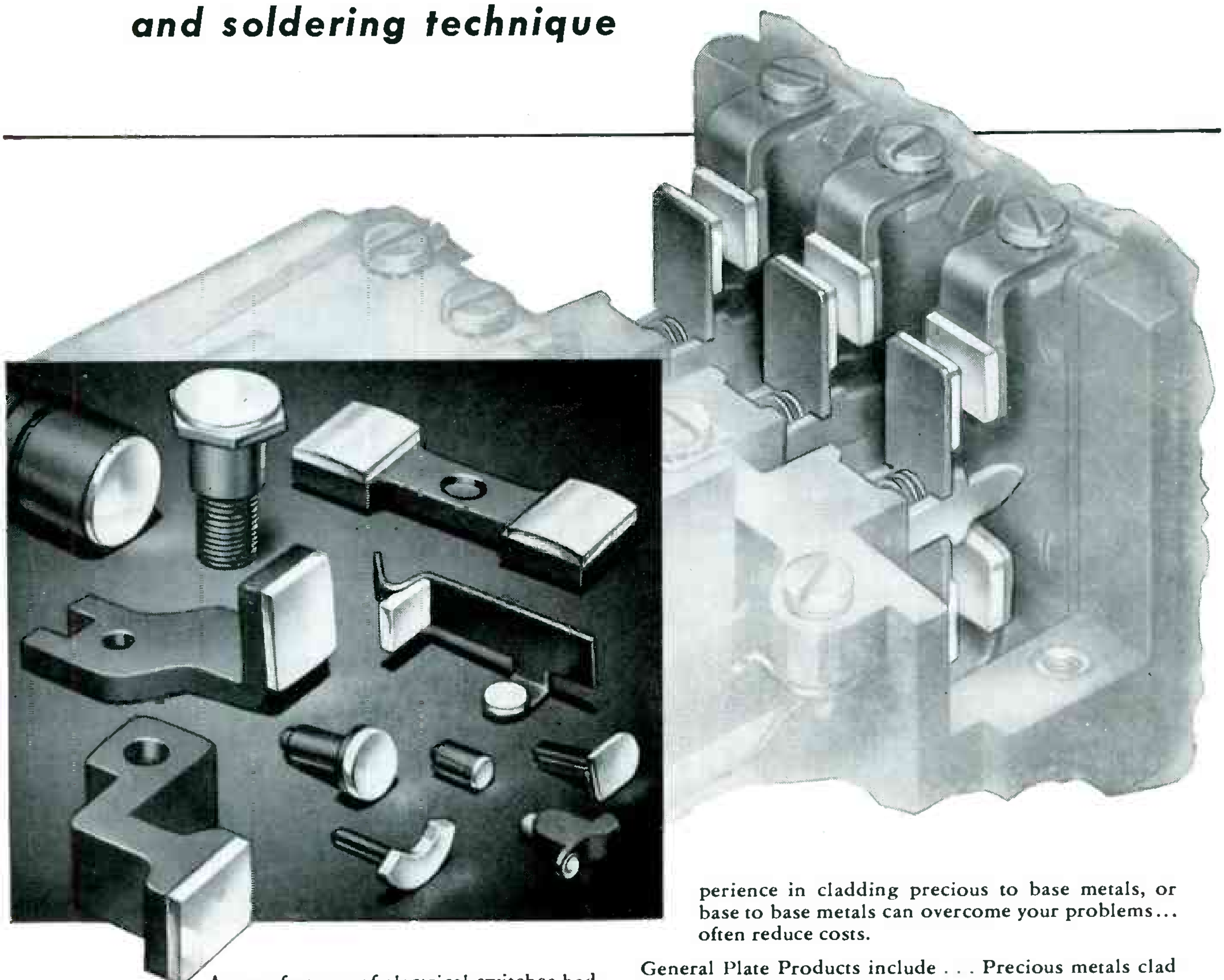
The basic elements of the device, as shown in Fig. 1, are a motor and its gear train, a torque-limiting clutch, a rotating shaft to which is fastened a notched stop-wheel, a pawl which engages the stop-wheel and a solenoid which actuates the pawl and also operates a pair of electrical contacts which control the motor. Associated with each unit is an electrical control system consisting of a remotely located selec-

PROBLEM:

How to braze silver contact to base metal to get maximum bond area

GENERAL PLATE

Provided the solution with a special solder and soldering technique



A manufacturer of electrical switches had difficulty in obtaining the required bond area in brazing a silver contact to a base metal part.

The problem was presented to General Plate engineers who provided the solution by developing a special solder and soldering technique. The result was a joint with 85% bond area which provided the necessary strength and electrical and thermal conductivity.

General Plate has extensive facilities for manufacturing brazed contact assemblies of various shapes. It will pay you to consult with General Plate on your problems.

And if you are concerned with composite metal problems, it will pay you to talk with General Plate. Their vast experience in cladding precious to base metals, or base to base metals can overcome your problems... often reduce costs.

General Plate Products include . . . Precious metals clad to base metals, Base metals clad to base metals, Silver solders, Composite contacts, buttons and rivets, Truflex® Thermostat Metals, Alcuplate®, Platinum fabrication and refining, #720 Manganese Alloy. Write for information.

Have You a Composite Metal Problem? General Plate can solve it for you

GENERAL PLATE

Division of Metals & Controls Corporation

32 FOREST STREET, ATTLEBORO, MASS.

Sales Potentials are BIG in the NUCLEAR ENERGY FIELD

Newspapers carry headlines and a sprinkling of manufacturers have their fingers in the nuclear pie. That is the sum total in comparison to the vast numbers that should be directly concerned, that have even the slightest conception of the vast potentials of this new industry.

But it is big — fantastically big, and it's about time manufacturers became more accurately aware of their potential stake in this new and expanding market. So here are some figures to start thinking about.

One small atomic energy laboratory, and there are hundreds of them, has $201,624.00 worth of technical equipment, $207,915.00 worth of "special furniture". The 1,105 items of technical equipment range from an air relief bag to x-ray equipment, and include practically every type of instrumentation. Average cost per technical item is $182.47. Furniture item is $1,083.00.

Don't forget that while this is a lot of equipment, it's all in one small laboratory and that total industry will spend 7 billion in '52. That's quite a field in which to stake a claim.

and here's how to sell that field.

Admitted that the industry is big, but how does one go about selling it? Who are the manufacturers to contact — who in those firms are purchasing influences, and how does one get their product tried, proven and bought?

Most times the "right man" can't be seen and government channels can be labyrinths of wasted time. But these men must be seen and sold.

NUCLEONICS is the magazine those men look for and read, because it is the only one that serves their interest. Its nearly 7,000 subscribers are in every focal point of study, test and purchase. Products advertised within its pages are important to them because in this new science industry products new or established are carefully scanned for application as nuclear components or equipment.

If your products fall within any of the basic classifications that follow . . .

Air Cleaners	Ceramics	Motors
Amplifiers	Chronographs	Ovens
Analyzers	Containers	Phosphors
Balances	Controls	Plastics
Bearings	Detectors	Power Supplies
Bellows	Electron Tubes	Pyrometers
Blowers	Gages	Resistors
Bridges	Generators	Shielding
Burners	G-M Apparatus	Test Chambers
Bushings	Insulators	Testers
Cameras	Ionization Chambers	Tile
Capacitors	Metals	Timers
Carboys	Mixers	Transformers
Centrifuges	Monitors	X-Ray

to mention only a few

***Then* you can sell it most effectively in the nuclear field through . . .**

For further information on the scope of the nuclear market, consult any NUCLEONICS representative for additional data. Complete data on the new enlarged NUCLEONICS is also available from him or write direct to our New York office.

NUCLEONICS

A McGraw-Hill Publication

330 W. 42nd St., N. Y. 36, N. Y.

WESGO CRACK-PROOF CERAMIC SHAPES FOR Furnace Brazing

Withstand any amount of thermal shock without cracking. Proven superior to carbon or metal brazing fixtures in positioning vacuum tube components for furnace brazing.

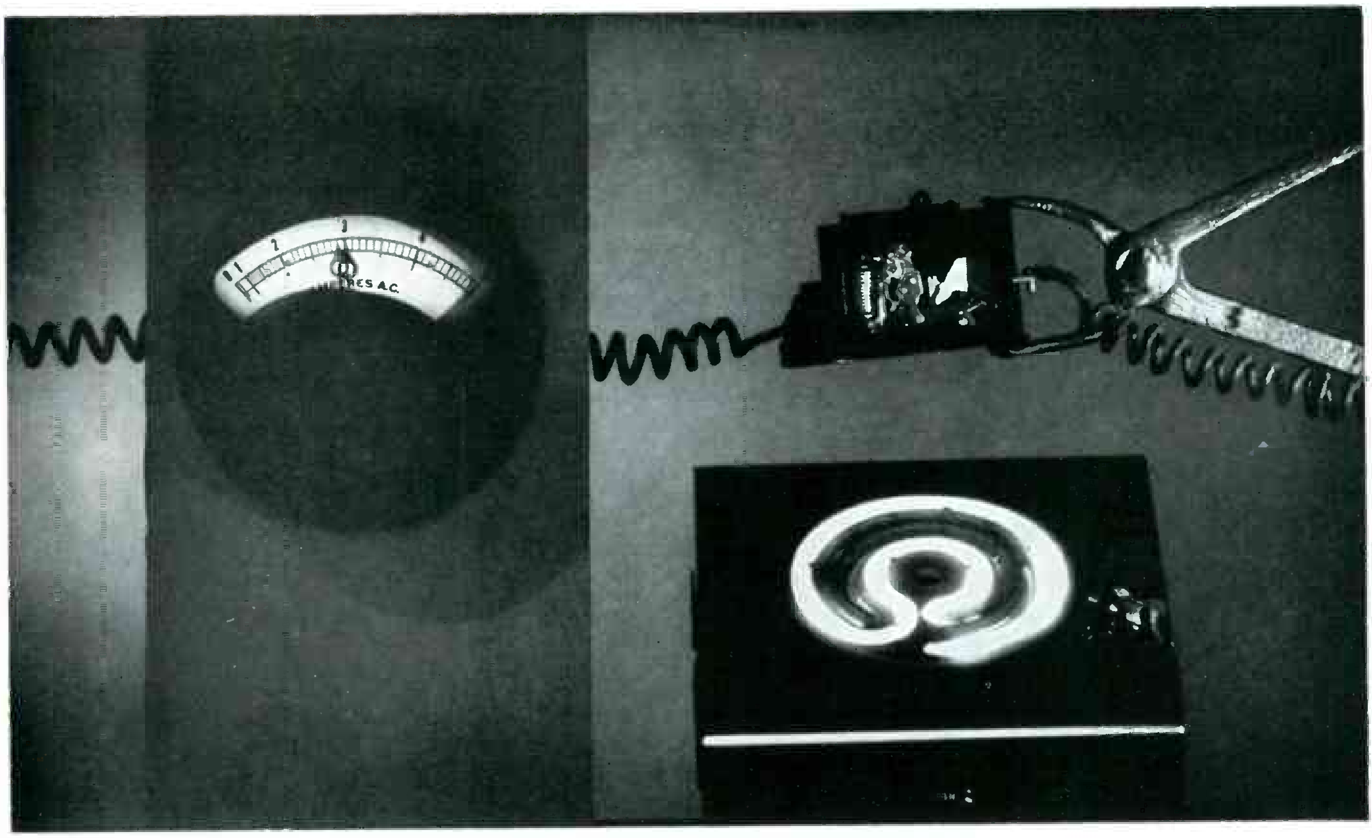
- Non reactive with any metals
- Retains shape at high temperatures
- Clean . . . will not rub off on hands and work pieces
- Permanent . . . do not react with air or reducing gases

Available in stock forms of boats or slabs. Special shapes made to your individual specifications.

WRITE FOR DETAILS

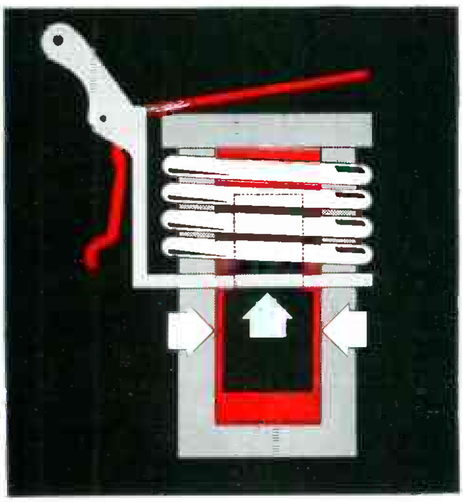
WESTERN GOLD & PLATINUM WORKS

589 Bryant Street • San Francisco, Calif.



Laboratory demonstration shows 30 amperes continuously flowing through 30 ampere Heinemann Circuit Breaker held over hot plate.

the one circuit breaker principle ...THAT IGNORES HEAT!



The FULLY MAGNETIC Principle

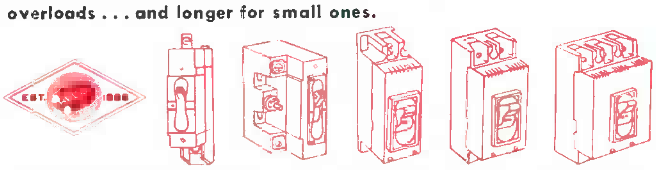
One magnetic coil is the entire actuation of HEINEMANN Circuit Breakers. Thermal warp elements are eliminated. On short circuits, the coil instantly trips the breaker. On small overloads, a time delay is introduced while the movable core is drawn toward the pole piece, increasing the magnetic flux. Moreover, the time delay is proportioned to the overload . . . being shorter for large overloads . . . and longer for small ones.

HEAT . . . the downfall of most circuit protection equipment . . . will not alter the performance of Heinemann Circuit Breakers. You never need to use false ratings to compensate for operating temperatures or room temperature. With Heinemann, current is the only consideration . . . and current (not heat) trips the breaker. There is never nuisance tripping, yet Heinemann provides the fastest circuit interruption available for short circuits and proportioned response for overloads.

Performance and dependability to this extent explains why most equipment manufacturers use Heinemann Circuit Breakers in their products.

Send for complete literature. HEINEMANN ELECTRIC COMPANY, 97 Plum Street, Trenton 2, N.J.

don't use heat... USE POWER



HEINEMANN Circuit Breakers . . One, two and three pole . . 10 milliamps to 100 amperes

HEINEMANN

Circuit breakers

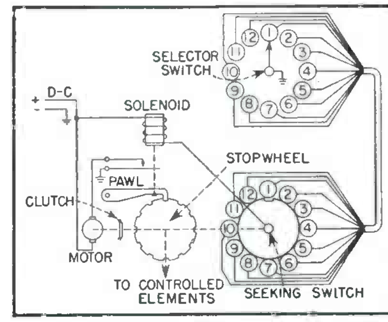


FIG. 1—Functional diagram of the system

tor switch and a "seeking" switch operated by the rotating shaft.

The control system is designed so that whenever the selector switch and seeking switch are not set to the same electrical position, the solenoid is energized, causing the unit to operate and drive its shaft to the proper position to restore the symmetry of the circuit.

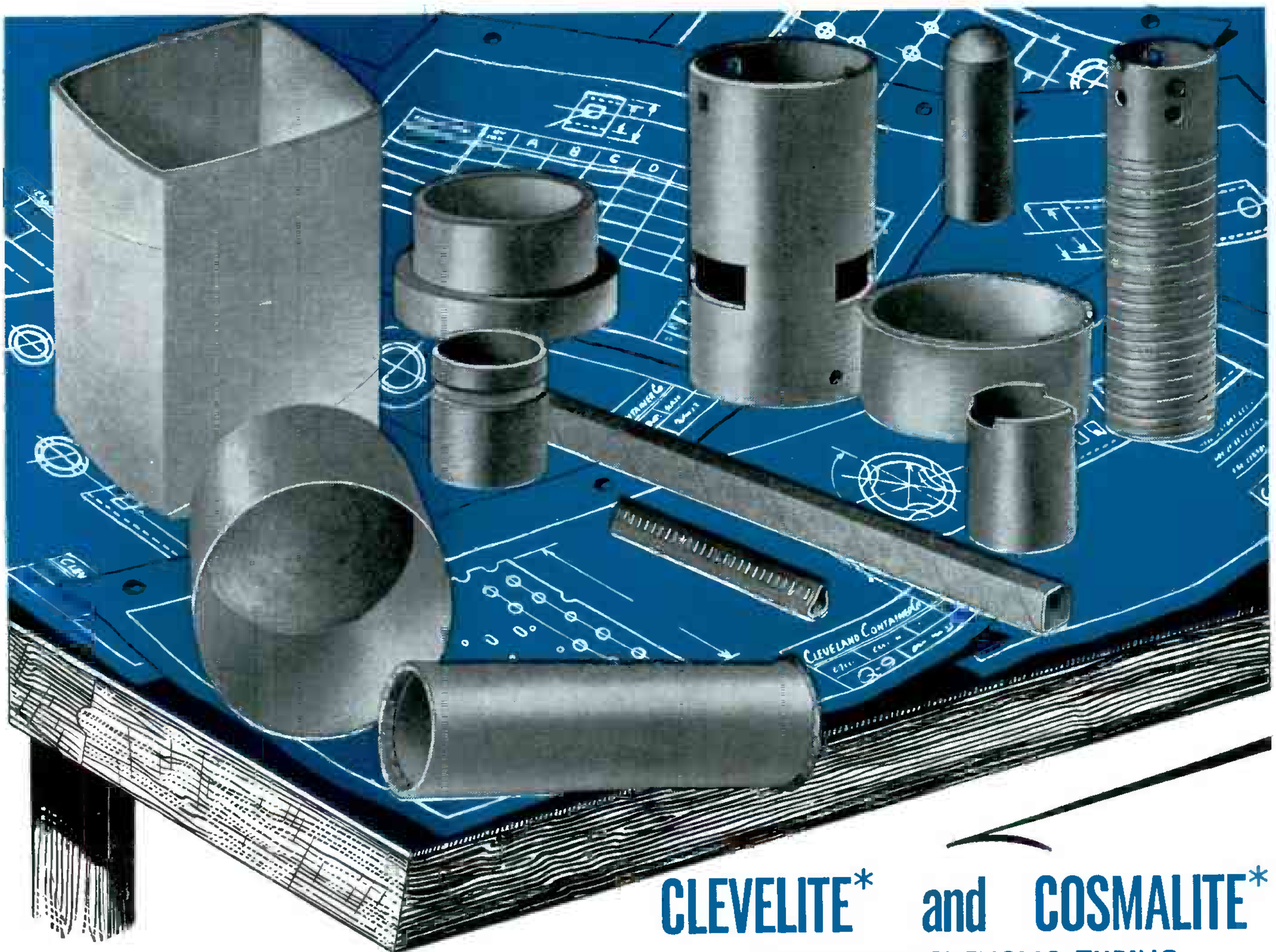
The system illustrated in Fig. 1 is of the simple "open-seeking" type in which one control wire is required for each controlled position. The remote selector switch grounds one control wire, closing the solenoid circuit, until the seeking switch is driven to the proper position to open the circuit. The solenoid then permits the pawl to drop into the selected stop-wheel notch and accurately position the shaft.

To reduce the number of control wires to a practical minimum and still retain the advantages of positive control, a special system to be described later has been developed which uses the control wires in binary combinations.

Because of the use of a wedge-shaped pawl to engage the stop-wheel notches, the accuracy with which the unit can be made to repeat a position can be held to better than 0.05 deg rotation.

To absorb the kinetic energy of the motor when the pawl stops the positioned shaft and to permit the operation of two or more auto-positioner units from a common drive motor, each unit is provided with a clutch of the de-energizing type.[1]

To provide a positive method of controlling the units using a minimum number of control wires, a special binary control system has been developed. This system can



CLEVELITE* and COSMALITE*

LAMINATED PHENOLIC TUBING

A GRADE FOR EVERY NEED!

Available in diameters, wall thicknesses and lengths to meet regular or special adaptations.

CLEVELITE

Grade E........Improved post cure fabrication and stapling.
Grade EX ......Special grade for TV deflection yoke sleeve.
Grade EE ......Improved general purpose.
Grade EEX ....Superior electrical and moisture absorption properties.
Grade EEE .....Critical electrical and high voltage applications.
Grade XAX ....Special grade for government phenolic specifications.

COSMALITE

Grade SP ......Post cure fabrication and stapling.
Grade SS ......General purpose.
Grade SSP .....General purpose — punching grade.
Grade SLF .....Thin wall tubing — high dielectric and compression strength.

Cleveland Container Co. is known for its EXCELLENT SERVICE and PROMPT DELIVERIES.

See our exhibit #207 at
The Radio Engineering Show
in New York City, March 3-6

. . . meets the most exacting requirements of the electronic and electrical industries!

Whether to insulate the live electrical parts of a rectifier, a high voltage transformer, or any one of countless other applications . . . satisfaction is ensured.

For wherever physical strength, low moisture absorption, high dielectric strength, low loss and good machineability are of prime importance . . . the combined electrical and physical properties of CLEVELITE and COSMALITE are essential.

DEPENDABLE • ECONOMICAL • LONG LASTING
Why pay more? . . . for the best call CLEVELAND

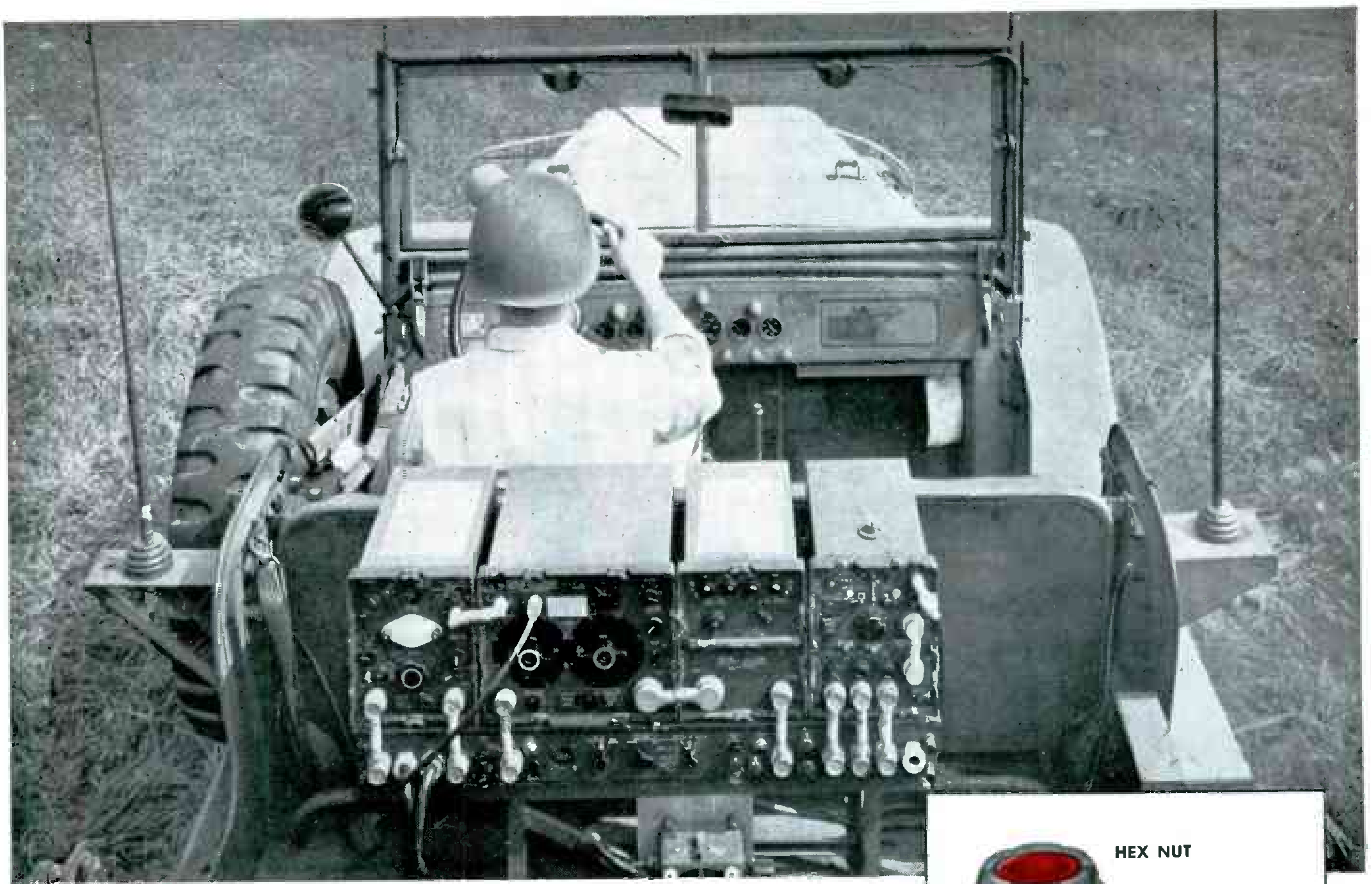
* Reg. U. S. Pat. Off.

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



Guarding Signal Corps Equipment from Fastener Failure

Communications equipment for mobile tactical units must be sturdy enough to follow the front lines cross-country and along battle-pitted roads. This AN/GRC-3 radio equipment, installed in all types of combat vehicles, must be ready to provide communications liaison between advancing units. And it must be ready twenty-four hours a day, despite the roughest operating conditions. For vital equipment of this type there is a growing recognition of the need for self-locking fasteners to protect the expensive and critical component parts which make them function.

Helping to keep this equipment operating by holding against severe and long-continued vibration are many ESNA machine screw hex nuts and clinch nuts. These Elastic Stop Nuts—*with fungus proof nylon inserts for extended reuseability*—offer the advantages of secure fastenings and at the same time simplify maintenance and field repairs.

ESNA HEX NUTS are quickly installed with power tools—permit accurate, precise adjustments, lock at any position along the bolt, and keep fastenings tight until deliberately removed.

ESNA CLINCH TYPE NUTS are available in various shank lengths for swaging on different gauges of sheet metal. Permanently clinched into place on frame members or to sections of the chassis, they provide permanent and pre-positioned fasteners for assembling panels or mounting component parts.

Red Nylon locking inserts Reusable over 100 times

DESIGN AHEAD WITH ESNA

THE FAMOUS RED ELASTIC COLLAR IS VISIBLE EVIDENCE OF LOCKING SECURITY

Threadless and permanently elastic, it provides these 4 outstanding features:

1. Protects against nuts loosening due to VIBRATION
2. Keeps locking threads CORROSION FREE
3. Provides for accurate BOLT LOADING
4. Seals against LIQUID LEAKAGE along the bolt threads

And can be used again and again

Specify ESNA hex and clinch nuts with the new red nylon insert *to assure adequate locking torque through hundreds of on-off applications.*

When you design equipment that needs similar fastening security, specify Elastic Stop Nuts. For complete dimensional and installation data write to Elastic Stop Nut Corporation of America, Vauxhall Road, Union, N. J.

ESNail ® ESNA TRADE MARK ROLLPIN TRADEMARK

ELASTIC STOP NUTS

DESIGN HEADQUARTERS FOR VIBRATION-PROOF FASTENERS

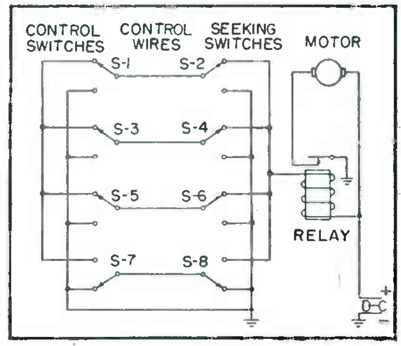


FIG. 2—Functional diagram of the binary control system

be understood best by considering a system of single-pole double-throw switches as shown in Fig. 2. Note that when the switches are set symmetrically (S-1 in the same position as S-2, etc.), there is no current path from the relay coil to ground and the motor will remain unenergized. If any one of the control switches is set to a position different from that of its seeking switch, a path to ground will be created and the motor will operate until the symmetry of the system is restored.

The total number of different combinations in a system such as this is equal to 2^n where n is the number of control wires used. In the case of the four-wire system shown, 16 combinations exist. However, one combination is not usable in this application. Consider what will happen if all the seeking switches were set to off. Then there can be no closed circuit regardless of how the control switches are set. Hence the maximum number of usable combinations is 2^n-1. A three-wire system can control 7 positions, four-wire 15 positions and a five-wire 31 positions.

The unit is adaptable for use with a number of different control systems.

REFERENCE

(1) R. W. May and N. H. Hale, Automatic Positioning Control Mechanisms, *Electronic Industries*, Jan. 1946.

R-F Rewarming

THE DEPARTMENT OF SURGERY, University of Toronto, has been conducting experiments on r-f rewarming techniques. During the past year, results from tests conducted with animals indicate that the same procedure might be applied to the resuscitation of humans with low-

NEWS FLASH FROM LONDON

ALUMINUM SOLDERING REVOLUTIONISED

by world's first commercial *ULTRASONIC* soldering equipment

IS the soldering of aluminum one of your production difficulties? Then here's the biggest—and best—news for you in years. The industrial problem of soldering aluminum and other metals that form refractory oxides has at last been overcome in a practical, commercial form by the use of ultrasonics.

The new soldering equipment developed in the Mullard Research Laboratories destroys oxide film by ultrasonic cavitation and provides a " clean " metallic surface.

The equipment comprises a small electronic amplifier, for supplying the ultrasonic power, and a soldering gun.

Two controls, a mains switch on the amplifier and a trigger on the gun, make the operation simple.

No flux is needed and standard soft solders can be used. Unskilled workers can operate the equipment with absolute ease and safety. And, since the ultrasonic frequency employed is inaudible to the human ear, there is no discomfort to the operator.

The Mullard Ultrasonic Soldering Gun and Amplifier. The unit operates from A.C. mains and is robustly made to suit workshop conditions.

Here is the practical solution to the tinning of aluminum and its alloys. The following are some of the companies who have been supplied with the equipment:

Westinghouse Electric Corp.
North American Aviation Inc.
Sylvania Electric Products Inc.
Bell Telephone Laboratories Inc.
Boeing Airplane Company
Hamilton Watch Company

Isn't there a soldering problem it can settle for *your* company, too?

Deliveries can now be made immediately from stock.

Mail the coupon below for more details.

Mullard

ELECTRONIC TUBES · RADIO · TELEVISION · X-RAY TUBES · LAMPS
SCIENTIFIC INSTRUMENTS · COMMUNICATIONS EQUIPMENT · MAGNETIC MATERIALS · ULTRASONIC GENERATORS

Mullard Overseas Ltd., Electronic Equipment Division, Century House, Shaftesbury Avenue, London, W.C.2, England.

Mullard Overseas Ltd., Century House, Shaftesbury Avenue, London, W.C.2, England | ENQUIRIES IN U.S.A. TO International Electronics Corp., 137 Hudson Street, New York 13, N.Y.

Please send full information of the Mullard Ultrasonic Soldering Equipment to :—

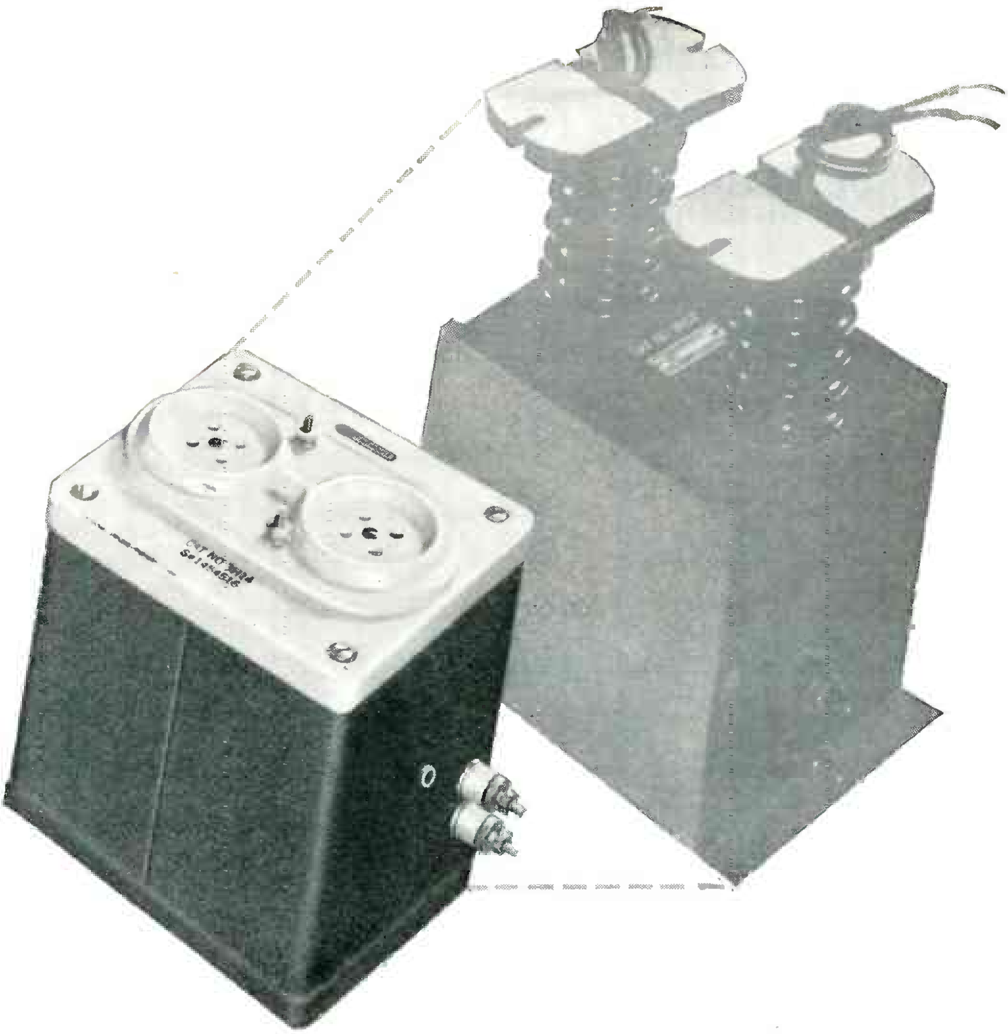
NAME ....

COMPANY ....

ADDRESS ....

CITY .... STATE ....

(MRE105 REV.)



Making little ones out of big ones . . .

Many a design problem has been simplified by the Westinghouse ability to reduce transformer size and weight.

Here, for example, is a case where a transformer was required to work in a voltage-doubler circuit at 18,000 volts. The old model created a space problem.

First step in redesigning, Westinghouse engineers applied a smaller, lighter Hipersil® Core. That, plus improved insulation, made it possible to reduce coil size and spacing. Then a wet-process porcelain cap, with integral tube sockets, eliminated the need for stand-off insulators. The net result was an over-all reduction of 30% in both size and weight of the completed power unit . . . with a great big bonus: The saving to the equipment assembler in installation costs alone made the new design highly profitable, because it was no longer necessary to wire tube sockets.

Savings like this are available to you, too. If size, weight, performance, or quantity production have any bearing on your transformer problem, call your Westinghouse representative, or write Westinghouse Electric Corporation, Specialty Transformer Department, Sharon, Pennsylvania. J-70610

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

TRANSFORMERS

ered body temperatures brought about by exposure to cold air or immersion in cold water.

Preliminary experiments indicate that r-f powers of 200 to 300 watts may be necessary for adequate human rewarming rates. Tests so far have employed from 125 to 150 watts. Because the thermal-regulating mechanism of the body assists in a return to normal body temperature, it seems likely that the higher power and a faster warming rate can be tolerated.

This information was abstracted from the Progress Report for January-March 1951 of the National Research Council of Canada, Radio and Electrical Engineering Division.

Ultrasonic Tire Testing

By John H. Jupe
Middlesex, England

An instrument which embodies one of the most important applications of industrial ultrasonics, namely the nondestructive testing of materials, has been put into operation for the production testing of aircraft and motor vehicle tires of all kinds. The device is used in the aircraft industry to determine whether the internal structure of aircraft tires has been damaged by the stresses brought about in landing.

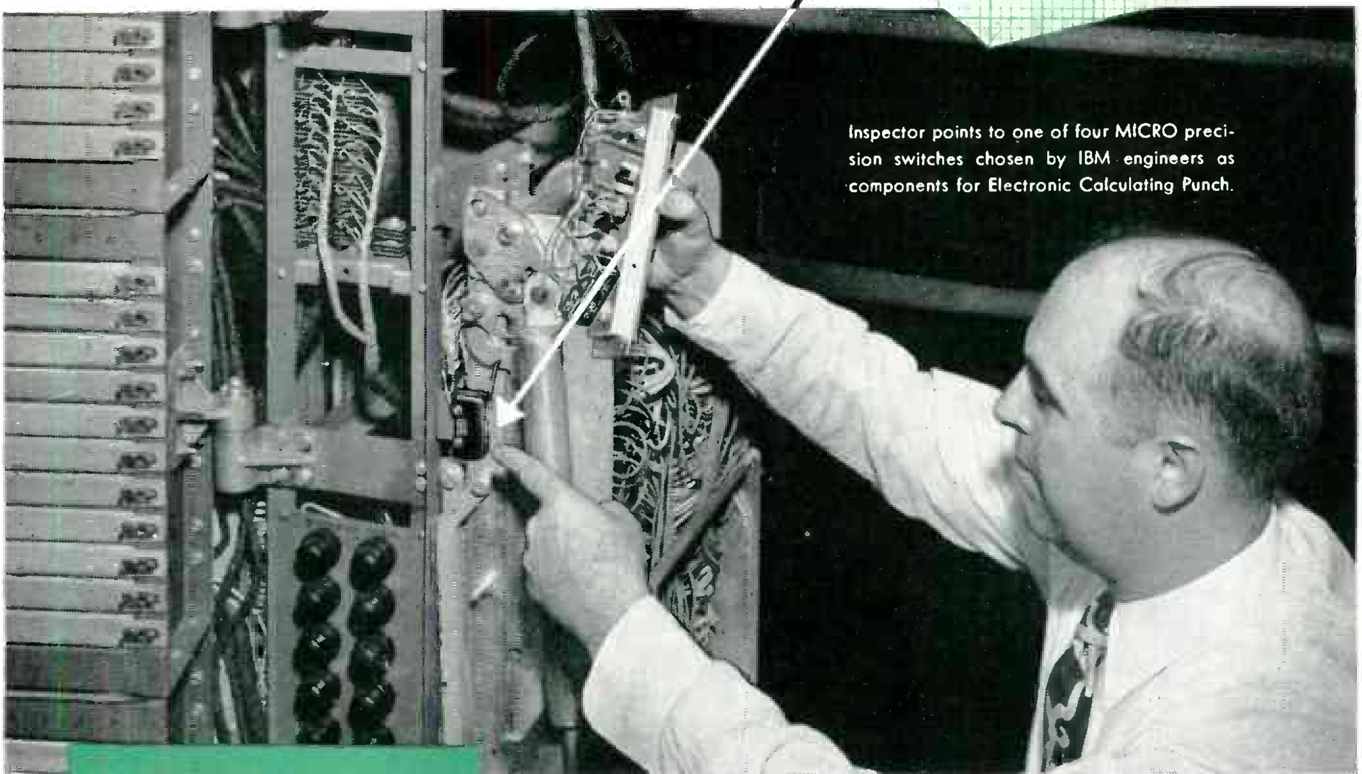
The method depends on the fact that any internal discontinuity such as imperfect bonding between rubber and fabric, will necessarily lead to the presence of an air film. The air film will necessarily cause 100-percent reflection of ultrasonic waves which reach it. Such a fault makes it inadvisable to renew the treads.

The equipment to be described is used on a production basis and can detect faults which have an area of $\frac{3}{8}$ by $\frac{3}{8}$ in. or more. It consists of an ultrasonic generator, amplifiers and pneumatic handling equipment for lowering the tires into an adjacent tank of water.

A water bath is used because water produces a good transmission path between the transmitter and receiver together with reasonable acoustic matching with the rubber. There is negligible absorption or

IBM relies on MICRO Precision Switches

for vital functions in its Type 604 Electronic Calculating Punch


Inspector points to one of four MICRO precision switches chosen by IBM engineers as components for Electronic Calculating Punch.


The large cabinet is the all-electronic unit: the smaller is the electrical card reading and punching unit.

HUNDREDS of International Business Machines Type "604" electronic calculators . . . 1400 tube electronic digital computing machines . . . are helping solve some of the most difficult calculating problems in science, engineering, business and government.

Four MICRO precision switches were selected by IBM engineers to perform important functions in this highly complex machine which operates at the rate of 50,000 pulses per second.

These MICRO units were chosen because—(a) their positive switching action insures good electrical connection in either position instantaneously, (b) fine adjustment minimizes travel necessary to make or break circuit, (c) ease of adaptability to the application, (d) low cost, (e) long life and dependability.

This use of MICRO SWITCH products by IBM engineers is typical of the reliance placed on these precise, accurate, snap-action switches for applications which demand only the best in all components. MICRO SWITCH field engineers, fully experienced in the requirements of electronic controls, are available to show YOU how MICRO products can help in the design and performance of your product. Call your nearest MICRO SWITCH branch.

MICRO Snap-Action Switches . . .
Honeywell Mercury Switches

MICRO SWITCH

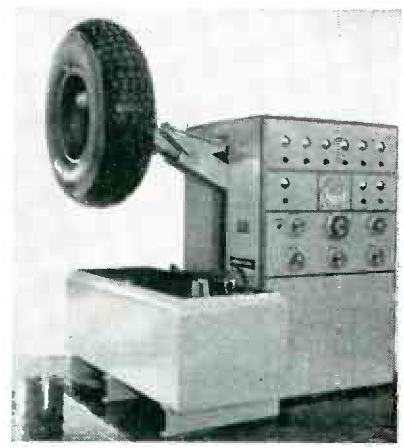
FREEPORT, ILLINOIS

HONEYWELL

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY reflection at the water-rubber boundary.

When the tire is lowered into the bath it rests on two rollers which are mounted in the tank above the water. The rollers can be used to revolve the tire at speeds up to 10 rpm during a test.

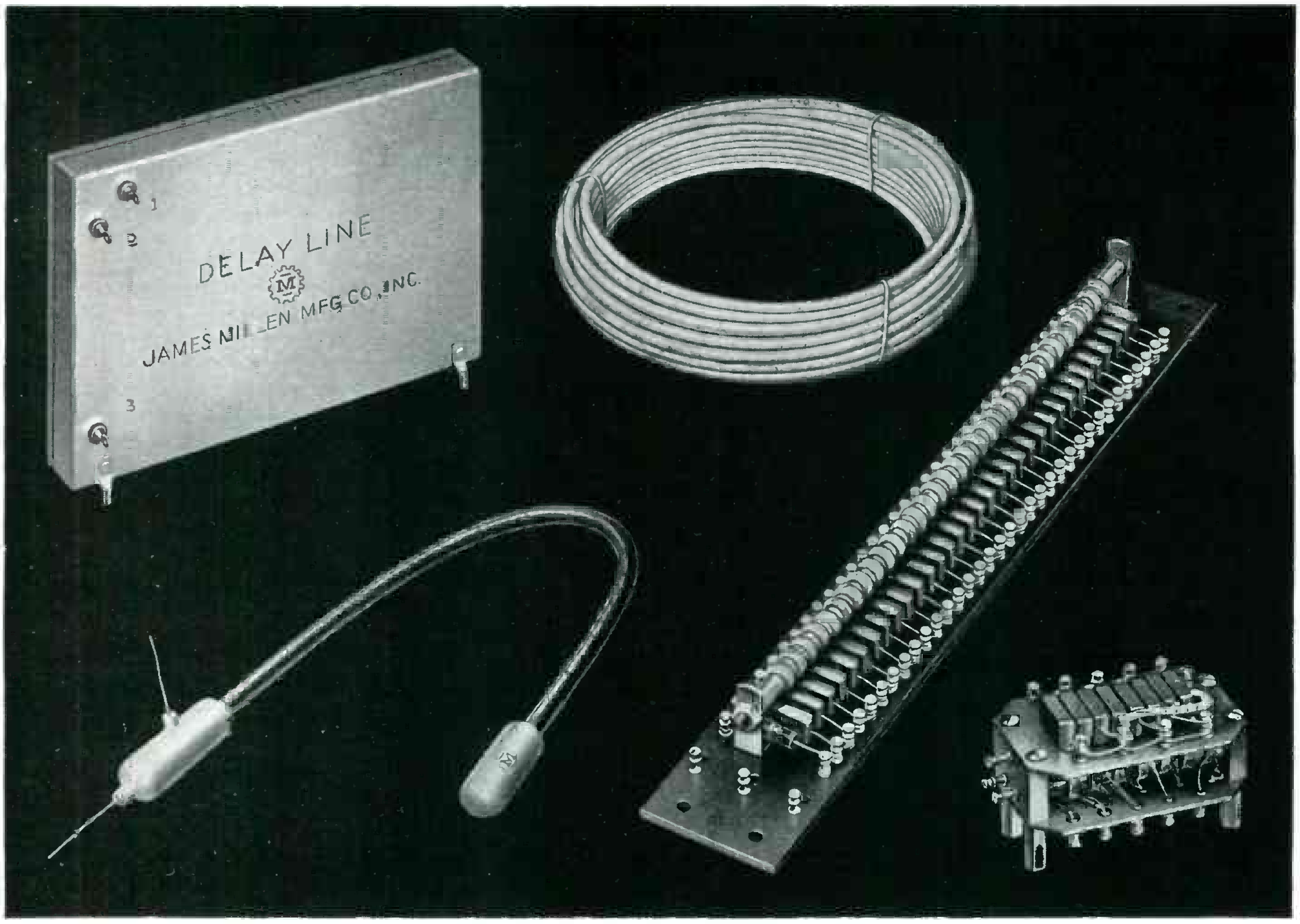
The ultrasonic transmitter head houses a ⅝-in. diameter quartz crystal mounted in a brass holder placed 1 in. from the rubber, in the wall of the tire, which is under water. The ultrasonic beam is radiated at an angle of 120 deg and a single transmitter within the tire can be used with up to six receiving crystals spaced around the outer wall. Leads are taken from each of the crystals to separate amplifiers. Outputs from the amplifiers are used for visual indication on six meters and for the operation of six alarm circuits.



Ultrasonic tire tester showing the pneumatic loading equipment in operation

Frequency of the ultrasonic generator is 50 kc and the power output about 1 watt. Absorption of ultrasonic energy by rubber increases rapidly with frequency and therefore sets a practical industrial upper limit of about 500 kc. By using 50 kc instead of 500 kc, a wide angle of radiation is produced and a single transmitter can serve six receiving crystals.

The instrument has been put in operation by the Dunlop Rubber Co., Ltd., in Britain and was developed jointly by the Dunlop Research Center and the General Electric Company of England.



"Designed for Application"

Delay Lines and Networks

The James Millen Mfg. Co., Inc. has been producing continuous delay lines and lump constant delay networks since the origination of the demand for these components in pulse formation and other circuits requiring time delay. The most modern of these is the distributed constant delay line designed to comply with the most stringent electrical and mechanical requirements for military, commercial and laboratory equipment.

Millen distributed constant line is available as bulk line for laboratory use and in either flexible or metallic hermetically sealed units adjusted to exact time delay for use in production equipment. Lump constant delay networks may be preferred for some specialized applications and can be furnished in open or hermetically sealed construction. The above illustrates several typical lines of both types. Our engineers are available to assist you in your delay line problems.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY

MALDEN, MASSACHUSETTS, U. S. A.

Production Techniques

Edited by JOHN MARKUS

STARTING this month, techniques for expediting the production of military and commercial electronic equipment and components will be presented to the readers of ELECTRONICS in this entirely new full-length department.

Here, production and methods engineers will see how problems comparable to theirs are solved in other plants.

The index at the left shows the topics covered in this first issue, starting with the jigs and fixtures of incoming inspection and going all the way down assembly lines to end up with the tricks of final packaging. Coming issues will cover still other techniques applicable to the production of electronic equipment or components, showing how to boost output, simplify an operation, improve quality or cut costs.

Contributions are welcomed, and will be paid for, with full credit to the author and his company.

Safety-match holders costing only 11 cents each hang on horizontal bars of racks

Inexpensive Match Safes Hold Small Parts on Benches

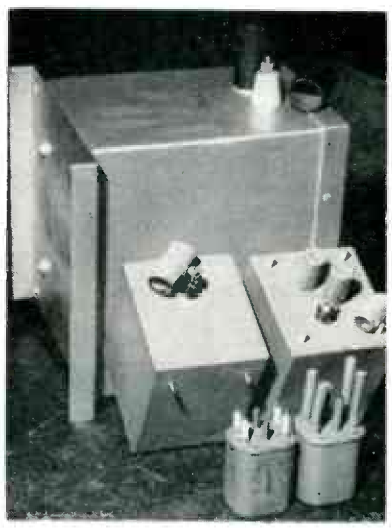
WHERE a large number of different kinds of small parts must be kept within easy reach of an operator, metal match safes proved more effective and far lower in cost than any other holder that could be purchased or fabricated for the purpose at DuMont's Television Transmitter Division in Clifton, N. J. The No. 320 match safe made by Continental Can Co. was obtained through the New York City office of the firm at 11 cents each on quantity orders.

These safes normally come painted in white, with floral decals and with side cutouts to expose the striking sandpaper area of the match box. Masking tape was used to cover the openings, and some were spray-painted a uniform color. If a sufficient number are ordered at one time the manufacturer indicates willingness to modify the dies so there will be no holes in the sides of the safes.

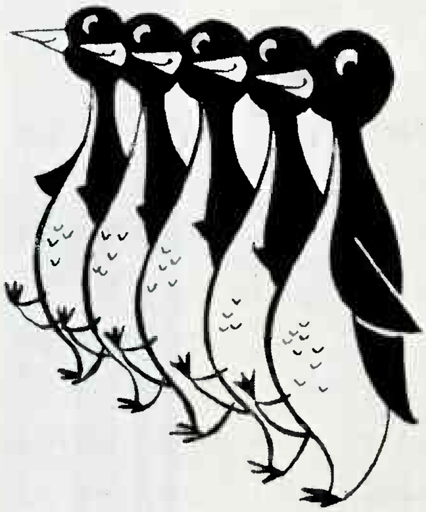
The safes are easily mounted by bending the top mounting tab over $\frac{1}{8}''\times\frac{1}{2}''$ strap iron bars on racks developed for holding them.

Masks for Spray-Painting

SHORT LENGTHS of spaghetti and cardboard tubing make ideal reusable masks for protecting terminals of hermetically sealed units during spray-painting. If the spaghetti sections are at least twice the terminal height, the ends can be left open without risk of getting paint in. With larger-diameter



Re-usable cardboard and spaghetti masks protect terminals of hermetically sealed components during final spray-painting



UNIFORM

KESTER FLUX-CORE SOLDER

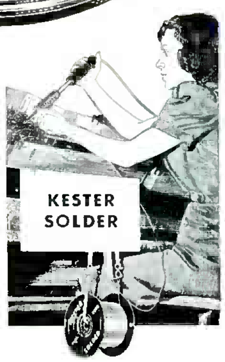
***UNIFORM* In Alloy**

***UNIFORM* In Flux Content**

Right down the line, spool after spool, Kester "44" Resin, "Resin-Five" and Plastic Rosin-Core Solders offer these features of uniformity so necessary to the best in soldering.

Alloy . . . just the right amount of Tin and Lead, complying with your specifications *every time*, and only the best metals used!

Flux content . . . not a single inch of the solder is without uniform flux distribution . . . and remember, *only* Kester can give you that flexibility in core size or flux content, more or less as needed, the exact *predetermined amount*. Kester is truly an engineered Solder.



Over 100,000 types Kester Flux-Core Solder Available

Kester meets all applicable Government Specifications.

Free Technical Manual — write for your copy of "SOLDER and Soldering Technique."

KESTER SOLDER COMPANY

4204 Wrightwood Ave., Chicago 39

Newark 5, New Jersey • Brantford, Canada

KESTER SOLDER

pieces of cardboard tubing the open end must be covered with masking tape or plugged with a cork to keep paint out. A large assortment of these tubular masks is kept on hand for immediate use at DuMont's Television Transmitter Division in Clifton, N. J.

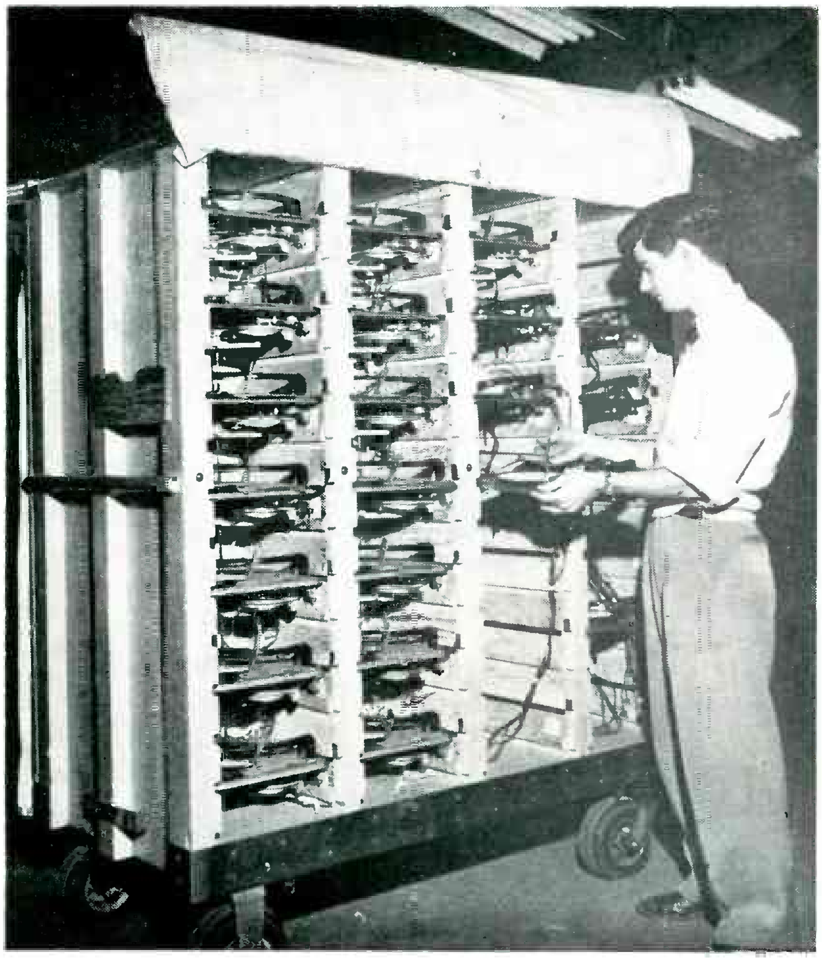
How to Bend Tubing

SOFT copper tubing for the work coils of induction heating generators or for any other purpose can be bent easily without deformation if first pushed into a tight-fitting close-wound steel spring having about the strength of a screen-door spring, according to Wallace Barnes Co., spring manufacturers in Bristol, Conn.

Plastic-Tubing Puller

TO SPEED up the pulling of protective plastic tubing over cables comprising up to a dozen or more plain and shielded wires used in interconnecting units of television transmitters, the tubing is first placed over a quarter-inch iron rod about 15 feet long. One end of the rod is attached to the wall. At the other end of the rod, a short length of braided metal sleeving is permanently attached.

The end of the sleeving is expanded with the fingers, the cable wire ends inserted, and the sleeving is squeezed until it grips the wires firmly just as do cable grips. A few turns of electrical Scotch tape over wires and sleeving maintain the grip for the pulling operation, in which the plastic tubing is pulled easily over the wires. The new technique, used in the cable harness department at DuMont's Television Transmitter Division in Clifton, N. J., is many times faster than the former method of pushing the wires laboriously into tubing.

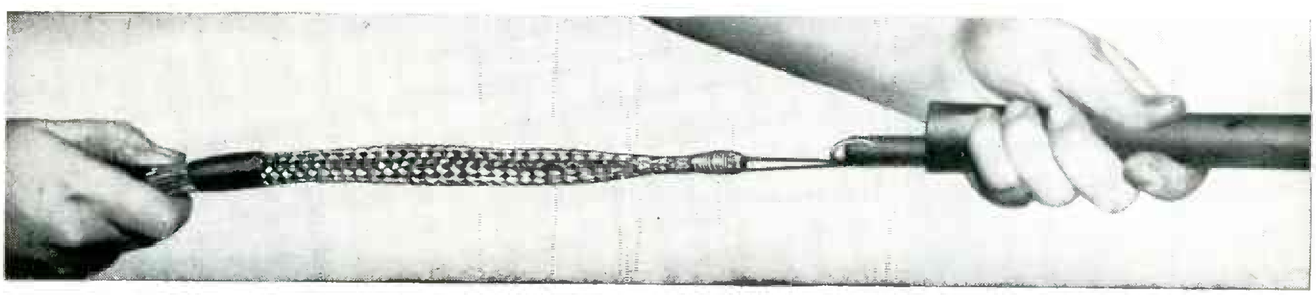


Dolly holding 28 record changers on each side is easily rolled from loading platform into trucks for delivery to receiver manufacturers, eliminating cost of cartons

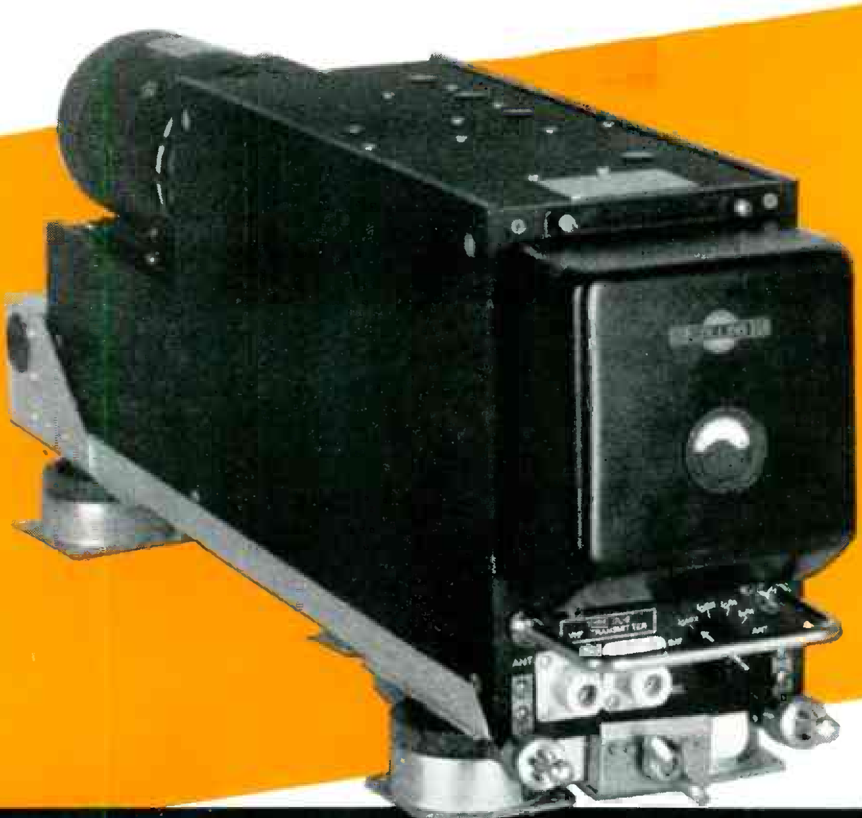
Dolly Rack Eliminates Cartons for Shipping Record Changers

DOLLY-MOUNTED racks each holding 56 record changers are used by General Instrument Corp. for trucking changers from Elizabeth, N. J. to Emerson's Jersey City plant and to other locations in the New York metropolitan area. Technique saves 30 to 40-cent cost of corrugated shipping carton normally needed for individual changers, saves time of packing and unpacking cartons, and reduces risk of damage en route.

Changers are slid into grooves in racks on each side of the cart, and heavy canvas is pulled down over sides to keep them in and keep out dust. The only packing material needed is a piece of corrugated cardboard pushed over the tone arm to keep the needle in the air; this is later needed when shipping the



Left to right: Wires in hand ready to go into tubing; electrical Scotch tape that holds wires inside sleeving; braided metal sleeving serving as grip for cable wires; wire for attaching sleeving permanently to iron rod; plastic tubing ready to be pulled over wires



Collins 17L VHF aircraft radio transmitter

NOW! Full use of VHF radio by owners of executive aircraft

Civilian "non-carrier" pilots are no longer confined to VHF frequencies of 122.1-122.9 megacycles for air-to-ground radio communications. By amendment of its Rules and Regulations Governing Aeronautical Services, the FCC has enabled *all owners of aircraft regardless of type* to utilize certain frequencies within the band 118.1-126.7 megacycles.

Not only that! Under the new Controlled Materials Plan we are now authorized to use priority DO-J-6 to get materials with which to fill orders from corporation plane owners for Collins 17L transmitters.

The businessman can now equip himself to operate in the same way under instrument conditions as the scheduled airline.

The Collins 17L transmitter provides transmitting facilities on all channels reserved for aircraft communication in the VHF band. Its frequency range is 118.0-135.9 megacycles, and all of the 180 channels assigned in this range are easily selectable over a simple and positive remote control system. The power output on voice is conservatively rated at eight watts. With this power, and the greatly increased number of frequencies now available, the pilot is assured that transmissions will be received and answered at the busiest air terminals.

The 17L is a companion to the 51R navigation receiver with which many executive planes are already equipped. The pair provides reliable two-way radio telephone communication.

We will be glad to send you a more complete description of the 17L transmitter on request.

For reliable radio communications, it's . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 18 | 1937 Irving Blvd., DALLAS 2 | 2700 W. Olive Ave., BURBANK

completed receiver, hence is not an extra cost.

Empty dollies are taken back to the record changer plant by trucks on their return trips, for refilling.

Rosin Fire Extinguisher

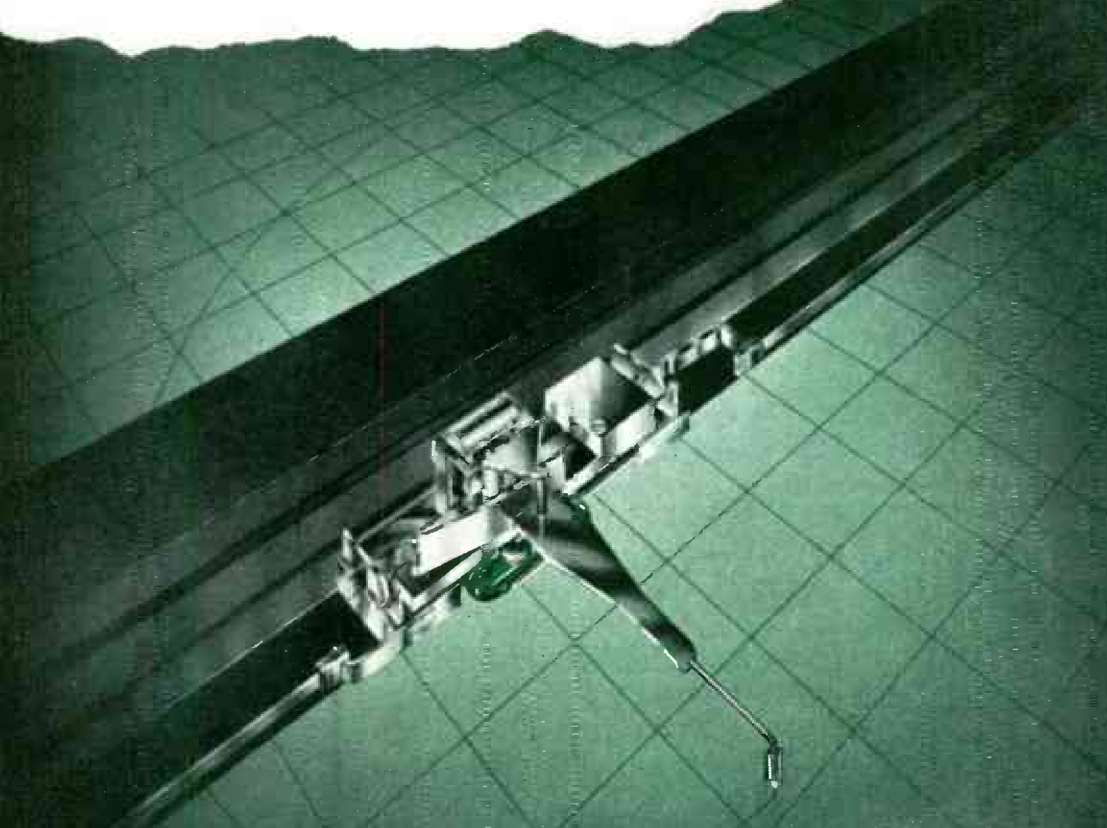
WHEN rosin pots catch fire in RCA's plant, the heat melts a catch that releases a hinged metal lid, snuffing out the fire. The catch is a commercially available window-closing link whose parts are fastened together with a low-melting-point solder. When used conventionally in factory window-opening chains, heat of a fire makes the catch come apart so that windows drop automatically to cut off draft.

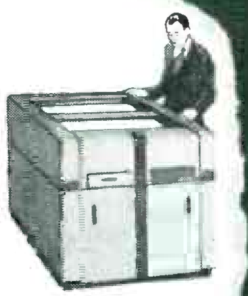
Fire in rosin pot is snuffed out automatically by lid when heat of flame melts solder in overhead link serving as catch in Camden plant of RCA Victor

Casting-Rod-Tips Guide Wire

INEXPENSIVE agate-type tips for casting rods work well as guides on automatic multiple coil-winding machines at DuMont's East Paterson plant in New Jersey. The steel rod sections have adequate flexibility yet can be bent readily to required shapes. Extra springiness is obtained for guides nearest the spools of wire by using a pivot mount and a coil spring attached to

A Pen That Automatically Records Two Variables With Precision Accuracy.





You are looking at a plotting pen of one of the Model 205 Series Variplotter Plotting Boards.

With this self-balancing potentiometer type recorder, you can plot on a 30-inch square plotting surface a precise, graphic representation of one variable DC voltage as a function of a second variable DC voltage. It is also possible to plot two sets of two independent variables simultaneously, both using the full surface of the plotting board.

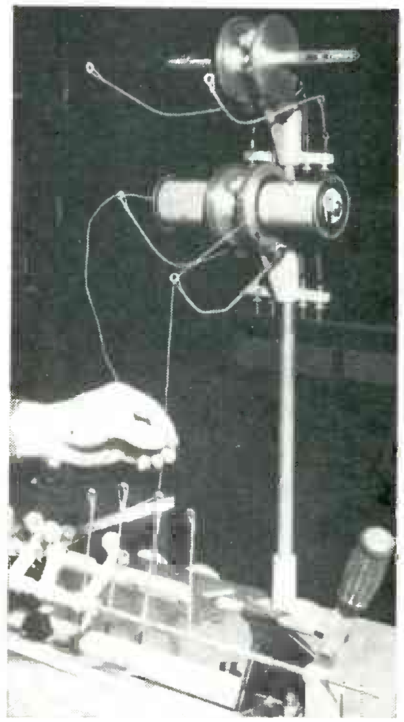
The Variplotter permits you to do this with speed and great accuracy — less than the width of the pen line itself. It produces a large, clear, permanent presentation that is easily interpreted.

Permit us to forward to you complete data on the new Variplotters and their accessories. We will also be very happy to study your plotting problems and make recommendations. Simply contact Electronic Associates, Inc., Long Branch, New Jersey.

ELECTRONIC ASSOCIATES *Incorporated*

Variplotter

Model 205 Series Plotting Boards



Tips of casting rods serve as guides for wire on coil-winding machine

the rear end of the rod. The anchor end of the spring is adjustable in position by means of a bolt and knurled battery terminal screw, for changing wire tension.

Anchoring Coil Leads

WHEN coils are wound on thermoplastic forms, the ends of the winding are anchored simply by pressing each in turn with a wood-burning iron. This embeds the lead solidly in the plastic, since the material hardens as soon as heat is removed. The technique is now being used at Emerson's Jersey City plant for production of coils for military electronic equipment.

Cable Harness Techniques

HOLDERS for keeping wire within reach, a method of wrapping cable harness with Scotch electrical tape by hand and by machine, and a 26-roll holder for numbered labelling tape are speeding up fabrication of complicated cable harnesses at several plants.

A coil spring fastened near the bottom of a cabling board holds the ends of wires coming from spools under the board. Thus the desired color of wire is always within reach when cutting wires to length for forming on the board at DuMont's

32 Preferred Types of E-I
SEALED TERMINALS

E I
INC

ECONOMICAL 50 SOLUTIONS
— for Hermetic Sealing
TERMINAL PROBLEMS

E-I has standardized over 50 types of sealed leads and multiple headers. These represent the most widely used types for general applications. Records extending over many years indicate they meet over 95% of all requirements.

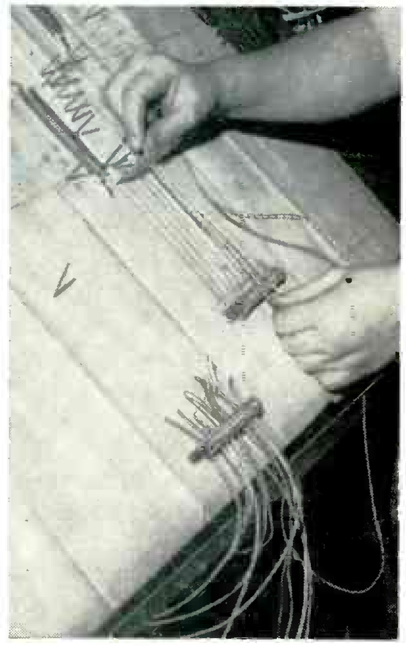
For maximum economy and fastest possible delivery — usually from stock — engineers and designers are invited to check these standard items against their requirements.

ELECTRICAL INDUSTRIES • INC
44 SUMMER AVE., NEWARK 4, NEW JERSEY

See the Complete line
at the IRE show
BOOTH 212

E I
INC

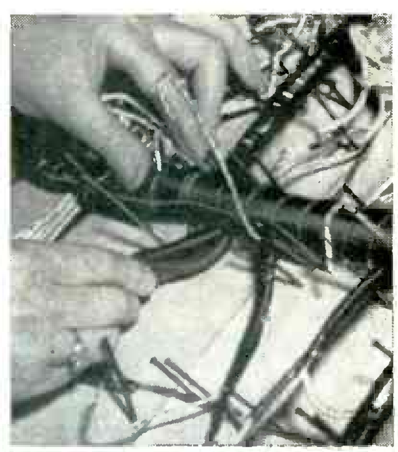
18 Basic Types of E-I
MULTIPLE HEADERS



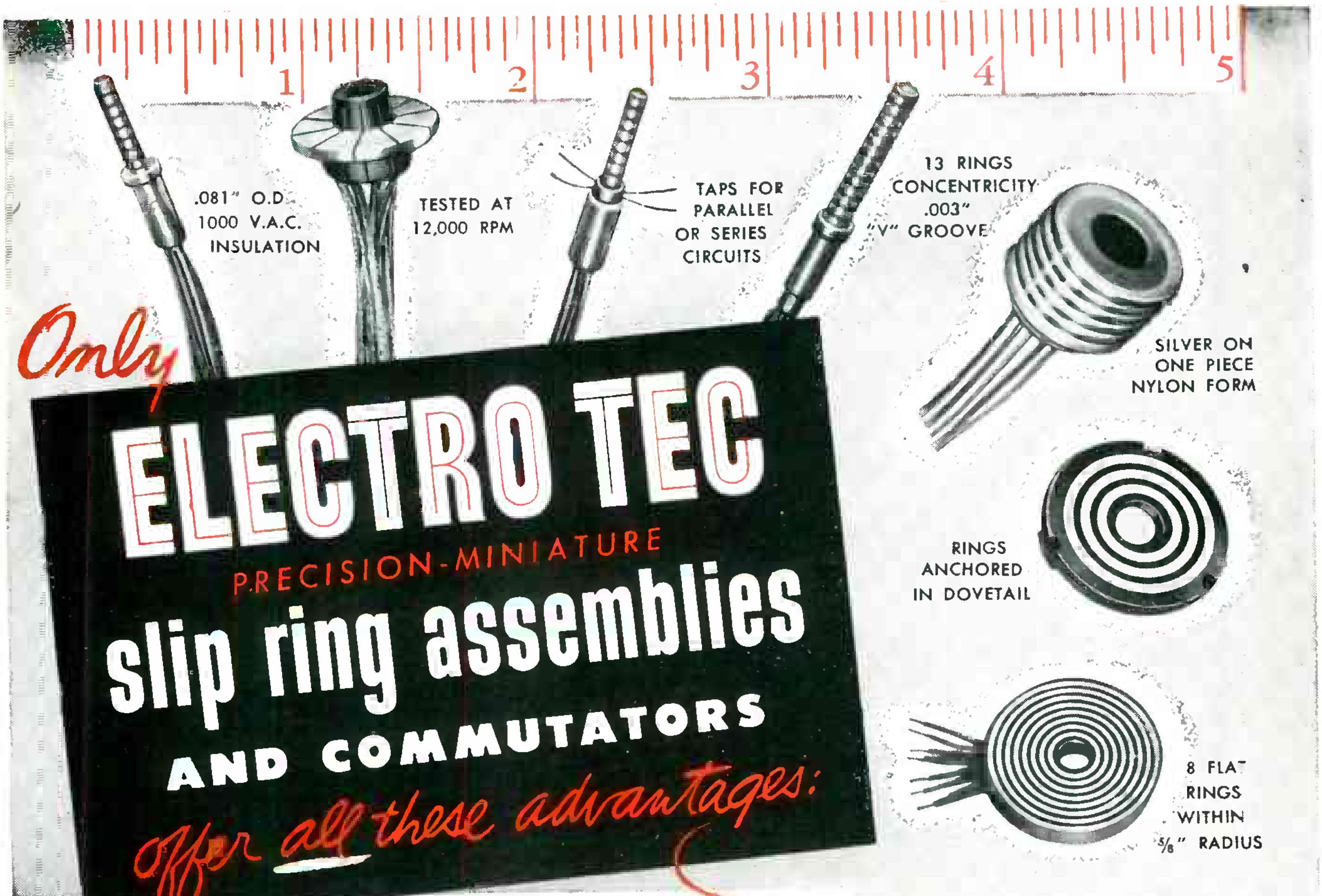
How pre-stretched coil springs are used for holding wire ends on cable harness board at DuMont plant

Television Transmitter Division in Clifton, N. J. The spring is bolted to a metal mounting strap so that the turns are pre-stretched to the desired spacing. Fastening the strap rather than the spring to the board permits moving the spring around on the board as often as desired without changing the spacing between turns. Mounted springs with various lengths and spacings are kept on hand for use when setting up cable boards, to hold the ends of already-cut cable wines on the cable board as well.

Scotch electrical tape is used in place of conventional waxed lacing



Pulling flat wad of Scotch electrical tape under harness during taping operation that replaces lacing at DuMont plant



Only

ELECTRO TEC

PRECISION-MINIATURE

slip ring assemblies AND COMMUTATORS

offer all these advantages:

EXCLUSIVE* ELECTRO TEC TECHNIQUES

insure closer tolerances, absolute uniformity, and the ultimate in miniaturization

Electro Tec units are the product of an exclusive manufacturing technique that results in accuracy unattainable by conventional fabricating methods. In this process a plastic is moulded around the wire leads. Accurate machining reduces this blank to the proper shape, complete with grooves. Hard silver is deposited into the grooves by electroplating to produce the required rings. Final machining insures concentricity and dimensional accuracy. The result is one-piece, unitized construction with conducting rings of 60 to 70 Brinell hardness.

Diameters of these assemblies range from .045" to 24" cylindrical or flat. Cross-sections may range from .005" to .060" or more. Rings are polished to a jewel-like finish and can be held to 4 micro-inches or better. Even the smallest sizes withstand a 1000 V.A.C. breakdown test. Most types easily withstand rotational speeds up to 12000 rpm.

ELECTRO TEC Assemblies are Specified by the Nation's Leading Precision Instrument and Equipment Manufacturers for Proven Greater Dependability, Longer Life, Smoother Functioning.

The uniformly superior performance of Electro Tec slip ring and commutator assemblies in thousands of industrial and governmental applications has resulted in wide adoption of these component units by most leading manufacturers of precision instruments and equipment. Although these products provide improved performance and extra dependability, prices are strictly competitive. Write today for fully illustrated literature.

- ONE PIECE, UNITIZED CONSTRUCTION
- ABSOLUTE MINIMUM TORQUE FRICTION
- DIAMETERS FROM .045" TO 24.0"
- MINIMUM 1000 V.A.C. HI-POT INTER-CIRCUIT
- UNIFORMLY HARD SILVER RINGS PLATED INTO GROOVES ON PRECISION MACHINED ONE PIECE PLASTIC FORM
- SPECIAL SURFACE DEPOSITS PREVENT TARNISH, MINIMIZE FRICTION, BRUSH NOISE AND PRACTICALLY ELIMINATE WEAR

ULTRA-MINIATURIZED SLIP RING ASSEMBLY

6 Insulated Contact Rings
Ring Width .030"
Barrier Width .015"
Ring Diameter .045"
Weight 5.5 Grains (1/80 Ounce)

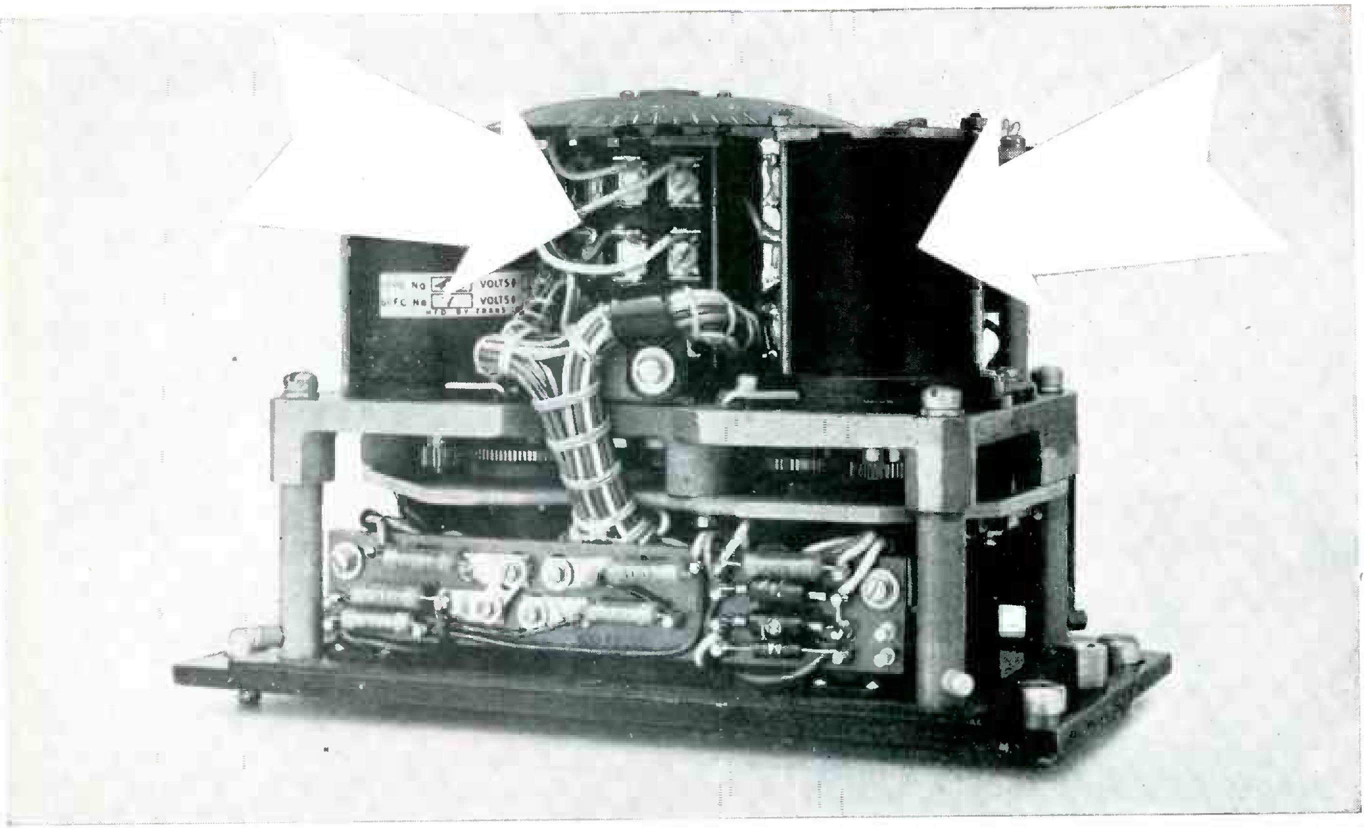
Rings 60-70 Brinell
Fine Silver
Tarnish Resistant,
Friction Minimizing
Surface Deposits
1000 Volt Hi-Pot
Between Rings
Color Coded Leads

*PATENTS PENDING

ELECTRO TEC CORPORATION

SO. HACKENSACK NEW JERSEY

PRODUCTS OF PRECISION CRAFTSMANSHIP BY A NEW AND REVOLUTIONARY PROCESS



Potentiometer precision—where it counts!

Engineers at Servomechanisms, Inc., needed control components that would go hand-in-hand with the extremely high accuracy they designed into this computer for a radar-gunfire control system. Two 3-gang Fairchild precision potentiometers are used for two principal reasons—

1. they have extremely high functional accuracy, and

2. their precision mechanical design eliminates backlash and binding which would cause serious errors in the computing system.

These potentiometers are driven through 72-pitch stainless-steel gears. Fairchild potentiometers depend on more than just accurate windings for precision. For details see below.

HOW PRECISION IS BUILT INTO FAIRCHILD POTENTIOMETERS

1. The *shaft* is centerless-ground from stainless steel to a tolerance of +0.0000, −0.0002 in. which together with precision-bored bearings results in radial shaft play of less than 0.0009 in.

2. The *mounting plate* has all critical surfaces accurately machined at one setting to insure shaft-to-mounting squareness of 0.001 in/in. and concentricity of shaft to pilot bushing within 0.001 in. FIR.

3. The *housing* is precision-machined from aluminum bar stock. Close tolerance of this construction permits ganging up to 20 units on a single shaft without eccentricity of the center cup, even though only two bearings are used for the entire gang.

4. The *windings* are custom-made by an exclusive technique. Guaranteed accuracy of linear windings in the types illustrated is 0.5%; non-linear 1.0%. Higher accuracies (to 0.05%) are available in other types. Guaranteed service life is 1,000,000 cycles.

DO YOU NEED THIS KIND OF PRECISION? *Fairchild Sample Laboratory engineers are available to help on special potentiometer problems. To get the benefit of their knowledge and experience write today, giving complete details, to Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, New York, Department 140-24A.*

Visit our exhibit at Booth 238-239 at the I.R.E. show

FAIRCHILD
PRECISION POTENTIOMETERS

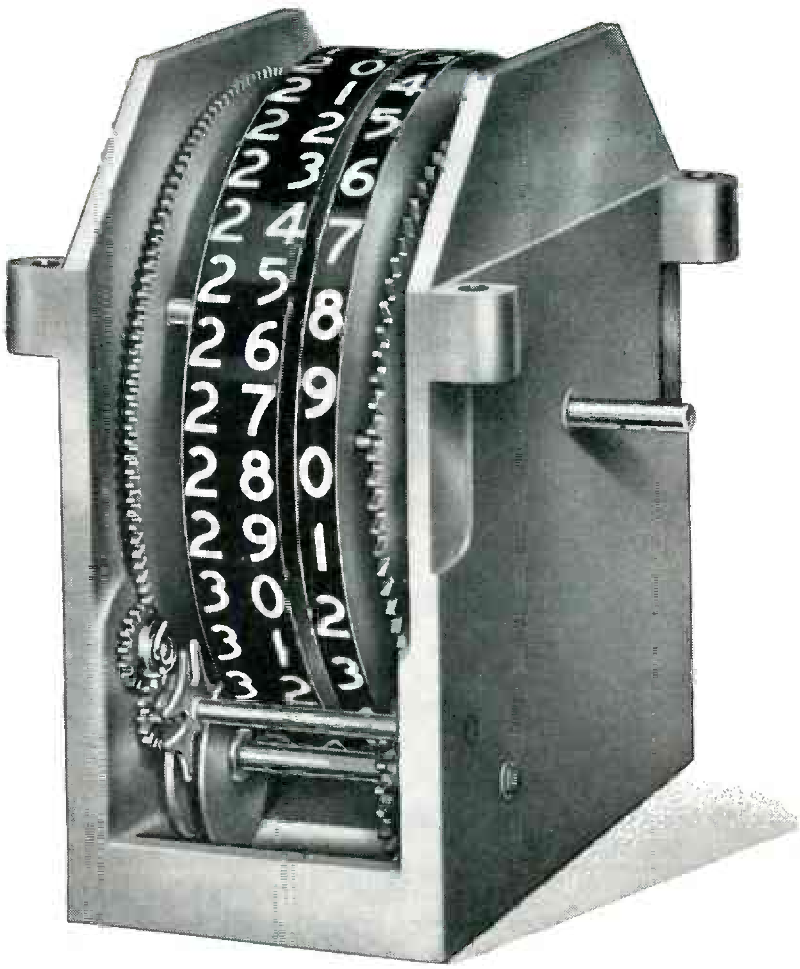
Rewinding tape into flat wad that is easily shoved under cable. Completed wad is at upper right on steel table, with fishpaper core under it

cord at Dumont's Television Transmitter Division. The formed cable cannot be lifted off the pegs on the board until completely taped, hence standard rolls of tape are too big to be pushed under the cable. The tape is therefore rewound into flat needle-like packets that slip under the cable easily. A piece of fishpaper is folded over a metal strip welded to a flat metal plate, and the tape is rewound onto the fishpaper. Straight runs of cable are left untaped on the board, and taped later at high speed in a Segur taping machine adapted for use of No. 22 Scotch electrical tape. A completely taped cable harness holds its shape much better at sharp bends and corners than a laced cable.

Application of numbered pieces of Scotch tape to wire ends of tele-

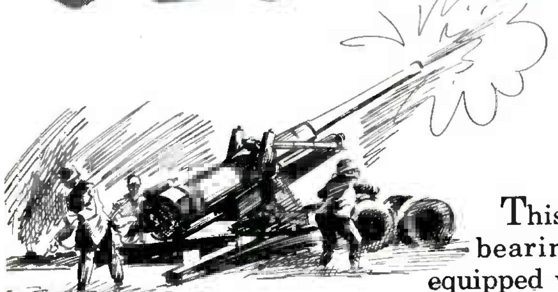
Winding Scotch electrical tape on formed cable harness with modified Segur taping machine

It helps Gunners to "Bear On" Target



Added Evidence that_______

Everyone Can Count on VEEDER-ROOT



This is a 360-degree bearing counter . . . equipped with high-speed Geneva transfer and large, readily readable figures . . . which speeds the work and heightens the accuracy of gunnery. And it might well be adapted to bring the same advantages to many other operations in defense work.

Now if your imagination is stirred by this suggestion, then you can count on Veeder-Root to help you add up to something that will really *count to YOUR advantage.*

VEEDER-ROOT INCORPORATED

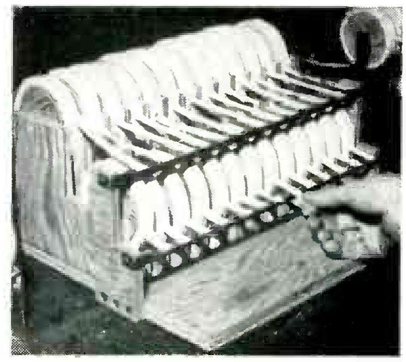
"The Name That Counts"

HARTFORD, CONN. • CHICAGO • GREENVILLE, S. C.

Montreal, Canada • Dundee, Scotland

Offices and agents in principal cities

"Counts Everything on Earth"



Dispenser holding 26 different numbered rolls of plastic adhesive tape. All plywood is ½ inch thick. Partitioning supports for rolls are all identical here, but outer two may be modified to serve as supports for serrated tear-off strips, instead of using separate plywood supports

vision transmitter cable harness was speeded up at DuMont by development of a dispensing holder that takes 26 different rolls. Round plywood discs serve as cores for the rolls of tape. Each disc has its own ¼-in. steel shaft projecting about ⅛ in. on each side. The shafts fit into slots in upright partitions, so that rolls of tape may be replaced individually. Serrated metal cutoff strips like those on individual tape dispensers were obtained from Minnesota Mining & Mfg. Co. and bolted to metal supporting straps. A welded metal version of the holder proved equally effective but was many times higher in fabrication cost.

When metal wire-holding clips for cable boards were hard to get, methods engineers at Federal Telephone and Radio Corp.'s Clifton plant switched to slotted wood pegs and found them equally effective. Slots are cut just a trifle narrower than the wire, and the hard maple wood used has enough spring to grip each wire end firmly yet permit easy removal.

Precut wires for cables of large industrial electronic equipment are supported within easy reach of the operator by a simple whirl-around holder in the Control Department at GE's Schenectady plant. Wires are looped over stiff metal rods projecting from the hub of the mount, arranged in the sequence needed by the operator. Tags on each rod identify the wire stored there. In

ADLAKE RELAYS AT WORK—One of a series of advertisements on specific ADLAKE applications.

for ASSURED SAFETY

in oven operation

The ADLAKE Relays in this oven control, manufactured by Baker Perkins of Saginaw, Mich., function in the safety circuit. They govern the time during which the oil solenoid remains open when the starter button is pushed. If the flame has not appeared during the specified time, the ADLAKE Relays close the solenoid valve, and the burner remains off until the operator attempts to re-start it.

Baker Perkins uses ADLAKE mercury relays

Because of their dependability and positive action, ADLAKE Relays are used in the burner control circuits of Baker Perkins bakery equipment, where they have an important "watchdog" job to do (see panel).

It's no wonder that Baker Perkins, like so many other leading manufacturers, specifies ADLAKE Relays. For they are designed and built to meet the most exacting requirements. Their mercury-to-mercury contact prevents burning, pitting and sticking, and their sturdy construction armors them against outside vibration or impact. And most important of all, *they require no maintenance*, for they are hermetically sealed.

For the full story on the part ADLAKE Relays can play in *your* business, just drop a card to The Adams & Westlake Company, 1107 N. Michigan, Elkhart, Indiana. No obligation, of course.

EVERY ADLAKE RELAY BRINGS YOU THESE ADVANTAGES:

HERMETICALLY SEALED—dust, dirt, moisture, oxidation and temperature changes can't interfere with operation.

MERCURY-TO-MERCURY CONTACT—prevents burning, pitting and sticking.

SILENT AND CHATTERLESS • REQUIRES NO MAINTENANCE

ABSOLUTELY SAFE

Adlake TRADE MARK

THE Adams & Westlake COMPANY Established 1857 • ELKHART, INDIANA • New York • Chicago

Manufacturers of ADLAKE Hermetically Sealed Mercury Relays

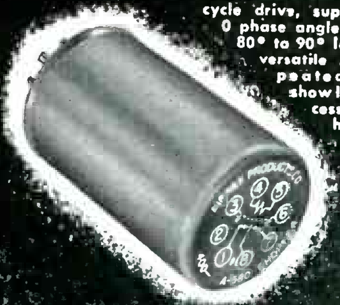
PRECISION-BUILT

CHOPPERS

YOU CAN DEPEND ON!

made by AIRPAX . . . pioneers in the field!

A589 . . . 6 volt, 400 cycle drive, used widely by the industry. Highly reliable, field-proven, tested, and approved by many major electronic and aircraft firms.



A580 . . . 120 volt, 400 cycle drive, supplied to 0 phase angle or with 80° to 90° lag. Most versatile . . . repeated tests show life in excess of 1000 hours.

A587 . . . 26 volt, 400 cycle drive . . . the phase of closure and break is held to close limits for interchangeable use as either modulator or demodulator.

A586 . . . 6 volt, 60 cycle drive, 45 phase lag. Here's a chopper so reliable that you can put it into service and forget it for thousands of hours!

AIRPAX PRODUCTS COMPANY — DESIGNERS — ENGINEERS

MIDDLE RIVER, BALTIMORE 20, MD.

FOR HIGH-SPEED INDUSTRIAL SOLDERING

Use G-E Calrod* Soldering Irons

HERE'S WHY THEY ARE PREFERRED BY . . .

PRODUCTION MEN . . . because they are built tough for long, continuous production line soldering. With calorized or ironclad tips, they stay clean, solder fast and can be easily disassembled.

MANAGEMENT MEN . . . G-E irons last longer and need less service. Exhaustive tests by some of the world's largest soldering iron users show that G-E irons save them money.

MAINTENANCE MEN . . . because superior features, like the cord-strain insulator which withstands a pull of 35 pounds, makes far less maintenance necessary. When it's occasionally necessary, the dependable G-E cartridge heater slips right out for servicing—just pull a pin.

FOR FREE BULLETIN, GEA-4519, ask your nearby G-E distributor, or write to: Sect. 720-66, General Electric Co., Schenectady, New York.

*Registered Trademark

GENERAL ELECTRIC

720-66

Precision Gear Train

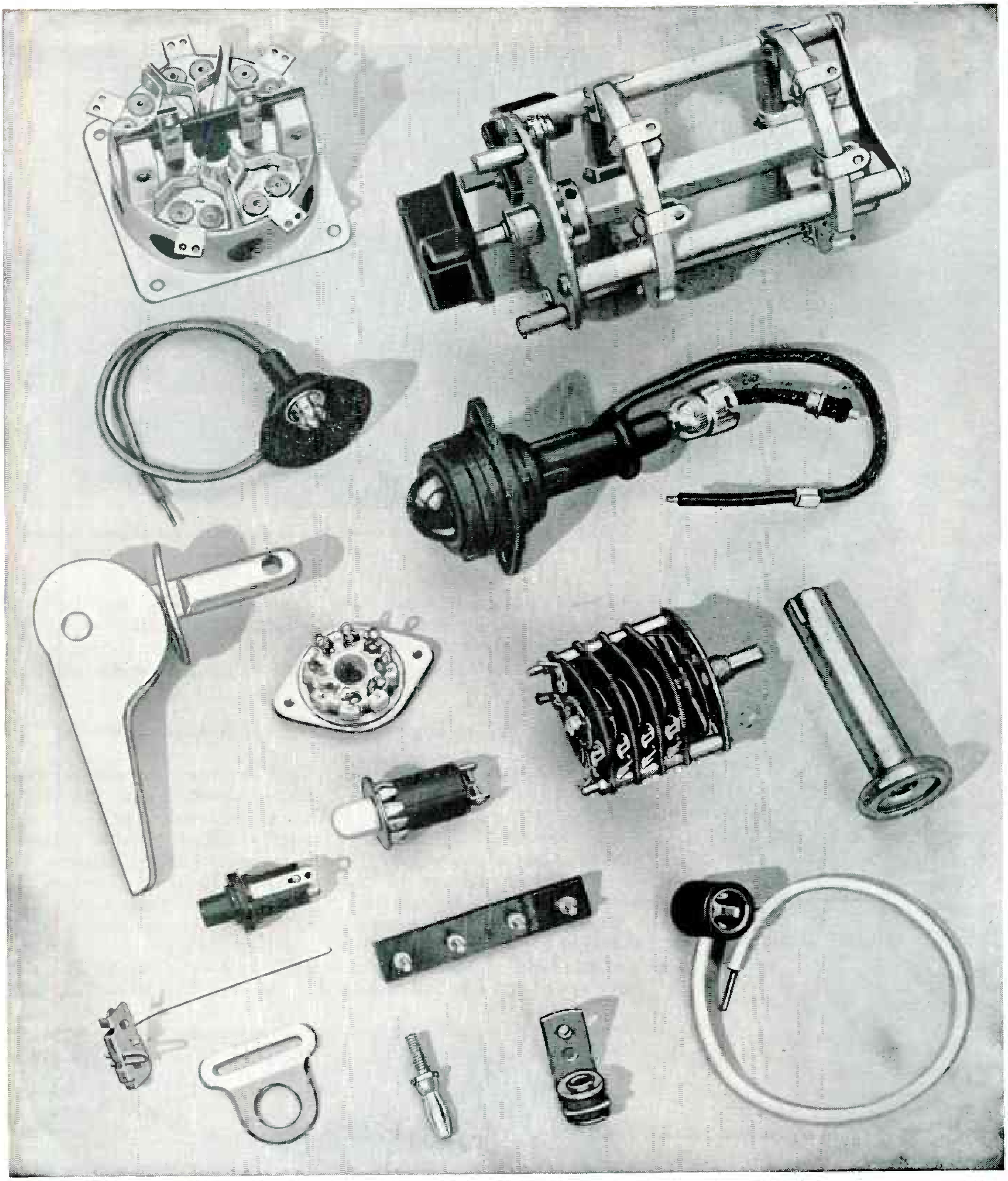
for STANDARD SERVO BREADBOARDS

1. *Ratios up to 15,000 to 1*
2. *Uniform transmission of torque with absolute minimum backlash*
3. *Face mounting may be provided for most control motors and electromechanical components*

WE SPECIALIZE in the design and production of miniature precision gear trains built to your requirements for use in laboratory and JAN specification equipment. Send us your job specifications for our estimate today.

Bowmar Instrument Corp.

4214 Leo Road • Fort Wayne, Indiana • Tel. Eastbrook 4294



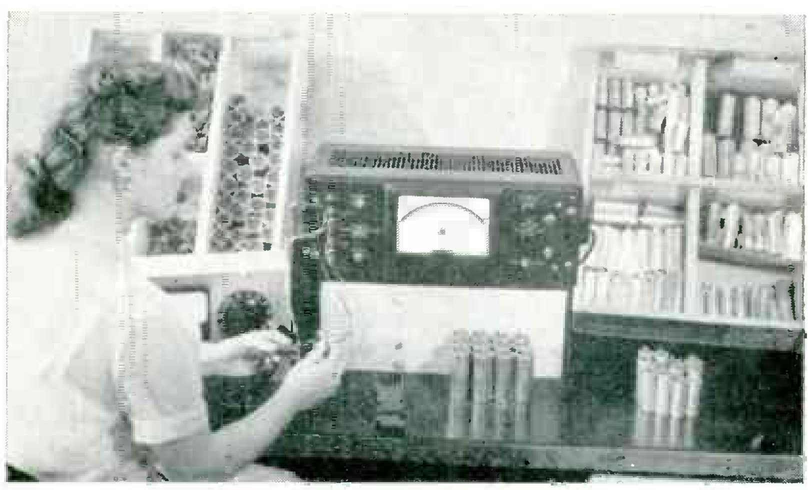
Holder for precut lengths of wire used in forming cable harness at GE plant. Circular wood rim is convenient for turning holder. Spool of lacing cord is on top

addition, individual wires are identified by printing or hot stamping on the insulation at each end. A rim supported by four wood spokes facilitates turning the holder. A wood peg projecting up at the center holds the spool of lacing cord used for tying the wires together.

Detecting High-Loss Electrolytic Capacitors

DESPITE wide capacitance variations of electrolytics, the loss or dissipation factor of incoming units is indicated directly on the meter of a production-tester developed by Carl G. Braun, field engineer for Holliday-Hathaway Co., Boonton, N. J.

The new technique for detecting and rejecting high-loss capacitors is based upon use of the Technology Instrument Corp. type 320-A phase meter in conjunction with the simple test circuit shown. The Variac serves principally to reduce the voltage applied to the electrolytic. The transformer isolates the ground of the power line from the ground of the phase meter. The value of the resistor used in series with the capacitor under test depends within a factor of 10 on *C*. If the capacitor is perfect, with



Setup for checking loss of electrolytics as fast as they can be placed across a pair of test terminals

Sylvania proudly presents 2 Zero Focus Voltage Picture Tubes

Paring anything off television set costs is a tough problem for today's designers. Sure, there are ways . . . and ways, but naturally you have a fine reputation to maintain. You want *confidence* as well as cost cutting.

And, that's just what Sylvania offers you. Now we proudly present 2 Zero Focus Voltage Electrostatic Picture Tubes . . . quality tested to assure finest possible performance, PLUS real design savings.

Types 17RP4 and 21FP4

These new Sylvania tubes are electrostatic focus, magnetic deflection, all-glass direct-view picture tubes.

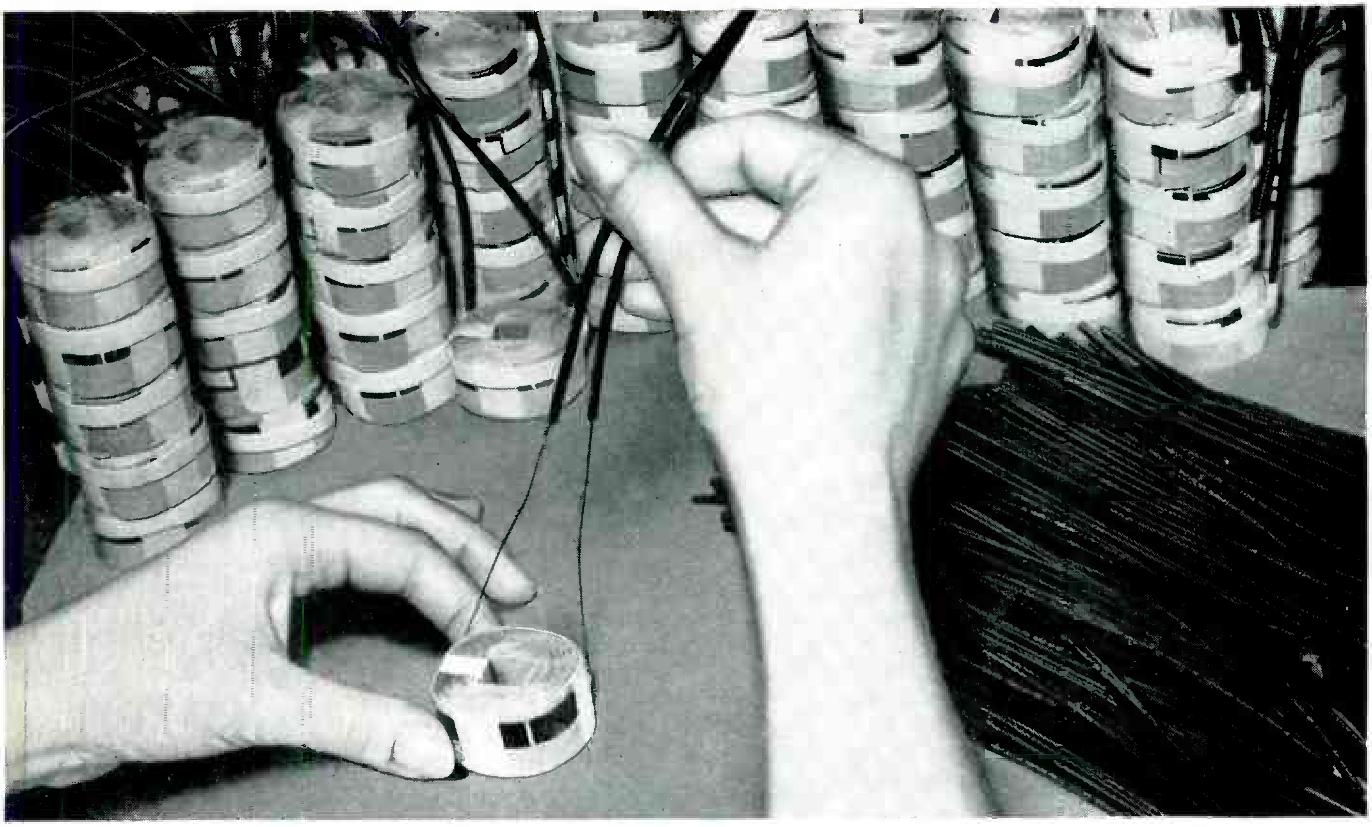
Outstanding Savings result from the elimination not only of focus coils and fixed magnets, but also potentiometers and condensers to adjust focus voltage.

Special features of these new tubes include: (1) a neutral filter face plate which greatly improves picture contrast; (2) the ion trap gun which focuses at zero voltage; (3) an external conductive coating that acts as a filter condenser.

Critical Materials are Saved, too. The elimination of magnets and other components conserves your allotments of cobalt, nickel, and copper . . . prevents plant tie-ups and costly delays. Complete data sheets for both these tubes are now available. For your free copies address: Sylvania Electric Products Inc., Dept. R-1402, Emporium, Pa.

SYLVANIA

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



Minneapolis-Honeywell eliminates soldering operations... by slipping TEMFLEX 105 over coil leads

Quantity use of Temflex 105 flexible plastic tubing effects substantial savings in assembly costs of the RA 117 Protectorelay oil burner control, according to Minneapolis-Honeywell Regulator Company, makers of the famous MH Control Systems and Brown Instruments.

Assembly of the control calls for suitable insulation of two lead wires from each of two coils of the type shown in the illustration. Conventional methods would call for clipping off the lead wires close to the coils, and making soldered joints to insulated wires — calling for four soldering operations for each control.

But Minneapolis-Honeywell merely slips a length of Temflex 105 over each lead. RESULT: Soldering operations are eliminated . . . leads are thoroughly insulated, remain flexible . . . assembly costs are cut down.

Service advantages of Temflex 105 — in this and many other applications — are even more outstanding. This Irvington tubing is approved by Underwriters' Laboratories for 90° C operation in oil — *as well as* for continuous operation at 105° C. In addition to this superior oil resistance, Temflex 105 offers good resistance to mineral and coal tar solvents — and prolonged exposure to acids and alkalies has little effect on its initial high dielectric strength of 1200 vpm.

Look to **IRVINGTON** for insulation leadership

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

STANDARD OF THE WORLD
IRVINGTON INSULATION
TRADE MARK REG. U.S. PAT. OFF.

Get the full facts on Temflex 105 — mail the coupon for free technical data sheet.

Send this convenient coupon now

Irvington
VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey

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

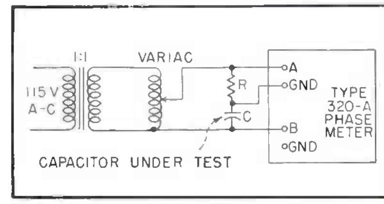
EL-2/52

Irvington Varnish & Insulator Co.
6 Argyle Terrace, Irvington 11, N. J.

Gentlemen:
Please send me your technical data sheet on Temflex 105 Plastic Tubing.

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

For Further Information, Consult pages 92-93 in the 1951-1952 Electronics Buyers' Guide



Test circuit used with phase meter

zero loss, the meter reads 90 degrees. If the capacitor has loss due to shunt or series internal resistance, the meter reads less than 90 degrees depending on the amount of loss and the size of C.

The meter scale may be revised to read dissipation factor directly, but in production tests it is usually only necessary to check that the angle measured is above some minimum value, using the "red-line" technique.

Paper Containers Cut Potting Costs

CHANGING from conventional iron mixing and pouring pots to paper containers reduced the cost of potting a military electronic component by 21¢ per unit at Emerson's Jersey City plant. The new production technique, introduced by chief methods engineer Tom Bellavia, eliminates cleaning of iron pots every 20 minutes with expensive and nauseating xylol solvent.

The conical paper cup now used is thrown away when empty. For pouring, the tip of the paper cup is cut off with scissors. A wood dowel rod held over the resulting hole

Demonstrating Emerson's use of conical paper cup and dowel-rod valve for filling containers with potting compound. Military classification prevents showing actual component. Compound is mixed in gallon icecream container at left


New 1952 HEATHKITS
Heathkit
TELEVISION GEN. KIT $39.50
Heathkit
ELECTRONIC SWITCH KIT $19.50
Heathkit
AUDIO GEN. KIT $34.50
Heathkit
CONDENSER CHECKER KIT $19.50
Heathkit
R. F. SIGNAL GEN. KIT $19.50
Heathkit
5" OSCILLOSCOPE KIT
● New "spot shape" control for spot adjustment — to give really sharp focusing.
● A total of ten tubes including CR tube and five miniatures.
● Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
● Greatly reduced retrace time.
● Step attenuated — frequency compensated — cathode follower vertical input.
● Low impedance vertical gain control for minimum distortion.
● New mounting of phase splitter and deflection amplifier tubes near CR tube base.
● Greatly simplified wiring layout.
● Increased frequency response — useful to 5 MC.
● Tremendous sensitivity 03 RMS per inch Vertical .6V RMS per inch Hor.
● Dual control in vernier sweep frequency circuit — smoother acting.
● Positive or negative peak internal synchronization.
● Multivibrator type Wide Range Sweep Generator.
A brand new 1952 Heathkit Oscilloscope Kit with a multitude of outstanding features and really excellent performance. A scope you'll truly like and certainly want to own.
The kit is complete with all parts including all tubes, power transformer, punched and formed chassis, etc. Detailed instruction manual makes assembly simple and clear — contains step-by-step instructions, pictorials, diagrams, schematic, circuit description and uses of scope. A truly outstanding value.
MODEL 0-7
SHIPPING WT. 24 LBS.
$43.50
Heathkit VACUUM TUBE VOLTMETER KIT
● New styling — formd case for beauty.
● New truly compact size — Cabinet 4⅛" deep x 4-1/16" wide x 7⅜" high.
● Quality Simpson 200 microamp meter.
● New ohms battery holding clamp and spring clip — assurance of good electrical contact.
● Highest quality precision resistors in multiplier circuit.
● Calibrates on both AC and DC for maximum accuracy.
● Terrific coverage — Reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
● Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
● New styling presents attractive and professional appearance.
The 1952 Model Heathkit Vacuum Tube Voltmeter! Newly designed cabinet combines style and beauty with compactness. Greatly reduced size to occupy a minimum of space on your work-bench. Covers a tremendous range of measurements and is easy to use. Uses only quality components including 1% precision resistors in multiplier circuit for greatest accuracy. Simpson 200 microamp meter with easy to read scales for fast and sure readings.
All parts come right with kit, and complete instruction manual makes assembly a cinch.
MODEL V-5
SHIPPING WT. 5 LBS.
$24.50
Heathkit
A.C. VOLTMETER KIT $29.50
Heathkit
SQUARE WAVE GEN. KIT $29.50
Heathkit
INTERMODULATION ANALYZER KIT $39.50
Heathkit
AUDIO FREQ. METER KIT $34.50
YOU SAVE BY ORDERING DIRECT FROM MANUFACTURER
EXPORT AGENT
ROCKE INTERNATIONAL CORP.
13 E. 40th ST.
NEW YORK CITY (15)
CABLE: ARLAB-N.Y.
The HEATH COMPANY
... BENTON HARBOR 14, MICHIGAN

serves as a pouring valve. The dowel rod is alternately raised and lowered as the cup is moved over a tray of units awaiting potting, to start and stop the flow of potting compound without drip. The cups fit in a simple metal holder. Dowel rods are discarded when compound hardens on them, as new rods are cheaper than the cost of cleaning them.

For initial mixing of potting compound, formerly used 2-quart porcelain pots have been replaced with disposable 1-gallon icecream containers costing 13¢ each in 1,000 lots. These containers are discarded when empty, eliminating the cost of cleaning porcelain containers. The faster pouring rate made possible by use of paper cups permits mixing twice as much compound as before and still using it up before thickening starts. Of the total saving, 11¢ per unit is due to use of gallon paper containers and 10¢ per unit to use of Lily conical paper cups for pouring. Similar savings are being obtained by using papers cups for pouring other potting compounds.

Pouring resin from disposable paper cup into mold containing Hamilton Standard's electronic subassembly for controlling flow of fuel to aircraft gas-turbine engines. Potted units, after removal from mold, are shown in foreground

Conventional flat-bottom paper cups are used for over-the-lip pouring of quick-hardening resin during potting of tiny electronic sub-

Q: Are all brands of Resistors similar in Quality, Specifications and Performance?

A: Naturally, no! That's why DAVEN has earned the right to add a superlative in naming its line

SUPER DAVOHM

PRECISION WIRE WOUND

RESISTORS

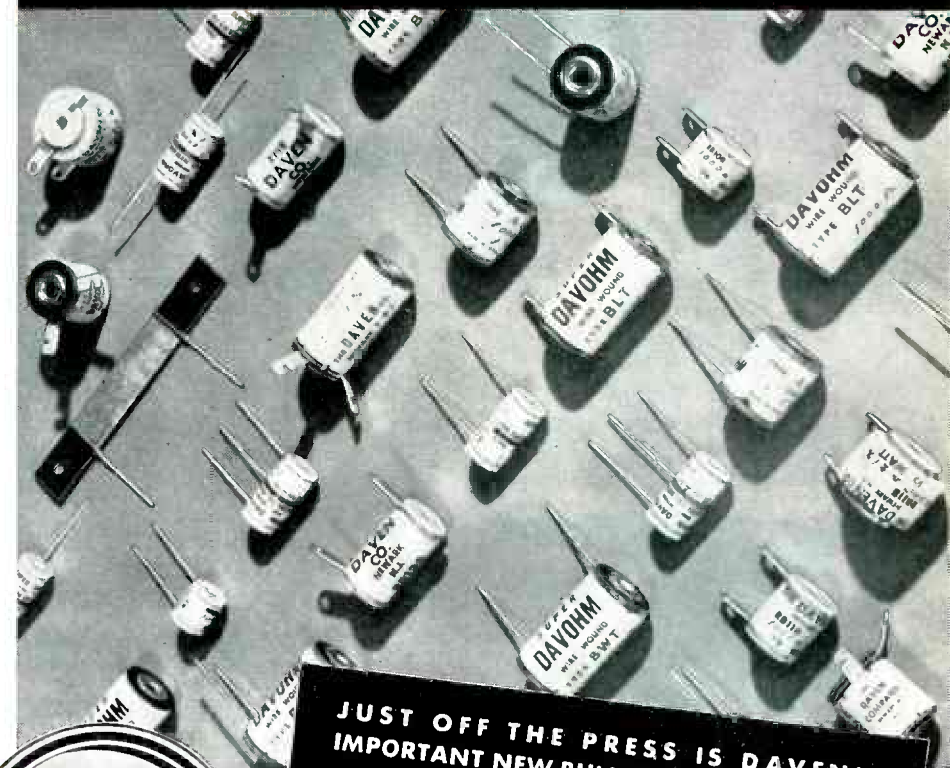
● Brands of Resistors vary as widely in the completeness of a line and in performance, as do brands of any other product.

DAVEN originated the first pie-type, wire wound Resistor more than a generation ago. Since that time, DAVEN has designed and manufactured Precision Wire Wound Resistors of every conceivable type to meet the increasing demands of the electronics industry.

SUPER DAVOHM RESISTORS are noted for their high stability and accuracy under extreme temperature and humidity conditions. DAVEN Resistors are made in accordance with JAN-R-93 specifications and are in use in all types of Army, Navy and Air Force electronic equipment.

DAVEN has developed special small precision Resistors for use in miniaturized assemblies. All types of mountings, sizes, tolerances and temperature coefficients are available from a large variety of standard types. That's why DAVEN can fill your precision Resistor needs.

Take advantage of DAVEN's advanced engineering and manufacturing techniques to help with any Resistor problem confronting you.



JUST OFF THE PRESS IS DAVEN'S IMPORTANT NEW BULLETIN ON RESISTORS.

Write for your copy today and prove to yourself, from the information supplied, that when you order Resistors you should specify only . . .

SUPER DAVOHM Precision Wire Wound RESISTORS

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

NOW scientific

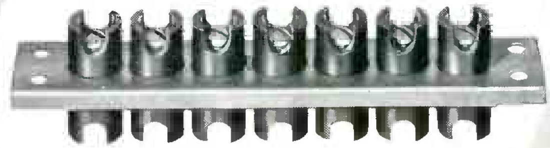
Chart Control

maintains definite quality standards for these and other dimensions and characteristics of ALLEN ⬡ SCREWS

1. Head radii
2. Head diameter
3. Body diameter
4. Thread form
5. Lead error
6. Thread size
7. Rockwell hardness
8. Head - Body - Thread concentricity
9. Head height
10. Socket size and depth

THE ALLEN MANUFACTURING COMPANY
Hartford 2, Connecticut, U. S. A.

For Sub-Panel and Chassis



CURTIS Type "FT" BLOCKS

TYPE:
Feed-thru, factory assembled 1 to 16 terminals.

TERMINALS:
Screw-type — separately insulated, held permanently in metal strip.

RATED:
300 Volts between terminals of opposite polarity and to ground. 20 Amps. (Conservative).

Write for Bulletin DS-111. For quick reference consult our condensed catalog in the McGraw-Hill Electrical Catalog for Production Engineers.

CURTIS DEVELOPMENT & MFG. CO.
3203 NORTH 33rd STREET • MILWAUKEE 16, WISCONSIN

Only with **CO-AX**

AIR SPACED ARTICULATED

R.F. CABLES

Patents Regd.Trade Mark.

THE LOWEST EVER CAPACITANCE OR ATTENUATION

LOW ATTEN. Types.	IMPED. Ohms.	ATTEN. db100ft. of 100Mcs.	LOADG. K.W.	O.D."	
A.1.	74	1.7	0.11	0.36	
A 2	74	1.3	0.24	0.44	HIGH POWER FLEXIBLE
A 34	73	0.6	1.5	0.88	
LOW CAPAC. Types	**CAPAC. mmf/ft.**	**IMPED. Ohms.**	**ATTEN. db100ft 100Mc/s.**	**O.D."**	
C 1	7.3	150	2.5	0.36	
PC 1	10.2	132	3.1	0.36	PHOTOCELL CABLE
C 11	6.3	173	3.2	0.36	
C 2	6.3	171	2.15	0.44	
C 22	5.5	184	2.8	0.44	
C 3	5.4	197	1.9	0.64	VERY LOW CAPACITANCE
C 33	4.8	220	2.4	0.64	
C 44	4.1	252	2.1	1.03	

We are specially organized to handle direct enquiries from overseas and can give ***IMMEDIATE DELIVERIES FOR U.S.A.***
Billed in dollars Settlement by your check.

TRANSRADIO LTD
CONTRACTORS TO H.M. GOVERNMENT.
138A CROMWELL ROAD, LONDON S.W.7 ENGLAND
CABLES: TRANSRAD LONDON.

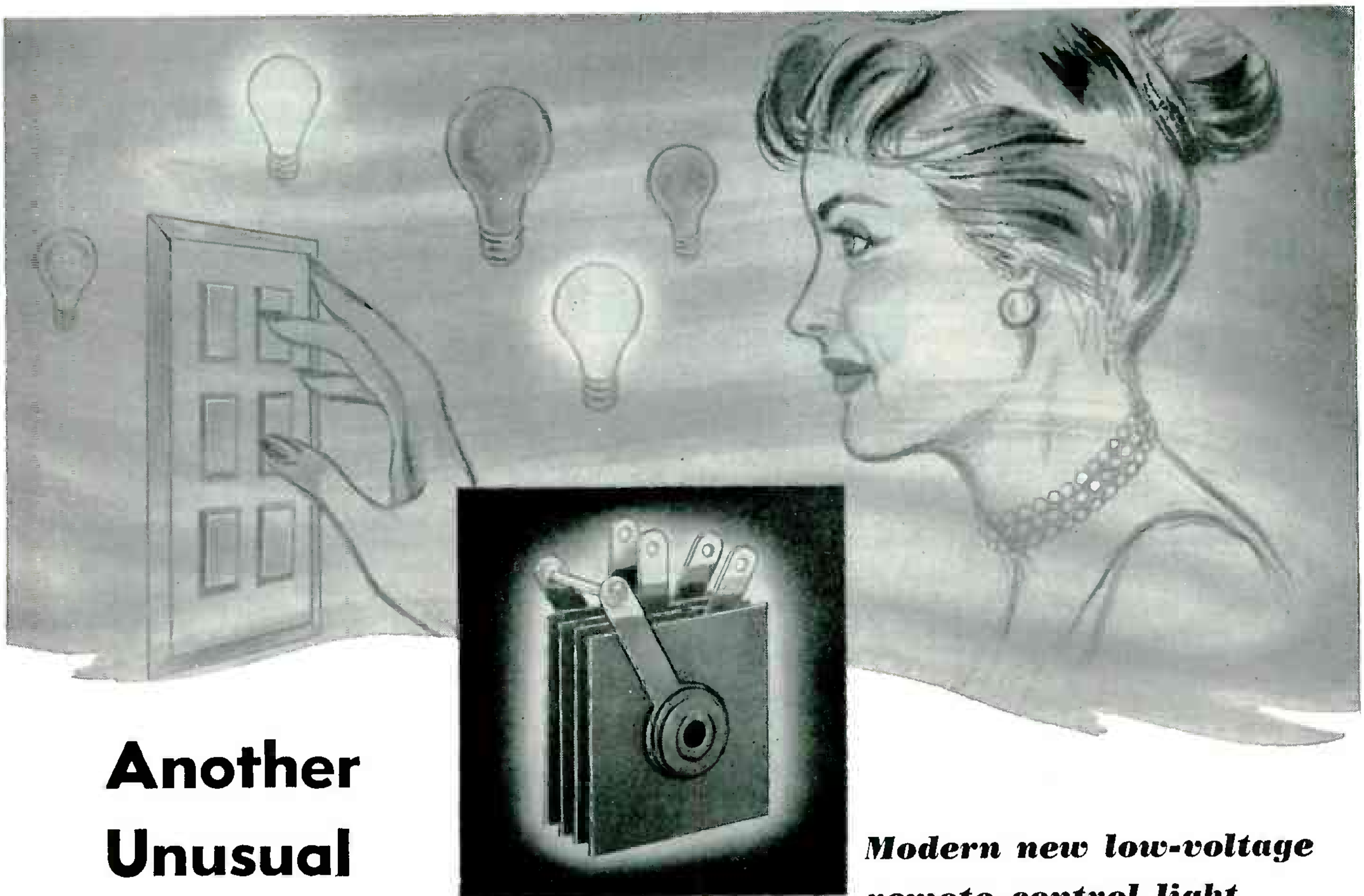
assemblies at United Aircraft's Hamilton Standard Division in East Hartford. Here again, cups are discarded when empty.

Leak Tester

AN ORDINARY vacuum cleaner, a water column, a tank of Freon gas and a Presto'ite plumber's torch are the essential elements in the technique employed at DuMont's East Paterson, N. J. plant for detecting and locating leaks in housings of military electronic equipment. One setup uses a dummy panel for checking the body housing, and another uses a dummy body for checking the gasketed cover panel.

For checking body units, the dummy panel is arranged for quick clamping to the body under test. Rubber hose goes from this panel to the valves of the system. With the dummy panel on a body, the vacuum cleaner is used to evacuate the body housing, with the water column serving as a visual indicator of the degree of vacuum. A valve in the vacuum cleaner line is then closed and the water column watched to see if the housing holds its vacuum. For the particular unit shown in production, tolerance limits permitted not more than a 1/8

Setup for detecting pinhole leaks in body housing of military electronic gear. Plumber's torch is on bench at left, next to dummy cover panel, and Freon gas tank is on floor at right



Another Unusual Seletron Application

Modern new low-voltage remote control light switch systems employs

Seletron

SELENIUM RECTIFIERS

Touch-Plate Mfg. Co. of Long Beach, Calif. considers the rectifier in each of its control units a highly important "artery" of the system . . . That's why, after severe tests for temperature, load capacity and longevity, they have chosen SELETRON Selenium Rectifiers.

The rectifier incorporated in "Touch-Plate" (Just touch it and the lights go on anywhere in the house!) is SELETRON's Model P1B1E1C, 1-3/16" cell size, and rated at 26V AC input. It converts AC to DC for the "Touch-Plate" relay.

SELETRON Selenium Rectifiers are available in ratings from a few mils, up to thousands of amps! New industrial electronic uses are *constantly* turning up for these versatile and dependable rectifiers—both in miniature sizes and heavy stack assemblies . . . and of course SELETRON is the choice of a growing list of manufacturers in communications and TV.

May we help with your rectification problems? Write us without obligation. Our engineering department can be of real assistance . . . And please ask for our helpful Bulletin No. 104-D-1.

Seletron

T. M. REG. U. S. PAT. OFF

SELETRON 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.

SIGNAL ENGINEERING

HEAVY DUTY

MULTIPLE ARM RELAYS

Designed for high degree of versatility and to meet severe operating conditions where performance reliability is vital. Adaptable to many different circuit arrangements. Rigid, cast aluminum bodies. Balanced armature construction. Highly resistant to shock and vibration. Available A.C.-D.C. Also special models built for specific requirements.

Relay assemblies can be modified to meet Armed Services applications.

Submit your requirements for our recommendations.

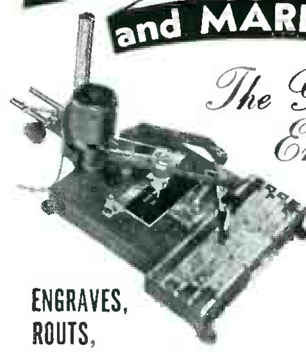
Engineering Representatives in Principal Cities

Write for Bulletin 30-6

Wheelock RELAYS
SIGNAL
ENGINEERING & MFG. CO.
154 WEST 14TH ST., NEW YORK 11, N.Y.

ENGRAVING and MARKING

The Green Engraver



ENGRAVES, ROUTS, PROFILES and MODELS

A real money saver for industry. Proven by the experience of tool and die, electronic machine, radio, electrical and instrument manufacturers.

The Green Engraver zips out precision work on metal, plastics, wood, glass, hard rubber, etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs . . . by simple tracing. Routing, profiling and three dimensional modeling indicate its versatility. Electronic etching attachment available.

Specify the Green Engraver for the best in low cost performance.

Special attachments and engineering service available for production work.

FREE — Fact-packed folder yours upon request.

Green Instrument Co.
INCORPORATED
363 Putnam Ave., Cambridge, Mass.

Pulse Generator and Calibrator

Model PC-100 R illustrated here

- The Teletronics Model PC-100 Pulse Generator and Calibrator was designed as an accessory for general use with triggered oscilloscopes. However, the variety of waveforms generated and the flexibility of operation provided make it a valuable instrument for many other purposes.

Incorporates design of HAZELTINE ELECTRONICS CORP. Model 1456 Senior Pulser

- The Pulse Calibrator produces two rectangular pulses of short duration whose amplitudes and polarities can be independently controlled. Their repetition frequency and the time interval between them are also adjustable. Accurate marker pulses and square-waves are generated for making both time and amplitude measurements. The unit can be synchronized from an external source or it may be operated self-synchronous in which case a pulse for synchronizing other equipment is generated.

For further information, write or wire

TELETRONICS LABORATORY INC.
WESTBURY, L. I., N. Y.

MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND PRODUCTION TEST EQUIPMENT

Linde
Trade-Mark

M. S. C.
(Mass Spectrometer Checked)

RARE GASES

HELIUM · NEON
ARGON · KRYPTON · XENON

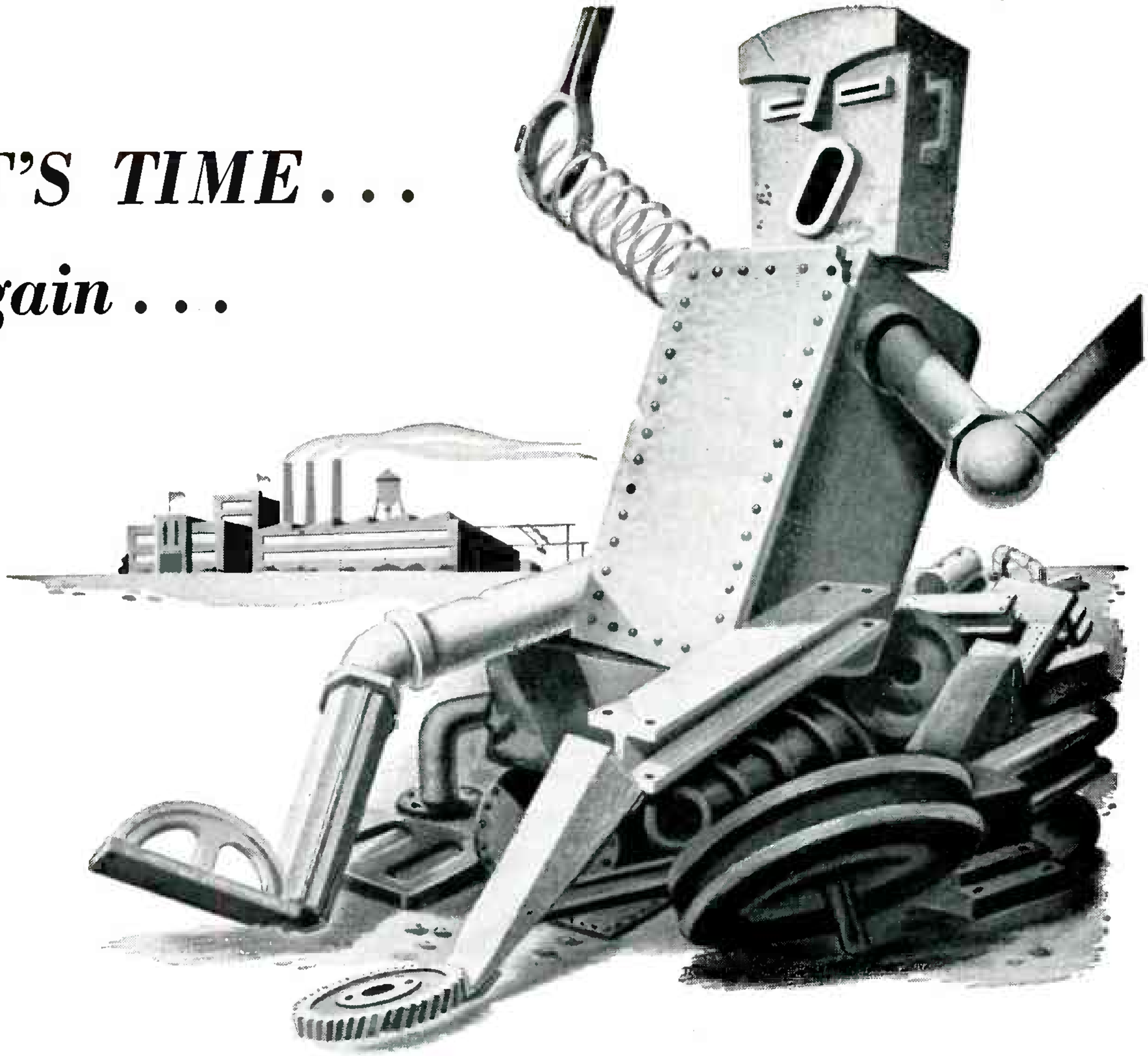
LINDE Rare Gases are mass spectrometer checked to assure you gases of known purity and uniformly high quality. Available in commercial-size cylinders and glass bulbs.

LINDE, the world's largest producer of gases derived from the atmosphere, can meet your individual needs of purity...volume...mixture...containers...

LINDE AIR PRODUCTS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street UCC New York 17, N.Y.
In Canada: Dominion Oxygen Company, Limited, Toronto

The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation

IT'S TIME . . .
again . . .



TO WAKE UP SCRAPPY!

Scrap's getting scarce again . . . compared to the amounts we need . . . and it's up to *all* of us to *help* produce enough steel.

107,000,000 tons of steel is the present rate of production in 1951 . . . 119,500,000 tons is expected in 1952.

Last year, 1950, we produced 97,800,000 tons.

All that extra steel—enough to take care of *both* military and civilian needs—calls for *more scrap iron and steel.*

Scrap Inventories Are Alarmingly Low

While steel mills are producing at a greater rate than ever, scrap inventories have dwindled. Many mills are operating on a hand-to-mouth basis with shut-downs threatened unless we furnish more scrap.

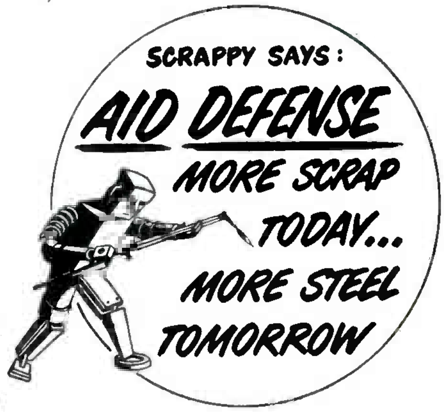
We *do* have the scrap. It's everywhere, not just in the form of *production* scrap—the "leavings" of machining, normally turned over to scrap dealers . . . but also in the form of *idle* metal: obsolete machines and tools, no-longer-usable jigs and fixtures, gears, chains, pulleys, valves, pipe, abandoned steel structures, etc.

We must have this *idle* metal to keep the furnaces running.

Please cooperate. Set up a Scrap Salvage Program in your plant—*now.* For a complete plan on "how to do it", write for booklet "Top Management: Your Program for Emergency Scrap Recovery". Address Advertising Council, 25 W. 45 Street, New York 19, N. Y.

Why Do We Need *Scrap?*

Steel is made half from pig iron, half from scrap. With production on the increase, more scrap must be purchased. And it's up to you to "dig it out" and sell it.



NON-FERROUS SCRAP IS NEEDED, TOO!

This advertisement is a contribution, in the national interest, by

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET NEW YORK 18, N. Y.

A PUBLIC SERVICE PROJECT THE ADVERTISING COUNCIL in. change in water column height in 30 seconds.

When a housing is outside of tolerance, Freon is admitted through another valve to the same pressure above atmospheric as the vacuum was below atmospheric. With the air intake of the plumber's torch modified so air enters only through an 18-inch length of rubber tubing, the torch is lighted and the end of the tubing is moved over the leaky housing as a searching probe. When Freon gas from a leak enters the torch flame, there is an immediate change from a normal blue flame to a yellow flame. A bad leak puts out the flame. The technique detects pinholes in metal as well as leaks around panel fittings.

The procedure for testing covers is the same except that now the rubber hose goes to a fitting on a dummy body. Separate tests of body and panel are important because the final military acceptance test involves submerging the completely assembled unit in water for a predetermined time, then opening to see if there is water inside.

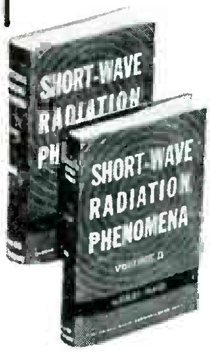
Soldering Hermetic Seals

USE OF HEAT from a 375-watt Sylvania infrared reflector lamp for soldering small hermetic-seal terminals to the cover of a pulse transformer reduces thermal stress between glass and metal and thus cuts down the number of rejects due to

Using infrared heat to solder hermetic-seal terminals to thin metal cover

THOROUGH REFERENCE

on theories and engineering treatment of radiation phenomena



Here is an intensive, thoroughgoing reference and study of all radiation phenomena in practical use today—from frequencies of about 30 megacycles per second up to the highest radio frequency. Gives a wealth of data, theory, and formulas, together with a host of numerical examples. Covers resultant field intensities (so important in modern use) as well as free field intensities. Picks up where electromagnetic volumes leave off—to bring a complete understanding of every modern and classical radiation concept.

Just Published!

SHORT-WAVE RADIATION PHENOMENA

By AUGUST HUND
Scientific and Technical Radiation Consultant

McGRAW-HILL RADIO COMMUNICATION SERIES

Arranged for maximum ease of reference, these two volumes are invaluable to the designer as well as the research scientist. Whenever a practical radiation phenomenon is described, the derivation of the formula is given along with the description, so that you do not have to refer to preceding sections to understand a particular problem.

2 volumes (not sold separately) 1382 pages 6 x 9 97 tables 394 illus. $20.00

9 big chapters give full coverage

1. **Fundamental Concepts and Relations of Currents and Electromagnetic Fields**
2. **Space Electromagnetic Fields of Elementary Electric and Magnetic Dipoles**
3. **Fundamental Methods Used in Electromagnetic Theory**
4. **Propagation Characteristics**
5. **Transmission Lines and Radiation**
6. **Unobstructed Space Radiation**
7. **Space Radiation in the Presence of Electromagnetic Obstructions**
8. **Electromagnetic Diffraction**
9. **Wave Guides and Cavities**

PAY ON EASY TERMS
SEE IT TEN DAYS FREE

McGRAW-HILL BOOK CO., INC.
330 West 42nd St., NYC 36

Send me Hund's SHORT-WAVE RADIATION PHENOMENA for 10 days' examination on approval. In 10 days I will remit $5.00 (plus a few cents for delivery) and $5.00 monthly until $20.00 is paid; or I will return the books postpaid. (We pay for delivery if you remit first installment with this coupon; same return privilege.)

(Print)
Name..

Address..

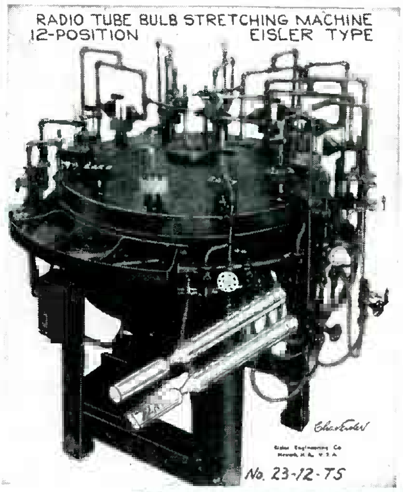
City.......................Zone....State......

Company..

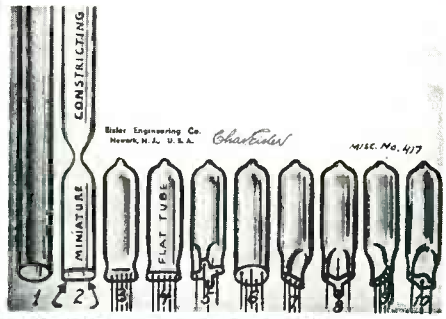
Position.......................................L-2-52

This offer applies to U. S. only

ELECTRONIC GLASS WORKING EQUIPMENT for RADIO, TELEVISION TUBES, INCANDESCENT LAMPS, GLASS LATHES for TELEVISION TUBE REPAIR. We make Transformers, Spot and Wire Butt Welders, Wire Cutting Machines and 500 other items, indispensable in your production. Eisler Engineers are constantly developing New Equipment. If you prefer your own designs, let us build them for you. Write to Charles Eisler who has served The Industry over 30 years.



Machines for small Radio Tubes of all kinds; 24-Head Stem, 24-Head Sealing and 24-Head Exhaust Machines, Spot Welders, etc.



EISLER ENGINEERING CO., Inc. 751 So. 13th St. Newark 3, N. J.

NEED SPECIFIC COILS?
BE SPECIFIC . . . .CALL DANO!

- Form Wound
- Paper Section
- Acetate Bobbin
- Molded Coils
- Bakelite Bobbin
- Cotton Interweave
- Coils for High Temperature Applications

ALSO, TRANSFORMERS MADE TO ORDER

From simple electrical coil winding to specially treated coils, Dano can supply the exact coils you need to do your exact job. That's why experienced engineers with an eye toward uninterrupted production specify Dano coils.

DANO

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

Quartz Crystals

Made to your specific specifications. Accurate to the minutest tolerance. Exacting in performance—with thorough dependability.

Whether one or a million, you get prompt shipment. Made by craftsmen with a quarter century experience.

Send us detailed description and quantity for prices.

MICHAEL STAHL, Inc.
215 Fulton Street New York 7, N. Y.

Modified soldering-iron used for soldering feed-through terminals to chassis

invisible cracks. With infrared heat, glass and metal are heated and expanded uniformly. The lamp is mounted about 2½ in. above the work.

When metal-to-glass terminals are to be soldered to a large heat-absorbing piece of metal such as a chassis, infrared heat is not sufficiently localized. For this kind of work the tip of a soldering iron was cut off and drilled to the same size as the metal flange on the terminal. The terminal is placed over a solder preform on the chassis, and the iron is held over the flange to fuse the solder without applying heat directly to the ceramic or glass insulator.

Both techniques are in use at the Television Transmitter Division of Allen B. DuMont Labs., Inc., Clifton, N. J.

Special Iron Solders Tube Base Pins

A RESISTANCE soldering iron using spring-loaded V-shaped carbon electrodes speeds up the operation of connecting the eight leads of a tiny pulse transformer to the eight pins of an octal tube base into which the transformer fits. The ends of the tool spread to go around an indi-

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 three 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:

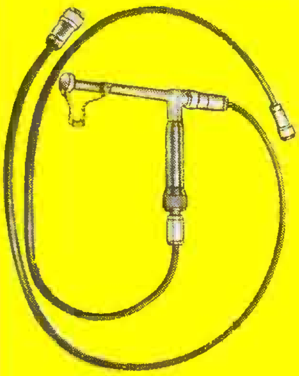
Model LTU-1 RF Tuning Unit—10 to 1000 MC.
Model LTU-2 RF Tuning Unit—940 to 4500 MC.
Model LTU-3 RF Tuning Unit—4460 to 16,520 MC.
Model LTU-4 RF Tuning Unit—15,000 to 21,000 MC.
Model LDU-1 Spectrum Display Unit.
Model LPU-1 Power Unit.
Model LKU-1 Klystron Power Unit.

Polarad PRECISION LABORATORY INSTRUMENTS

BROAD BAND MICROWAVE ATTENUATOR

Model SIJ

4 kmc to 12.4 kmc



Polarad's Broad Band Microwave Attenuator is intended for use as an external attenuator in microwave measurements with signal sources, receivers and for power measurements. Its useful frequency range is from 4000 mc to 12,400 mc. Model SIJ can be used as a standard calibrated attenuator or to couple a small amount of energy from a high level source for circuit protection, or for monitoring and for measurement purposes without introducing discontinuities or to insure rf circuit isolation.

By its use a Polarad Microwave Signal Source or a laboratory oscillator is converted into a signal generator.

Features:

- Continuously variable attenuation.
- Stub tuned 50 ohm impedance.
- Waveguide beyond cutoff attenuator.

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 11,000 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 11,000 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.

FREQUENCY MARKER

Model FM-L

950 mc to 2,040 mc

Polarad's Frequency Marker, Model FM-L, provides accurate frequency determination to within 10 kc over the frequency range 940 to 2020 mc.

The Frequency Marker produces calibration signals at precisely determined frequencies and these signals may be displayed and compared with an unknown rf signal, whose frequency can then be accurately measured.

Features:

- Frequency standard accurate to one part in 10^6.
- Frequency determination accurate to ±10 kc.
- Ten mc, 1 mc, and interpolation markers available.
- Markers throughout entire frequency range, 940 mc to 2040 mc.

Polarad *Electronics Corporation*

100 METROPOLITAN AVE., BROOKLYN 11, N. Y. • STagg 2-3464

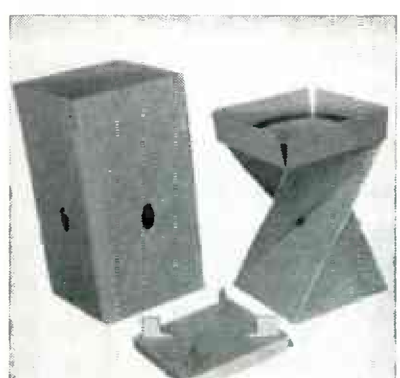
Resistance soldering tool gives cleaner soldered pins

vidual pin, heating it enough so that solder applied to the open end of the pin runs down inside. With this technique, used at DuMont's Television Transmitter Division in Clifton, N. J., a perfect half-spherical globule of solder is easily achieved on the end of each pin, and no solder runs down the sides of the pins.

Picture-Tube Carton

A RADICALLY new design of corrugated shipping carton for glass or metal picture tubes gives a solid stackable box that can be inexpensively glue-sealed. The inner support is fabricated as a box and then twisted into an hour-glass shape by hand to provide support for the funnel of the tube. This inner construction braces the outer box.

The new tube package was de-



New picture-tube carton converts from box to hour-glass shape by twisting

A NEW Insulating Laminate...

INSURVOK* GRADE T-812

COMBINES:

- SUPERLATIVE INSULATION RESISTANCE
- LOW MOISTURE ABSORPTION
- VERY HIGH STRENGTH
- EXCELLENT PUNCHABILITY

*Reg. U. S. Pat. Off.

INSUROK T-812 is a new paper-base punching stock that laughs at heat and humidity! It has outstanding properties that have never before been combined in one insulating laminate. T-812 has excellent electrical characteristics, plus a spectacular ability to retain them through extremes of heat and humidity. Its insulation resistance after humidity conditioning is particularly noteworthy.

INSUROK T-812 retains all of the properties of the well-known INSUROK T-725 and, in addition, has lower moisture absorption and much higher insulation resistance. It punches readily into intricate shapes. Investigate INSUROK T-812 for your product. Information upon request.

T-812's *Property Combination* —Unmatched by any other material!

Thickness tested......1/16"
Moisture Absorption (24 hours)......0.38%
Expansion after 24 hours' immersion in water at 77°F. Center....0.0001" Edge..............0.0002"
Tensile Strength, psi.......Main Direction..........19,500..........Cross Direction..........14,500
Flexural Strength, psi.......Main Direction..........23,000..........Cross Direction..........18,000
Dielectric Strength (perpendicular to laminations) V/Mil, Short Time......725 Step by Step......625

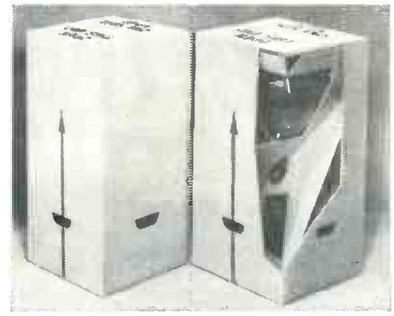
	Tests at Room Conditions	After 96 hrs. at 90% Rel. Hum. at 104°F.
Power Factor at 1 megacycle	0.028	0.030
Dielectric Constant at 1 megacycle	4.4	4.5
Loss Factor at 1 megacycle	0.13	0.14
Insulation Resistance, megohms		1,000,000

The RICHARDSON COMPANY

FOUNDED 1858—LOCKLAND, OHIO

2797 Lake St., Melrose Park, Illinois (Chicago District)

SALES OFFICES: CLEVELAND • DETROIT • INDIANAPOLIS • LOCKLAND, OHIO • MILWAUKEE • NEW BRUNSWICK, (N. J.) • NEW YORK • PHILADELPHIA • ROCHESTER • SAN FRANCISCO • ST. LOUIS



Sealed carton, and cutaway view showing how tube is suspended so it cannot be damaged by careless handling. In shipment, face of tube is down and resting on reinforced pad

veloped by Richard E. Paige Inc. of New York City. Electrical and Musical Industries, English manufacturer, has adopted the box.

Miniature-Tube Inserter

TO REST weary thumbs of operators who insert miniature tubes all day long in sets coming down the line at the rate of three a minute, methods engineers at Emerson's Jersey City plant devised a tube holder from brass tubing and wood. Several slits were sawed in the end of the brass tube to get springiness, and additional phosphor bronze strips were fastened inside to grip the miniature tubes. The holder is intended only for occasional use, as operators work faster without the tool.

Inserting miniature tube in socket with holder. Punched-up flanges in chassis, on opposite sides of socket holes, cost little more than plain socket holes yet serve to hold tubes upright in socket and provide grounding supports for shields

BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

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

Small Screw Machine Products—Courtesy Milford Manufacturing Co., Milford, Conn.

Making Small Screw Machine Parts from Brass

Small screw machine parts come in an endless variety of shapes and applications. Being small, close tolerances are necessary. Each job presents a special problem of manufacture and requires a lot of ingenuity and know-how.

Essentials for Quality Control

Long runs are necessary for profitable operation in order to absorb the cost of working out a job to meet customers' requirements for quality, speed of production and price per thousand. To meet the above the following should be observed:

1. The brass rod must have the correct composition and physical properties and must be uniform in diameter, machinability and temper.

2. Machines must be kept in tiptop condition—not worn or sloppy. You cannot operate profitably with worn-out machines.

3. Sharp tools, correctly ground are essential. They should be kept ahead of the job so that replacements can be made before they become too dull. Dull tools destroy finish, produce burrs, and slow down the operation.

On long runs carbide tools, despite their higher costs as compared to high speed steel, generally prove most economical.

4. Coolant-lubricant must be ample and well directed to keep tools and work cool. Light mineral oils are still popular for brass and most other metals although many operators prefer soluble oils.

How Samples Were Made

Most of the samples illustrated above were made on OO-G Brown and Sharpe machines although some operators prefer Swiss machines for the extremely small parts. The outside threads and knurls are rolled on the machine. Straight flute taps are used for shallow holes. Deep internal threads are made with a tap with spiral flutes to remove the shavings more readily. Ledrite 6 — Standard (approximately 61% copper, 3.4% lead, remainder zinc) free cutting brass rod gives excellent results for this type of work.

Phosphor Bronze and Brass Give Long Life to Snap-Action Switches

Because they are subjected to constant use on coin-operated vending machines, record changers, washing machines and many kinds of aviation, automotive, industrial and marine controls, dependable snap-action performance is of utmost importance in switches such as that pictured below.

On this switch, the brackets and actuators are of .032 inch brass, the contact is made of ⅛ inch diameter silver, and the other material used is .012 inch phosphor bronze. The excellent spring properties of phosphor bronze are retained under repeated flexing, making it an ideal material for this application. It resists fatigue and wear from rubbing against other materials, and has excellent arc resistance.

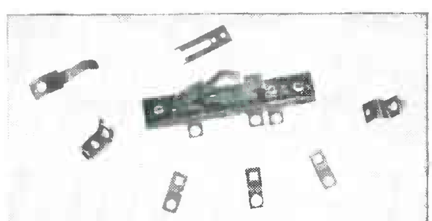
All parts are made to close tolerances, so that the operating and release points do not exceed plus or minus .025 inches of nominal.

The precision fabrication and assembly, plus the use of high-quality materials, enable these switches to achieve exceptionally long service life.

Tests have shown the following results:

125 volts A.C.: 1 amp—2.5 million operations
125 volts A.C.: 3 amp—2.0 million
125 volts A.C.: 5 amp—1.7 million
125 volts A.C.: 6 amp—1.5 million

These tests were made at 6 cycles per minute, 20% over travel, resistive load. (7864)

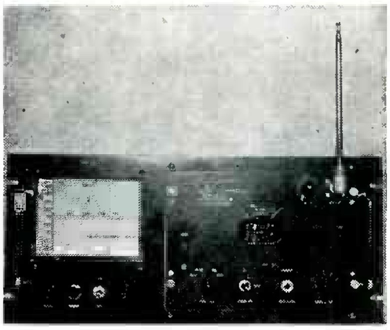


The blade of the snap-action switch is made from .012 inch phosphor bronze. Other parts are of .032 inch brass. Photo courtesy Cherry-Channer, Highland Park, Ill.

NEW PRODUCTS

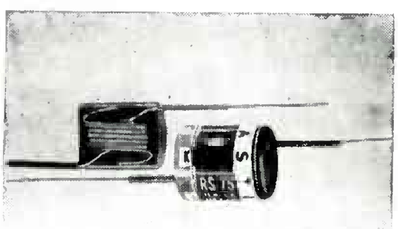
Edited by WILLIAM P. O'BRIEN

Instruments For Measurement And Control Stand Out . . . Equipment For Research And Development Is Also Featured . . . Thirty-Nine Manufacturers' Catalogs Contain Much Engineering Data



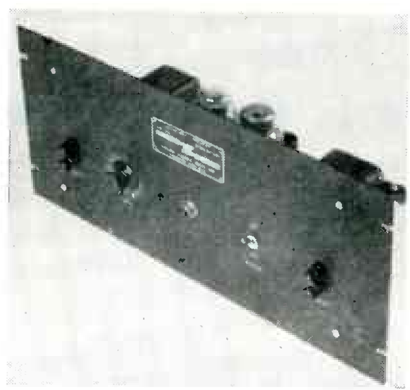
VHF Meter

GERTSCH PRODUCTS, INC., Los Angeles , Calif., is now producing the new direct-reading model FM-1A vhf meter. Frequency range is 20 to 480 mc; and power supply is PS-L/FM-1A regulated power supply to provide proper voltage with line voltage variations from 105 to 125 v. Provision is made to modulate the carrier frequency at a minimum of 30 percent at 1,000 cycles. The FM-1A employs a unique and original circuit utilizing an extremely accurate 1.0-mc crystal, with variable capacitance trimming to allow exact adjustment. All frequency measurements are referred to the crystal, which has a temperature coefficient of 0.0001 percent per deg C.



Molded-In Selenium Rectifiers

ELECTRONIC DEVICES INC., 429—12th St., Brooklyn, N. Y. All ratings up to 200 ma d-c output in the Plastisel line of miniature electronic selenium rectifiers are molded-in similar to small tubular capacitors. The outer case is spiral-wound phenolic wax which is rock hard at 100 C. The excellent thermal conductivity of this wax and the low loss plates compensate adequately for the loss of cooling due to molding in. These rectifiers are manufactured with bare or insulated tin-copper leads. In ratings from 250 to 500 ma d-c the standard open-plate construction is used. However, the high-efficiency plates lead to cooler operation and resultant longer life. All Plastisel rectifiers are guaranteed for 1,000 hours or 1 year, whichever occurs first.



Laboratory Amplifier

HERMON HOSMER SCOTT, INC., 385 Putnam Ave., Cambridge 39, Mass. The relay-rack type 221-A laboratory amplifier features extended frequency response, high power output and negligible hum and distortion. Specifications are: rated power output, 20 w; frequency response flat from 12,000 to 55,000 cycles with controlled cutoff characteristics beyond for maximum stability and freedom from spurious oscillation and distortion; first-order difference-tone intermodulation component less than 0.1 percent at full-rated peak output; harmonic distortion less than 0.5 percent at full 20 watts output; hum level −90 db below full output; input for full rated 20-watt output, 0.5 v on low level input, 1.5 v on high level input; input impedance 0.5 megohm for low level and 1.5 megohms for high level input.

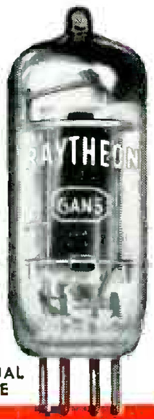
UHF Receiving Tube

GENERAL ELECTRIC CO., Schenectady, N. Y., has begun production of the 6AF4, a miniature receiving tube for use in uhf reception. A seven-pin triode, it is designed for use as a local oscillator for the new uhf channels from 470 to 890 mc. Other characteristics are: plate voltage, 150 v; plate current, 28 ma; plate input, 2.5 w; plate dissipation, 2.25 w; heater voltage, 6.3 v; and heater current, 225 ma.

Pulsed Carrier Generator

KAY ELECTRIC CO., Pine Brook, N. J. offers a pulsed carrier generator, the Rada-Pulser, designed to give rapid and accurate transient response information in laboratories, on production lines and in the field. Specifications are as follows: carrier frequencies, 30 mc and 60 mc; pulse widths, 0.1 and

NEVER ASLEEP AT THE SWITCH



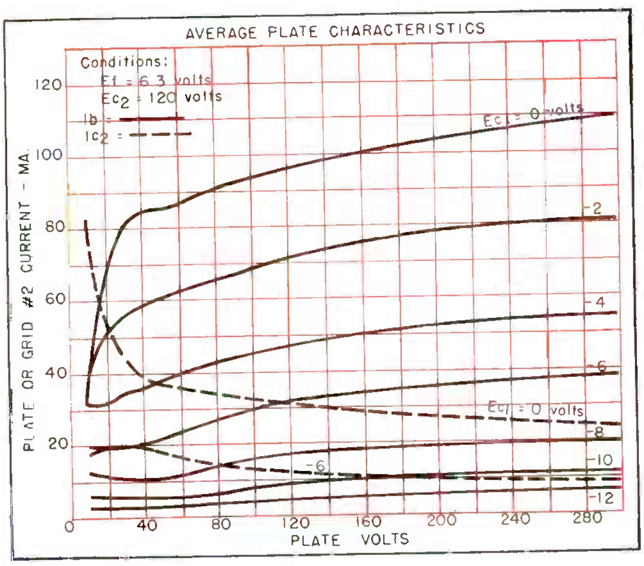
ACTUAL SIZE

THE RAYTHEON 6AN5

MINIATURE PENTODE

For Computer Applications

The Raytheon 6AN5 was the first of its kind — the first with low interface resistance to avoid *"sleeping sickness"*. It remains the first choice of designers of dependable, long lived computing devices.



The Raytheon 6AN5 has been in continuous production for over two years. This means maximum reliability, minimum failures.

Important characteristics of the 6AN5 drop less than 10% in 5000 hours *under on, off, or flip-flop conditions.*

The Raytheon 6AN5, providing high efficiency with low plate voltage is also recommended for such services as

Video Output Amplifier
Wide Band RF Amplifier
Wide Band IF Amplifier
RF Class C. Amplifier
Class C. Frequency Multiplier

NOW AVAILABLE FOR IMMEDIATE DELIVERY

Write for data sheets which contain complete information on this and many other Raytheon Special Purpose Miniature and Subminiature Tubes.

RAYTHEON ®

RAYTHEON MANUFACTURING COMPANY

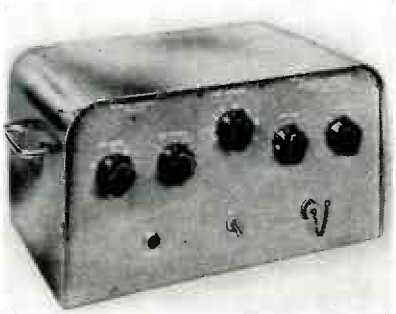
Receiving Tube Division

Newton, Mass., Chicago, Ill., Atlanta, Ga., Los Angeles, Calif.

Excellence in Electronics

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

0.25 μsec; pulse repetition rate, continuously variable from 500 to 2,000 pps; maximum r-f output, approximately 1 volt at 70 ohms; attenuators, 20 db, 20 db and 10 db switched 10 db continuously variable. Pulse output is 50 v at 70 ohms. Price is $595.00.



D-C Breaker Amplifier

LISTON-BECKER INSTRUMENT CO., INC., 20 Beckley Ave., Stamford, Conn. Model 14 ultrasensitive d-c breaker amplifier can be furnished for operation with input circuits between 5 and 100,000 ohms. It has a noise level which closely approaches the limits imposed by thermal agitation and has a zero stability of 0.005 μv per day. This amplifier can be employed in circuits which formerly used highly sensitive suspension galvanometers. It has the advantages of fast speed, output suitable for recording and flexibility of sensitivity and controls. Price is $665.

Manometer and Flowmeter

HASTINGS INSTRUMENT CO., INC., Super Highway and Pine Ave., Hampton 10, Va., has announced a highly sensitive electronic manometer and flowmeter having no glass or plastic tubes and containing no fluids. The manometer operates from a noble metal thermopile using the same principles which the company has applied to its vacuum and air-velocity measuring instruments. To operate, the two taps on the gage tube are simply connected to the two points at which the pressure difference is to be measured. To use the instrument as a flowmeter, the tube is placed directly in the line for flow rates or connected to pressure taps on two sides of a calibrated orifice for high flow rates. The manometer will measure extremely low pressure differences and has a dual range of 0.001 in. to 0.1 in. and 0.1 in. to 2 in. water. The instrument may be used for direct indications or attached to a recorder. It operates on 110-v, 60-cycle a-c. A constant voltage transformer is available to eliminate any effects from variation in the line voltage.

Oil-Immersed Rectifier Tubes

WESTINGHOUSE ELECTRIC CORP., 306 Fourth Ave., Pittsburgh 30, Pa. Two high-voltage oil-immersed rectifier tubes set new standards of compactness. One is a 40-kv peak-inverse-voltage tube capable of 150 ma average and 900 ma peak current, but it is only about the size of a tennis ball. It is oil immersed, which is desirable not only to keep the size down but also to maintain the voltage breakdown strength and to reduce the effect of rapid temperature and pressure changes when carried aloft as part of a radar set. The second rectifier, of similar construction, provides 125-kv (peak inverse) for heavy-dust precipitation equipment. It is rated at 300 ma average and 1 ampere peak, but is only 11½ in. long, and the tube portion only 4 in. in diameter. It is only about one-tenth as large as the air-cooled variety.

Automatic Temperature Control

THE LAWRENCE INSTRUMENT CO., 4903 Twelfth Ave., Brooklyn 19, N. Y. The Firelator electro-mechanical automatic temperature control unit is manufactured in three standard ranges up to 2,250 F and one special range up to 3,000 F. It combines the features of an automatic limit control and automatic temperature maintenance control in one unit. It is designed to operate as a plug-in unit and may be used to control any electrical furnace. Unaffected by voltage surges, it will operate from 70 v a-c to 140 v a-c without requiring any adjustment. Control is achieved by use of a thermocouple, pyromillivolt meter and an adjustable photocell bridge.

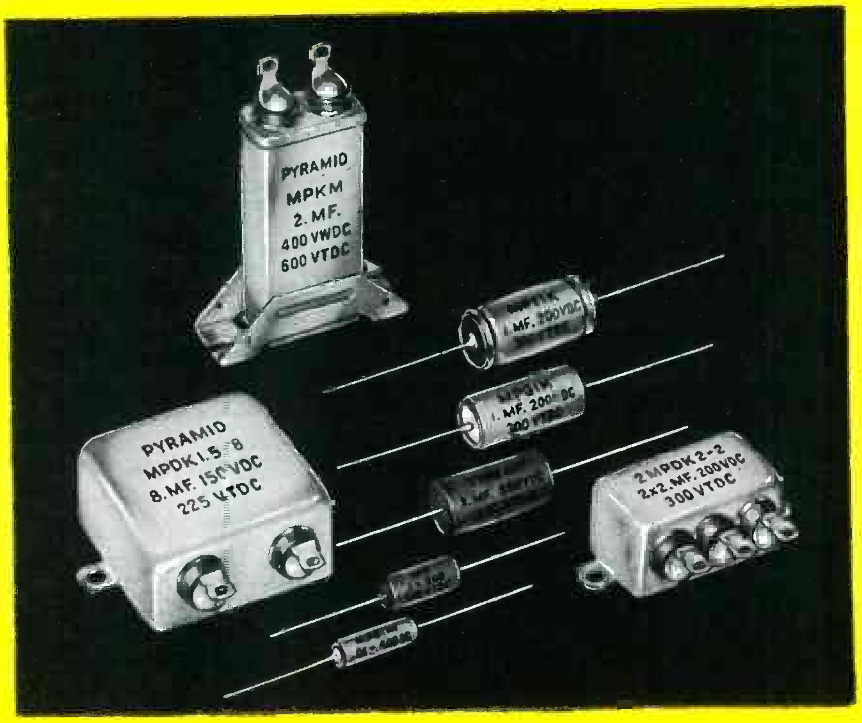
Servo Amplifiers

INDUSTRIAL CONTROL CO., Wyandanch, L. I., N. Y. The 421-A and 423-A are universal, 400-cycle servo amplifiers designed to drive two-phase servo motors requiring 6 and 9 watts per phase respectively. They feature independent, screw-driver

Now in **MASS PRODUCTION...**

PYRAMID ULTRA-COMPACT

metallized paper capacitors



PYRAMID Series M CAPACITORS use a specially-prepared metallized paper, providing all-important savings in size and weight.... Pyramid now produces large quantities of these capacitors in a wide variety of cardboard or hermetically sealed metal containers.

Your lette-head inquiries are invited

PYRAMID ELECTRIC COMPANY • 1445 HUDSON BLVD., North Bergen, N. J.

controls on damping, gain and carrier phase, and thus can be stocked for use in all servo loops requiring their respective servo motors. Other characteristics are: maximum gain, 1,000; phase adjustable through 160 deg; internal pickup below 2 mv; damping adjustable over wide range. By using these units together with breadboard mechanical apparatus, a servo loop can be set up in the few hours required to design and construct an interconnecting harness.

Volume Level Indicator

THE DAVEN CO., 191 Central Ave., Newark 4, N. J. The improved series 911 portable volume level indicator is designed to indicate audio levels in broadcasting, sound recordings and allied fields where precise monitoring is important. The unit is completely self-contained, requiring no batteries or external power supply. The indicating meter is a copper-oxide type instrument possessing ideal characteristics for monitoring purposes. The adjustment is such that the pointer will indicate 99-percent normal deflection at zero vu in approximately 0.3 second. Overswing is not more than 1 to 1.5 percent. Meter scale is calibrated in vu and percent.

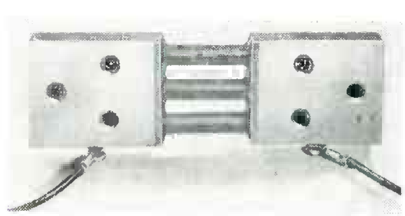
Crystal Sockets

UNITED STATES GASKET CO., Fluorocarbon Products Div., Camden 1, N. J., is offering a new line of crystal sockets designed for use where

extremely low losses and frequency stability are desired and mechanical shock and vibration are problems. Made of Teflon (tetrafluoroethylene resin), these Chemelec sockets have a loss factor of less than 0.0005 and a dielectric constant of only 2.0 from 60 cycles to 30,000 mc. Having zero water absorption rating, they are unaffected by extreme humidity. They are serviceable at temperatures from 110 F to 500 F with negligible change in critical electrical characteristics. The sockets are made in three sizes: for 0.050-in. pins spaced 0.500 in.; 0.095-in. pins spaced 1.500 in.; and 0.125-in. pins spaced 0.750 in.

Audio Amplifier

THE RADIO CRAFTSMEN, INC., 4401 N. Ravenswood Ave., Chicago 40, Ill. Model 500 ultrafidelity all-triode audio amplifier is based on the Williamson circuit. Total harmonic distortion is less than 0.1 percent at 10 watts at midfrequencies; intermodulation distortion, less than 0.5 percent at 10 watts; power response, 12 watts, ± 1 db, 10 to 50,000 cps; frequency response, ± 0.1 db, 20 to 20,000 cps and ± 2 db, 5 to 100,000 cps.



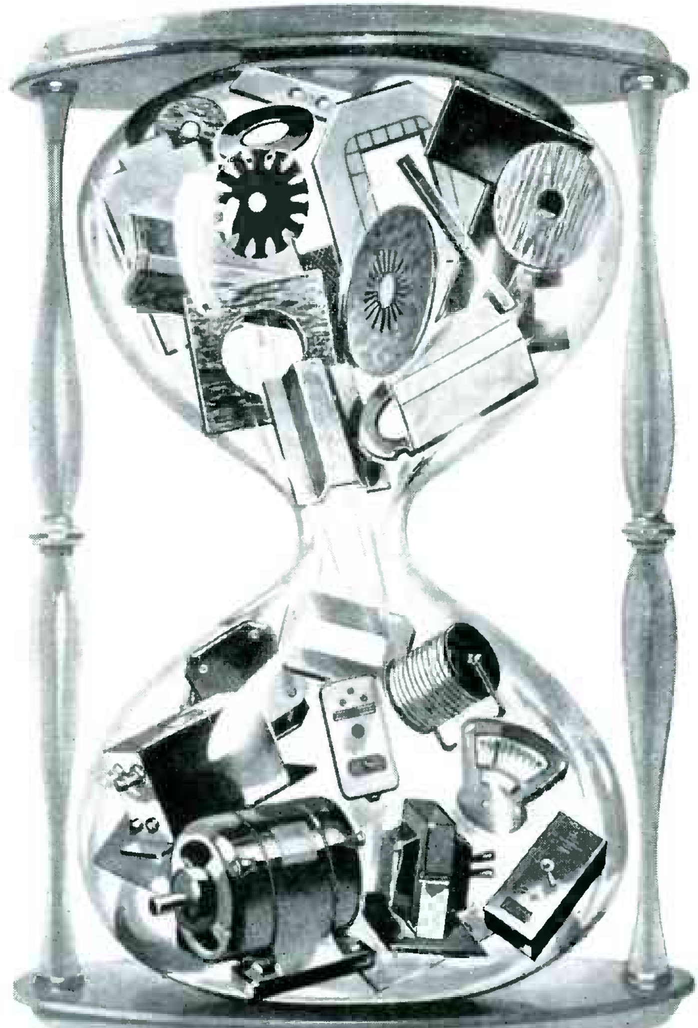
Switchboard Shunts

INDUSTRIAL RECTIFIER CO., 120 Cedar St., New York, N. Y., has introduced a new line of 50-mv switchboard shunts for d-c instruments, supplied with calibrated

Save Assembly Time

with ready-to-use **Inmanco**®

INSULATION PARTS



• *Time-per-assembly* drops to record lows when Inmanco Insulation Parts are specified for electrical and electronic equipment, because Inmanco parts are fabricated with precision. They slip into place easily and snugly . . . no time wasted in struggling to fit inexact parts.

By manufacturing insulation parts with specialized high speed equipment on a production line basis, Inmanco produces fabricated parts with maximum economy. Designs are reproduced exactly by shearing, sawing, slitting, die cutting, creasing, forming, cuffing, or rotary cut molding.

You can be sure of the *specific* protection you need, too . . . because Inmanco parts are fabricated from such a wide variety of materials. *You can select* the dielectric strength, heat resistance, toughness, and other properties required for your application.

Inmanco engineers are always glad to show how fabricated parts can save time in the production of military and civilian electronic and electrical equipment . . . including motors, coils, controls, transformers and instruments. Get full information on ready-to-use Inmanco Insulators *now.*

Inmanco Parts Can Be Fabricated From These Insulation Materials

- All rag, part rag, wood pulp papers and press boards
- Varnished cambric-paper combinations
- Hard maple wood
- Laminated plastics
- Plastic films
- Plastic film-paper combinations
- Silicone resin coated glass cloth
- Vulcanized fibre and fishpaper
- Varnished asbestos, cambric, canvas, and glass cloths and paper

Ask For

FREE

literature on Inmanco fabricated electrical insulation parts, today.

Inmanco® **products are manufactured exclusively by Insulation Manufacturers Corporation**

WHERE TO GET INMANCO FABRICATED INSULATORS

INSULATION MANUFACTURERS CORPORATION

CHICAGO • CLEVELAND • DAYTON • MILWAUKEE • PITTSBURGH

Also represented by: **H. R. Brethen, Detroit • H. A. Holden, Inc., Minneapolis • W. C. Johnson, Peoria, Ill.**

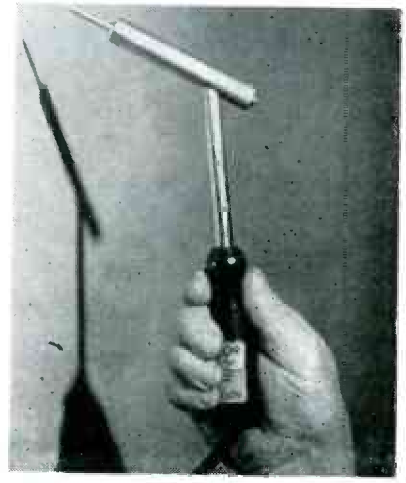
ROBERT McKEOWN COMPANY
Newark, New Jersey

EARL B. BEACH COMPANY
Pittsburgh, Pa.

DIAMOND STATE FIBRE COMPANY OF CANADA, LIMITED
Toronto, Ont., Canada

INSULATION AND WIRES INCORPORATED
Adrian, Mich. • Atlanta • Boston • Detroit • Fort Worth • Houston • Kansas City, Kas.
Los Angeles • Memphis • Newark • Portland, Ore. • St. Louis • San Francisco

10-ft leads and hardware, with current capacities of 100 to 3,000 amperes. These shunts are dipped in a special corrosion-resistant enamel and then sprayed with moisture and fungus-proof varnish.



Electric Soldering Tool

KELNOR MFG. CORP., 222 Kearny St., San Francisco, Calif. Model OS-7 precision light-weight electric soldering tool was specially designed for production lines. All nickel plated, it has a 125-watt improved heating element with simplified replacement assembly; more rugged one-piece construction to withstand hard industrial use; and improved all-ceramic insulation. Soldering temperature is reached in 48 seconds. The unit has a 3/16-in. extendable tip and weighs 10 oz. A descriptive catalog sheet and price list are available.

Audio Oscillator

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1214-A unit oscillator is a simple two-frequency oscillator (400 and 1,000 cycles) useful as a modulating source for high-fre-

We hired an engineer over Berlin

"The Boeing Flying Forts came through a wall of flak and fighters that night to hit Berlin right on the nose. They never let us down—not then or on any of the raids to come. I was proud to fly the old Boeings. Now I'm prouder still to be on the great engineering team that designs the new ones."

Boeing engineers feel that way. And they'd be honored to have you join them as they pioneer in dramatic new fields of aviation. There are excellent openings in Seattle now for experienced and junior aeronautical, mechanical, electrical, electronics, civil, acoustical, weights and tooling engineers for design and research; for servo-mechanism designers and analysts; and for physicists and mathematicians with advanced degrees. Or, if you prefer the Midwest, there are similar openings at the Boeing Wichita, Kansas, Plant. Inquiries indicating a preference for Wichita assignment will be referred to the Wichita Division.

The steady growth of Boeing's Engineering Division over the past 35 years is an index of stability. There's great work to be done in all phases of aircraft design . . . in the fascinating new field of guided missiles . . . in jet propulsion.

You'll find here some of the world's best research facilities and you'll work with men who have helped establish Boeing's world leadership in aviation research, design and engineering. You'll like the pay, too. It's good and it grows with you. Moving and travel expense allowance is provided.

Be a Boeing man. No other name in aviation will loom larger in importance during the years to come.

Write today to the address below, or use the convenient coupon.

JOHN C. SANDERS, Staff Engineer—Personnel
Dept. H-2
Boeing Airplane Company, Seattle 14, Wash.
Engineering opportunities at Boeing interest me. Please send me further information.

Name ____________________

Address ____________________

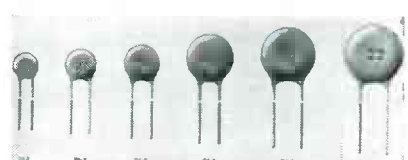
City and State ____________________

BOEING

quency oscillators as well as a general-purpose laboratory source. The 0.2-watt output, with less than 3-percent distortion, is also adequate for bridge-measurement work and many other fixed-frequency applications. The 1214-A has its own power supply built in. This was done as an economy because the iron-core tuning inductance could have an isolated output coupling coil thus allowing the type 117N7-GT diode-pentode, used as a voltage doubler, to work directly off the a-c line.

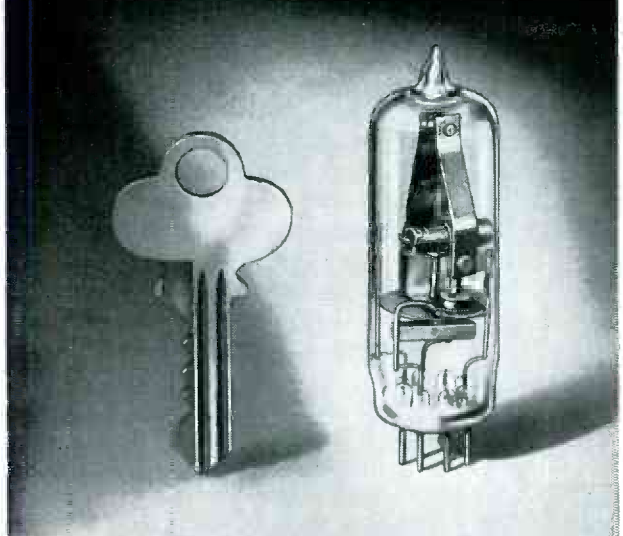
Helical Potentiometer

VAN DYKE INSTRUMENTS, INC., 1927 First Ave., South, P.O. Box 355, St. Petersburg 1, Fla., has developed the type H-50 subminiature helical potentiometer. Its resistance element, 12 in. long, is contained within a case ½ in. in diameter. The unit is primarily intended for use in precision bridge-balancing circuits and similar applications where the potentiometer is adjusted by means of an insulated screwdriver or similar adjustment tool. Power rating is 0.5 watt, continuous. Standard resistance values are 250, 500, 1,000, 2,500, 5,000, 10,000 and 25,000 ohms for 10-turn units. Standard tolerance is ±10 percent overall resistance and ±0.5 percent linearity.



Ceramic Capacitors

ELECTRICAL REACTANCE CORP., P. O. Box 493, Olean, New York, has announced two new lines of Hi-Q ceramic disk capacitors. These



SCARCELY LARGER THAN YOUR DOOR KEY

FOR . . .
Cathode Protection
Gyro Erection
Motor Starting
Integration
Holdovers
Overload Protection
Current Interruptions (Flashers)
Cycling Durations
Emergency Circuit Switchovers

Announcing

. . . a NEW Miniature by EDISON

EDISON announces its new Model 207 Miniature Thermal Relay — designed to meet the need for a space-saving time-delay relay.

Into the design and development of this sealed-in-glass miniature, EDISON has applied the experience of over 20 years in the thermal engineering field and has built into it many of the quality features of the widely-used EDISON Model 501 Thermal Relay. In numerous applications the two relays have similar operating characteristics.

Pilot production started in December 1951. For free bulletin, just clip coupon and mail.

Thomas A. Edison
INCORPORATED
Instrument Division • West Orange, N. J.

SPECIFICATIONS • MODEL 207

Sealed-in-glass
Arc quenching atmosphere
Precision timing — Final adjustment made after sealing by patented feature
Weight: ½ oz. (approx.)
Diameter: ¾" (approx.)
Height: 2¼" maximum (sealed)
Standard Heater Voltages: 115v, 27.5v, 6.3v
Contact Ratings: 2.5 amps @ 125v ac., 1.0 amp @ 125v dc.
Ambient Compensation: −60 to +85°C
Nominal Heater Input: 2 watts
Mounting: Miniature Button 7-pin
Range of Delay Periods: 5 secs. to 120 secs.

●

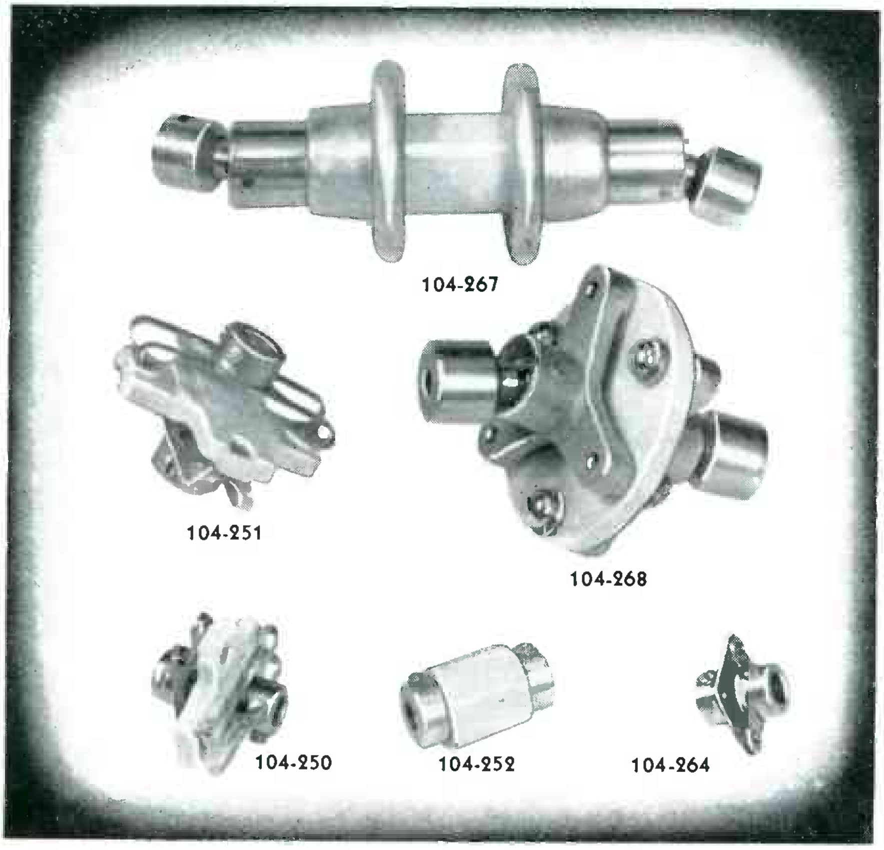
OTHER INSTRUMENT DIVISION PRODUCTS

Sealed Thermostats
Sensitive Relays
Temperature Monitors
Electrical Resistance Bulbs

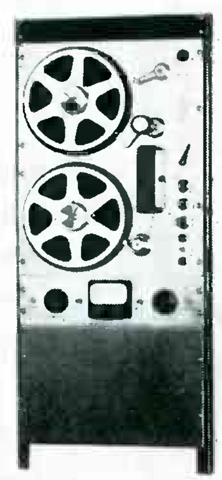
To: *Instrument Division,* THOMAS A. EDISON, INC.
63 Lakeside Avenue, West Orange, New Jersey
We may have an application for your Miniature Thermal Relay to____________________

Please send E3 bulletin to:__________
Name and title__________
Company__________
Address__________

YOU CAN ALWAYS RELY ON EDISON



temperature-compensation disk capacitors have a capacitance range of 475 μμf on the D1–6 N1400 material down to 0.3 μμf on the D1–1 size with tolerances of ±5 percent or greater. Conforming to RTMA, Class I ceramic capacitors they are conservatively rated for working voltage at 500 v d-c and flash tested at 1,500 v d-c. Extended-temperature compensating disk capacitors were developed for applications requiring a very large gradient of capacitance versus temperature. They exhibit relatively higher dielectric constants permitting capacitances in the range intermediate between the high K and linear or normal group of ceramics. The Q (a minimum of 250 at 1 mc) is somewhat lower than the Class 1 ceramics.



Magnetic Tape Recorder

AMPEX ELECTRIC CORP., Redwood City, Calif. Model 307 magnetic tape recorder, especially designed for recording signals telemetered from aircraft and missiles, is the second of a line of special recorders designed for recording original telemetered data. It has a frequency range of from 100 to 100,000 cps, thereby permitting the recording of all f-m/f-m telemetering channels recommended by the Telemetering Panel of Research and Development Board. The recorder is designed for three tape speeds: 60, 30 and 15 inches per second. The extended frequency range of the unit makes it useful for recording many types of data which previously could be recorded only by

NEW! Synchronous Motor Driven SINGLE CAM and MULTI-CAM RECYCLING TIMERS

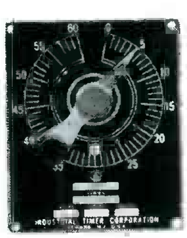
The new Industrial Cam Recycling Timer continuously repeats a constant cycle consisting of definite ON and OFF periods which can be adjusted from 2% to 98% of the cycle. By means of percentage calibrations on the cam face any desired setting is quickly and accurately obtained. The time cycle itself can also be changed easily by substituting simple gear-rack assemblies. Thus, from one timer, by using different gear racks you can obtain 50 different cycles ranging from the lowest cycle of the timer up to nine times that cycle. The snap action switch operated by the timer is a single pole double throw, totally enclosed 10 ampere type. We can supply 500 different time cycles in this model ranging from one revolution in 15 seconds to one revolution in 72 hours.

The Multi-Cam Recycling Timer is identical to the Single Cam Timer but operates from 2 to 6 circuits and incorporates several additional features. On this timer all cams are mounted on a single driving shaft which assures a common time cycle for all circuits. Each cam, however, is independently adjustable for a specific timing sequence. This is accomplished by actually rotating the cam with finger pressure using the drum calibrations for guidance. Thus a range of timing sequences from 0% to 100% is obtainable on each circuit with ease. The elimination of cam followers and other types of moving parts makes possible this compact unit. 11 models are available with time cycles ranging from one revolution in 1 minute to one revolution in 72 hours.

REMOTE CONTROL FOR SINGLE CYCLE OPERATION AVAILABLE.

Send today for complete details—or, if you would like to send us specifications, we shall be glad to make recommendations based on your particular needs.

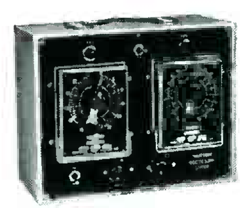
Manufacturers of These and Other Timers and Controls for Industry



TIME DELAY TIMERS

INSTANTANEOUS RESET TIMERS

MANUAL SET TIMERS



TANDEM AUTOMATIC RECYCLING TIMERS

RUNNING TIME METERS

Timers that Control the Pulse Beat of Industry

INDUSTRIAL TIMER CORPORATION

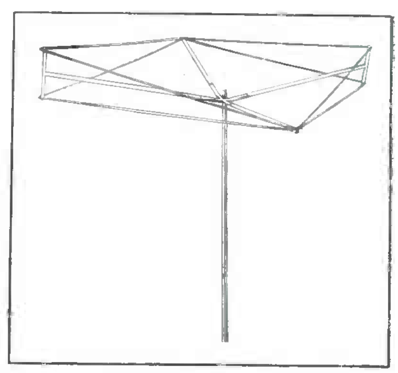
INDUSTRIAL TIMER CORPORATION

115 EDISON PLACE, NEWARK 5, N. J.

means of a cro and moving film camera.

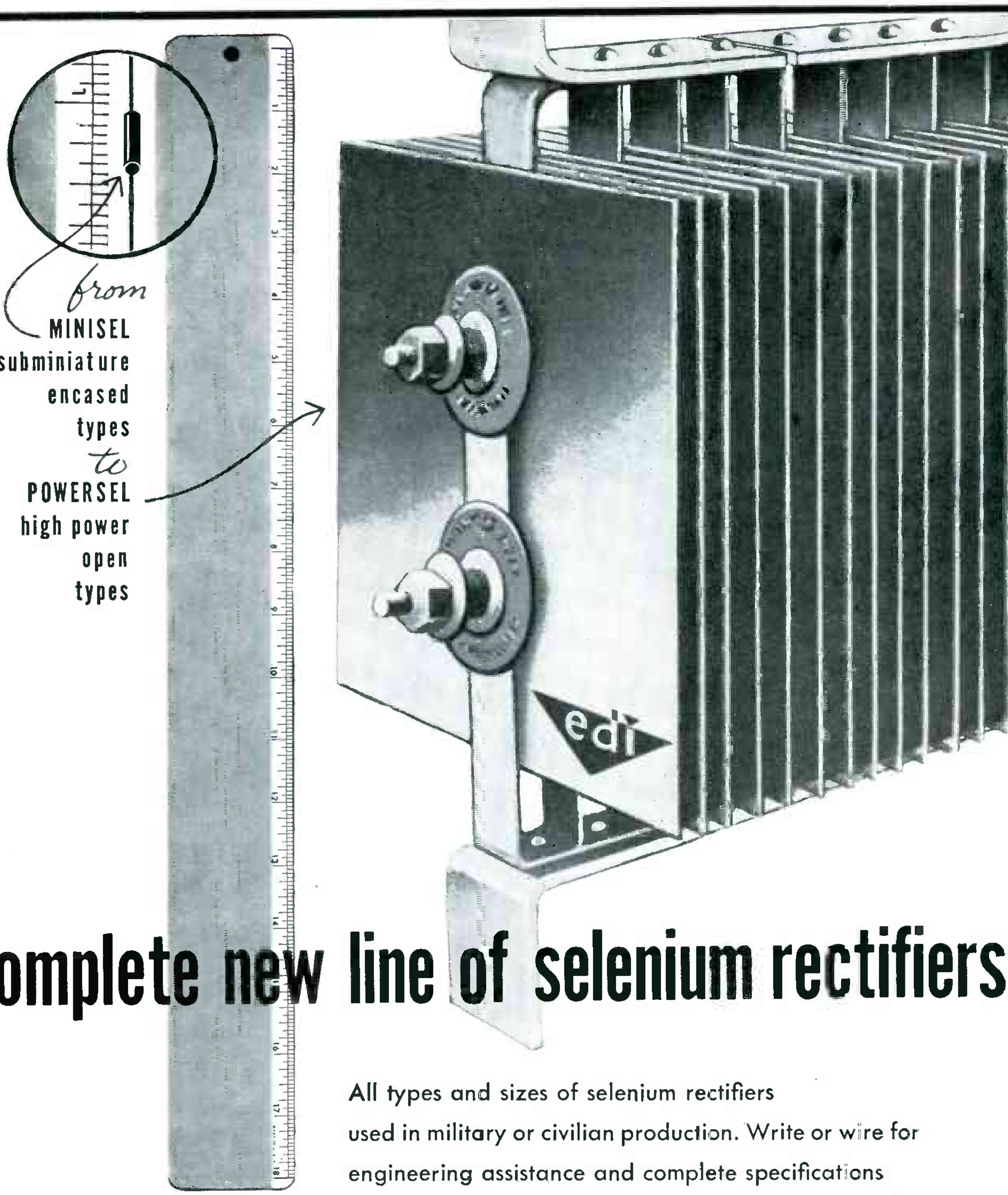
Industrial Gamma Tube

TRACERLAB, INC., 130 High St., Boston 10, Mass., has developed a rugged stainless steel tube especially designed for industrial process control procedures using gamma rays and for cosmic ray counting. Features of the TGC-16 industrial gamma tube include the complete absence of any flanges, bases and base pins making it particularly adaptable for a wide variety of uses, a wall thickness of approximately 400 mg per cm^2, life greater than 2×10^8 counts, a starting potential of 870–930 volts, and a minimum plateau length of 200 volts with a slope of approximately 1 percent per 100 v. The fill gas used is helium with an organic quench and the tube has a recovery time of approximately 200 μsec. Overall dimensions of the standard tube are 15¼ in. × 1 in. o.d.



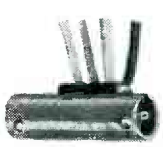
Super Rhombic Antenna

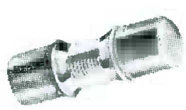
DAVIS ELECTRONICS, 3047 W. Olympic Blvd., Los Angeles, Calif. The aluminum alloy Super Rhombic antenna is designed to eliminate stacked arrays and overcome the

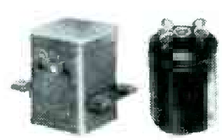


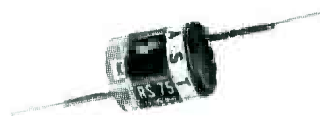
a complete new line of selenium rectifiers

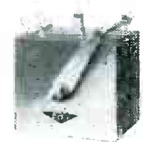
All types and sizes of selenium rectifiers used in military or civilian production. Write or wire for engineering assistance and complete specifications on your individual rectifier problems. No cost or obligation.


MINISEL
Phenolic
Cartridge Type


MINISEL
Sealed-in-Glass
Fuse Type


MINISEL
Hermetically Sealed
Metal Type


PLASTISEL
Molded-In
Electronic Type


POWERSEL
High Power Type
Rectifier

edi PRECISION RECTIFIERS

ELECTRONIC DEVICES, INC.

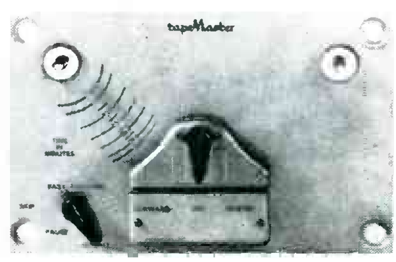
PRECISION RECTIFIER DIVISION

429 12th STREET • BROOKLYN 15, NEW YORK

problems of fringe and ghost area reception. The antenna gives all-channel coverage with a gain of over 12 db. It has a tilt of 15 degrees, directivity of 12 degrees. Construction permits use of common lead-ins without a matching transformer. Shipped preassembled, the light-weight antenna may be installed in a matter of minutes.

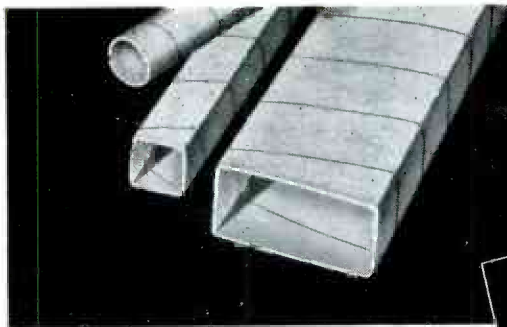
Base Loading Coils

MALLARD MFG. CO., 6025 N. Keystone Ave., Chicago 30, Ill., has introduced loading coils for mobile antennas available in two models, for 20 and 75-meter operation, and designed to fit all standard mounts and whips. With the adaptor supplied they can be used with non-standard types. The Hi-Q 20 loading coil is wound with heavy plated $\frac{1}{8}$-in. diameter solid copper wire. The Hi-Q 75 features two pie-wound coils of heavy insulated wire adjustable for maximum efficiency over a powdered iron core slug. Coils are treated with Insulex to resist moisture and fungus growth and to maintain high Q.

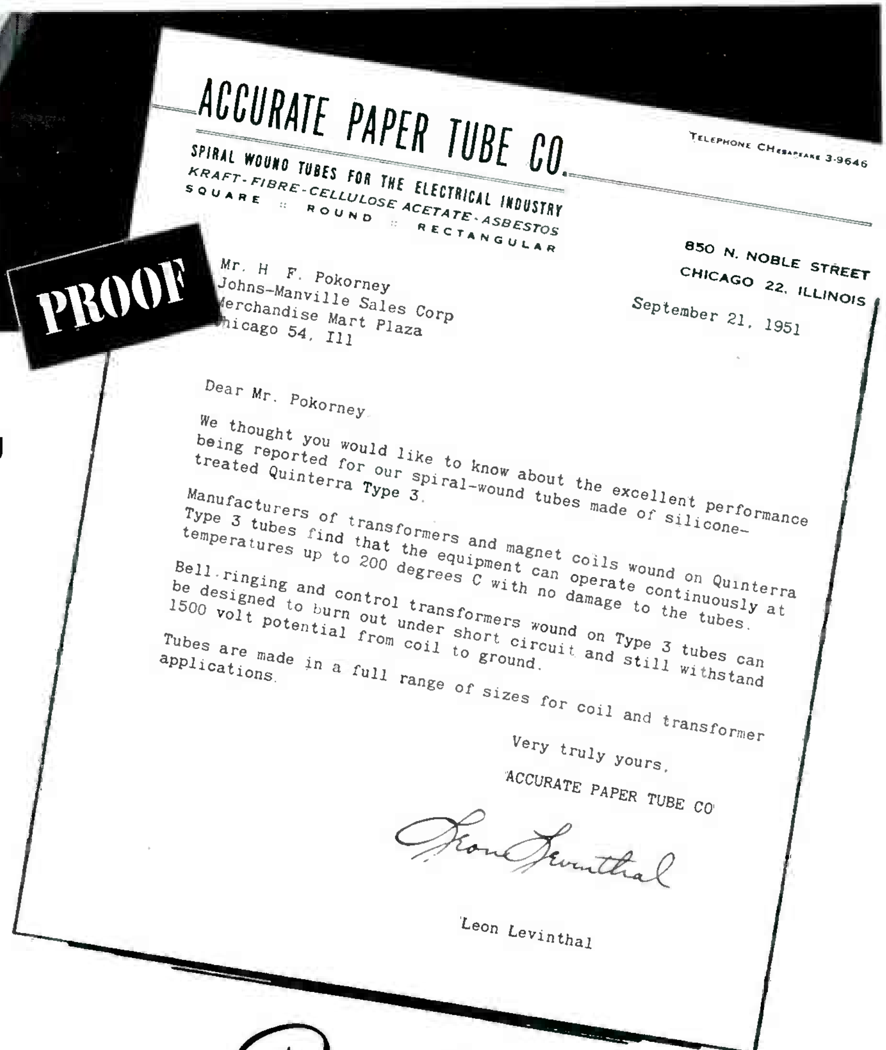


Tape Transport Mechanism & Preamp

TAPE MASTER, INC., 13 W. Hubbard St., Chicago 10, Ill., has announced model TH21 tape transport mech-



Tubes made by Accurate Paper Tube Company using Quinterra Type 3.



ACCURATE PAPER TUBE CO.

SPIRAL WOUND TUBES FOR THE ELECTRICAL INDUSTRY
KRAFT-FIBRE-CELLULOSE ACETATE-ASBESTOS
SQUARE :: ROUND :: RECTANGULAR

TELEPHONE CHESAPEAKE 3-9646

850 N. NOBLE STREET
CHICAGO 22, ILLINOIS

September 21, 1951

Mr. H F. Pokorney
Johns-Manville Sales Corp
Merchandise Mart Plaza
Chicago 54, Ill

Dear Mr. Pokorney

We thought you would like to know about the excellent performance being reported for our spiral-wound tubes made of silicone-treated Quinterra Type 3.

Manufacturers of transformers and magnet coils wound on Quinterra Type 3 tubes find that the equipment can operate continuously at temperatures up to 200 degrees C with no damage to the tubes.

Bell ringing and control transformers wound on Type 3 tubes can be designed to burn out under short circuit and still withstand 1500 volt potential from coil to ground.

Tubes are made in a full range of sizes for coil and transformer applications.

Very truly yours,

ACCURATE PAPER TUBE CO

Leon Levinthal

Leon Levinthal

HERE'S PROOF THAT YOU CAN MAKE INDUCTION EQUIPMENT

Safer... Smaller... at Lower Cost...

with silicone-treated *Quinterra** TYPE 3

(A purified Asbestos Class H sheet insulation)

TRANSFORMER WITH CONVENTIONAL INSULATION

TRANSFORMER WITH SILICONE-TREATED QUINTERRA TYPE 3 INSULATION

Photograph above shows two signal corps transformers having same rated output—illustrating savings in space and materials made possible by use of silicone-treated Quinterra.

(Photo — Courtesy Chicago Transformer Division, Essex Wire Corporation.)

As the above letter from the Accurate Paper Tube Company testifies, users of this newest Johns-Manville electrical insulation find that it raises overload limits and assures greater safety.

And as you can see from the photograph at left, Quinterra Type 3 also permits important savings in both space and materials . . . a fact substantiated by leading manufacturers of quality transformers.

You can not only improve your induction devices with Quinterra Type 3 . . . but you can also reduce the total cost of production because rejections will be minimized.

Silicone-treated Quinterra Type 3 is a high grade Class H dielectric . . . ideal for both interlayer and wire-wrapping insulation as well as the formation of tubes. It has outstanding moisture resistance, high temperature stability, and electrical characteristics—plus flexibility and adequate physical strength for many applications.

Quinterra Type 3, like all treated Quinterras, is made from a completely inorganic base sheet of purified asbestos that has a hole-free closed structure. This sheet has an inherent dielectric strength of at least 200 VPM which is retained even under temperature of 400 C. The silicone-treated sheet maintains a dielectric strength of at least 225 VPM under continuous exposure to temperatures in excess of the Class H maximum, 180 C.

If you have a problem that Quinterra Type 3 may solve, why not consult our sales engineers—without obligation? For samples and additional information, write Johns-Manville, Box 290, N.Y. 16, N.Y.

*Quinterra is the registered trade mark of Johns-Manville's purified asbestos electrical insulation.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville ELECTRICAL INSULATIONS

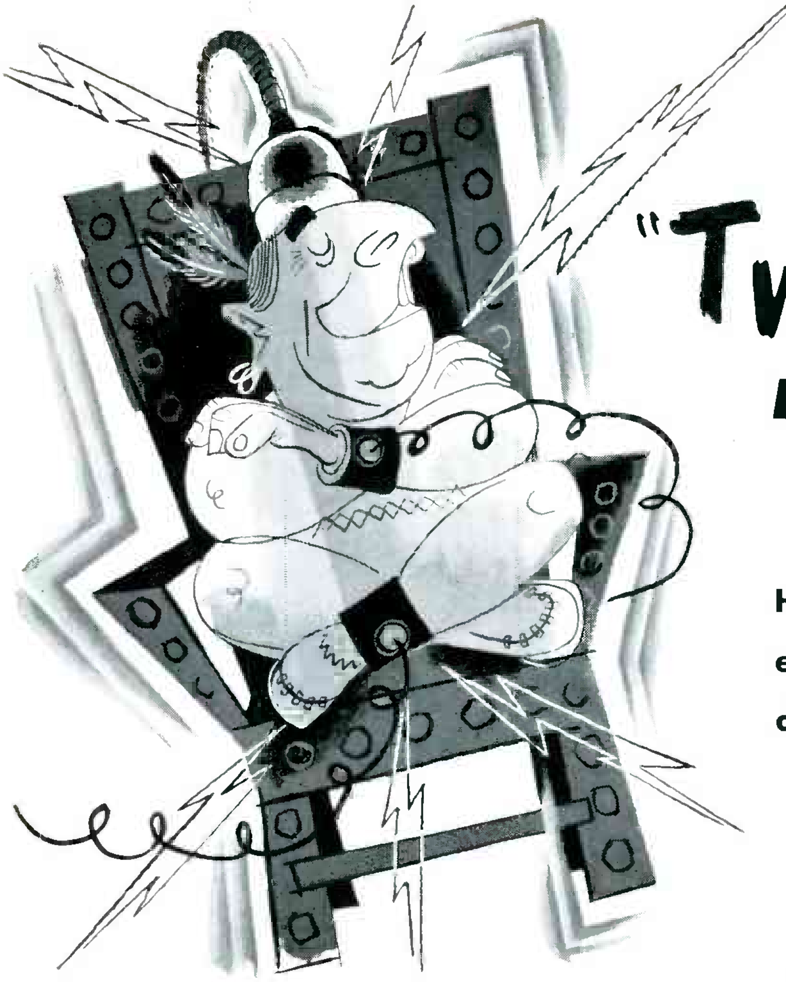
anism and a matching preamp-bias erase oscillator. The mechanism illustrated operates at a tape speed of 7½ in. per sec and incorporates both fast forward and fast rewind, single switch control, an oversized motor and practically vibrationless operation. The model PA-1 preamp unit is fully wired and incorporates a push-pull bias-erase oscillator, full monitoring, inputs for both radio phono and microphone, outlets for amplifier and headphones, complete master switching and neon recording level indicator. Combination of both units with any high grade audio amplifier makes a complete high-fidelity tape recording and playback system. Net price for both is $81.50.

Resin Core Solder

KESTER SOLDER Co., 4201 Wrightwood Ave., Chicago 39, Ill., has announced a new and highly active resin flux known as "44" resin. The solder melts, wets the metal and flows or spreads all in one instantaneous action with such speed that it is impossible to distinguish the separate actions. The solder is noncorrosive and electrically nonconductive. It conforms with Army-Navy-Air Force specifications MIL-S-6872 (AN-S-62) and the extremely rigid USAF specification No. 41065-B Method 31, also Federal specification QQ-S-571b. For complete information write for bulletin 444.

Extra-Thin High-Heat Insulation

IRVINGTON VARNISH & INSULATOR Co., 6 Argyle Terrace, Irvington 11,



Sangamo "Twist-Tabs"*

never flinch in a hot seat!

High surge voltages and extreme ripple currents don't faze them . . .

***Type PL Electrolytic Capacitors**

Sangamo "Twist-Tab" (Type PL) Electrolytic Capacitors are designed particularly for all television and electronic applications that demand long life and dependable performance at 85° C under conditions involving extreme ripple currents and high surge voltages.

These quality components are sealed in round aluminum cans and have twist prong tabs for washer or direct chassis mounting. All connections from the capacitor are securely fastened to the terminal lugs, providing permanent low resistance connections. The aluminum cans are negative, and the mounting ring provides the negative connection.

Sangamo "Twist-Tabs" offer a selection from the largest listing of capacities and voltages available from any single source. Write for full information.

Your Assurance of Dependable Performance

SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

The SANGAMO Tribe

PAPER · MICA · SILVER · ELECTROLYTIC CAPACITORS

IN CANADA: SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO

SC52-1

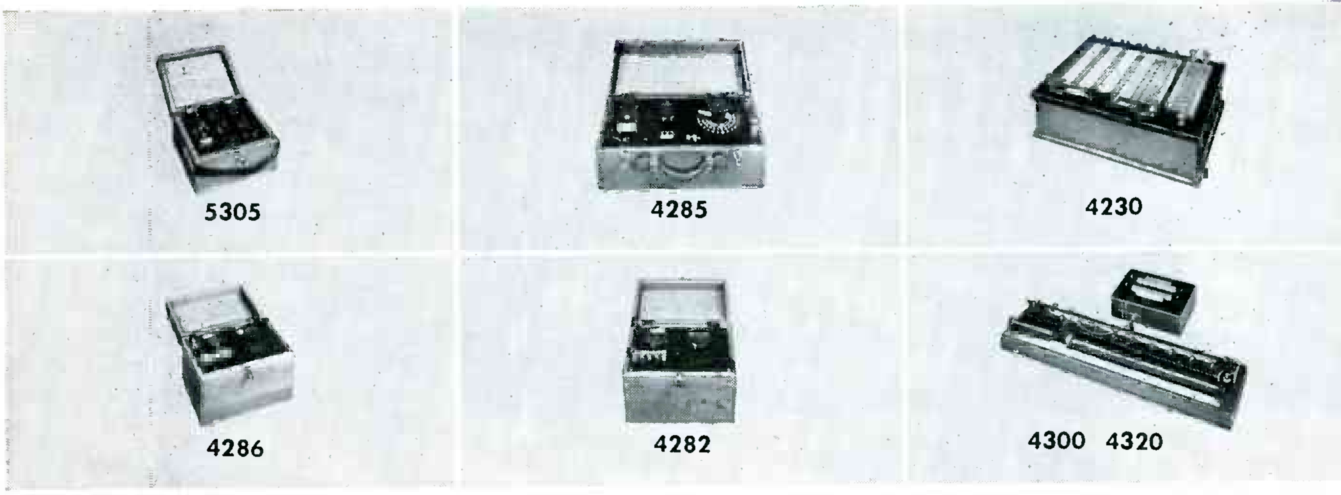
N. J., has available a new insulation known as Silicone-resin-coated Novabestos. Although but 0.003 in. thick, it can be used at operating temperatures of 180 C. It is composed of 97-percent-pure asbestos and 3 percent organic material. The long fiber construction of this base asbestos sheet also gives it unusual physical properties for such a thin material.

High-Voltage Probe

PRECISE DEVELOPMENT CORP., Oceanside, L. I., N. Y. Model 999 high-voltage probe has multiple insulation: two areas of air insulation, plastic inside insulation and an outside plastic insulation which protects against voltage breakdown. Tips are interchangeable and include an alligator clip plus the conventional probing type. The probe also has interchangeable resistors for use with any vtvm or 20,000 ohms-per-volt meter. Price is $6.98.

TV Receiver Tube

GENERAL ELECTRIC CO., Schenectady 5, N. Y., has developed type 6BK7 low-cost miniature tv receiver tube designed to reduce snow in fringe



For D-C Resistance Measurements...

check this complete L&N line

Wheatstone Bridges

Model	List No.	Limits of error	Ratio Arms	Comparison Standard
Anthony Pattern for laboratory standard	DM-4230	±0.03%	Two sets of 1, 10, 100, 1000, 10,000 Ω†	0 to 11,111 Ω†
Open Dial Switch for high precision	DM-4725	±0.06%	Two sets of 1, 10, 100, 1000, 10,000 Ω†	0 to 10,000 Ω‡
Enclosed Switch for moderate precision	DM-4760	±0.15%	Seven settings, 0.001, 0.01, 0.1, 1, 10, 100, 1000	0 to 9,999 Ω
Post Office Pattern for student instruction	DM-4250	±0.15%	Each have four resistors, 1, 10, 100, 1000 Ω†	0 to 11,110 Ω†
Type S-1 Test Set for resistance measurement and fault location	DM-5300*	±0.15%	Seven settings, 0.001, 0.01, 0.1, 1, 10, 100, 1000 Has provision for Murry and Varley Loop Tests‡	9(1+10+100+1000) Ω‡
Type S-2 Test Set for resistance measurement	DM-5305*	±0.15%	Seven settings, 0.001, 0.01, 0.1, 1, 10, 100, 1000	9(1+10+100+1000) Ω‡
Ohmmeter for rapid routine testing	DM-4282*	± 1%	Slidewire approximately 12" long, calibrated 0 to infinity. Continuously adjustable	1, 10, 100, 1000, 10,000 Ω†
Per Cent Limit for fast resistor inspection	DM-4270	±0.5 %	0 to ±15%	Uses external standard resistor
Type U Test Set for locating cable faults	DM-5430A*	±0.15%	Eight settings, 1/1000, 1/100, 1/10, 1/9, 1/4, 1/1, 10/1, 100/1. Has provision for Murry and Varley Loop Tests‡	Four decades 10(1+10+100)+9 x 1000 Ω† infinity

* Portable self-contained unit, includes battery and galvanometers. † Plug and block connectors. ‡ Rotary switches.

Kelvin Bridges

Model	List No.	Limits of error	Ratio Arms	Comparison Standard	Range
Precision for precise measurement	DM-4320 DM-4300	±0.05%	Two sets of 100, 300, 400, 1000 and 10,000 Ω.	Nine fixed resistors, each 0.001 Ω and 0.001 Ω graduated bar having 110 div.	0.01μ Ω to 1 Ω
General Purpose for moderate precision	DM-4306	±0.1%	Seven settings: 0.1, 0.2, 0.5, 1, 2, 5, 10.	Nine fixed sections and a divided bar, each 0.01 Ω. Scale has 100 div.	0.00001 Ω to 1 Ω
Student's for teaching	DM-4340	±0.7%	Three Settings: 0.1, 1, 10.	Bar, total resistance 0.01 Ω. Scale has 100 divisions.	0.00001 Ω to 0.1 Ω
Portable for moderate precision	DM-4285*	±0.25%	Adjustable slidewires, 1.5 to 2.66 and 1 to 1.6	Dial switch, 0.0001, 0.0002, 0.0005 etc. up to 10 Ω.	0.0001 Ω to 26.6 Ω
Ohmmeter for routine testing	DM-4286*	±2%	Adjustable slidewires: 0.01 to 0.11	Plug switch 0.01, 0.1, 1, 10, 100	0.0001 to 11 Ω
Hoopes Conductivity for production testing conductor wire	DM-4870	±0.2%	Adjustable slidewires to compensate for sample weight.	4872 Copper Std. calibrated to International Annealed Copper Std. Gauge nos. 21, 18, 15, 12, 9, 6, 3, or 0 as specified.	0 to 105% conductivity

*Self contained

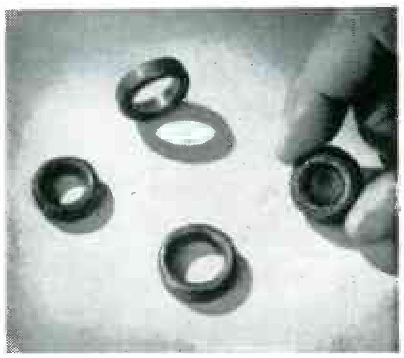
For more information, send for Catalog E-33, D-C Resistance Measurements.

LEEDS & NORTHRUP COMPANY

4979 STENTON AVENUE, PHILADELPHIA 44, PA.

Jrl. Ad EF2(2)

area reception. Noise factor is 7 db as a cascode amplifier at 216 mc. Intended primarily for cascode service in vhf reception, it may also be used as a low-noise first-intermediate-frequency amplifier in uhf. Typical operating conditions include: plate supply voltage, 150 v; cathode bias resistor, 56 ohms; amplification factor, 40; plate resistance, 4,700 ohms; transconductance, 8,500 μmhos; plate current, 18 ma.



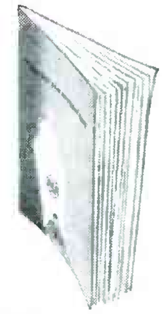
Toroidal Cores

LENKURT ELECTRIC CO., 1113 County Road, San Carlos, Calif., is now producing moulded powdered-iron toroids in a size range extending from 0.800 to 3.375 in. outside diameters. Included is the wedding-ring type, the smaller size illustrated. These are available in magnetic materials which can be chosen to accentuate high-Q, high inductance, low generation of harmonic distortion products, high magnetic and temperature stability, or small size and low cost. The same cores are also supplied wound to individual specifications, cased, uncased, or hermetically sealed.

Regulated Power Supply

KEPCO LABORATORIES, INC., 149-14 41st Ave., Flushing, N. Y. Model 1020 high-voltage-regulated power

Help to Engineers



who are concerned with the future of their careers

ARE YOU IN A "DEAD END" JOB with no chance to move forward?

Would you like work that challenges your creative thinking and skills?

Is your present position limiting your opportunity for the complete expression of your talents in electronics?

Do you and your family worry about your career, or where you live now, or about security and your future?

If the answer is "yes" to one or more of these questions—then you should send for a *free* copy of RCA's new booklet CHALLENGE AND OPPORTUNITY, *The Role of the Engineer in RCA.*

This 36-page, illustrated booklet, just off the press, will show you the splendid opportunities offered by RCA to put your career on the upswing. See how, as part of the RCA team, daily contact with the best minds in various fields of electronics, and with world-renowned specialists will stimulate your creative thinking.

For graduate engineers who can see the challenge of the future, RCA offers opportunities for achievement and advancement that are legion. Send for a copy of CHALLENGE AND OPPORTUNITY, *The Role of the Engineer in RCA.* It is yours *free* for the asking.

To Qualified Engineers:

If you qualify for any of the positions listed below, write us for a personal interview—include a complete résumé of your education and experience. Write to address in coupon.

RADIO CORPORATION of AMERICA

POSITIONS OPEN IN THE FOLLOWING FIELDS:

- *Television Development*
- *Electron Tube Development*
- *Transformer and Coil Design*
- *Communications*
- *Radar—Missile Guidance*
- *Computer Development and Design*
- *Navigational Aids*
- *Technical Sales*
- *Electronic Equipment Field Service*

MAIL COUPON NOW!

MR. ROBERT E. McQUISTON, Manager
Specialized Employment Division, Dept. 46B.
Radio Corporation of America
30 Rockefeller Plaza, New York 20, N. Y.

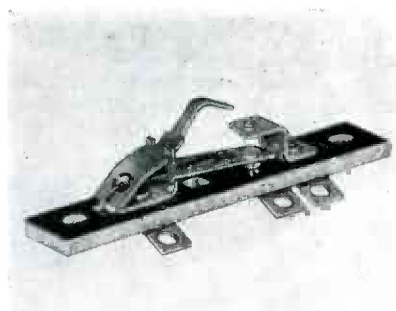
Without obligation on my part, please send me a free copy of CHALLENGE AND OPPORTUNITY

Name ____________________

Address ____________________

City ____________ State ____________

List degree or degrees ____________________ supply is continuously variable from 0 to 1,000 v and delivers from 0 to 50 ma. In the 100 to 1,000-volt range the output voltage variation is less than 0.1 percent both for line fluctuations from 105 to 125 v and load variation from minimum to maximum current. In the 30 to 100-v range output voltage variation is less than 0.5 percent for both. Ripple is less than 10 mv. There is included a 6.3-volt, 10-ampere a-c output. The unit measures 10½ in. high × 19 in. wide × 13 in. deep and weighs 66 lb.



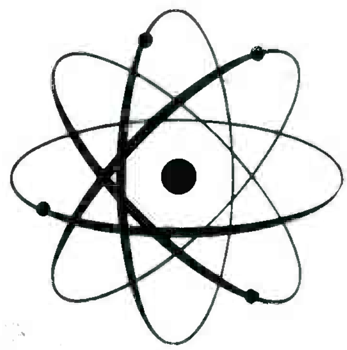
Snap-Action Switches

CHERRY-CHANNER CORP., 1488 Skokie Blvd., Highland Park, Ill., has developed two new standard model snap-action switches. The switches are mounted on Bakelite panels; bracket and actuator materials are brass; blades are phosphor bronze and contacts are of fine silver. Type 2000 has a release force of 5.5 oz and requires an operating force of 7.5 oz. Type 2001 has a release force of 2.7 oz and requires an operating force of 4 oz. Both are Underwriters' Laboratories inspected and have ratings of 6 amperes, 125 volts a-c and 3 amperes, 250 volts a-c.

Power Supply

WESTINGHOUSE ELECTRIC CORP., 306 Fourth Ave., Pittsburgh 30, Pa. Need for an adjustable source of power up to 5 kw and at any frequency up to about 10,000 cycles can now be satisfied electronically. A new power amplifier for any of the audio frequencies below 1,000 cycles takes a signal of about 0.01 watt from any conventional source and builds it up to 5 kw. The power supply uses aircooled apparatus (a WL 5736 power tube) and a Rectox

R.F. INTERFERENCE FILTERS



- Facilities Available Immediately
- R.F. Ranges to 1000 megacycles
- Manufactured to SPECIFIC Requirements
- Conformity to Military Specifications
- Experienced Electronic Engineers
- Completely Equipped Laboratories

Send your blueprints or engineering specifications today for immediate action:

Air Associates
INCORPORATED
TETERBORO, NEW JERSEY

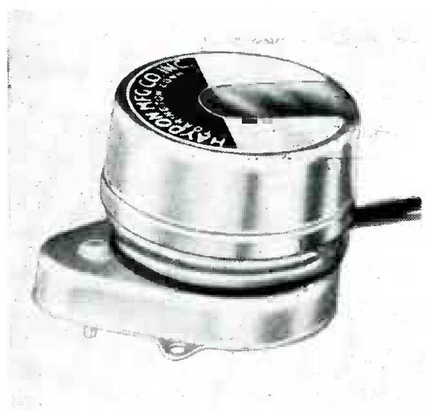
AIR INC. ASSOCIATES

ELECTRONIC PRODUCTS DIVISION 513 JOYCE STREET ORANGE, N. J.

rectifier for the high-voltage element. Such power supplies are useful in laboratories, in connection with vibration studies, and in many industrial processes.

Distribution Amplifier

BLONDER-TONGUE LABORATORIES, 38 North 2nd Ave., Mount Vernon, N. Y. The DA8-1-M 8-outlet all-channel distribution amplifier for master antenna systems has 4 tv set outlets on the front, and 4 on the rear of the unit. The simple screw-type terminals will handle both 75 and 300-ohm line. Matching transformers are built in. Need for special connectors, individual channel equipment and engineering services has been eliminated. Any required number of DA8-1-M units can be connected together to form a system to supply up to 2,000 tv sets. List price is $87.50.



Timing Motor

HAYDEN MFG. CO., INC., 2433 Elm St., Torrington, Conn., has developed a new 400-cycle timing motor for use as time standard in applications involving relatively light loads. This hysteresis-type synchronous timing motor is designed for use either as a separate component or in a variety of types of standard timers. At any given frequency control it is better than with comparable d-c motors because variations in temperature, supply voltage and load, within the operational limits of the motor, do not affect timing. Full technical data may be found in Engineering Bulletin No. 2.

Deflection Yokes

STANDARD TRANSFORMER CORP., 3580 Elston Ave., Chicago, Ill. Two new deflection yokes with cosine distributed windings designed to provide antiastigmatic focusing over the entire tv tube picture area have been announced. The DY-8 and DY-9, latest components in the company's tv replacement line, are both 70 deg, ferrite core deflection yokes with coils wound on nylon bobbins. Type DY-8 has a horizontal inductance of 8.5 mh and DY-9 has a horizontal inductance of 13.5 mh. Each is priced at $10.75. Bulletin 387 describes both in detail.

Test Leads

INSULINE CORP. OF AMERICA, 3602–35th Ave., Long Island City 1, N. Y., has brought out a pair of extra-long-handled test leads designed

steatite, ceramic & lava insulators

for electrical and electronic applications

Custom-molded, extruded or machined to close tolerances to meet your exact specifications. Prompt delivery at low cost on large or small orders. Over half a century of service is your guarantee of complete satisfaction.

FIND OUT TODAY. Illustrated bulletin with complete technical data will be sent on request.

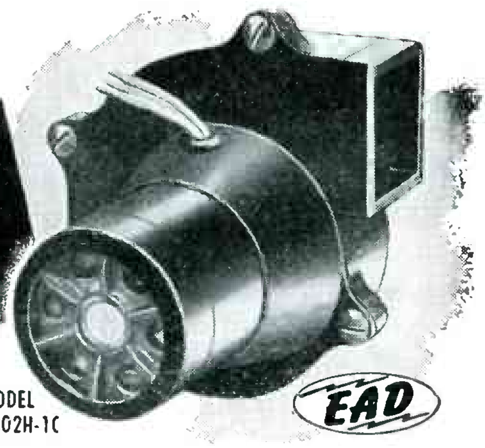
M. KIRCHBERGER & COMPANY, INC.

Established 1890

1423 37th St., Brooklyn 18, New York • GEdney 6-1144

West Coast Representative:
S. Siegel, 1145 So. La Cienaga Blvd., Los Angeles 35, Calif.

Variable Frequency CENTRIFUGAL BLOWER



MODEL
B302H-1C

with **PERFORMANCE** that far **EXCEEDS** its **SIZE & WEIGHT**

For aircraft or other confined area installations where weight and size are critical. Large cooling capacity — precision balanced for smooth operation at the higher frequencies.

SPECIFICATIONS

115 volts AC variable frequency • 320—1000 cycles • 1.4 amps. • 1.5 mfd. • 40 CFM minimum at 0" static pressure • overall dim. 4⅜" x 4-13/64" • weight 25 oz. • Fungus proof • Silicon impregnated.

Other models available for greater air delivery. 60 cycle, 400 cycle variable frequency.

EASTERN AIR DEVICES, INC.

585 DEAN STREET • BROOKLYN 17, N. Y.

"HOLY MOSES...

there's something I never knew before!"

F-11A

Unless you're exceptionally well-informed there are probably lots of things YOU never knew before right here in the advertising pages of this magazine. Alert manufacturers use these advertising pages to get the *news* about their products and services to you . . . quickly and effectively. Their advertisements contain information designed to help *you* do your job better, quicker and cheaper. To be well-informed about the latest developments in *your* industry . . . and to stay well-informed . . . *read all the ads too.*

McGRAW-HILL PUBLICATIONS

HEADQUARTERS FOR INDUSTRIAL INFORMATION

to speed up and simplify circuit probing in complicated radio and tv chassis. Eight inches long and made of polished hard rubber, the handles are fitted with short, sharp-pointed tips which minimize the possibility of short-circuiting of adjacent connectons. The flexible leads are of kinkless wire 48 in. long, have standard phone tips on their ends and can be used with practically all types of test instruments. List price is $5.00.

Literature

Components Guide. Hudson Radio & Television Corp., 48 W. 48th St., New York 19, N. Y., has prepared a JAN cross-reference guide showing joint Army-Navy components and their commercial equivalents and also commercial-to-commercial equivalents. Listing thousands of items, it is expected to save purchasing agents and engineers hours of searching through individual catalogs for critically needed parts and supplies. The guide will be kept up-to-date by the publication of supplementary charts. Copies of the guide are available to persons writing on company stationery.

Servo Amplifier System. Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. Instrumentation data sheet 10.20-4 describes and illustrates the new high-gain type 40X servo amplifier system that produces motor drive from signals as low as 0.05 μv. The application, operation and special design considerations of the new amplifier are discussed. Photographic and schematic illustrations are included.

Bridging Amplifier. Keithley Instruments, 3868 Carnegie Ave., Cleveland 15, Ohio, has released a 4-page bulletin describing the model 102 Phantom Repeater. The instrument discussed is a bridging amplifier with an extremely high input impedance and is used to increase the accuracy of vtvms and oscilloscopes on high impedance circuits. The bulletin lists complete specifications and includes diagrams of typical applications such as simultaneous measurements of voltage, shape inspection and aural monitoring with negligible loading of test circuits.

Steatite Ceramics. Stupakoff Ceramic and Mfg. Co., Latrobe, Pa., recently published the 52-page catalog No. 951 on steatite ceramic products. Included in the brochure are drawings and dimensions of principal steatite products such as tubing, coil forms, standoffs, strains, assemblies, appliance parts, bushings and a variety of others. More than 500 parts are cataloged and photographs illustrate many of them. A special feature of the catalog is a chart that shows 18 technical characteristics of 14 of the company's typical ceramic products. Also included is a nine-page section devoted to the general standards for steatites and other electronic grade ceramics as adopted by Steatite Research Council.

Reliable Subminiatures. Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass., has issued a 22-page booklet on its line of reliable cathode-type subminiature tubes. Five types are shown, with application notes, complete description, mechanical and electrical data, characteristics and typical operation. Information concerning quality tests on reliable types is shown.

Technical Manual File. Grant-Jacoby Studios, 936 N. Michigan Ave., Chicago 11, Ill., has available for the asking a technical manual file. Developed primarily to aid prime contractors with technical manual procedure problems the file contains essential information on government and commercial technical manual preparation and cost procedures. A sample cost estimate form is included.

TV Control Replacement. Clarostat Mfg. Co., Inc., Dover, N. H., issued a manual in the Spring of '51 listing 343 set listings covering nearly 1,500 tv models, 105 standard controls with 5,705 applications and 222 RTV or exactduplicate controls with 3,451 applications. The new supplement will give a continuation of RTV numbers listing the manufacturer's part that they are used to replace. It lists by receiver manufacturer the frequency of use of the various controls.

Line Loss Chart. Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif., has announced chart 101, a new wall chart of impedance mismatch and line loss versus line impedance and line length. Available free to sound specialists and audio installation engineers, it shows a comparison between the losses to be expected from long loudspeaker lines at voice coil impedances using various sized wires, and the commonly used higher impedance lines using conventional 18 gage wire.

Detector Comparator. Menlo Research Laboratory, Box 522, Menlo Park, Calif. A four-page brochure describes the various features and models of the Fluoretor, a portable single-unit ultraviolet generator, fluorescence tester and comparator combined. Specifications list the materials and exclusive design details that permit the unit to be used in broad daylight. Four types are cataloged. Also included is a full listing and description of the six sample holders and the Neoprene cone viewing accessory which makes possible the viewing of large surfaces with daylight excluded. Details are given on registration, guarantees and operating costs.

Varnished Insulation. Electro-Technical Products Division of Sun Chemical Corp., 113 East Centre St., Nutley 10, N. J., has available a booklet made up of data sheets dealing with varnished insulation for the electrical industry. Included are a classification, temperature limitations, and technical descriptions for a wide variety of insulating materials.

Crystal Sockets. E. F. Johnson Co., Waseca, Minn. A single-page bulletin covers three types of crystal sockets—the 126–105–1, designed for the HC-6/U crystal holder; the 122–223–2, for use with

HC-5/U crystal holder; and the 126–120–1 multiple crystal holder that accommodates up to ten FT-243 crystals. Descriptions and dimensional drawings are given.

Oscillographs and Amplifiers. Rahm Instruments Inc., 12 West Broadway, New York 7, N. Y. Bulletin R1052 gives illustrations, applications and structural and performance characteristics of the type RO recorders and type OB amplifiers. The direct recording oscillographs and associated amplifiers described are designed to provide the optimum in linearity and frequency response characteristics while maintaining versatility of application and structural ruggedness.

Crystal Manufacture. The James Knights Co., Sandwich, Ill., has available a one-hour color film showing the step-by-step manufacture of crystals. The 16-mm silent motion picture film records in dramatic detail the processing of crystals from raw quartz through x-raying, testing, mounting and calibrating to bring them up to final precision standards. The film may be obtained by interested groups and associations.

Step-Motor Impulse Counter. General Electric Co., Schenectady 5, N. Y. The single-page bulletin GEC-829 gives an illustrated description of a new step-motor impulse counter for counting at intermediate rates. The unit discussed provides accurate counting from 0 to 60 counts per second and is especially useful in radiation counting. Chief features and technical specifications are included.

Solder Seal Bushings. T. C. Wheaton Co., Millville, N. J., has published a single-sheet bulletin illustrating and describing its 1300 series of Tronex-solder seal terminals. In addition to the latest specifications applicable to the 1300 series, the leaflet contains many valuable suggestions and recommendations on the use of metallized glass type, soldered seal terminals.

Instruments Catalog. Kay Electric Co., 14 Maple Ave., Pine Brook, N. J. The new and revised illus-

trated catalog B-51-52 includes in its table of contents: ordering information; price list and index; high-frequency test equipment; speech, subaudio and audio-frequency analysis equipment; industrial instruments; production and service test equipment; and several pages of accessories and components. Also shown is a lineup of engineering representatives with their addresses.

Steatite Standoff Insulators. Thor Ceramics, Inc., 225 Belleville Ave., Bloomfield, N. J. A complete line of standard steatite standoff insulators for electronic and high-frequency equipment are illustrated and fully described in catalog 151. Complete with full engineering data, specifications and dimensional drawings, the 4-page catalog covers the company's insulators that are made to conform to government and commercial specifications.

Magnetic Tape Recorder. Audio & Video Products Corp., 730 Fifth Ave., New York 19, N. Y., has issued a 4-page brochure describing the Ampex model 307 three-speed magnetic tape recorder with frequency response out to 100,000 cps. The unit discussed is primarily designed for telemetering, data recording, vibration studies, shock analysis and other such special recording work which is found in the fields of scientific and military research. The back page of the brochure also describes the Ampex model 375 60-cycle tuning fork amplifier which provides a source of accurate 60-cycle power which is intended to drive the capstan motors of any Ampex tape recorder to that tape speed will be entirely independent of power line frequency variations.

Relay Catalog. American Relay & Controls, Inc., 4939 W. Flournoy St., Chicago, Ill. Attractively printed in two colors, the new catalog contains 12 pages of information valuable to relay users. It includes a section on the selection of relays, giving the method and data required to choose a relay for any specific application. The catalog also describes the complete line of Amrecon relays, with illustrations and data on ten basic

FOR YOUR PANEL

DIALCO

A NOVEL and UNIQUE CIRCUIT INDICATOR

DESIGNED FOR NE-51 NEON LAMP

For 110 or 220 volt circuits

The required resistor is an integral part of this assembly —"built-in."

RUGGED • DEPENDABLE LOW IN COST

UL

PATENTED: No. 2,421,321
Cat. No. 521308-997

WILL *YOU* TRY A SAMPLE?

Write on your company letterhead. We will act at once. *No charge, of course.*

SEND FOR THE 192 PAGE HANDBOOK OF PILOT LIGHTS

Among our *thousands of Pilot Light Assemblies* there is one which will fit *your special conditions.* Many are especially made and approved for *military* use. We pride ourselves on prompt deliveries—*any quantity.*

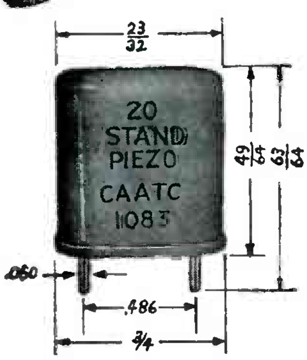
ASK FOR OUR APPLICATION ENGINEERING SERVICE

Foremost Manufacturer of Pilot Lights

The DIAL LIGHT COMPANY of AMERICA

900 BROADWAY, NEW YORK 3, N. Y. SPRING 7-1300

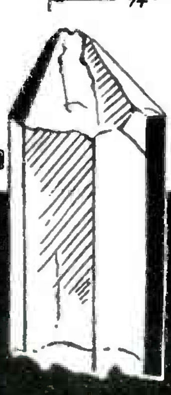
Eliminate CRYSTAL TEMPERATURE CONTROL COSTS . . .



Now you can forget temperature control. Just specify Standard's Type 20 Crystal Unit for your products.

In addition to lowering power requirements and weight, it increases compactness, durability and dependability. Type 20 meets all Government specifications, too.

Discover how the Standard Type 20 can cut costs and increase sales for you. A letter will bring Engineering data and complete details by return mail.



Standard Piezo
COMPANY
CARLISLE, PENNSYLVANIA

MAILING LISTS THAT WORK . . .

McGraw-Hill Industrial Mailing Lists are a direct route to today's purchase-controlling executives and technicians in practically every major industry.

These names are of particular value now when most manufacturers are experiencing constantly increasing difficulty in maintaining their own lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled changes in industrial personnel. These lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nation-wide field staff, and are maintained on a twenty-four hour basis.

Investigate their tremendous possibilities in relation to your own product or service. Your specifications are our guide in recommending the particular McGraw-Hill lists that best cover your market. When planning your industrial advertising and sales promotional activities, ask for more facts or, better still, write today. No obligation, of course.

McGraw-Hill Publishing Co., Inc.

DIRECT MAIL DIVISION

330 WEST 42nd STREET
NEW YORK, 36, N. Y.

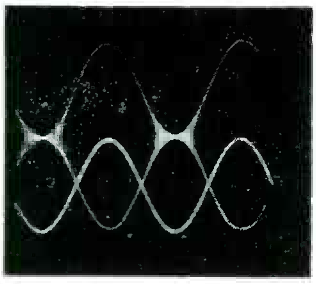
models (including both a-c and d-c types) and their many variations. Also discussed are snap-action and latching relays; screw-terminal type relays; plug-in mountings; and hermetically sealed models.

Output Transformer Chart. Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill. The No. 375 output transformer chart lists 129 of the most frequently used output transformers and the tubes with which they should be used. This handy guide simplifies the selection of the proper transformer for use as replacement in radio receivers or in the construction of audio amplifiers. In almost all cases more than one transformer is listed so that there is a choice of mounting types, and the application, class and operating characteristics of the tube and transformer are shown in ready reference form.

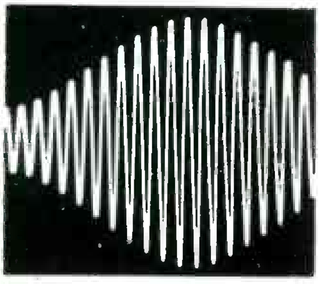
Glass-to-Metal Hermetic Seals. The Sealtron Co., 9701 Reading Road, Cincinnati 15, Ohio, has issued a new 4-page general bulletin with pictures and specifications of hermetic seals and subassemblies. Twenty-five sales representatives in major cities from coast to coast are also listed with their addresses and phone numbers.

Precision Potentiometers. The Gamewell Co., Newton Upper Falls 64, Mass., has available an 8-page bulletin dealing with a line of precision potentiometers. It is completely illustrated and contains technical specifications and applications. A full page of ordering and pricing information is included.

Capacitors and Filters. Astron Corp., 255 Grant Ave., East Newark, N. J., has published catalog AC-3 offering educational information on performance data and test characteristics that should prove helpful to all users of capacitors and filters. Listed and illustrated are the comprehensive line of dry electrolytic capacitors, along with all applicable engineering data. The Metalite section features, in addition to pertinent data, a history of the



320 kc modulated 400 cps; audio on second beam.



24 kc modulated 60% 1 kc.

We shall be pleased to see you at the

I. R. E. CONVENTION BLOCK 137

100% MODULATION....

...A.M. WITHOUT F.M.

Excellent amplitude modulation is a feature of the Standard Signal Generator TF 867—a.m. accompanied by minimum spurious f.m.—less than 100 cps below 5 mc, 1,000 cps above. Other features are:

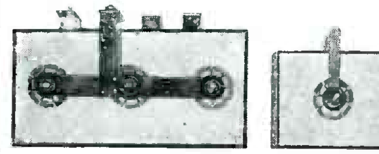
Wide range—15 kc (or less) to 30 mc in 11 bands on full vision scale. **Crystal accuracy**—0.01% 1 mc harmonic source built-in. **Easy tuning**—discrimination 1 part in 10,000 on total 15 ft. scale length. **High output**—4 volts down to 0.4 microvolts. Flexible modulation—internal 400 and 1,000 cps, 0-100%, external 50-10,000 cps ± 2db.

MARCONI INSTRUMENTS 23-25 Beaver Street, New York

CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: MARCONI INSTRUMENTS LIMITED ST. ALBANS, HERTS.

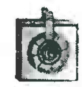
SYNTRON

SELENIUM RECTIFIERS



Made by a new process to a uniform, high quality for continuous, heavy-duty service.

1" sq. to 12" x 16" cells—in stacks, or single cells for customer assembly.



Write for literature

SYNTRON CO.
241 Lexington
Homer City, Pa.

air system sockets

Vacuum Tube Accessories By Eimac — *Now Available!*

Designed primarily to simplify and increase the efficiency of cooling the most popular Eimac tetrodes. Sockets are supplied with necessary mounting screws, clips, and a pyrex glass chimney The 4X150 socket, in addition, incorporates a built-in screen to cathode by-pass capacitor.

• *Write for new Eimac Catalogue Summary showing Eimac tubes and other accessories.*

Eimac

EITEL-McCULLOUGH, INC. · San Bruno, Calif.

ELECTRONICALLY REGULATED

LABORATORY POWER SUPPLIES

• STABLE • DEPENDABLE • MODERATELY PRICED •

MODEL 28 STANDARD RACK MOUNTING

PANEL SIZE 5¼" x 19"
WEIGHT 16 LBS.

- **INPUT:** 105 to 125 VAC, 50-60 cy
- **OUTPUT #1:** 200 to 325 Volts DC at 100 ma regulated
- **OUTPUT #2:** 6.3 Volts AC CT at 3A unregulated
- **RIPPLE OUTPUT:** Less than 10 millivolts rms

For complete information write for Bulletin E

LAMBDA ELECTRONICS CORPORATION
CORONA NEW YORK

use of metallized paper in capacitors; advantages of their self-healing property, subminiature size and light weight; and engineering performance data, curves and test procedures. The newly developed type AQ capacitors, for operation at 125 C without derating, are presented; and r-f interference filters are listed and illustrated, with drawings, attenuation charts and other design aids.

Calibrating Standard. Radio Wire Television Inc., 100 Sixth Ave., New York 13, N. Y. A two-page bulletin deals with the type 300 oscilloscope calibrating standard. Mechanical specifications, illustration, chief use and features are given. By the standard described complex waveforms and parts of such waveforms can be measured quickly and separately. The unit discussed, connected between the equipment being tested and an oscillograph, provides a source of calibrating voltages ranging between 0.001 and 100 v that can be displayed on the screen by simply turning a knob.

Nuclear Instruments. El-Tronics, Inc., 2647 N Howard St., Philadelphia, Pa., offers a catalog listing data on their line of nuclear instruments used for the detection and count of all types of nuclear radiation. The instruments described are used by hospitals, industrial laboratories and civilian defense. A free copy may be obtained on request for bulletin A1150.

Metallic Rectifiers. Radio Receptor Co., Inc., 251 W. 19th St., New York 11, N. Y. Totalling 16 pages and cover, the thoroughly illustrated article with application photographs, drawings, diagrams, and charts, reviews the background of metallic rectifiers and clarifies the various factors in their application to electronic circuits. It is of value not only to the novice, but to the engineer with specialized experience in the field. Also included is a helpful glossary of terms.

Tantalum Electrolytic Capacitors. P. R. Mallory & Co., Inc., Indianapolis 6, Ind. A recent four-page folder gives illustrations and technical information on the type XT

SMALL METAL STAMPINGS

PATTON-MacGUYER

For over 33 years P-M has been a dependable source for small metal stampings. An extensive modern plant, complete equipment, specialized engineering experience and toolmaking skill combine at P-M to produce stamped metal parts accurately, economically, promptly. Moderate die charges. Modern facilities for large volume production. Special stamping problems are gladly accepted; recommendations for the most efficient and economical solutions are made promptly. Send prints for your next stamping job to P-M.

TERMINALS for ELECTRIC WIRES

Being long experienced specialists in the terminal field, we have dies to produce over 400 different kinds of separate terminals, and every modern facility to meet your standard or special requirements. We also provide terminals in continuous form, supplied on reels, with machine for attaching and soldering tandem terminals to wires in one continuous operation. Send for folder.

PATTON-MacGUYER COMPANY

EDGEWOOD STATION, PROVIDENCE 5, R. I.

ENGINEERS • SCIENTISTS • TECHNICIANS •

ARMOUR RESEARCH FOUNDATION of ILLINOIS INSTITUTE OF TECHNOLOGY

URGENTLY NEEDS TOP LEVEL ENGINEERS AND SCIENTISTS FOR ITS EXPANDED RESEARCH AND DEVELOPMENT ACTIVITIES.

Electronic engineers with experience or advanced training in antennas, microwave, television or general communications work.

Electronic engineer for general circuit work on instrumentation for medical, meteorological and industrial applications.

Engineer with training and experience in servomechanisms, including systems analysis, network synthesis and instrumentation for flight simulators, fire control systems and industrial control applications.

Engineer with experience in electronics and/or electromechanical design for research and development in the magnetic recording field.

Engineer with experience in development of electromechanical or electromagnetic devices such as small motors, relays, and transformers.

Engineer or physicist interested in precision electrical measurements, electrical insulation or arc interruption problems. Prefer man with advanced training or equivalent experience.

Electronics or electrical engineering technicians for work as laboratory assistants in development of prototype models of equipment. Prefer men with trade school training or equivalent experience.

ARMOUR RESEARCH FOUNDATION SERVES INDUSTRY AND GOVERNMENT IN RESEARCH AND DEVELOPMENT COVERING THE FIELDS OF SCIENCE AND ENGINEERING. WORK IS STIMULATING AND OFFERS DIVERSIFIED ACTIVITY AS WELL AS WIDE CONTACT IN PROFESSION AND INDUSTRY. POSITIONS DESCRIBED OFFER OPPORTUNITIES FOR PROJECT LEADERSHIP IN IMPORTANT NEW FIELDS OF RESEARCH. SALARIES OPEN FOR DISCUSSION AND WILL BE COMMENSURATE WITH TOP LEVEL CAPABILITIES REQUIRED FOR THESE POSITIONS.

Write for descriptive brochure of the Foundation. Interviews will be arranged. Address inquiries to:

ASSISTANT DIRECTOR for PERSONNEL
ARMOUR RESEARCH FOUNDATION OF ILLINOIS INSTITUTE of TECHNOLOGY
35 West 33rd Street
Chicago 16, Illinois

THE NEW 6T-4 Stroboconn

PRECISION STROBOSCOPIC FREQUENCY METER

MEASURES FREQUENCIES INSTANTLY BY PURELY VISUAL MEANS!

ACCURATE TO 0.05%

FILL IN AND MAIL TODAY for FREE Literature
C. G. CONN Ltd.
Electronics Division, Elkhart, Ind.
Department 212

Send me descriptive literature on NEW 6T-4 STROBOCONN.

Name ____________________

Street ____________________

City ____________ State ____________

Measures transient vibrations. Finds precise speed of rotating mechanical parts. Calibrates or checks precision tachometers, oscillators, other pulse generators. Used in place of bridge methods in measuring inductance and capacitance. Many other uses.

MAIL COUPON FOR COMPLETE INFORMATION . . . SEE HOW STROBOCONN CAN HELP YOU!

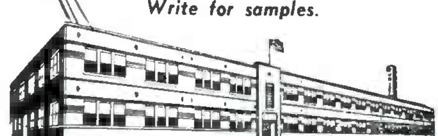
Runzel WIRE, CORD and CABLE

SOLVE YOUR WIRING PROBLEMS

In almost endless variety of colors, sizes and specifications to your order, Runzel products will assist you in your wiring problems. Shielded wire and cords . . . popular hook-up and lead-in wire . . . speaker cords and all types of insulated wire products.

Geared for fast production . . . Centrally located . . . our facilities for service are unexcelled.

Write for samples.



RUNZEL CORD & WIRE CO.
4723 Montrose Avenue
Chicago 41, Illinois

tantalum electrolytic capacitors for extreme temperature electronic applications. Dimensional and mounting data and electrical characteristics are found therein.

Braze-Clad Metals. American Silver Co., Inc., 36–07 Prince St., Flushing 54, N. Y., has issued a 4-page bulletin designated as BC-51 that gives useful technical information relative to Braze-Clad metals and also suggests applications where they can be profitably used. Description and a possible engineering service are included.

Connector Handbook. Cannon Electric Co., P. O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif., recently published a 32-page pocket-size service manual on using the AN-M connector—a vibration proof and pressurized connector for aircraft, radar, instrument and general electrical applications. Presented in a 2-color, varnished, plastic-bound cover, bulletin SIM-1 uses 44 illustrations giving detailed instructions for installation, inspection, disassembly and reassembly operations.

Screen Booth Filters. Tobe Deutschmann Corp., Norwood, Mass. In response to stepped-up wartime demand for its line of electronic interference filters, the company has instituted a major revision of its entire catalog. First section off the press is catalog 201—Screen Booth Filters. Other sections on the complete line of filters, capacitors and electronic devices will follow shortly.

Photoelectric Colorimeter. Photovolt Corp., 95 Madison Ave., New York 16, N. Y., has available the 20-page bulletin No. 420 on the Lumetron photoelectric colorimeter, model 402-E. The bulletin has been completely revised and enlarged by the description of a number of recently developed accessories. Illustrations and price lists are included.

Miniature Transformers. Triad Transformer Mfg. Co., 2254 Sepulveda Blvd., Los Angeles 64, Calif. Highlighting the trend toward miniaturization and elimination of weight for use in military equipment, bulletin 451 announces the addition of miniature transformers for portable equipment, voice frequency audio components, power transformers, filament transformers and filter reactors. Described is the use of the 380 to 1,500-cycle line frequencies for power equipment that permits notable reduction in size of transformers and reactors. New developments in core materials and new winding and impregnating techniques that permit further reduction are covered.

Low-Pressure Cells. Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa., presents in bulletin 326 two pages of information on the type SR-4 low-pressure cells of 0–10 to 0–100 lb-per-sq-in. capacity for measuring variations in gas or liquid pressures. The bulletin includes illustrations of the cells, wiring diagram, dimensional diagrams and specifications.

Testing & Measuring Equipment. General Electric Co., Schenectady 5, N. Y. A new 80-page catalog summarizes for the first time under one cover all of the company's testing and measuring equipment for laboratory and production line use. To be used primarily as a reference to the apparatus available for the complex measurements to be made in industry, catalog GEC-1016 contains more than 150 photographs and diagrams and describes the uses, features, specifications and prices of more than 130 testing and measuring equipments. The booklet also contains publication references to company bulletins that describe each device in more detail.

Nickel-Free Ferrites. Ferroxcube Corp. of America, 50 E. 41st St., New York 17, N. Y. New data on improved nickel-free ferrite cores for coils and transformers used in tv and electronics are contained in engineering bulletin FC-5101-A. The bulletin contains performance curves for the type 3C series of cores, which have improved

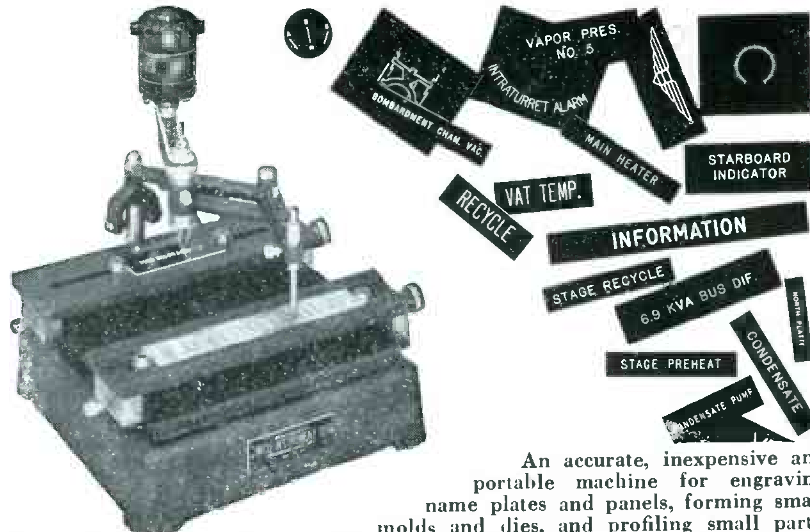
On the job!

Our volunteer speakers are saving thousands of lives *today* . . . in factories and business offices . . . at neighborhood and civic centers . . . at social, fraternal and service group meetings all over this land . . . by showing people what they can do to protect themselves and their families against death from cancer.

To find out what you yourself can do about cancer, or if you want us to arrange a special educational program for your neighbors, fellow-workers or friends, just telephone the American Cancer Society office nearest you or address a letter to "Cancer," care of your local Post Office. One of our volunteer or staff workers will be on the job to help you.

American Cancer Society

MICO ENGRAVERS



An accurate, inexpensive and portable machine for engraving name plates and panels, forming small molds and dies, and profiling small parts. Geometrically correct for true three dimensional work. Accurately duplicates master copy in metals, plastics or wood. Rugged, sturdy construction.

COMPARE THESE SUPERIOR FEATURES.

- Engraves in 2 or in 3 dimensions.
- Pantograph permits 4 reduction ratios.
- Micrometer depth control graduated in thousands of an inch.
- High speed, ball bearing spindle.
- Chuck ⅛" to take variety of small tools, burrs, mounted points as well as standard cutters.

Send for Illustrated Catalog

MICO INSTRUMENT COMPANY

76 E. Trowbridge St. Cambridge, Mass.

distributors for 30 years
of radio and electronic
components for all your needs

RADIO WIRE TELEVISION
INCORPORATED

NEW YORK 13, N.Y.
100 Sixth Avenue
WAlker 5-8883

NEWARK 2, N. J.
24 Central Avenue
MArket 2-1661

BOSTON 10, MASS.
110 Federal Street
HUbbard 2-7850

Lafayette 100 SIXTH AVE.
DIV. RADIO WIRE TELEVISION, INC.
FOR CUSTOM RADIO AND TV COMPONENTS

Custom assemble your own high fidelity phono - radio - television ensemble. All famous name components at lowest prices. Send for *Free* hi-fi catalog to Dept. E.

temperature stability over older materials, as well as drawings of the many standard shapes available. The cores described can be directly substituted for nickel-containing ferrite cores in most horizontal tv deflection yokes and horizontal output transformers without need for redesign.

Potentiometer Circuits. Minneapolis-Honeywell Regulator Co., Brown Instrument Div., Wayne and Windrim Ave., Philadelphia 44, Pa. Bulletin B15-13 discusses the characteristics of the measuring circuits used in the Electronik potentiometer. It is the second of a series for the benefit of those who wish to apply and utilize this versatile instrument to unique or specialized measurements frequently encountered in scientific and technical investigations.

Products Catalog. General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill. Catalog No. 155 is a 64-page illustrated description of a wide line of products for the radio and electronic industries. It is divided into four parts: (1) radio chemicals; (2) radio and tv parts and service aids; (3) alignment tools and radio tools; and (4) radio hardware. Prices of all items are included.

Midget Relays. Signal Engineering & Mfg. Co., 154 W. 14th St., New York 11, N. Y. Bulletin MTR-64 is a 4-page brochure describing and illustrating the series 80 line of midget telephone type relays. It contains information and drawings regarding types of covers, characteristics, general specifications and pertinent data.

Sensitive Photometer. Ultrasonic Engineering Co., P. O. Box 46, Maywood, Ill., has published a four-page bulletin completely describing its electron-multiplier photometer that is ultrasensitive and line operated, using a stabilized direct-connected amplifier with two independent power supplies. With the instrument described changes in light strength of the order of 5/1,000,000 microlumens are easily measured. Characteristics chart and price list are included.

Built Right! Priced Right!

BECO UNIVERSAL IMPEDANCE BRIDGE

for accurate
RESISTANCE
CAPACITANCE
INDUCTANCE
measurements

Exclusive
DEKADIAL
for high precision readings

Shown: Model 250-C

Write today for complete information and current low price

BROWN ELECTRO-MEASUREMENT CORP.

Instrument BECO *Specialists*

4635-37 S. E. HAWTHORNE BLVD. PORTLAND 15, OREGON

Completely Accessible

from operating surface

dependable instruments

Heiland
DENVER

Type A-708 . . . 24-channel

FEATURES

- Completely accessible from operating surface
- Compact...can be mounted in a minimum of space...lightweight
- Can be panel mounted
- 6 to 24 channels
- Paper widths 5", 8", 12", 18"
- Simplicity of loading
- Direct monitoring of galvonometer light spots
- Flexibility of operation
- Simultaneous viewing, recording and scanning
- Trace identification...zero mirror...synchronizing reference trace
- Adjustable automatic record length

AUTOMATIC OSCILLOGRAPH RECORDER

Affording complete accessibility from operating surface and requiring only a minimum of space for mounting, the HEILAND A-708 meets the exacting specifications of research and development personnel in aircraft flight testing, laboratory and industrial testing.

Write for complete details

HEILAND RESEARCH CORPORATION • 130 East Fifth Ave. • Denver, Colo.

THIS IS IT!

World-wide recognition for this outstanding line of electric soldering irons —

HEXACON

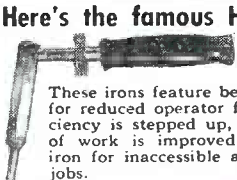
- specified by the big names for the *TOUGH JOBS!*

WESTERN ELECTRIC, BENDIX, MINNEAPOLIS HONEYWELL RADIO CORP. OF AMERICA, STROMBERG CARLSON, SPERRY, WESTINGHOUSE, EMERSON, KAISER, etc.

PLUG OR SCREW TIPS 40 to 700 Watts
1/8" to 1 3/4" Tip Dia.

Follow the leaders and you'll specify HEXACON! They'll efficiently solve your soldering problems. Write for literature.

Here's the famous HATCHET TYPE



These irons feature better balance for reduced operator fatigue. Efficiency is stepped up, and quality of work is improved. The ideal iron for inaccessible and intricate jobs.

HEXACON ELECTRIC CO.

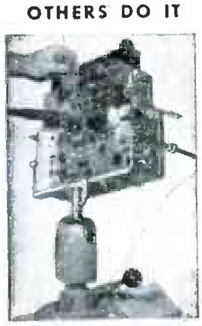
130 W. CLAY AVE., ROSELLE PARK, N. J.

Cut Your Costs, Too, With

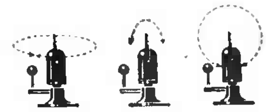
POWRARM

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

News From The Field

Edited by WILLIAM P. O'BRIEN

RACES Proposal by FCC

THE PROPOSED Radio Amateur Civil Emergency Service would set up machinery for a temporary radiocommunication service to be carried on by licensed amateur radio stations while operating on specifically designated segments of the regularly allocated amateur frequency bands under the direction of authorized local, regional or federal civil defense officials according to an approved civil defense communications plan. The Commission will receive comments upon its proposal until Feb. 15, 1952.

In effect, the Federal Communications Commission offers a formula for tapping at least a portion of the nearly 100,000 licensed amateurs and their existing equipment for civil defense use. Although the plan is predicated upon the individual operator, already licensed, it provides safeguards to insure that his authorization and activity are properly sponsored and directed. He is prohibited from engaging in defense communications except with permission and under the control of an established network.

Municipalities desiring to make use of their amateurs must file a comprehensive civil defense communications plan that has been approved down the line. It must appoint a qualified Civil Defense Radio Officer responsible for the utilization of the plan. All such officers and operators must be shown reliable and loyal.

Among the technical requirements, most of which follow standard amateur procedure, are the frequency bands and authorized emissions listed below. Selection and use of specific frequencies within the bands depends upon coordination of local and area plans. In the range from 1,800 to 2,000 kc, the availability of frequencies depends upon the loran system use as already set forth in FCC rules.

Table I—RACES Bands and Emissions

FREQUENCY BAND	Authorized Emissions							
	0.1 A1	1.1 F1	2 A2	3 F2	6 A3	6 A4	6 F3	40 F3
1,800–1,825 Kc......	●				●			
1,875–1,900 Kc......	●				●			
1,900–1,925 Kc......	●				●			
1,975–2,000 Kc......	●				●			
3,500–3,510 Kc......	●	●						
3,990–4,000 Kc......	●	●			●	●		
28.55– 28.75 Mc...	●				●	●	●	
29.45– 29.65 Mc...	●	●			●	●		●
50.35– 50.75 Mc...	●		●		●	●	●	
53.35– 53.75 Mc...	●	●	●	●	●	●		●
145.17–145.71 Mc...	●	●	●	●	●	●		●
146.79–147.33 Mc...	●	●	●	●	●	●		●
220–225 Mc.........	●	●	●	●	●	●		●

Emission data is given in the form of a bandwidth figure in kilocycles followed by the modulation method, amplitude being represented by A and frequency modulation by F. The practical designations possible are also listed below.

0.1 A1—Continuous-wave telegraphy;
1.1 F1—Frequency-shift telegraphy;
2 A2—Telegraphy, amplitude-modulated at audio frequency;
3 F2—Telegraphy, frequency-modulated at audio frequency;
6 A3—Commercial-quality amplitude-modulated telephony;
6 F3—Narrow-band frequency or phase-modulated telephony;
40 F3—Wide-band frequency or phase-modulated telephony;
6 A4—Amplitude-modulated facsimile.

Components Conference Scheduled

AIMED at promoting still further improvement in the quality of electronics components, particularly for military equipment, a second government-industry conference will be held in Washington, D. C., from May 5 to 7, 1952. This announcement was made recently by J. G. Reids, Jr., of the National Bureau of Standards, chairman of the Conference Steering Committee.

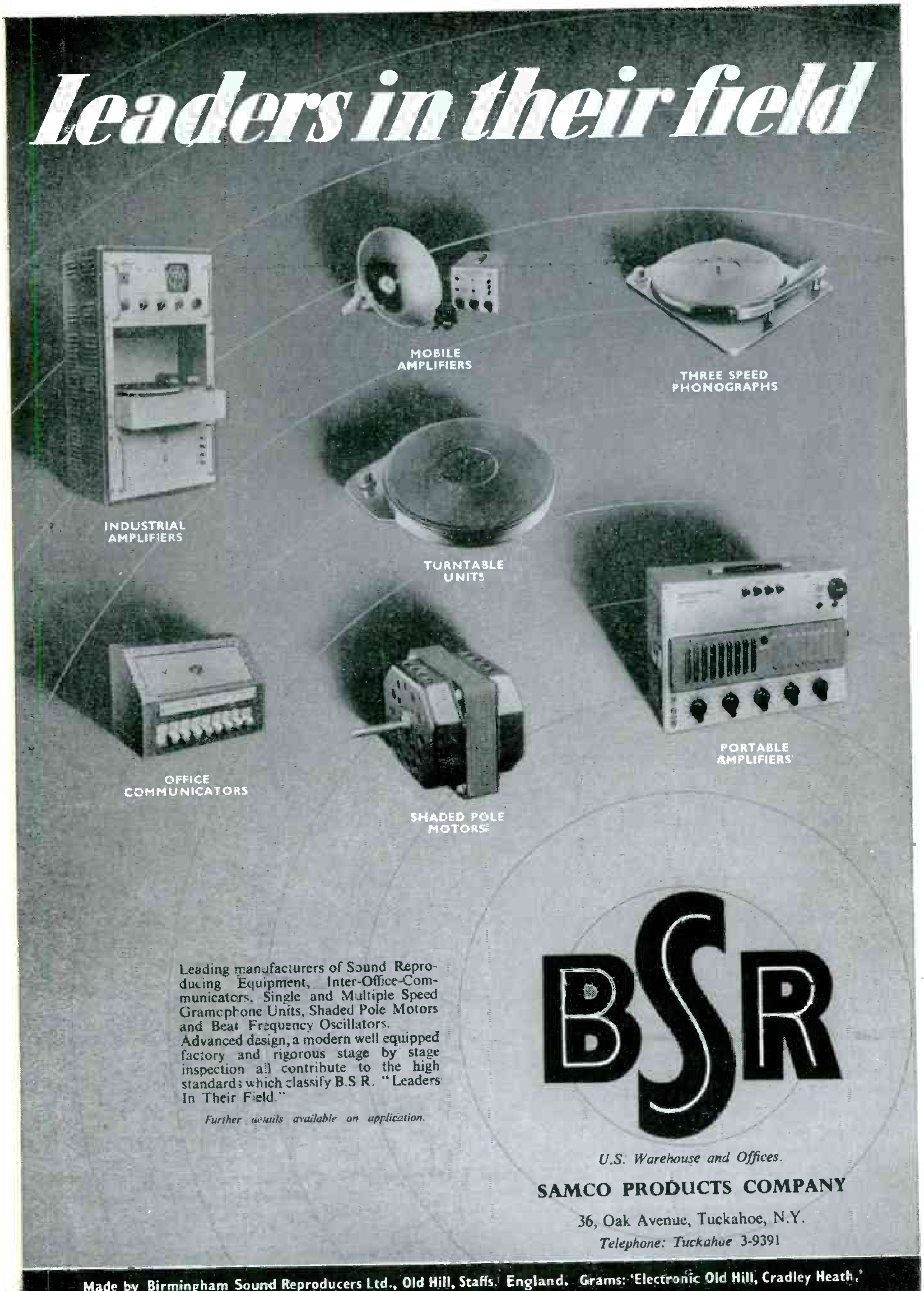
Like the last conference held in May 1950, the forthcoming session is sponsored jointly by the RTMA, the IRE and the AIEE, in cooperation with the Research and Development Board and other Department of Defense agencies and the National Bureau of Standards.

Army Mobile Radio Station

A FIVE-UNIT radio station on wheels has been developed by the Signal Corps and is now being put into use in Korea. Its range is several hundred miles.

The units, designed for use by Psychological Warfare teams, are housed in a pair of 26-foot trailers and three 11-foot shelters. They can be transported by truck and trailer on land, by cargo planes aloft and by ships at sea. During amphibious assaults, the units can be floated ashore after simple sealing preparations.

Equipment for this mobile station includes sound-proofed, air-conditioned studio and control


Leaders in their field
MOBILE AMPLIFIERS
THREE SPEED PHONOGRAPHS
INDUSTRIAL AMPLIFIERS
TURNTABLE UNITS
OFFICE COMMUNICATORS
SHADED POLE MOTORS
PORTABLE AMPLIFIERS
Leading manufacturers of Sound Reproducing Equipment, Inter-Office-Communicators, Single and Multiple Speed Gramophone Units, Shaded Pole Motors and Beat Frequency Oscillators.
Advanced design, a modern well equipped factory and rigorous stage by stage inspection all contribute to the high standards which classify B.S.R. "Leaders In Their Field."
Further details available on application.
BSR
U.S. Warehouse and Offices.
SAMCO PRODUCTS COMPANY
36, Oak Avenue, Tuckahoe, N.Y.
Telephone: Tuckahoe 3-9391
Made by Birmingham Sound Reproducers Ltd., Old Hill, Staffs. England. Grams: 'Electronic Old Hill, Cradley Heath.'

Cpl. Charles Cooper, radio engineer of Parkersburg, W. Va., cues two soldiers to begin propaganda message on new Signal Corps mobile radio broadcasting station. All are members of Army Psychological Warfare units. The new station can handle over a half-million words of copy daily, has own studio, control room and power supply

rooms, magnetic tape-recorder-reproducer units, turntables and remote pickup units for on-the-spot broadcasts away from the roving station.

Signal Corps completed the first station in a record time of four months, with construction already started on four additional units to be used at other overseas outposts.

Changes Among Engineers

A SERIES of personnel changes affecting many companies in the electronics field has recently taken place. Among them are the following:

Joseph H. Lancor, Jr., has been appointed director of the transducer division of *Consolidated Engineering Corp.*, Pasadena, Calif. He will be responsible for directing design and development of various types of transducers, including vibration pickup, accelerometers and pressure pickup. In his former position as director of product engineering of *Vitro Corp. of America*, he supervised classified Navy projects, including guided missiles and electronic weapons.

Robert L. Rod has been promoted from project engineer to assistant director of research at *Bogue Electric Mfg. Co.* The president of the company stated that Mr. Rod will assist David H. Ransom, director of research, in directing research and development in the fields of magnetic amplifiers, microwave communications systems and industrial control equipment.

The appointment of Paul Hines as director of engineering for *Workshop Associates*, Division of Gabriel Co., has also been announced. Formerly with *Raytheon Mfg. Co.*, he will be in direct charge of the new Workshop laboratory soon to be opened in Natick, Mass.

William E. Osborne, formerly director of electronics at *Hycon Mfg. Co.* of Pasadena, Calif., has been elected president and general manager of *Resdel Engineering Co.* of Los Angeles.

Also noted recently is the appointment of Brig. Gen. Tom C. Rives (Ret.) to the post of manager of the newly established *General Electric Advanced Electronics Center* at Cornell U., Ithaca, N. Y.

Saul Decker has been promoted from assistant chief tv engineer to chief tv engineer of *CBS-Columbia, Inc.*, manufacturing subsidiary of the Columbia Broadcasting System.

Robert L. Wolff, formerly chief radio-electrical engineer, has been promoted to director of *Centralab Products* engineering.

SMPTE Elections

FRANK E. CAHILL, JR., of the Warner Bros. Circuit Management Corp., N. Y., was recently elected financial vice-president of the Society of Motion Picture and Television Engineers.

Other newly elected officers of SMPTE are: treasurer, Barton Kreuzer of RCA Engineering Products Dept., Camden, N. J.; and engineering vice-president, Fred T. Bowditch of National Carbon Div. of Union Carbide and Carbon Co., Cleveland. Mr. Bowditch was reelected to this post.

Newly elected governors of the society include Axel G. Jensen of Bell Telephone Laboratories, Murray Hill, N. J.; Joseph E. Aiken of Naval Photographic Center, Anacostia, D. C.; George W. Colburn of G. W. Colburn Laboratories, Chicago; Ellis W. D'Arcy of DeVry Corp., Chicago; John K. Hilliard of Altec-Lansing Corp., Beverly Hills; and Fred G. Albin of American Broadcasting Co., Hollywood.

Newly elected officers and governors took office January 1 and will serve two-year terms.

Radiolocation Service

BECAUSE of increasing demands for oil and the problems of prospecting underwater as far as 150 miles into the Gulf of Mexico, the FCC has established a Radiolocation Service allocation.

Standard loran and microwave systems have so far proved impracticable for the distances and accuracies required. Current workable systems employ phase-comparison methods at low or medium frequencies (ELECTRONICS, p 70, April 1949). But since present operations are on a temporary basis, there has

ORIENTED ELECTRICAL STEELS for a wide range of uses

These are typical flux-current loops for Armco Oriented Electrical Steels. They demonstrate the wide range of thicknesses that Armco offers in these iron-silicon alloys, and illustrate the excitation and loss characteristics when operating at frequencies within the range of highly efficient performance.

The broad selection of thicknesses extends the advantages of preferred orientation to many new applications, serving commercial- to high-frequency requirements.

Complete information on the 14-mil thick Armco Tran-Cor 2X-O and 3X-O is given in the booklet, "Armco Oriented Electrical Steels." The booklet "Armco Thin Electrical Steels" gives data on Armco Tran-Cor T-O in 1-, 2- and 4-mil thicknesses and Armco Tran-Cor T-O-S, a super-oriented electrical steel in 4-mil thickness only.

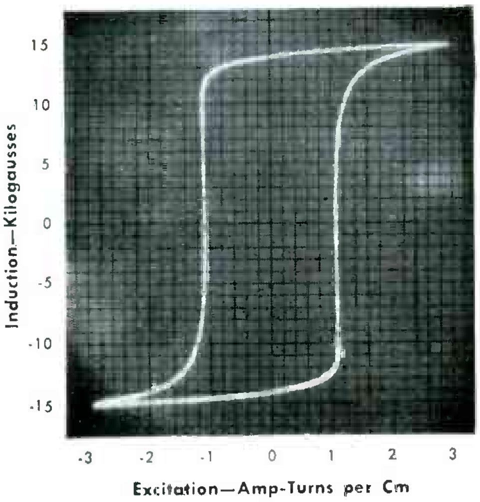
Data on ¼-, ½- and ¾-mil Armco Tran-Cor T-O are being prepared. There are Armco Electrical Steels in 5- and 7-mil thicknesses for multi-directional applications as well as a complete line of Hot-Rolled and Radio grades. Write us for the information and booklets you want.

ARMCO STEEL CORPORATION

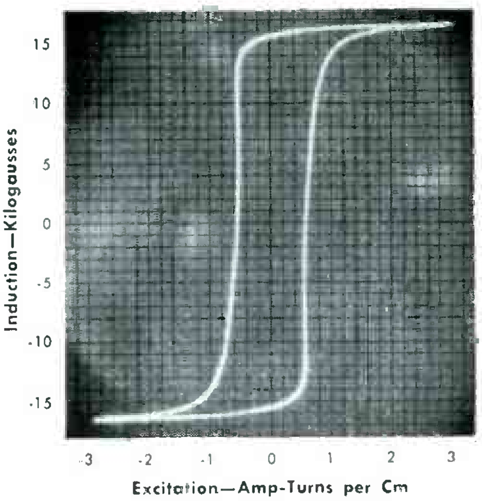
1162 Curtis Street, Middletown, Ohio • Plants and sales offices from coast to coast • Export: The Armco International Corporation

ARMCO

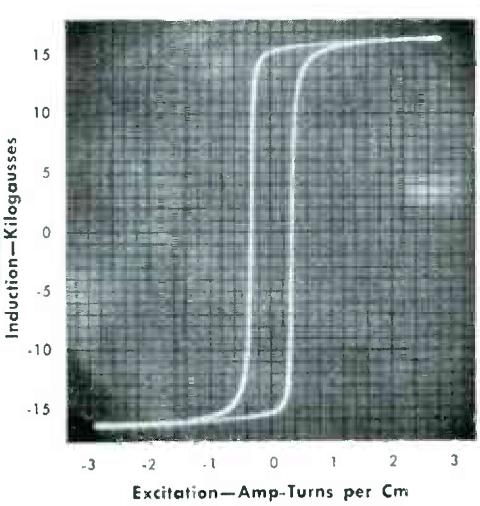
FLUX-CURRENT LOOPS
(Both eddy current & hysteresis losses)



Armco TRAN-COR T-O
½ mil thick
10,000 cps



Armco TRAN-COR T-O
4 mils thick
400 cps



Armco TRAN-COR 3X-O
14 mils thick
60 cps

been little incentive for development of systems using these frequencies.

Radiolocation has been assigned the band between 1,750 and 1,800 kc on a shared basis with the Disaster Service. This arrangement is possible because tests and drills, aside from operations in actual emergency, are primarily carried on at night. The petroleum industry's radiolocation activities occur chiefly during the day. However, a portion of the machinery set up for administering radiolocation will involve methods of immediately shutting down this service if it interferes with the Disaster Service.

Although the new service is a "permanent allocation", it has been placed upon a "developmental basis" until at least July 1954, before which time it will be completely reviewed.

Signal Corps Seeks Electronics Workers

There is an urgent need for electronics equipment installer-repairmen for duty in the Army Communication Center at the Pentagon, Washington, D. C., the Signal Corps has announced. The Civil Service positions, paying from $1.47 to $2.27 per hour, require rotating-shift duty.

No written test is required. Applicants are rated on a basis of their training and experience, as described in their applications. A certain amount of credit is allowed for advanced amateur radio operation.

Persons interested in these positions should file Application Form 57, Supplemental Experience Form CSC-206, and Card Form 5001 ABC with the Executive Secretary, Board of U. S. Civil Service Examiners, Military District of Washington, Room 2E-1030, Concourse, The Pentagon, Washington 25, D.C.

Complete information regarding duties and minimum qualification requirements, together with application forms, may be obtained from the Executive Secretary, Board of Civil Service Examiners, MDW, Room 2E-1030, Concourse, The Pentagon, Washington 25, D. C.; from the Fourth U. S. Civil Service Re-

TRIED and PROVEN THE WORLD OVER

LETTINE MODEL 240 TRANSMITTER WITH MOBILE CONNECTIONS AND A.C. POWER SUPPLY

This outstanding transmitter has been acclaimed a great performer throughout the world. It is excellent for fixed station, portable or mobile operation.

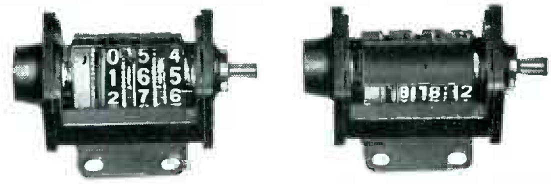
The 240 is a 40 watt transmitter for CW and plate modulated Phone operation, operating on any frequency from 1.8 to 30 mc.; complete with self contained 115 volt A.C. power supply, mobile connections, meter, (8 x 14 x 8) cabinet and tubes: 6V6 osc., 807 final, 6SJ7 crystal mike amp., 6N7 phase inverter, 2 6L6's mod., 5U4G rect. Weight 30 lbs. 90 day guarantee. Also used on 160 to 10 meter Amateur bands.

PRICE: less coils and crystal $76.55
Coils for any one freq. from 1.8 to 3.5 mc. . $3.60
Coils for any one freq. from 3.5 to 30 mc. . $2.91

Send order to:

LETTINE RADIO MFG. CO.
62 Berkley St. Valley Stream, N. Y.

PRODUCTIMETER "SPECIALS"
for Radar and Electronic Applications



Companion shutter counters used as dual direction indicators. One counter adds while the other subtracts. Shutter blanks out counter which is on negative side of 000.

"Y" 2-figure Rotary Counter used in navigating instruments.

High-speed, non-reset "Y" type counter for building into radar instruments.

Special Model "Y" with window at rear designed for use in radar equipment.

These are a few of the "specials" developed by Durant for Radar and Electronic applications. When one of the many standard Productimeters is not the exact answer to a problem, Durant engineers modify, combine, or develop entirely new counters to meet the particular requirements of the job.

Write for Bulletin

DURANT MFG. COMPANY
1912 N. Buffum St. Milwaukee 1, Wis. 112 Orange St. Providence 3, R.I.
Representatives in Principal Cities

PRODUCTIMETERS SINCE 1879 Speedometers OF INDUSTRY

SPECIALISTS IN
ELECTRONIC GEARS

QUAKER CITY GEAR WORKS
1910 N. FRONT ST.
PHILADELPHIA 22, PA.

MIDGET CONDENSER MICROPHONE
for Precision Sound Measurements and High Quality Sound Recording

Built to give years of service without change in calibration. Even without dessicators, Kellogg Midget Condenser Microphones show no detectable drift in laboratory service. Proven in use for optimum performance for more than 15 years.

- RUGGED CONSTRUCTION
- EXCEPTIONAL CALIBRATION STABILITY
- UNAFFECTED BY VARIATIONS IN HUMIDITY

PRINCIPAL CHARACTERISTICS

	MODEL A	MODEL B
RESPONSE (Referred to 1 volt/dyne/cm2)	-59 db	-55 db
FLAT TO WITHIN	± 3 db from 20 to 11,000 cps, for closed cavity without grille.	± 4 db from 20 to 15,000 cps with or without grille for perpendicular incidence in free field.

Users Include government laboratories, universities, audio development laboratories, sound studios, and industrial plants manufacturing sound equipment.

- SEND FOR FULL SPECIFICATIONS TODAY! WRITE DEPT. 26 B

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
Established 1897
MIDGET CONDENSER MICROPHONE
6650 South Cicero Avenue, Chicago 38, Illinois

gion, 4th and Jefferson Drive, Southwest, Washington 25, D.C.; or from the U.S. Civil Service Commission, Washington 25, D.C.

Plant Expansions Announced

SEVEN plant expansions were reported on the west coast:

Hoffman Radio Corp., Los Angeles, has acquired the one-story building adjacent to its No. 5 plant at 6200 So. Avalon Blvd., for tv set manufacturing. Known as plant 5A, it contains 38,000 sq ft of floor area, making the total of the seven Hoffman plants approximately 700,000 sq ft.

Purchase of a new factory building at 1521 E. Grand Ave., El Segundo, Calif., has been announced by *International Rectifier Corp.* Its

New International Rectifier plant

present plant in Los Angeles will be maintained for research and development.

Technical Associates, Inc., Burbank, Calif., has just moved into its new building providing more than three times the space of the original location. The enlarged facilities were made necessary by the expansion of the company's efforts in government defense production of nuclear research instruments.

Philco Corp. has established in Los Angeles a factory branch known as Philco Los Angeles, a division of Philco Distributors, Inc.

Varian Associates, presently located in San Carlos, Calif., has leased a 10-acre site in Palo Alto on which it will build a 30,000-sq ft structure. The company has contracts with all branches of the military and will specialize in klystron oscillators and modulators used in radar and other electronic devices.

Dalmotor Co., Santa Clara, Calif., manufacturer of motors used in

TEST YOUR MAGNETIC CIRCUITS

RAWSON FLUXMETER TYPE 504

The only portable fluxmeter available which returns rapidly to zero when a single button is depressed. Simple and fast in operation. Convenient and light in weight.

Not limited to a single type of measurement. Has universal application for laboratories or production. Measures strength of magnets and electromagnets, premeability and hysteresis loops for iron and steel, total flux lines in circuit, flux lines developed in air gap, etc.

Has a mechanical clamp to protect the pivots and jewels when in transit.

Also in production, the NEW ROTATING-COIL GAUSSMETER

RAWSON ELECTRICAL INSTRUMENT COMPANY

111 POTTER STREET, CAMBRIDGE 42, MASS.

Representatives

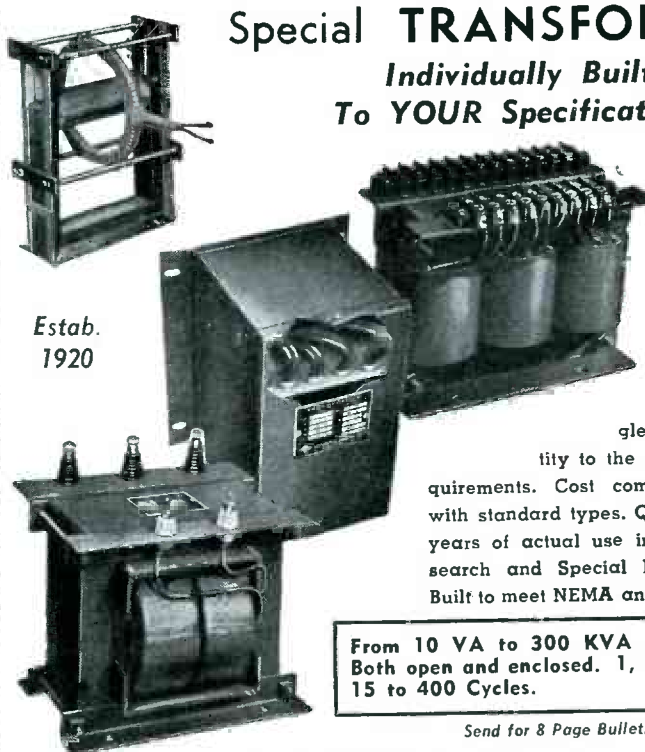
CHICAGO LOS ANGELES

Special TRANSFORMERS

Individually Built To YOUR Specifications

IN SMALL QUANTITIES

Estab. 1920



For 31 years we have been building transformers in single units or in quantity to the most exacting requirements. Cost compares favorably with standard types. Quality proved by years of actual use in Electronics, Research and Special Instrument fields. Built to meet NEMA and ASA Standards.

From 10 VA to 300 KVA Dry-Type only. Both open and enclosed. 1, 2 and 3 Phase. 15 to 400 Cycles.

Send for 8 Page Bulletin, and Price List

NWL

NOTHELFER

WINDING LABORATORIES

9 ALBEMARLE AVE., TRENTON 3, N. J.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION NEMA MEMBER

QUALITY RIBBONS and STRIPS

for the ELECTRONIC INDUSTRIES

- MOLYBDENUM
- TUNGSTEN
- TANTALUM
- FORMED PIECES

Your Special Metals Rolled to Thin Sizes and Close Tolerances

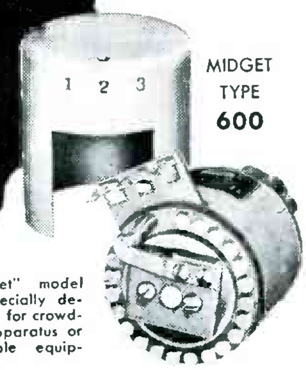
YOUR INQUIRIES WILL RECEIVE PROMPT ATTENTION

H. CROSS CO.

15 BEEKMAN ST., N. Y. 38, N. Y.

WOrth 2-2044 and COrtlandt 7-0470

ATTENUATORS by TECH LABS



MIDGET TYPE **600**

"Midget" model is especially designed for crowded apparatus or portable equipment.

STANDARD TYPE **700**

- **Solid silver contacts and stainless silver alloy wiper arms.**
- **Rotor hub pinned to shaft prevents unauthorized tampering and keeps wiper arms in perfect adjustment.**
- **Can be furnished in any practical impedance and db. loss per step upon request.**
- **TECH LABS can furnish a unit for every purpose.**
- **Write for bulletin No. 431.**

TECH LABORATORIES, INC.

Manufacturers of Precision Electrical Resistance Instruments

PALISADES PARK • NEW JERSEY

radar equipment by the armed services, is doubling the size of its present plant to 10,000 sq ft.

The center core of an aircraft components plant which has the capacity to expand physically by 500 percent if necessary has been completed by *The Garrett Corp.*, Los Angeles, for its newest division, *AiResearch Mfg. Co.* of Arizona at Phoenix.

Reports from the midwest indicate three major plant expansions:

Bodine Electric Co. has opened a new addition to its No. 2 Chicago plant, located at 2650 Addison St. The new building has a floor space of 14,000 sq ft.

Now nearing completion is an addition to the Lac du Flambeau Wisconsin branch of the *Simpson Electric Co.* The new wing, adjoining the main factory building, will provide more assembly lines for test equipment and panel meters and will also give full employment to the remainder of the Chippewa Indians who live on the nearby reservation and are now 75 percent employed by Simpson.

Sprague Electric Co. announces the opening of an application engineering office at 3 East Second St., Dayton, Ohio. This is intended to provide more effective contact with midwestern Government research and development laboratories.

In the east also, a number of plant expansions are reported:

Raytheon Mfg. Co. has leased a one-story brick building on Seyon St., Waltham, Mass., providing 50,000 sq ft of space and increasing the company's employment rolls by approximately 400 workers.

Technitrol Engineering Co., manufacturers of manometers, ballistocardiographs, electronic computing machines and such components as acoustic memory units, have moved into a new plant with more than three times the floor space formerly occupied. The new address is 2751 N. Fourth St., Philadelphia, Pa.

Tel-O-Tube Corp. of America, c-r tube manufacturer, has purchased the entire equipment and inventory of the *Video Industry Products Co.* of Paterson, N. J. The move will enable Tel-O-Tube to expand its facilities into large-scale production

NEWS FROM THE FIELD (continued)

of test equipment and electronic instruments. William Kiselewsky and Steve Ikker, formerly chief engineer and production manager respectively of the Video Industry Products Co., hold similar positions in Tel-O-Tube's new division.

CBS-Columbia Inc., New York, N. Y., has announced a five million dollar expansion program with the purchase of approximately 275,000 sq ft additional manufacturing space for the production of tv and radio receivers. With the company's present manufacturing facilities in Brooklyn, the new plant, located in Long Island City, N. Y., will make available a total of over 500,000 sq ft of manufacturing space for civilian and military production requirements.

A new wing providing approximately 7,000 sq ft of floor space is being added to the dry-type air-cooled transformer plant of *Acme Electric Corp.*, Cuba, N. Y. A battery of coil-winding machines is being installed to produce wound coils completely insulated and taped for hand finishing and testing operations.

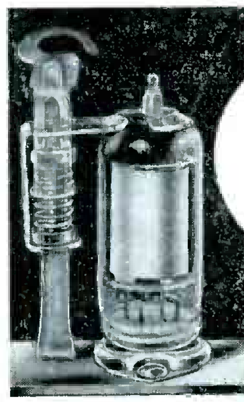
National Research Corp., Cambridge, Mass., will build additional plant facilities on Charlemont St., Newton, Mass. The new plant will be occupied by the equipment division. Complete machine shop, welding shop and electronic assembly facilities are planned as well as accommodations for the engineering and drafting departments.

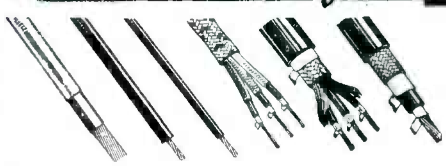
Fifteen Appointed to Executive Posts

IN A further expansion of *Philco Corporation's* divisionalization program and to handle the greatly increased volume of industrial and government electronic production, Joseph H. Gillies has been appointed vice-president and general manager of the Government and Industrial Division. He had been a director of Philco since 1947.

At the same time, William J. Peltz, who had been manager of government and industrial operations, was appointed vice-president —operations of the Television and Radio Division, Philco Corp.

Appointment of Larry LeKash-





man as a vice-president of *Electro-Voice*, Buchanan, Mich., has also been announced. He was formerly with *RCA* and prior to that was vice-president and general manager of *Radio Magazines, Inc.*

Directors of *Webster-Chicago Corp.* have elected Gus W. Wallin to the newly created position of vice-president in charge of engineering. Wallin joins the company after eleven years with *Motorola, Inc.*, most recently in charge of that firm's military engineering. He holds a number of patents in radio and tv circuits and design and has served as co-chairman of the NTSC panel on color tv and on the FM receiver committee of the RTMA.

G. W. Wallin

H. A. Gumz

H. A. Gumz, production manager of Webster-Chicago Corp., has been named vice-president of the firm. He will be responsible for following through on all government orders from receipt to final delivery.

Other recent executive appointees with their companies are as follows:

Harold C. Weingartner, vice-president and general manager of the equipment division of *National Research Corp.*, Cambridge, Mass.; John W. Belanger and Nicholas M. DuChemin, vice-presidents of *General Electric Co.*, Schenectady, N. Y.; Robert L. Werner and Ernest B. Gorin, vice-presidents of *RCA;* Raymond S. Perry, vice-president and director of *Federal Telephone and Radio Corp.*, Clifton, N. J.; Jerry A. Matthews, Jr., vice-president in charge of manufacturing at *Edo Corp.*, College Point, L. I., N. Y.; Carl E. Scholz, vice-president and chief engineer of the *American Cable & Radio Corp.;* George I. Long, vice-president and general manager of *Ampex Electric Corp.*, Redwood City, Calif.; and Anthony H. Lamb, vice-president in charge of manufacturing at *Weston Electrical Instrument Corp.*

NEW BOOKS

Advanced Engineering Mathematics

BY C. R. WYLIE JR., *Professor and Chairman, Department of Mathematics and Astronomy, University of Utah. McGraw-Hill Book Co., Inc., New York*, 1951, 640 *pages*, $7.50.

A COMPLETE course in advanced mathematics is presented in unusually clear and concise form. The first half of the book deals in differential equations, Fourier series and integrals, the Laplace transform and Bessel functions. The third quarter covers functions of complex variables, including integration in the complex plane, residues and conformal mapping. The last part presents vector and numerical analysis. An appendix of 63 pages is so organized and so cleverly condensed as to provide a complete review of pertinent background material.

The book is outstanding in several respects. Most of the material presented is explained by practical examples with well-organized steps and clear explanations. A great deal of teaching before a class and answering questions is reflected in the author's writing.

"Advanced Engineering Mathematics" is strongly recommended as text book or reference for advanced students in electrical engineering. —J.F.

Fundamentals of Electronics

BY F. H. MITCHELL, *University of Alabama. Addison-Wesley Press, Inc., Cambridge, Mass.*, 1951, 243 *pages*, $4.50.

A ONE-SEMESTER text designed for two purposes: to lay the ground work for more advanced courses in electronics, and to give nonelectronics students a feel for electronic measuring apparatus and techniques, something they are certain to cope with somewhere along their march from college to technical competence in their chosen field, whatever that may be. The emphasis throughout is on the tube as a measuring tool and the choice of contents has been governed by this viewpoint.

The many basic tube circuit combinations are treated, after

which those special combinations useful in instruments are discussed. Thus the diode as a rectifier, the multielement tube as an amplifier of voltage, current and power, and the peculiar properties of gas-filled tubes have individual chapters. These accompany chapters on sine-wave oscillators, special-purpose tubes (electrometers, ionization gages and electron multipliers) wave-shaping and control circuits and, of course, the many phases of vacuum-tube voltmeters and cathode-ray techniques.—K.H.

Elements of Television Systems

BY GEORGE E. ANNER. *Prentice-Hall, Inc., New York*, 1951, 804 *pages*, $10.35.

THIS excellent volume offers the most comprehensive treatment of television techniques currently available. Written primarily for use in college courses by Professor Anner of N.Y.U. this book is the eighteenth to appear in the Electrical Engineering Series edited by W. L. Everitt. It maintains the high standard set by the previous volumes in the series. The illustrations are copious and well chosen.

The book is cast in three sections. The first consists of eight chapters on "closed systems", that is, systems not containing a radio-frequency link. Standards of transmission, scanning methods and generators, picture tubes, camera tubes, and video amplification are treated here in comprehensive fashion.

The second part discusses the commercial telecasting system, bringing into focus those parts not previously treated. The factors underlying the choice of number of lines for commercial use, synchronization methods, vestigial sideband transmission, picture transmitters, home receivers, and antennas are included, as well as a chapter on stagger-tuning of i-f amplifiers and one on televising film. The final part is devoted to color television, describing the CBS, CTI and RCA systems as presented in 1949–50 to the FCC.

This is a thoroughly practical book, although written primarily

SECON development and production METALLURGISTS

BASE, RARE AND PRECIOUS METALS AND ALLOYS

SMALL UNITS

SMALL SIZES

CLOSE TOLERANCES

Nickel alloy, filament wire and ribbon: flat, grooved, crowned.

Grid wire electroplated.

Alloys for special requirements, bare or enamelled.

•

Further details upon request.

SECON METALS CORPORATION
228 East 45th Street, New York 17, N. Y.
MUrray Hill 7-1594

FOR TESTING QUADRATURE DEVICES

THE NEW ACME MODEL S-561 QUADRATURE GENERATOR

Designed to supply signals of extremely low distortion and of very exact quadrature for testing phase sensitive devices, this ACME S-561 Quadrature Generator has proven accurate to a degree heretofore impossible.

This instrument supplies various 400 cycle A.C. voltages with phase relationship of 90° plus or minus. 1° and with extremely stable signal frequencies. The Generator comes complete with its own external power supply.

This special purpose device which is used for testing discriminator circuits or other devices dependent on quadrature voltages can be modified to meet other test requirements. For complete information, write us your specifications.

WEST COAST ELECTRONIC MANUFACTURERS ASSOCIATION

Acme ELECTRONICS, INC.
300 No. Lake Ave., Pasadena 4, Calif.

Wave Filters • Delay Lines • Magnetic Amplifiers • Special Transformers & Chokes • Toroidal, Universal & Solenoid Wound Inductors

---

The New STAVER MINI-SPRING

TRADE MARK REG. AND PAT. PEND

Available! Special Improved Types for Military Apparatus

Gives support two ways—Keeps pressure downward and gives sideway support. The spring action is constant and resilient permanently. Send for catalog sheet.

THE Staver COMPANY INCORPORATED
91 PEARL ST. • BROOKLYN 1, N. Y.
ULSTER 5-6303

NOW! **ELECTRO-TECH'S**

OFF-THE-SHELF SERVICE

can save months on your schedule

ONE SOURCE OF SUPPLY for all kinds of ELECTRICAL METERS, INSTRUMENTS and INDUSTRIAL CONTROLS

No need to hold up production for lack of a meter, controller or other instrument! Electro-Tech's warehouse is bulging with panel meters, solenoids, transformers, rectifiers, timers, counters and every other kind of meter and control device. *Plus*—complete laboratory facilities to convert, repair and re-scale stock meters and instruments to fit your needs.

- SIMPSON
- WESTON
- STRUTHERS-DUNN
- MICRO SWITCH
- SUPERIOR ELECTRIC
- GENERAL ELECTRIC
- WHEELCO

— *and others*

FREE! *Write today for the big, useful Electro-Tech BUYER'S GUIDE.*

ELECTRO-TECH
EQUIPMENT COMPANY, Dept. E-2
308 Canal Street, New York 13, N. Y.

ELECTRO-TECH EQUIPMENT CO.

for academic consumption. Circuits are described in detail on the basis of physical operation, as well as from the theoretical standpoint. Liberal use is made of mathematics likely to be possessed by the senior in engineering courses, including calculus and transient analysis, but the descriptions of apparatus are self-contained so that benefit can be derived without a working knowledge of mathematical aids.

The bibliography is adequate, as are the subject and name indexes. Nearly 200 problems, covering all chapters except three, are collected at the end of the book. These are for the most part of senior-college difficulty.

Professor Anner evidently knows the whole field of technical television very well, is thoroughly familiar with the periodical literature, and has the faculty for organizing his material and presenting it clearly. He has produced a very worthwhile text which should meet an as-yet-unfilled need among senior and graduate students.

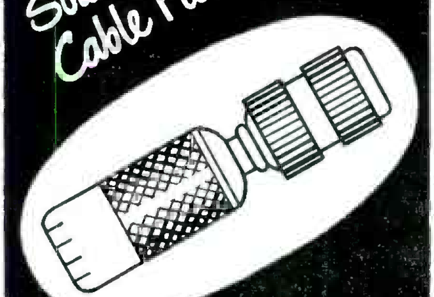
There are a few shortcomings. The material on color systems is, inevitably, out of date so far as compatible systems go. This is, of course, no fault of the author and can be corrected in a subsequent printing after the NTSC development is stabilized. The omission of numerical answers to the problems is a serious disadvantage for the reader who must study the book by himself. The highly mathematical flavor may prove a stumbling block for practicing engineers, five or more years out of college. But the book was not written for such as they. It is a textbook and a good one.—D.G.F.

Fundamentals of Radio Communications

BY ABRAHAM SHEINGOLD, *U. S. Naval Postgraduate School. D. Van Nostrand Co., Inc. New York*, 1951, 442 *pages* $5.25.

THIS is essentially a nonmathematical text of an intermediate level for students in colleges and technical schools. It includes a short refresher on d-c and a-c circuits and circuit analysis plus general material on the basic components—re-

Solderless Cable Fittings



WORKSHOP provides a complete line of solderless cable fittings for RG-59/U, RG-11/U and RG-8/U coaxial cables—all in current production and available in large quantities. Pictured above is the W-50 male cable connector, silver plated and specially slotted to withstand strain. Write for catalog and complete specifications.

THE WORKSHOP ASSOCIATES
Division of the Gabriel Co.
135 Crescent Road
Needham Heights 94, Mass.

---

for EMERGENCY

for CONVENIENCE

SOUND POWERED INTERCOM *and* TEST SYSTEMS

SERVICE · QUALITY · WHEELER · DEPENDABILITY

by

WHEELER

- No auxiliary power is required
- Operates over two conductor full metallic or single wire, ground return circuit
- Satisfactory operation up to 25 miles with #16 twisted; up to 15 miles with #19 twisted
- Explosion proof
- No spark or fire hazard is generated
- High fidelity speech transmission
- 12 handsets can be incorporated in communications system for group conversation

MANUFACTURED BY
The WHEELER INSULATED WIRE Co., Inc.
A DIVISION OF THE SPERRY CORPORATION

Niagara

RADIO SUPPLY CORP. Dept. 2-E

DIgby 9-1132-3-4

160 Greenwich Street, New York 6, N. Y.

---

after you've read this magazine

. . . and clipped pertinent ideas, articles and advertisements for reference, *please do not burn or throw it away.*

Here are two sound reasons why:

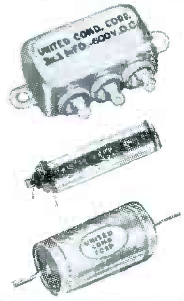
1) Wastepaper can help to swell the funds of your local Boy Scout Troop, your church or other community organization. It gets a good price these days.

2) Whether in magazine form or not, wastepaper helps to fill the increasing need for paper pulp brought on by the mobilization effort.

Collect it. Give it to your favorite organization. Chances are they have scheduled pickups.

Depend on...Unicon

CAPACITORS



Take no chances with ordinary capacitors — INSIST ON *UNICON* oil impregnated, hermetically sealed Capacitors. Made to meet JAN-C-25 specifications. Specially designed for severe military and tropical service.

We also specialize in miniaturization of 125°C capacitors meeting CP 10 and 11 requirements.

Catalogs and Quotations on Request!

- Oil Impregnated
- Vacuum Filled
- Hermetically Sealed
- Non-Corrosive Containers
- Made to JAN Specs.

UNITED CONDENSER CORP.
337 E. 139th St., N. Y. 54, N. Y.

SPECIFICATION

AN-P-89

PANELS - DIALS - ETC.

BODNAR INDUSTRIES, INC.
19 RAILROAD AVE., NEW ROCHELLE, N.Y.

sistance, inductance and capacitance, out of which all radio circuits are made. The manner in which these elements are combined to produce selective circuits of the resonant or iterative types or to transfer power is covered in two chapters, followed by chapters on the generation and propagation of radio waves, fundamentals of electron tubes and functions of tubes.

The up-to-date nature of this text can be gathered from the fact that it contains chapters on pulse circuits, uhf techniques and the important navigation systems now in use.

The book is well produced and easy to read and should be a useful first text in a field which is ever-changing.—K.H.

Semi-Conducting Materials

EDITED BY H. K. HENISCH. *Academic Press, Inc., New York*, 1951, 281 *pages*, $6.80.

IN JULY, 1950, a conference was held at the University of Reading on the subject of Semi-Conducting Materials. This conference was sponsored by the International Union of Pure and Applied Physics in cooperation with the Royal Society, and was organized by Professors R. W. Ditchburn of Reading and N. F. Mott of the University of Bristol. The volume under review constitutes the proceedings of this conference and contains in full the 28 papers presented.

Many of the papers discuss material that was new at the time of the conference, some of which had not come to this reviewer's attention before reading this book. As might be expected, a considerable amount had previously appeared as scattered papers read at meetings and as communications. We hasten to add that, in such cases, the Reading papers bring together the previous reports in such fashion that a much clearer picture is nearly always presented.

Results of the work done on semiconductors during and since World War II and discovery of the transistor effect have served to widen enormously the interest and activity now being devoted to these materials, not only upon the part of physicists but also upon the part of an ever-widening portion of the engineering profession. While the papers were, in general, written by and for specialists in the field of solid-state physics, it is safe to assume that "Semi-Conducting Materials" will be found both interesting and helpful to a large number of readers.

In this connection it may be of interest to quote one of the papers, that by Scott and Mayer: "Germanium, silicon, and other amphoteric semiconductors appear to be following a similar course of evolution"—to that of selenium—"in that the chemical (metallurgical) problems are well to the fore at present. However, in such cases physical theory, developed rapidly in the last year or two, has opened up the field in such a way that much more rapid progress may be expected. The physical side is likely to make even more spectacular advances when the chemistry of these materials is further clarified."

The same writers also quote Frederick Seitz as having said that "there is still a chance that the field of solid-state physics will be claimed by chemistry and electrical engineering." In the year and a half that has elapsed since the Reading Conference, the rate at which activity in semiconductor work has increased in the fields of chemistry, metallurgy and electronics overwhelmingly bears out the trends foreseen.

Scope of Papers

It is interesting to note that ten of the papers were written by Americans, ten by British and the remainder by Continental authors. Of the American papers, more than half are concerned with the properties of silicon and germanium; this may be taken as an indication of the impetus given to the study of these materials through government and industrial interest in the crystal diode and the transistor. Interest in silicon and germanium and in the transistor is not, of course, confined to this side of the Atlantic. Work on semiconductors in Europe does, however, seem to be somewhat more diversified and with greater emphasis on semiconducting compounds.

The list of titles and authors follows:

Semi-conductors, N. F. Mott
On the Energy States of Impurities in Silicon, G. W. Castellan and F. Seitz
New Phenomena of Electronic Conduction in Semi-conductors, W. Shockley
Semi-conductor Surface Phenomena, W. H. Brattain
Nucleon-bombarded Semi-conductors, K. Lark-Horovitz
Appendix I: Effect of Bombardment upon a Classical Semi-conductor in Thermal Equilibrium, V. A. Johnson and K. Lark-Horovitz
Appendix II: Fermi Levels in Bombarded Semi-conductors, H. M. James and G. W. Lehman
Crystal Triode Action in Lead Sulphide, P. C. Banbury, H. A. Gebbie and C. A. Hogarth
Recent Experiments on Lead Sulphide Contacts, H. K. Henisch and J. W. Granville
Electrical Characteristics and Anomalies of Germanium, P. R. Aigrain, C. R. Dugas and H. W. Etzel
Electron Traps and Electron Conduction in Irradiated Alkali Halide Crystals, R. W. Pohl
Motion of Electrons and Holes in Silver Chloride, L. P. Smith
Semi-conduction and Photo-conduction in Barium Oxide Crystals, R. L. Sproull and W. W. Tyler
Infra-red Optical Properties of Silicon and Germanium, H. Y. Fan and M. Becker
Work Function of Germanium, E. W. J. Mitchell and J. W. Mitchell
Oxidic Semi-conductors, E. J. W. Verwey
Some Properties of Mixed Lanthanum and Strontium Manganites, J. Volger
Electrical and Optical Properties of Zinc Oxide, P. H. Miller, Jr.
On the Properties of Semi-conducting Oxides, T. J. Gray
Electronic Properties of Grey Tin, G. Busch, J. Wieland and H. Zoller
Electrical and Optical Properties of Certain Sulphides, Selenides and Tellurides, R. A. Smith
Measurements of the Temperature-dependence of Conductivity and Hall Coefficient in Lead Sulphide and Lead Telluride, R. P. Chasmar and E. H. Putley
Some Experimental Studies of the Resistance and Electromotive Force of Selenium Blocking Layer Cells, A. E. Sandstrom
On the Thermo-electric Properties of Selenium, H. K. Henisch and M. Francois
Crystallization of Semi-metals and the Formation of Lattice Effects, H. Krebs
Engineering and Chemical Aspects of Semi-conductors, T. R. Scott and S. E. Mayer
Electrical Conductivity of Very Thin Metallic Films Evaporated in High Vacuum, N. Mostovetch and B. Vodar

A word of appreciation is due Dr. H. K. Henisch of Reading University, who served as Secretary of the Conference, for an especially competent job in the onerous task of editing the proceedings.

—GEORGE D. O'NEILL,
Head Solid State Section, Physics Laboratories, Sylvania Electric Products Inc.

THUMBNAIL REVIEWS

QUALITY-CONTROL HANDBOOK. Edited by J. M. Juran. McGraw-Hill Book Co., New York, 1951, 800 pages, $10.00. Compilation, by many authors, of known principles and practices for achieving better quality at lower cost. Intended primarily for reference by engineers, supervisors and executives. Based on material originally used for training courses in industry. One entire chapter covers quality

The Largest Selling LIGHTNING ARRESTER At Any Price!

Protects Home and TV Set Against Lightning Hazards

$2.25 LIST

U.S. Patent No. D-4664

- Installs anywhere
- No wire stripping, cutting or splicing

(Complete with strap and ground wire.)

OVER 1,000,000 IN USE TODAY!

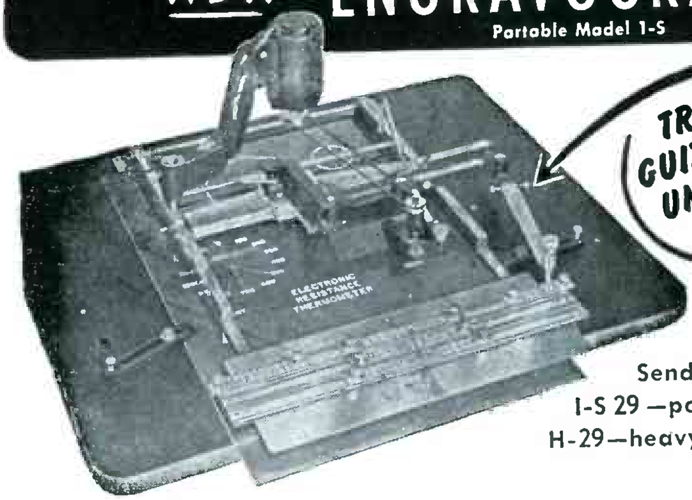
See Your Jobber or Write for Form No. 84

JFD MANUFACTURING CO., Inc.
6145 B 16th AVENUE, BROOKLYN 4, N. Y.
FIRST in Television Antennas and Accessories

Engrave

. . . PANELS UP TO 25" WIDE IN YOUR OWN SHOP WITH THE *NEW* ENGRAVOGRAPH

Portable Model 1-S



TRACER GUIDED FOR UNSKILLED LABOR

Send for Booklets
I-S 29 —portable model
H-29—heavy duty model

NEW HERMES, Inc. • 13-19 University Place, New York 3, N. Y.
CANADA: 359 St. James St., Montreal

Wanted . . .

CHIEF MECHANICAL ENGINEER

Salary $8,000 to $10,000 start

This is a permanent position with established electronic & microwave equipment mfr.

Qualifications:

(1) At least 10 years of senior design experience with precision mechanisms involving gearing, castings, cams and linkages that have been manufactured.
(2) Knowledge of production tooling for short run and shop production methods.
(3) Familiar with military specifications covering mechanical parts and instruments.
(4) Creative ability for product design and development work.
(5) Evaluate existing production designs for improvement and economy.
(6) Direct and supervise a group of designers and detailers.
(7) Must be willing to assist and execute designs on drafting board.
(8) Must be U. S. Citizen.

LOCATION—BROOKLYN, N. Y. SUBWAY TRANSPORTATION

Liberal benefits including Hospitalization, Life Insurance Sick Leave. Paid vacation

Send complete resume.

P-2765, Electronics
330 W. 42 St., New York 36, N. Y.

---

new hermes

Engravograph

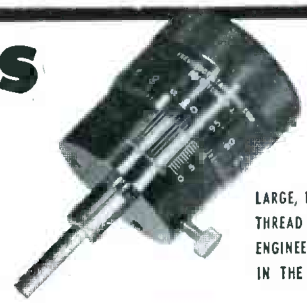
TRADE MARK

- The *only* portable machine which reproduces 15 sizes from one master alphabet.
- The *only* one with *adjustable* copy holding slides for multiline engraving in one set-up.
- Self-centering holding vise for nameplates and dials.

NEW HERMES, Inc. • 13-19 University Place, New York 3, N. Y.
World's Largest Manufacturer of Portable Engraving Machines

FS MICROMETER HEAD

for the Electronics Industry



LARGE, LEGIBLE, EASY TO READ CALIBRATIONS, PLUS A THIMBLE STOP TO PREVENT THREAD JAMMING, ARE FEATURES FOUND IN FS MICROMETER HEADS WHICH HELP ENGINEERS SPEED UP THEIR WORK. THESE AND MANY OTHER FEATURES ARE DESCRIBED IN THE NEW BULLETIN ON FS MICROMETER HEADS, OBTAINABLE ON REQUEST.

3

FREQUENCY STANDARDS
P. O. BOX 66, EATONTOWN, N. J. • TELEPHONE ASBURY PARK 1-1018

control of electron tubes, and another covers incoming inspection of vendor material.

TELEVISION EQUIPMENT THEORY AND OPERATION. Broadcast Equipment Section, Engineering Products Dept., Radio Corporation of America, Camden, N. J., Sixth Edition, 1951, 444 pages, $8.00. Manual for television technical training, with four major sections covering Transmitters, Antennas, Video and Audio. Each starts with general principles of design and operation presented much as in handbooks or textbooks, followed by descriptions of available RCA equipment and sections dealing with recommended specific operating procedures.

PROBLEMS FOR THE NUMERICAL ANALYSIS OF THE FUTURE. National Bureau of Standards Applied Mathematics Series 15, 21 pages, 20 cents from Govt. Printing Office, Wash. 25, D. C. Four of papers presented at symposia dedicating NBS Institute for Numerical Analysis on Univ. of Calif. campus: Some Unsolved Problems in Numerical Analysis; Numerical Calculations in Nonlinear Mechanics; Wave Propagation in Hydrodynamics and Electrodynamics; Linear Programming.

ACOUSTICAL TERMINOLOGY. American Standards Association, 70 E. 45th St., New York, 1951, 50 pages, $1.50. American Standard Z24.1-1951, sponsored by Acoustical Society of America in cooperation with IRE. Revision of 1942 edition.

MATHEMATICS FOR ENGINEERS. By Raymond Dull and Richard Dull. McGraw-Hill Book Co., New York, 1951, Third Edition, 822 pages, $7.50. Quick reference book for engineers, giving in a single volume a concise yet complete review from algebra through differential and integral calculus.

DESIGN, CONSTRUCTION & OPERATING PRINCIPLES OF ELECTROMAGNETS FOR ATTRACTING COPPER, ALUMINUM AND OTHER NON-FERROUS METALS. By Leonard R. Crow. The Scientific Book Publishing Co., Vincennes, Indiana, 1951, 38 pages, $1.25. Based on repulsion effect of conductive washer serving as short-circuited secondary of an a-c electromagnet, on use of shading coils and on use of short-circuited copper secondary on center core leg of three-legged a-c eletcromagnet. Many dramatic arrangements for educational demonstrations are described and pictured.

PRACTICAL ELECTRICITY AND MAGNETISM. By Maurice Rubin. Chemical Publishing Co., New York, 1951, 356 pages, $7.50. Elementary survey, with emphasis on recent developments. Includes chapters or sections on photoelectric emission, electronics, conductivity of gases, radio, television and radar. The final chapter deals almost entirely with new electronic developments.

ANNUAL REPORT OF THE NATIONAL BUREAU OF STANDARDS FOR 1950. Government Printing Office, Washington, 113 pages, $.50. Summaries of scientific investigations at NBS during 1950 and accounts of current activities. Includes details of the SEAC automatically sequenced electronic computer, NBS electronic currency counter and the omegatron which discriminates between atomic particles of different masses.

TV AND ELECTRONICS AS A CAREER. By I. Kamen and R. H. Dorf. John F. Rider Publisher, Inc., New York, 1951, 326 pages, $4.95. A comprehensive book-size answer to the perennial question fired at those in the electronic industry, "How can I get into television or electronics?" After an opening chapter on selecting a career, seven chapters cover the eight major types of careers: Television Broadcasting; A-M F-M Broadcasting and Communications; Radio and Television Manufacturing; Electronic Engineering; Television Servicing; Distribution; Electronics in the Armed Forces.

BACKTALK

Addendum

DEAR SIRS:

ON PAGE 270 of the November 1951 issue of ELECTRONICS, the third footnote for Mr. Baruch's article entitled, "Close Differential Thyratron Relay", needs the following information added to it: *AIEE Transactions*, **69**, p 270, 1950. This addendum may prove helpful to others who were interested in the article.

GLEN M. DODD
Code 425, Navy Electronics Laboratory
San Diego, California

Wider Range

DEAR SIRS:

AFTER looking over my article "Universal Equalizer Chart" in the November 1951 issue of ELECTRONICS (page 132), I was very pleased at how well the charts were reproduced. However, I felt it was unfortunate that the word "audio" crept into the abstract as well as the front contents page. This detracts from the generality of the chart.

As a matter of fact, in the Bell System the bridged-T equalizer is the most abundant type of phase and delay equalizer for video facilities.

D. A. ALSBERG
Bell Telephone Laboratories
Murray Hill, New Jersey

Book Reviews

DEAR SIRS:

I HAVE READ your review of the "Radio Amateur's Handbook" and the "Radio Handbook" which appears in the December 1951 issue of ELECTRONICS on page 322. I wish to congratulate you on your objective comments and criticisms of the publications.

Particularly, it is most noteworthy that you have compared the two books in various fields and that you have done this on an "individual merit" basis. This is a far cry from the usual, generally laudatory "Well, boys, here is another edition of X Handbook" reviews which have appeared in the technical press for many years.

Certainly the thoughtful and objective review discussed here is one of the finer examples of the reviewers' art. Perhaps it will even stir a policy review in at least one publisher's household.

I must note that I have been finding the book review section of ELECTRONICS stimulating. For example, the recent and controversial discussion of the new edition of August Hund's "High Frequency Measurements" (a McGraw-Hill book, too) was most interesting.

J. N. BOLAND
Raytheon Manufacturing Co.
Waltham, Massachusetts

Electronics Quiz

LAST month's problem involved a feedback amplifier of the type illustrated in Fig. 1A The amplifier has an open loop gain of A at an angle of thirty degrees leading and feedback as shown. The problem

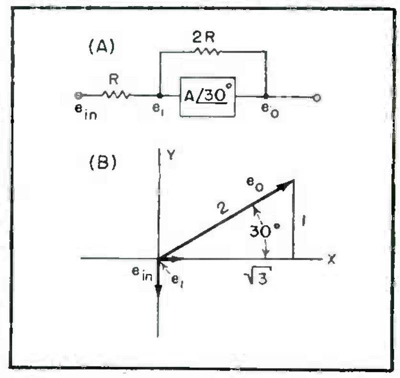


FIG. 1—Illustration of statement and solution of last month's brain teaser

was to determine the maximum value of $|e_o|/|e_{in}|$.

The solution for the problem, as furnished by John J. Antul of the Transducer Corp., is illustrated in Fig. 1B. Since e_1 has no Y component, e_{in} must have a Y component of $-\frac{1}{2}$ the Y component of e_o. With e_o constant, maximum $|e_o|/|e_{in}|$ occurs when e_{in} is minimum, and then e_{in} has no X component. Therefore

$$\frac{|e_o|}{|e_{in}|} = \frac{2}{\frac{1}{2}} = 4$$

Incidentally, it is interesting to note that A is equal to the magnitude of e_o divided by one third the X component of e_o, or $A = 3.464$, and e_o leads e_{in} by 90 deg plus 30 deg, or 120 deg.

PROFESSIONAL SERVICES

Consulting—Patents—Design—Development—Measurement

in

Radio, Audio, Industrial Electronic Appliances

• CONTACTS •

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.

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT • BUSINESS
EQUIPMENT — USED OR RESALE

OPPORTUNITIES

UNDISPLAYED: $1.50 per line, minimum 3 lines. Count 5 average words as one line. POSITION or SELLING OPPORTUNITY WANTED are ½ these rates, payable in advance.

BOX NUMBERS care of this publication count as one additional line.

DISPLAYED: $14.00 per column inch per insertion. Contract rates are quoted on request. The advertising inch is ⅞" deep by 2¼" wide. There are 10 inches to one column, 30 inches to the page.

NEW ADVERTISEMENTS received by Feb. 1 at the New York office, 330 W 42nd St, N. Y. 36, will appear in the March issue, subject to limitation of space available.

SALES ENGINEER

to organize and direct sales department

COIL WINDING MACHINERY

Excellent opportunity for man who understands coil winding machines and can sell a line unsurpassed in quality. Must have thorough experience all phases coil winding equipment and end products. Our organization knows of this advertisement. Replies in strict confidence.

Write Box P-3006, Electronics
330 W. 42nd Street, New York 36, N. Y.

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)

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1920, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L, 241 Orange St., New Haven, Conn.

SELLING OPPORTUNITIES WANTED

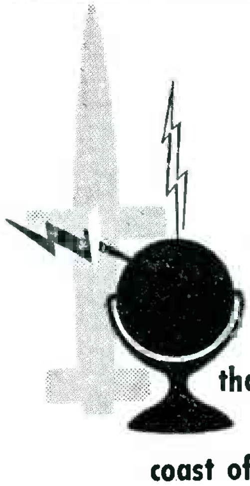
AN OLD American machine sales establishment is looking for new connections and would like to represent American manufacturers in the United States and foreign countries, not necessarily on an exclusive basis. We are interested in handling machine tools and electrical appliances. We have offices and warehouses in New Jersey. Reply to RA-2915, Electronics.

ELECTRICAL COMPONENTS Representative covering N. Y. City, L. I. and Northern N. J. desires additional line. Ten years experience, excellent contacts with mfrs. RA-2970, Electronics.

PATENTS

Consult A. John Michel.
Registered Patent Att. specializing in Electronics. 15 Park Row, New York 38, N. Y. Tel. CO-7-9034.

CONSULT: Z. H. POLACHEK,
Reg. Patent Attorney, 1234 Broadway, New York 1, N. Y.



ENGINEERS

Special opportunities for YOU in

SAN DIEGO

that sunshiny, smog-free city on the coast of CALIFORNIA

Convair (Consolidated Vultee Aircraft Corporation) is now accepting applications for these following positions in its modern, progressive Engineering Department.

Microwave Engineers
Servomechanism Engineers
Electronics System Engineers
Electronic Circuit Designers

Unusual opportunities for those experienced in the design and analysis of Radar and Missile Guidance Systems.

WORKING FACTS: You get two holidays a week at Convair — overtime accomplished in 5-day week. Attractive salary ranges. An "engineers" engineering department . . . with stimulating, competent associates . . . and interesting, challenging, essential, long-range projects of a wide variety including — commercial aircraft, military aircraft, missiles, engineering research and electronic development. Excellent patent royalty arrangements. Top-notch retirement plan — better than-average life and health insurance. Complete progress-salary review for each person twice yearly. Opportunity for continuing engineering education.

LIVING FACTS: San Diego, with its wonderful residential areas, offers you and your family incomparable living. Ideal climate — cool, clean, dry. Mountains, desert, Mexico, Hollywood, Los Angeles, Pacific Ocean, beaches and bay — only hours or minutes away. It offers you a new way of Life . . . pleasant, refreshing, happy.

If you qualify, you will receive generous travel allowances. ***SEND COUPON*** for free booklets and complete information.

THANK YOU

Mr. H. T. Brooks, *Engineering Department 900*
Convair, 3302 Pacific Hiway, San Diego, California

Please send me ***FREE*** booklets describing the Convair Opportunity for me and my Convair Application Form.

My name ______________________

Occupation ______________________

Address ______________________

City______________ State______________

ATOMIC WEAPONS INSTALLATION

NEEDS

ELECTRONIC ENGINEERS

Two to ten years' experience in research, design, development or test. Patent history desirable but not necessary. A variety of positions open for men with Bachelor's or advanced degree qualified in one or more of the following fields:

- RELAYS
- TELEMETERING
- PULSE CIRCUITS
- UHF TECHNIQUES
- SERVO-MECHANISMS
- INSTRUMENTATION
- QUALITY CONTROL
- LOW POWER APPLICATION
- TEST EQUIPMENT RELATING TO ABOVE FIELDS

TECHNICAL WRITERS

Experienced in preparation & publication of standards, electronic & mechanical technical manuals. Engineering background necessary.

JOB ANALYSTS

Mechanical & electrical engineers experienced in job evaluation & other wage administration activities.

PHYSICISTS

With pure physics background.

STANDARDS ENGINEERS

Experienced in writing specifications, in liaison work, and in correlating design information to accepted standards. Aircraft industry experience desirable.

These are PERMANENT POSITIONS with Sandia Corporation in Albuquerque, New Mexico. The Laboratory is operated by Sandia Corporation, a subsidiary of Western Electric Company, under contract with the ATOMIC ENERGY COMMISSION. This laboratory offers good working conditions and liberal employee benefits, including paid vacations, sick leave, and a retirement plan.

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment." Albuquerque lies at the foot of the Sandia Mountains, which rise to 11,000 feet. Climate is sunny, mild and dry the year 'round. No housing shortage in Albuquerque.

MAKE APPLICATION TO

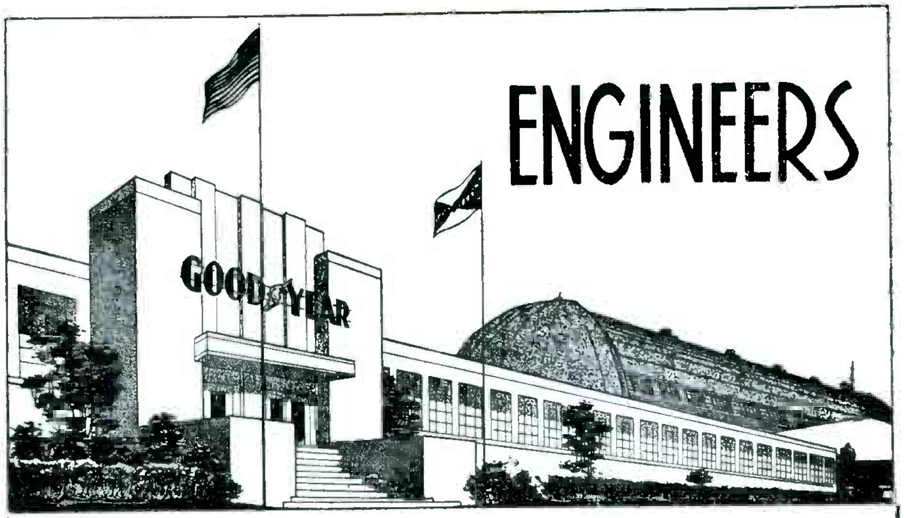
Professional Employment

SANDIA CORPORATION

SANDIA BASE

ALBUQUERQUE, N. M.

ENGINEERS



ENGINEERING WITH A FUTURE

RESEARCH • DEVELOPMENT • DESIGN

The continued and steady growth of established research and development projects has opened a number of unusual opportunities for outstanding and experienced men.

ENGINEERS • SCIENTISTS • PHYSICISTS

Positions are available in our organization for qualified personnel in the following fields:

Circuit Analysis	Aerodynamics
Microwaves	Applied Mathematics
Analog Computers	Physics
Servomechanisms	Flight Test
Dynamics	Design

Openings exist at several levels, and inquiries from recent graduates are also invited. Salaries are based on education, ability, and experience. Liberal salary, vacation, insurance, and retirement plans are yours if you qualify.

If you are interested in a secure future in these experimental fields, write and give full details to Mr. C. G. Jones, Salary Personnel Department.

GOODYEAR AIRCRAFT

GOODYEAR Aircraft CORPORATION

Akron 15, Ohio

Large Electronic Manufacturer located in Boston area has immediate openings for

MECHANICAL BUYER

Man with experience in procurement of large and small machined components to tight machine tolerances. Machine shop experience valuable consideration in selection of applicant. Past experience in electronic or allied industry preferred. Ability to evaluate prints for methods and cost estimating is important. Please write giving full particulars.

SHEET METAL BUYERS

Man with experience in procurement of sheet metal components (chassis—cases—panels, etc.) Applicants should have thorough knowledge of equipment, methods and cost estimating of both ferrous and non-ferrous sheet metal fabrication and welding. Past experience in buying similar components under tight quality control regulations desired. Please write giving full particulars.

P-2874, Electronics
330 W. 42nd St., New York 18, New York

Want a Better Job?

ELECTRONIC

ENGINEERS & TECHNICIANS

investigate

HASTINGS INSTRUMENT CO.

HAMPTON, VIRGINIA

Designers • Manufacturers of

☆ **Raydist** — Most precise of all radio positioning and tracking systems for land, marine and aviation work — accurate to 1 foot in a mile.

☆ **PRECISION**—Velocity, pressure, flow and vacuum measuring and recording equipment.

• Hastings offers interesting opportunities for engineering and technical personnel in a long term development and production program — Excellent salary — Pleasant working and living conditions — Ideal climate — Investigate this aggressive, medium sized, pioneering, company · today — Work with a select group of exceptionally qualified young men. Your inquiry will receive prompt reply.

WORK FOR A GROWING COMPANY IN THE HEART OF VIRGINIA'S FAMOUS RESORT AREA

Write Today

HASTINGS INSTRUMENT COMPANY, INC.

HAMPTON 21, VIRGINIA

Engineers

choose your area of specialization at Minneapolis-Honeywell

Minneapolis-Honeywell Regulator Company, the leader in the field of automatic controls and instrumentation, is presently engaged in research and design work in the areas listed below in both the aeronautical and general engineering divisions. Much of this work borders closely on so-called "pure" or "basic" research.

If you as an engineer are primarily concerned with any of these fields of work; if you have the proper background; and if you are interested in becoming associated with a stable progressive firm, please let us hear from you.

- electronics
- servo-mechanisms
- hydraulics
- electro-magnetics
- heat transfer
- vacuum tubes
- gyros
- relays
- computors
- electro-mechanical devices
- semi-conductors
- bearings
- electrical contact phenomena

Excellent opportunities for advancement in an expanding organization. Promotions granted on basis of merit. Salaries commensurate with background. Address reply to:

R. WAGNER

Minneapolis-Honeywell Regulator Company

2753 Fourth Avenue South
Minneapolis, Minnesota

MINNEAPOLIS **Honeywell**
First in Controls

California Calling

AIRCRAFT ELECTRICAL and RADIO DESIGNERS

A better job, a better life, a better future can be yours in California—at Lockheed Aircraft Corporation.

On the job, you enjoy increased pay; fine, modern working conditions; association with top men in your profession—men who have helped build Lockheed's reputation for leadership.

Off the job, you live in a climate beyond compare—where outdoor living can be enjoyed the year around.

In addition, Lockheed's production rate and backlog of orders—for commercial as well as military aircraft insures your future.

REQUIREMENTS:

Design experience in aircraft electrical installation, circuit layout and systems analysis; experience in radio and radar circuit design and installations, as applied to aircraft.

NOTE TO ENGINEERS WITH FAMILIES:

Housing conditions are excellent in the Los Angeles area. More than 35,000 rental units are available. Thousands of homes have been built since the war; huge tracts are under construction now. You will find the school systems as good—from kindergarten to college.

Send today for free, illustrated brochure describing life and work at Lockheed in Southern California. Use handy coupon below.

Mr. M. V. Mattson, Employment Manager Dept. EL-1

LOCKHEED

AIRCRAFT CORPORATION, Burbank, California

Dear Sir: Please send me your brochure describing life and work at Lockheed.

My name

My address

My city and state

My occupation (type of engineer)

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

CORNELL AERONAUTICAL LABORATORY, INC.

an affiliate of Cornell University

employs about 700 people on vital research work in all branches of aeronautical science. We are gradually expanding our scientific staff, and have several permanent positions open for:

ELECTRONICS ENGINEERS
PHYSICISTS
MECHANICAL ENGINEERS
AERODYNAMICISTS
AERONAUTICAL ENGINEERS
CHEMICAL ENGINEERS

in such fields as:

GUIDED MISSILES
RADAR RESEARCH
BASIC AND APPLIED PHYSICS
ELECTRONIC COMPUTERS
SYSTEMS ANALYSIS
AIRCRAFT PRECISION INSTRUMENTATION
WIND TUNNEL RESEARCH
FLIGHT RESEARCH
DEVELOPMENT ENGINEERING
HEAT TRANSFER
THERMODYNAMICS

Minimum requirement is a B.S. Advanced degrees are even better, but experience to back up the degree is really best. We pay industrial salaries. Other tangible advantages here (for example, our self-sponsored internal research policy) should be of particular interest to men with intelligence, ingenuity, and initiative. Send us your resume; all inquiries are strictly confidential. Promising candidates will be invited to Buffalo for interviews at Laboratory expense.

CORNELL AERONAUTICAL LABORATORY, INC.
P. O. Box 235 Buffalo 21, New York

LOOKING AHEAD?

If you're a top performer in the field of physics, electronic engineering or design, and you're looking for a career as well as a well-paid position, it will pay you to investigate the excellent opportunity we offer.

• • •

BASIC QUALIFICATIONS: Minimum of four year's experience in advanced research or development related to:

- PULSE CIRCUITS
- COMPUTERS
- NUCLEAR INSTRUMENTS
- MINIATURIZATION

• • •

ILLUSTRATED BROCHURE on request. Please write (giving summary of your education and experience, plus salary requirements) to:

THE BERKELEY SCIENTIFIC CORP.
2200 Wright Avenue
RICHMOND, CALIFORNIA

AC SPARK PLUG DIVISION of GENERAL MOTORS CORPORATION

PRECISION INSTRUMENT PLANT

Positions now available for highest caliber personnel in the field of airborne automatic electro-mechanical control equipment.

MECHANICAL DESIGN ENGINEERS
ELECTRONIC ENGINEERS
SERVO ENGINEERS
ELECTRONIC DESIGNERS
MECHANICAL DESIGNERS

New and expanding division of an established firm with 20 years of successful experience in the instrument field. Work involved deals with the manufacture and development of highly complex equipment of the most advanced type.

Write or Apply

AC Spark Plug Division
GENERAL MOTORS CORPORATION
1925 E. Kenilworth Place
Milwaukee 2, Wisconsin

EMPLOYMENT . . . EQUIPMENT . . . BUSINESS
OPPORTUNITIES
Whatever your need— think "SEARCHLIGHT" FIRST

ELECTRONIC ENGINEERS

Seniors and Juniors

Outstanding opportunities for engineers with background in one or more of the following fields:

- Wide Band Video and Low Power Pulse Circuitry, Including Amplifiers, Oscillators, Modulators
- Wide Band FM Circuits
- Microwave Techniques, Incl. Antenna Design, RF, Plumbing and Tubes, Such as Traveling Wave, Klystron, Magnetron

Experience should include design, analysis, and development in above fields.

To work with internationally known scientists in well equipped Manhattan laboratories of leading electronic concern on fundamental research and development problems. Our staff advised of this ad.

Top compensation for qualified men.

Write full details including salary required to

Box P-2893, Electronics
330 W. 42nd Street, New York 36, N. Y.

ELECTRONIC ENGINEERS

Permanent expansion program offers fine career opportunities with one of the leading companies in the industry.

Tung-Sol Electric Inc. Radio and Television tube manufacturers, is now interviewing qualified engineers for immediate job openings at excellent salaries with fine opportunities for advancement.

Experienced Engineers—If you have had experience in any phase of radio tube manufacturing including design, development, production, application or special problems involving glass technology, shrinkage control, etc., we would like to hear from you.

Trainees—We also have a limited number of openings in our training program for those men who hold a degree in electronics but have no experience in this field.

Write or apply in person to

Personnel Director

TUNG-SOL ELECTRIC INC.

200 Bloomfield Ave.,
Bloomfield, N. J.

ENGINEERS WANTED

Motorola Research Laboratory

PHOENIX, ARIZONA

Permanent positions available in ideal healthful climate. Only fully qualified project leaders and development engineers should apply. Microwave, measurement communications, pulse technique, and antenna specialists needed. Exceptional opportunity for qualified microwave radar project leader and microwave antenna specialists.

First confidential letter should include summary of education, experience and past salary schedules. Similar positions open in MOTOROLA Chicago laboratories.

WRITE

Daniel E. Noble

Communications & Electronics Div.,

MOTOROLA, INC.

4545 Augusta Blvd. **Chicago 51, Illinois**

ATTENTION!

Former Field Engineers

We urgently need men with electronic background, and preferably radar or computer experience, to supervise, instruct and assist in installation—maintenance of electronic equipment.

Excellent starting salary during factory training, plus overtime premium in field. Substantial insurance program. Overseas duty not mandatory. Salary will be commensurate with experience.

Please forward your personal experience record to:

Personnel Supervisor
Field Eng. Div.

Reeves Instrument Corp.
215 East 91st St.
New York, 28, N. Y.

MECHANICAL ENGINEER

SENIOR

FOR SYLVANIA'S

LONG ISLAND RESEARCH & DEVELOPMENT LABORATORIES

To work on mechanical design and development of vacuum tubes, electronic devices, experimental tools, dies, and laboratory equipment.

BS in ME and minimum of 5 years experience in electro-mechanical field essential.

Please send complete resume to:

MANAGER OF PERSONNEL
DEPT. ME-I

SYLVANIA

Electric Products, Inc.
40-22 Lawrence St.
Flushing, N. Y.

TOP EXECUTIVE

Manufacturer of Capacitors

Top executive position in existing electronics capacitor manufacturing company located in California available for right kind of man who can take over complete management and run sales and engineering department. Salary and other terms open for negotiation. Please write giving all details as to present and former employers, references and background. Replies held confidential. Address: Box No.

P-2977, Electronics
330 W. 42nd St., New York 36, New York

ENGINEERS

and

PHYSICISTS

Work in Challenging Design and Development Fields Combining the Benefits of Essential Work with Security and Rapid Professional Advancement. Enjoy, among other Benefits:

- **Overtime (5-day week)**
- **Company-Paid Insurance**
- **Periodic Merit Reviews**
- **Excellent Compensation**

IMMEDIATE OPENINGS EXIST FOR MEN EXPERIENCED IN THE FIELDS OF

- GYROSCOPICS
- ANALOG COMPUTERS
- FIRE CONTROL SYSTEMS
- SERVO MECHANISMS
- INSTRUMENT DESIGN
- CONTROL CIRCUITS

Reply by sending complete resume to

TECHNICAL PERSONNEL OFFICE

ARMA CORP.

254 36th St. **Brooklyn 32, N. Y.**

Additional Positions Vacant Ads on the following page

CHICAGO MIDWAY LABORATORIES

Long Range Research on the UNIVERSITY OF CHICAGO CAMPUS

Qualified research men are needed in the fields of:

INFRA RED, TEST EQUIPMENT, MICROWAVES, MACHINE DESIGN, BALLISTICS, INSTRUMENT DESIGN, ELECTRONICS, SERVO MECHANISMS, OPTICS, TELEMETERING, SOLID STATE

This laboratory is undertaking fundamental and applied research on the problems of tactical air warfare. You will work with top level research men as well as many senior scientists of the University of Chicago.

Qualified men will enjoy rapid advancement in this stimulating academic atmosphere. Recent engineering and science graduates will gain valuable experience with which to start a research career. The salary scale is that generally prevailing in industry, with generous vacation allowance and benefits.

Since the laboratory is being established at the request of the air force, the high priority of the work involved should furnish a favorable basis for draft deferments. Applicants must be U.S. citizens.

Address your inquiries to:

CHICAGO MIDWAY LABORATORIES

The University of Chicago
Watts S. Humphrey
Director of Scientific Personnel
6040 South Greenwood Avenue
Chicago, Illinois

PERPLEXED?

The keystone of our long range program is a carefully planned seminar devoted to advanced study and management participation which, after an introductory period, you will be invited to join. Your ideas and opinions on technical, managerial, and personnel problems will be welcomed and used.

Positions in Antenna Research and Development for Senior and Junior Engineers, Physicists and Mathematicians. Liberal patent and other benefits. Send resume to Arthur Dorne.

DORNE AND MARGOLIN
Sheridan Ave., Bethpage, N. Y.

CHECK CIRCLE FOR VALUES!

STANCOR TRANSFORMERS

T-101—Pri. Z. 75 ohms, Sec. Z. 125,000 ohms, Turns Ratio 1-41, 020 watts, Pri. D.C. Res. 5.50 ohms, Sec. D.C. Res. 2620 ohms, Freq. Resp. 200-5000 .... BRAND NEW $2.45

T-102—Pri. Z. 6000, Sec. Z. 6000, Turns Ratio 1-1, 20 watts. D.C. Res. Pri. 170, D.C. Res. Sec. 215, Freq. Resp. 200-5000. Test 3000 V. BRAND NEW $2.95

T-201—Pri. Z. 7500, Sec. Z. 600, Turns Ratio 3.85-1, D.C. Res. Pri. 560 Sec. 42, Freq. Resp. 200-5000. Test Volts—1500.. BRAND NEW $2.75

DYNAMOTORS

D-104—Dual 12 V. input, output 225 and 440 V. .... BRAND NEW $19.00

Type PS-225—28 V. input, 375 output @ .150 amps. $4.95

PE-94—Used, good $2.95

CONTROL BOXES

C-237/APG15, Brand New .... $8.95 ea.

C-141/APG15, New .... $9.95 ea.

ANTENNA ASSY AS-69APT, Brand New $5.95

ARC-5 PLUGS .... 59¢ ea.

CANNON PLUGS—AP-4-14 or AP-6-14, New 39¢ ea.

WESTERN ELECTRIC VOLTAGE REGULATOR

BC-937 B, used, excellent .... $7.75 ea.

SURPLUS WANTED!!

ELECTRONICS*

* Telephone & Teletype Equipment

WE PAY TOP DOLLARS! ANY QUANTITY!

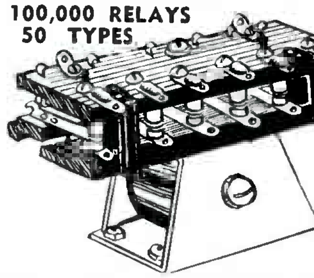
TERMS—Send 25% deposit with order, balance C.O.D. Shipped F.O.B., N.Y.C. (N.Y.C. residents add 3% sales tax.)

CIRCLE SALES CORP.
113 GREEN ST., N.Y. 12, N.Y. - WOrth 4-1541-2

Priced Right—Immediate Delivery

100,000 RELAYS
50 TYPES

E X A M P L E



Six-Pole Double Throw Allied # BN-18D-39 has 10 AMPERE CONTACTS 2800 ohm coil operates on 30 mills DC $6.95

Struthers-Dunn 115v. AC Coil Micalex Base & Cross-arm D.P.D.T. ¼" contacts conservatively rated 6 amp. @ 500v. rf $3.95

Guardian #150-A—Double Pole Double Throw 8 Ampere Contacts. 115V. A.C. Coil. Single screw mounting $2.50

Advance Series 1000 115v. AC. Coil ¼" silver D.P.D.T. cts. Ceramic insulation $3.95

Advance Series 2000 115v. DC Coil 4200 ohms. All Other Specs as above $3.95

Potter & Brumfield #MR7D—Double Pole N.O. 10 ampere contacts. 6000 ohm coil operates on 110V. D.C. $1.95

Potter & Brumfield #MR7A—Double Pole N.O. 10 ampere contacts. Coil operates on 6V. A.C. .. $1.95

Leach Relay #1024-A 3 Pole N.O. 100 ohm coil operates on 6v. DC $1.95

G.E. Relay #CR 2791-B109P36—S.P.D.T. double break contacts rated 3 amps. 10,000 ohm coil operates on 8 mills DC $1.95

Allied #BO 635 D.P.D.T. 15 amp. cts. 24v. dc 230 ohm coil $2.50

RADIO DEVELOPMENT & SALES CO.
323 Atlantic Ave., Brooklyn 2, N. Y. ULster 5-0488

POSITIONS OPEN

Location
KANSAS CITY, MO.

Electronic & Mechanical Engineers

ELECTRONIC ENGINEERS: Must have considerable development experience in radio transmitting and receiving equipment. Ability to fill position of Senior Project Engineer a requisite.

MECHANICAL ENGINEER: Must have development experience in mechanical design of electronic or similar precise equipment. Practical and theoretical knowledge of materials, finishes, sheet metal, and machine shop design are basic requirements. Position is one of considerable responsibility.

SALARY: Open.

These positions are permanent.
Write stating educational and professional history direct to:

Jay V. Wilcox, *President*
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut St. Kansas City 1, Mo.
Dependable communications since 1931

COIL WINDING EQUIPMENT FOR SALE

RF—IF—TV Coil Manufacturers who are interested in Universal and Stevens Winders, Production TEST Equipment, LABORATORY Equipment and many items of WIRE, CORES, ETC., may obtain complete list and arrange for inspection on premises of former Coil Manufacturer. Address inquiries to

FS-2961, Electronics
520 N. Michigan Avenue, Chicago 11, Illinois

Reliance Specials

TIMING MOTOR
8 RPM 115V 60 cyc
E. Ingraham Co.

$1.95

GEAR ASSORTMENT
100 small assorted gears. Most are stainless steel or brass. Experimenters dream! .... Only $6.50

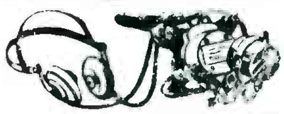
VERNIER DIAL or DRUM (From BC-221)
DIAL—2⅝" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0.50 in 180°. Black with silver marks .... either 85c

SOUND POWER HANDSET
BRAND NEW

Includes 6 ft. cord.—No batteries or external power source used. $17.60 pr.

AC LINE CORDS—4 ft. long with molded rubber plug 10¢

Sound Powered Chest Set RCA—With 24 Ft. Cord
Per Pair
USED $17.60
NEW $26.40



400 CYCLE INVERTERS
Leeland Electric Co.

#10800 in: 20-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 400 Cyc. 1 phase, 1500 V.A. 90 PF $24.95

3AG FUSES

AMP	Per 100	AMP	Per 100	AMP	Per 100
1/8	$4.00	3/4	$4.00	6	$3.00
3/8	4.00	4	3.00	10	3.00
1/2	4.00	5	3.00	15	3.00

DELAY NETWORK—ALL 1400Ω
T 114—Approx. 2.2 micro sec. delay .... } 95¢
T 115 Similar to T 114 with tap brought out .... } each

BEARINGS

Mfg. No.	ID	OD	Thickness	Price
MRC5028-1	5 1/2	6 1/2"	1"	$3.50
MRC7026-1	5 5/64	6 15/64	9/16	3.50
Timken 37625	4 5/16	6 1/4	29/32	4.25
MRC-7021-200	4 1/8	5 9/32	23/64	2.95
Norma A 545	2 1/16	2 5/8	1/4"	1.00
MRC 106 M2	1 17/64	2 7/16	25/64	1.75
MRC 106 M1	1 13/64	2 7/16	25/64	1.60
Federal LS 11	1 1/8	2 1/2	5/8	1.75
Norma S 11 R	1 1/8	2 1/8	3/8	1.25
Fafnir B 541	1 1/16	1 1/2	9/32	.55
Hoover 7203	5/8	1 9/16	7/16	.90
Norma 203 S	5/8	1 9/16	7/16	.90
SCHATZ	3/4	1 3/4	9/16	1.00
NS 5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	1 5/32	11/32	.55
Norma S 3R	3/8	7/8	7/32	.45
MRC 39 R1	11/32	1 1/32	5/16	.45
ND CW 8008	5/16	5/16	13/32	.45
MRC 38 R3	5/16	55/64	9/32	.45

NEEDLE BEARINGS
TORRINGTON B108 ½" wide ⅝" 13/16" 30¢

Brand New Meters—Guaranteed
0-10 ma. D.C. 3½"... 3.95 | 0-80 Amp. D.C. 2½"..$2.25

SELENIUM RECTIFIERS
Full Wave 200 MA 115V $1.79
Half Wave 100 MA 115V .... .91

SPAGHETTI SLEEVING—assortment—99 feet....$1.00

TYPE "J" POTENTIOMETERS

100	3/8	1,000	9/16	10K	5/8 •	100K	S.S.•
100	S.S.•	1,500	1/4S.S.	15K	1/4	200K	5/8
150	S.S.	2,000	1/4	15K	S.S.•	200K	S.S.•
300	S.S.	2,000	S.S.•	25K	S.S.•	250K	5/8
400	3/8	2,500	3/8	50K	S.S.	250K	S.S.•
400	S.S.•	3,000	3/8	70K	S.S.	500K	S.S.•
500	S.S.•	4,000	3/8	80K	S.S.	1Meg	3/8
1,000	3/8	5,000	1/4	100K	7/16	1Meg	S.S.

• SPLIT LOCKING BUSHING .... $1.50 each

JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2-140Y	$0.13	4-141W	$0.30	3-142	$0.21
3-140¾W	.19	5-141	.26	7-142	.42
6-140	.25	5-141¾W	.37	2-50	.39
10-140W	.53	7-141	.36	3-150	.54
10-140¾W	.53	7-141¾W	.49		
3-141¾W	.24	8-141¾W	.58		
3-141W	.24	9-141Y	.64		

TIME DELAY RELAY

Eagle Signal Corp., Moline, Illinois
1 Min. Delay. 115 V., 60 Cycle
2½ second recycling time—spring return • Micro-switch contact, 10A • Holds ON as long as power is applied • Fully Cased •
ONLY $6.50

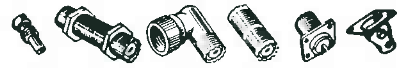
AN CONNECTORS
IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

NEW COAXIAL CABLES

	Price per 1,000 Ft.		Price per 1,000 Ft.
RG 5/U	$140.00	RG 22A/U	$285.00
RG 6	180.00	RG 24	675.00
RG 7*	85.00	RG 26	475.00
RG 8*	135.00	RG 29*	50.00
RG 9*	250.00	RG 34	300.00
RG 9A/U	275.00	RG 35	900.00
RG 10	240.00	RG 41*	295.00
RG 11*	135.00	RG 54A/U	97.00
RG 12	240.00	RG 55*	110.00
RG 13	216.00	RG 57*	325.00
RG 17	650.00	RG 58*	65.00
RG 18	900.00	RG 58A/U	80.00
RG 19	1250.00	RG 59*	70.00
RG 20	1450.00	RG 62*	75.00
RG 21	220.00	RG 77*	100.00
RG 22/U*	150.00		

Add 25% for orders less than 500 feet.
* No minimum order—others 250′ minimum.

COAXIAL CABLE CONNECTORS



15¢ UG 175/U | $1.30 83-1F | 30¢ 83-1AP | 80¢ 83-1J | 40¢ 83-1R | 10¢ HOOD

83-1AC	$0.42	83-22R	.68	UG 85/U	1.75
83-1AP	.30	UG 13/U	1.75	UG 87/U	1.60
83-1F	1.30	UG 21/U	1.20	UG 88/U	1.35
83-1H	.10	UG 21B/U	1.45	UG 167/U	2.05
83-1J	.80	UG 22/U	1.30	UG 175/U	.15
83-1R	.40	UG 24/U	1.30	UG 176/U	.15
83-1SP	.60	UG 25/U	1.25	UG 206/U	1.60
83-1SPN	.60	UG 27/U	1.30	UG 260/U	1.35
83-168	.15	UG 30/U	2.50	UG 281/U	.77
83-185	.15	UG 57/U	2.30	UG 290/U	1.35
83-2R	1.30	UG 58/U	.80	UG 499/U	1.25
83-22AP	1.10	UG 60/U	2,40		

UG 255 .... 2.45 | UG 59A/U 2.25
UG 224/U .... 1.40 | UG 306 .... 2.95

DIFFERENTIAL
115 V., 60 Cyc.
#C78249

$3.95 ea.

3⅝" dia. x 5⅝" long

Used between two C78248's as dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted) $4.50
Mounting Brackets — Bakelite for selsyns, and differentials shown above .... 35¢ pair

2J1G1 SELSYNS
400 CYCLE—BRAND NEW

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
7	23	47	80	160	390	650	.0012	.0036
7.5	24	50	82	175	400	680	.0013	.004
8	25	51	90	180	470	750	.00136	.0044
8.2	26	56	100	220	500	mfd	.0015	.0056
10	30	60	110	240	510	800	.0016	.006
15	33	62	120	250	560	820	.001625	.0062
18	39	68	125	300	580	910	.002	.0065
20	40	70	130	350	600	.001	.0027	.0068
22	43	75	150	370	620	.0011	.003	.0082
								.01

Price Schedule
8.2 mmf to 910 mmf .... 5¢
.001 mmf to .001625 .... 8¢
.002 mfd to .0082 mfd .... 15¢
.01 mfd .... 28¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
10	40	82	155	325	470	800	.0026	.005
18	47	100	170	350	500	875	.0027	.0051
22	50	110	180	360	510	.0011	.00282	.0056
23	51	115	208	370	525	.0015	.002826	.006
24	60	120	225	390	560	.0016	.003	.0068
27	62	125	240	400	570	.001625	.0033	.0082
30	66	130	250	410	680	.0022	.0039	
39	68	135	270	430	700	.0023	.004	
	75	150	275	466				

Price Schedule
10 mmf to 875 mfd .... 10¢
.0011 mfd to .0023 mfd .... 20¢
.0026 mfd to .0082 mfd .... 50¢

PULSE TRANSFORMERS
UTAH—9262 9278 9280 9340
WESTERN ELECTRIC—D166173 D161310
KS8696, KS9365, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—K2731 80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

PRECISION RESISTORS—¼ WATT—30¢

2	10.48	12.32	14.98	62.54	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89		123.8	366.6	50,148
6.68				125	414.3	59,148

PRECISION RESISTORS—½ WATT—35¢

.25	13.15	87	970	6,500	16,700	37,000
.334	13.3	125	1,375	7,000	17,000	45,000
.444	15	178	1,490	7,300	19,860	47,000
.502	18.75	179.5	1,500	8,000	20,150	50,000
.557	25	180	2,500	8,500	21,300	56,000
.627	45	210	2,850	8,800	25,000	59,000
.76	46	240	3,995	10,000	26,667	59,905
1	49	260	4,000	12,000	30,000	68,000
1.53	52	270	4,285	14,825	32,700	70,000
2.04	55.1	290	4,300	15,000	32,888	79,012
3.25	60	298.3	4,451	15,750	33,000	92,000
5.24	61	400	4,750	15,755	33,300	100,000
5.26	65	723.1	5,714	15,810	35,888	180,000
5.89	66.6	855	5,900	16,000	36,000	
10.58	69					
11.1	75					

PRECISION RESISTORS—1 WATT—45¢

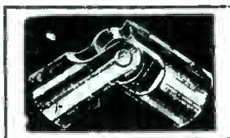
.1	2.55	12.8	60	1,530	7,000	50,000
.11	2.58	15	71	1,800	7,800	55,000
.2	2.6	18	80	2,200	8,000	56,000
.31	2.66	27.4	125	2,215	8,250	65,000
.4	3.1	28	250	2,250	9,000	68,000
.861	3.39	30	270	3,300	10,000	70,000
1.01	4.29	38	312	4,000	12,000	84,000
1.106	4.3	45.5	420	5,000	12,420	90,000
1.21	5.21	54.25	425	5,221	12,500	95,000
2.1						

PRECISION RESISTORS—1 WATT—60¢

100,000	166,100	320,000	399,000	590,000
105,000	220,000	340,000	413,000	600,000
120,000	240,000	348,000	520,000	645,000
128,000	260,000	375,000	522,000	650,000
130,000	270,000	376,000	550,000	700,000
132,000	296,000	390,000	560,000	876,457
149,500	310,000			

1 MEGOHM 1 WATT 1%—$1.50—5%—60¢

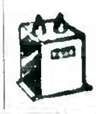
PRECISION RESISTORS—2 WATT—75¢
4,385 5.000 6.000 10,000 19,917 23,000



UNIVERSAL JOINTS ALUMINUM
3/16" hole x ⅜ O.D. 1-⅛" long— **50¢**
¼" hole x ½ O.D. 1-⅛" long— **75¢**

OIL FILLED

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.125	35,000	$35.95	4	1,500	$2.95
.125	27,000	28.95	3	1,600	1.59
.1	25,000	25.95	4	1,000	1.95
.25	20,000	19.95	2	1,000	.90
.15-.15	8,000	2.75	1.02	1,000	.65
.1	7,500	1.95	1	1,000	.65
.03	7,500	1.69	7	800	1.98
.1-.1	7,000	1.98	1	800	.55
.1	7,000	1.85	10	600	2.95
.02-.03	7,000	1.40	8-8	600	1.69
.1	6,000	2.75	8	600	2.05
.03-.03	6,000	1.35	7	600	1.75
.01-.03	6,000	1.35	4	600	1.63
2	4,000	4.95	4 x 3	600	1.95
.3 x .2	4,000	2.50	2	600	.69
.1	4,000	2.25	2 x 2	600	1.40
.06	4,000	1.45	8	500	1.55
.1	3,500	1.95	4	500	.98
.25	3,000	2.25			
8	2,000	4.95			
3	2,000	3.75			
.5-.1	2,000	1.95			
.5	2,000	1.95			
.3	2,000	1.75			
.1-.1	2,000	1.65			
.02	2,000	.79			
1	1,500	1.50			



2 mfd. 4,000 V.D.C. G.E. $4.95

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
.2	750	$ .69	25	330	$5.95
8	660	4.95	20	330	5.50
6	660	4.95	15	330	4.50
5	660	4.50	10	330	3.95
4	660	4.25	6	330	2.95
2	660	3.25	4	330	1.95
1	660	2.35	3	330	1.25
15	440	4.95	2.5	330	.98
6	440	3.50	2	330	.65
5-3	440	3.95	10	220	2.95
4.4	375	2.15	20	220	4.95
30	330	6.50			

1N34 Crystal Diode .... .79¢

300 Twin Lead .... .02½ per ft. $18.95 per M

Dynamotor DM 33A .... $3.75 ea.

Chokes: 30 Hy. 80MA @....$1.29; 6Hy. 80MA @....79¢

Power Tap Switch—OHMITE # 312-5—5 Taps non-shorting 25A 150 V. A.C. $3.95

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A. C. Fully cased Plugs into octal socket $6.50

BC-224-D Receiver 12 V. D. C. 1.5 mc to 18 mc. Brand new. Includes tubes, dynamotor, shock mts....$125.00

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated .... 25¢

Minimum Orders $3.......All orders f.o.b. PHILA, PA.

RELIANCE MERCHANDIZING CO.
Arch St. Cor. Croskey Phila. 3, Pa. Telephone RIttenhouse 6-4927

METERS

1 MA DC 3½" R DeJur Mod 310 (0-4KV scale) . $5.75
3MA DC 2½" R—Simpson black scale 3.35
500 Microamps, DC—2½" round—Sun 4.30
1ma. DC Fan type—4" scale (rem. from equipt) 3.95
500 ma. DC 2½" R.—General Electric 2.95
2 amp. RF 2½" Sq.—Simpson 3.15
5 amp. AC 4½" R.—JBT 4.11
30 V DC 2½" R—General Electric 3.95
3 amp. RF 3½" R.—Weston 6.00

OIL-FILLED 35 KV AND 50 KV ISOLATION TRANSFORMERS

Pri. 460V 60 cy. Sec. 115V 200 VA Insulated for 50KV DC—G. E. Form EIR—36"H x 13" D $125.00
Pri. 115V 60 cy. Sec. 115V 250 VA Insulated for 35 KV DC—G. E. Form EIR—29"H x 12½"D $125.00

VOLTAGE DIVIDER

G.E. Cat. 8248886G-1 and 9001934G-1 17,246,400 ohms 35KV 70:1 ratio wire wound shielded oil-filled 40"H x 12"D $77.50

2 ϕ LOW INERTIA SERVO MOTORS

DIEHL Type FPE 25-11 75 Volt 60 cycle 4 watts—new $34.50
KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50

OIL FILLED CONDENSERS

MFD	VDC	Price	MFD	VDC	Price
2	400	$.55	.1-.5	2000	.95
5-5	400	1.65	.25	2000	1.50
1	600	.55	.3	2000	1.30
2	600	.69	1	2000	1.95
2	600R'd	.69	12	2000	8.95
4	600	1.65	1-1	2500	3.85
4	600R'd	1.65	32	2500	15.80
5	600	1.75	.5	3000	2.40
6	600	1.85	.03	4000	1.25
8	600R'd	1.85	3 x .2	4000	2.95
8-8	600	1.95	.1	5000	1.60
4-4-4	600	2.50	.2	5000	2.50
4 x 3	600	2.50	1	5000	4.88
1	1000	.65	.01-.03	6000	1.65
2	1000	.90	.1	7000R'd	1.79
2	1000R'd	.95	.1	7500	2.85
3.5-.5	1000	1.85	1	7500	12.50
4	1000	1.95	.1	12KV	8.95
6	1000	2.50	.045	16KV	4.70
8	1000	3.25	.05	16KV	4.95
1	1200	.85	.075	16KV	8.95
1-1-1	1200	1.85	.25	20KV	19.95
.1	1500	.59	10	330VAC	3.95
.5	1500	1.25	5	440VAC	3.10
4	1500	2.95	7	660VAC	4.25
			8	660VAC	4.50

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

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
Raytheon—Pri. 115V 60 cy. Sec. 8500/6450V CT 43 MA Hermetically sealed $22.50

CRYSTAL DIODES

1N21	$1.19	1N23	$1.95	1N34	$ .79
1N21A	1.69	1N23A	3.25	1N34A	.95
1N21B	4.00	1N23B	5.25	1N45	.94
1N22	1.09	1N27	1.79	1N52	1.05

ANTENNAS

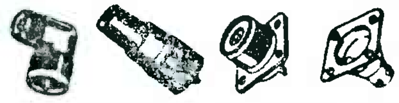
AT-38A/APT (70 to 400MC) $13.70
AT-49/APR-4 (300 to 3300MC) 13.70
AN-74B (125 to 150MC) 3.25
AN-65A (P/O SCR-521) 1.50
AN-66A (P/O SCR-521) 1.75
AIA-3CM conical scan 125.00
ASB Yagi—5 element 450 to 560MC 7.00
ASB Yagi—Double stacked 6 element 12.70
ASA Yagi—Double stacked 370 to 430MC 29.40

RELAYS

Sigma type 4AH—2000Ω 4 ma DC coil—SPDT contacts—hermetically sealed 5 pin plug-in base $3.30
Sigma type 4R—8000Ω 1 ma DC coil—SPDT contacts—enclosed type 5 pin plug-in base $4.25
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—4PST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 Amp contacts $3.20
Leach type 1521—115 V 60 cy. AC coil—SPST NO double bk 15 Amp contacts—mycalex insul ... $3.25
Cramer type 1C2H—110 V 60 cy. interval timer—two SPST 15 Amp contacts (on 1 hr. off 1 hr.) .. $3.95
Sperti 1S21 vacuum relay switch (for AN/ART-13) $9.50
G.E. 561 vacuum relay switch SPDT 15 Amp contacts $3.50

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.

COAXIAL CONNECTORS



83-1AC	$ .42	83-1RTY	$ .65	83-22R	$ .68
83-1AP	.30	83-1SP	.50	83-22SP	1.15
83-1F	1.30	83-1SPN	.60	83-22T	1.95
83-1H	.10	83-1T	1.30	83-168	.15
83-1HP	.25	83-2AP	1.95	83-185	.15
83-1J	.80	83-22AP	1.40	83-765	.24
83-1R	.40	83-22F	2.10	83-776	.85
		83-22J	1.50		

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS IN STOCK

UHF—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG-83/U	$1.85	UG-185/U	$1.60
UG-12/U	.95	UG-85/U	1.75	UG-191/AP	.80
UG-15/U	1.50	UG-86/U	2.50	MX-195/U	.75
UG-18/U	1.25	UG-87/U	1.60	UG-197/U	2.80
UG-19/U	1.80	UG-88/U	1.35	UG-201/U	1.95
UG-21/U	.95	UG-89/U	1.60	UG-203/U	.85
UG-21A/U	1.50	UG-90/U	1.60	UG-206/U	1.80
UG-21B/U	1.35	UG-98/U	1.85	UG-224/U	1.40
UG-22/U	1.35	UG-102/U	1.15	UG-236/U	3.85
UG-22B/U	1.65	UG-103/U	.68	UG-245/U	2.30
UG-23/U	1.20	UG-104/U	1.40	UG-254/U	2.75
UG-23B/U	1.90	UG-106/U	.15	UG-255/U	2.45
UG-24/U	1.30	UG-108/U	2.60	UG-260/U	1.35
UG-25/U	1.35	UG-109/U	2.60	UG-261/U	1.60
UG-27/U	1.30	UG-146/U	2.55	UG-262/U	1.60
UG-27A/U	2.95	CW-159/U	.60	UG-273/U	2.25
UG-29/U	1.55	UG-166/U	32.50	UG-274/U	2.75
UG-30/U	2.30	UG-167/U	5.85	UG-275/U	5.50
UG-34/U	16.50	UG-171/U	2.80	UG-276/U	2.75
UG-36/U	17.50	UG-173/U	.40	UG-290/U	1.35
UG-37/U	17.50	UG-175/U	.15	UG-291/U	1.75
UG-57/U	2.30	UG-176/U	.15	UG-306/U	2.95
UG-58/U	.80	UG-177/U	.24		

QUOTATION UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358	MC-277	PL-259A	PL-325
M-359	MC-320	PL-274	SO-239
M-359A	PL-258	PL-284	SO-264
M-360	PL-259	PL-293	TM-201
93-C	49120	D-163950	ES-685696-5
93-M	49121A	D-166132	ES-689172-1

COAXIAL CABLE

Type	Price Per M Ft.	Type	Price Per M Ft.
RG-5/U	$140.00	RG-22/U	$150.00
RG-6/U	180.00	RG-22A/U	285.00
RG-7/U	85.00	RG-24/U	675.00
RG-8/U	135.00	RG-26/U	475.00
RG-9/U	250.00	RG-29/U	50.00
RG-9A/U	275.00	RG-34/U	300.00
RG-10/U	240.00	RG-35/U	900.00
RG-11/U	135.00	RG-54A/U	97.00
RG-12/U	240.00	RG-55/U	110.00
RG-13/U	216.00	RG-57/U	325.00
RG-17/U	650.00	RG-58/U	65.00
RG-18/U	900.00	RG-58A/U	80.00
RG-19/U	1250.00	RG-59/U	70.00
RG-20/U	1450.00	RG-62/U	75.00
RG-21/U	220.00	RG-77/U	100.00

ADD 25% TO PRICES SHOWN FOR QUANTITIES UNDER 500 FT.

GENERATORS

- 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 1235-1A. Output—30 Volts DC 15 Amps. Brand New—Original Packing .. $15.50

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"		

DUAL "JJ" POTENTIOMETERS

50	SS	500	SS	1 Meg	SS
100	SS	1K	SS	2.5 Meg	SS
250	SS	2500	SS	5 Meg	SS
330	SS	10K	SS	1K/25K	3/8"

TRIPLE JJJ POTENTIOMETERS

100K/100K/100K—3/8"   20K/150K/15K—3/8"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A260   W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH
TS-10 Type Handsets .... $8.92 ea.

3 PHASE INVERTERS

Voltage and Frequency Regulated
Eclipse Pioneer Type 12121A

DC Input—24Volts   18 Amps
AC Output—115 Volts   1.25 Amps   3 Phase
250 VA   0.7 P.F.   400 Cycles
12,000 RPM   65°C Temp. Rise

Brand New $225.00

TEST EQUIPMENT

- Gen. Radio 475B Frequency Monitor *$200.00
- Gen. Radio 681A Freq. Deviation Meter .. *$87.50
- I-222A Signal Generator *$79.50
- I-72K Signal Generator $48.50
- C-D Quietone Filter Type IF-16 110/220V AC/DC 20 Amps. *$9.00
- TS-127/U Freq. Meter w/spares $69.50
- TS-143/CPN Oscilloscope *$95.00
- Dumont 175A Oscilloscope *$225.00
- LM-20 Frequency Meter *$49.50
- Gen. Radio 757-P1 Power Supply *$27.00
- TS-6/AP Frequency Meter *$42.00
- I-130A Signal Generator *$85.00
- A.W. Barber Labs. VM-25 VTVM *$86.00
- TS-10A/APN Delay Line Test Set $45.00
- TS-19/APQ-5 Calibrator $75.00
- REL W-1158 Frequency Meter 160-220 MC $32.95
- 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 *$95.00
- BC-221 Freq. Meter (with modulation) .. *$125.00

All items New Except Where noted * (Exc. Used Condition

MISCELLANEOUS EQUIPMENT

I-82F Selsyn Indicator $6.95
SCR-515 compl. w/dynamotor, control box 69.50
PE-218 Inverter—28 VDC to 115 VAC 400 cy 1500 VA. 49.50
G.E. 5D21NJ3A Inverter—24 VDC to 115 VAC 400 cy 485 VA 32.50
Amperex 1B98 Gamma Counter 9.87
Powerstat 1226—115/230V Input—0-270V out @ 9 amp 37.00
EIMAC 35T Ionization Gauge 5.95
ATR Inverters 6VDC to 110 VAC 60 cy 75W ... 22.95
R-7/APS-2 Receiver 49.50
R-78/APS-15 Receiver 49.50
FL-8 1020 cycle filter 2.95
RM-29 remote control unit 8.95
RM-14 remote control unit 8.95
RTA-1B 12/24 V dynamotor 40.00
BC-1206-CM2 Receiver 12.95
CY-230/MPG-1 Radar Console 575.00
ASB-4 Radar equip. Complete 69.75
T-9/APQ-2 less tubes 16.50
RCA AVR-15 Beacon Recvr 18.50
Pioneer Type 800-1B Inverters—28VDC to 120V 800 cy 7 amp AC (used) 22.65
G.E. Inverter—28VDC to 120 VAC 800 cy 750VA 1 ϕ 39.50
Navy SD-3 Radar complete 1200.00
Navy DP-14 Direction Finder complete 385.00

PULSE TRANSFORMERS

UTAH 9262 9278 9280	UTAH 9318 9340 9350
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-2469A	Philco 352-7150
G.E. K-2744B	Philco 352-7071
AN/APN-9 (901756-501)	Philco 352-7178
AN/APN-9 (901756-502)	Raytheon UX-7350
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 187AW2F	W.E. KS-9563

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2600 cy 135W.

Originally designed to record pulse or sine-wave modulated signals received by AN-APR-1, AN/APR-2, AN-APR-4, AN/APR-5, BC-348, S-27, SX-28. BRAND NEW $147.50

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

15 E4-.91-400-50P. 15KV, "E" circuit .91 microsec. 400 PPS, 50 ohms imped. 4 sections $16.50

15-A-1-400-50P, 15KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms imped $37.50

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120 V.D.C. to 120V A.C. 60 cy. 1Ph., .4PF. Complete with Magnetic Controller, 2 Field Rheos and Full Set of Spare Parts including Spare Armatures for Generator and Motor. Full spec. on request. New........$285.00

2 KVA O'Keefe and Merritt. 115V DC to 120V AC. 50 cy. Idles at 3 Ph. syncs motor on 208V, 50 cy. New. Export crated........$165.00

1.25 KVA Allis-Chalmers. 230 DC to 120 AC, 60 cy. 1 Ph. Fully enclosed. Splashproof, Ball Bearings, centrifugal starter. New, complete with kit of Spare parts........$175.00

M.G. 164, Holtzer-Cabot Motor: 440V, 3Ph, 60 cy., .90A. 1/3HP, 1750 RPM. Generator; 70V, 3Ph, 146 Cy., .140KVA. Exciter: 115DC, 1A. New...$67.50

Type CG-21302. 440V AC. 60 cy., 3Ph., 1500 VA to 875 DC and 300V DC. New........$69.50

INVERTERS

Onan MG-215H. Navy type PU/13. Input 115/230, 60 cy, 1 Ph. Output 115, 480 c. 1 Ph. 1200W and 26V DC at 4 amps. New........$295.00

G.E. Model 5D-21NJ3A. Input: 24V, DC, Output: 115V, 400 cy., 485 Va. New........$29.50

Leland Elec. Co. Model PE206A. Input: 28V, DC, 38 Amps. Output, 80V., 800 cy, 485 VA. New $22.50

G.E. J8169172. Input: 28V, DC, Output: 115, 400 cycles at 1.5 KVA........$32.50

DYNAMOTORS

Navy-Type CAJO-211444, 105/130V DC to 13V DC at 40A or 26V DC at 20A. Radio Filtered. Complete with Line Switch. New........$89.50

Eicor. 64V DC to 110V AC. 60 cy. 1 Ph. 2.04 Amps. New........$24.50

Eicor. 32V DC to 110V AC, 60 cy, 1 Ph. 0.43 Amps. New........$22.50

Type PE94C. For use with SCR522 Transmitter-Receiver. Brand new in export cases........$15.00

Carter 6V DC to 400V DC at 375 mils. New $39.50

AMPLIDYNES

G.E. Model 5AM21JJ7. 4600 R.P.M. Motor Compound wound. 150 Watts. Input: 27V DC. Output: 60V DC, Sig. Corps. U. S. Army MG-27-B. New........$34.50

Edison type 5AM31NJ18A. Input: 27 volts, 44 Amps., 8300 RPM. Output: 60V DC at 8.8 amps. 530 Watts. New........$22.50

SMALL D.C. MOTORS

G.E. Model 5BA50LJ2A. Armature 27V D.C. at 8.3A. Field 60V DC at 2.3A. RPM 4000. H.P. 0.5 New........$27.50

Electrolux Corp. of Canada. P/O vent fan assembly for SCR-602-T6. 1/35HP, 28.5V, 2.15 amps., 2200 RPM. Price........$16.50

Oster type E-7-5, 27.5V, 1/20HP, 3650 RPM. Shunt wound. Price........$15.00

Dumore Co. Type EBLG, 24V DC, 40-1 gear ratio, for use with type B-4 Intervalometer. Price $17.50

SYNCHROS

Ford Inst. Co. Type 5SDG. Brand New....$22.50

Electrolux Torque Motor........$16.50

FL BLOWER

Westinghouse 115v. 400 cy. 17 c.f.m. Includes capacitor. Price........$12.50

BASIC SCOPE UNIT

For 80/115V, 400/2600 cycles
Part of Panadapter AN/APA-10

Consists of two chassis containing complete high and low voltage supply, 150V DC and 300V DC filtered and regulated and 400V DC and 1200V DC filtered. CR tube socket part of chassis. Uses 3BP1, 3lB1, 2-VR150, 5R4GY, 5R4G, 2x2 and 6AK5 DC reinserter tube. Has controls for intensity, focus, aux. focus. Brand New less tubes........$29.50

HI-VOLT CAPACITORS

.25 Mfd., 20KV........$26.50
.25 Mfd., 15KV........$22.50
.5 Mfd., 25KV........$34.50
1 Mfd., 15KV........$34.50
1 Mfd., 7.5KV........$12.50
2 Mfd., 6.0KVA........$14.50

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—375 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets less tuning units.
R111A/APR-5A Receiver—1000 to 6000 MC.
AU/APR-4 Tuning Units TN-17 (76-300 MC)
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (950-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
BC1203 APN-4 Test Sets.
AN/APA-10 Panoramic Adapters 115V/60 cycles.

RADAR

Antenna-Trans-Rec Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUZ-50AGD (SD-5 Radar)
Radar Crystal Units 98.35kc, Raytheon.
1N21B Sylvania Diodes.
Repeater Adapters CBM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.
SG Rectifier Power Units CRP-20ABN.
SG Rectifier Power Unit CRP-20ABM.
SG Modulation Generators CRP-35AAH.
SG Radar Receivers CRP-46ABD-1.
SG Complete trans. RF Coupling Assemblies.
SG Power Control Chassis.
SG Driver Modulator Assemblies.
SG Complete sets equipment spares.
SG Load Divider Modernization kits.

CRYSTALS—W.E. TYPE CR-1A/AR

5910 - 6350 - 6370 - 6470 - 6510 - 6610 - 6670 - 6690 - 6940 - 7270 - 7350 - 7380 - 7390 - 7480 - 9720 Kilocycles. Available in quantity.
Price........$1.25 each

REPLACEMENT PARTS FOR BC348 MODELS H, K, L, R AND BC 224 F, K

We can supply for above models only:
All coils for Ant., RF., Det. and Osc. bands.
All I.F. trans., including C. W. Osc. and xtal filters.
4 gang condensers, engraved front panels, complete dial mechanism assemblies, Dual Volume Controls, Circuit Diagrams, etc.
Write for complete listing.

AMPLIFIERS

GE Servo type 2CV1C1 400 cycle
Constant Output Line BC-730C
Synchro Amplifiers for Radar
Intercommunication type BC-605

ANTENNAS

Coast Guard MR-162 Whips 23½ ft.
Microwave types AT-49, AT-38, AS-125
APT-2 Dipole Antennas
TDY Radar Jammer Horns
Paraboloids, Magnesium Dishes 17¼" dia.
SCR 634-A (Part of RC-153-B Antenna).

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven
SO-1 Parabolic Reflector

RECTIFIERS

G.E. No. 6 RC89F16 for 54 cells 10 amps.
G.E. No. 6 RC133F2—In: 110/220/60/1. Out: 15/30V-75-150A
Mallory APS-20—In: 115/230/60/3. Out: 12/24V-65-130A
Turret Trainer Supply. In: 220/60/3. Out: 28V-130A
RA20 Vibrator Power Supply
Complete specs on request

MISCELLANEOUS

SCR522 Transmitter Receivers Brand New
TCB Transmitters 125 watt Ship to Shore
BC966A Transponders
RT7-AN/APN-1 Receivers
BC-423B Modulators
BC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat No. 80G184. KVA .945S-520P Volts 460/345/200/115. New $4.95

FILAMENT. 400/2600 cy. Input: 0/75/80/85/105/115/125V. Output: 5V3A/.5V3A/5V3A/5V3A 5V6A/5V6A/6.3V6A/6.35A. New........$2.95

THRYRATRON POWER. 400/1600 cy. Raytheon UX-8876, 400/1600 cy. Pri: 115, Sec: 50-0-50V at 1.5A, 6.3V at 1.2A. Test r.m.s. 1780. New....$2.75

PLATE WECO KS9560, 400/800 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........$49.50

PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V. Sec #1: 930-0-930. Sec #2: Three 6.3V windings........$3.95

FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.25A/6.35V1.5A Elecstat shdld. Wt. 0.5 lbs. New........$1.95

PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec. #2=400VDC at 130MA. Fil. Secs: 6.4V4.3A/6.35VO.8A (Ins. 1500V)/5V2A/5V2A........$4.95

RETARD. 400 cy. WECO KS9598. 4 Henry 100MA. $1.75

60 CYCLE TRANSFORMERS

FILAMENT. Raytheon Hypersil Core, Pri: 115V. Sec: 6.3V22A/6.3V2.4A/6.3V2.25A/6.3VO.. 6A Ins. for 1700V........$5.95

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........$89.50

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........$29.50

PULSE TRANSFORMERS

PULSE. WECO KS-9563. Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wdg. 1.3=.032H at 100 cps.....$5.00

PULSE. WECO D-161310, 50 KC to 4MC, 1¾" Dia. x 1⅞" high. 120 to 2350 ohms. New....$1.95

RAYTHEON VOLTAGE REGULATOR

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V., 60 Watts, ½ of 1% Reg. Wt. 20 lbs. 6⅛" H x 8¼" L x 4⅝" W. Overload protected. Sturdily constructed. Tropicalized. Special........$14.75

RELAYS

Struthers-Dunn 1BXX129, 110 D.C.
Advance type 455C, SPDT, 115 A.C.
Leach type 1154A, SPDT, 115 A.C.
Leach type 1054, BSN 20-28V D.C.
Clare Plug-in base No. 30FMX 115 A.C.
G.E. Plug-in base Sensitive K27J853
Allied Control type BJ 452-1128
Western Electric D-163781 Plug-in
Guardian Time Delay type B-9-SPDT
Haydon Time Delay 17717 110V/60

SONAR EQUIPMENT

Hoist Train Mechanisms, Navy type 78219, for Model QBG, Underwater Sound equipment. Purpose: To lower or raise projector. Travel 2'3". Includes 1 partial set of spare parts. 1 wooden box per set; Weight and cube per box: 427 lbs., 42.0 cu.

MISCELLANEOUS

Cathode Ray Shields for 3" tube........$3.75
Variac type Motor Controls 600 watt........$13.50
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.)........$1.00
Fusetron (Bus FRN 50 Ampere 250V)........$.25
Switchboard Lamp Receptacles & Jewels........$.40

SOUND POWERED PHONES

Western Electric No. D173312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable........$17.50

Automatic Elec. Co. No. GL843AO. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable........$16.00

U. S. Instrument Co. No. A-260. Complete with 20' cable and plug. Brand new........$17.50

W. E. type TS-10M Handset. New........$16.50

INDICATORS

ID-24/ARN-9........$12.50
ID-14/APN-1........$14.50
I-82A........$9.75
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual
$245.00

ELECTRONICRAFT
INC.
27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE: BRONXVILLE 2-0044

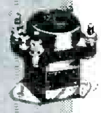
Over 300,000 RELAYS in our Vast Stock

OVER 1,000 DIFFERENT TYPES

AIRCRAFT SOLENOID CONTACTORS

TYPE B5A

50 Amp Contacts
24VDC, SPST,
Double Make,
Spec. #94-32351A



Allen Bradley, Bulletin X91419, 100 ohm, #R105 $1.95
Hart, Cat. No. 692R4, 150 ohm, #R105H.....$1.95
Square "D", Class 9350, 150 ohm, #R25....$2.25
Cutler Hammer, Bulletin 6041H2B, 100 ohm, #R24 $2.25

TYPE B4

200 Amp Contacts,
24 VDC, SPST,
Double Make,
Spec. #94-32324A

Hart, Spec. No. 569A, Cat. No. 694R19. 75 ohm, #R127A $2.95
AutoLite, B4, 90 ohm, #R174 ....$3.50

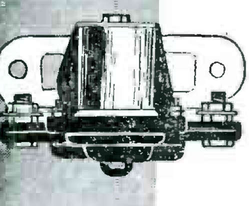
TYPE B6B

100 Amp Contacts,
24VDC, SPST,
Double Make

Allen Bradley, Part No. X95395, 65 ohm, #R606 $3.95

TYPE B8

200 Amp Contacts,
24VDC, SPST,
Double Make,
Spec. #94-32424A



AutoLite, B8, 8 ohm, #R128 ....$2.75
Guardian, 34056, 8 ohm, #R129 ....$3.95
Hart, Cat. No. 694R15A, 8 ohm, #R601 ......$3.50
Cutler Hammer, Bulletin 6041H139A. 10 ohm, #R130 ....$3.95
Leach, Part No. 7210-24, 8 ohm, #R602 ......$3.95

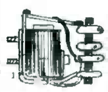
MAGNECON

200 Amp Contacts,
SPST, Double Make

Holding Current
Automatically
Cut by 90%

305381-2, 36VDC, 14 ohm Start, 140 ohm Hold. **#R589** $2.95
305381-3, 72VDC, 60 ohm Start, 600 ohm Hold. **#R590** $3.25
305281-4, 120VDC, 200 ohm Start, 2000 ohm Hold. **#R591** $3.50

ALLIED BJ



BJ6D36 24VDC, DPDT 255 ohm #R420 ....$1.55
BJX-42 12 or 24 VDC, SP Dble break, 240 ohm CT #R226 $1.25
BJU (Electrical Latching) 6VDC, 4PDT, 16 ohm ea coil, dust-proof shield, 11 Pin Plug Base #R435 ....$6.95

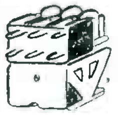
ALLIED BO & BOY

HEAVY DUTY
10 AMP. CONTACTS

BO13D35 6VDC, SPDT, double make, 240 ohm #R06......$1.25
BO1535 24VDC, Dble make and break, 240 ohm #R238.....$1.30
BO9D23 6VDC, 3PDT, 14 ohm #R225....$2.25
BO1332 12VDC, 80 ohm, coil and frame only (no contacts) #RC-358 .... 40¢
BOYX40 12 ma., DPDT, 3940, #R587.....$2.95
BN12D34 24VDC, 4PDT, 227 ohm, #R434..$3.49

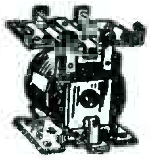
GM 12000 SERIES

DUAL COIL
10 AMP CONTACTS



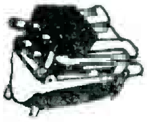
12566 6-12VDC, 3PDT, 45 ohm, #R593 ....$1.95
12889-2 24VDC, 3PDT, 800 ohm #R594 ....$2.95
12792-1 18-24VDC, 3PDT, 100 ohm, #R240 ....$1.75
12885-1 24VDC, 1A, 1B, 2C, 300 ohm, #R595 $3.25

G.E. CR2791 SERIES



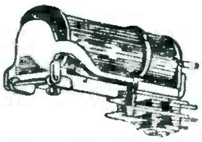
CR2791B100P36SP 10,000 ohm 10 ma., 3PDT #R603 $2.50
CR2791B106J3 24 VDC, 3PDT, 180 ohm, 3A contacts #R237 ......$1.25
CR2791B100J42 8-12VDC, 3PDT, 60 ohm, 3A contacts #R361 ......$1.25
CR2791B100J4 4-6VDC, 3DPT, 12 ohm, 3A contacts #R361 ......$1.25
CR2791B100F3 24VDC, 2PDT, 150 ohm, 5A contacts #R164 .... 98¢
CR2791B101V46 12VDC, Dble, make, 100 ohm, 10A contacts, #R165.................. 70¢
CR2791D107F3 24VDC, DPDT, 100 ohms, 5A contacts, ceramic insul. #R229.........$5.95

ARC 1 & 3 MINIATURES



23025 RBM 48VDC, SPDT, 8000 ohm, 6 ma #R428 $1.50
55251 Telechron, 24VDC, SPST n.o. (1A) 300 ohm, #R174 .... 90¢
55340 Price, 24VDC SPST n.o. (1A) 300 ohm #R170 .... 90¢
55342 Telechron, 24VDC. Makes 3 Breaks One (2As, 1C) 300 ohm, Anti-Capacity Arms, Low Loss Bakelite Insulation #R171........$1.25
55526 Cook, 24VDC. Makes 2, Breaks One, (1A, 1C) 300 ohm Ceramic Insulation, #107.. 95¢
55528 G.E. 12VDC, 6PST n.o. (6As), 150 ohm, #R426 ....$1.50
55531 Cook, 12-24VDC. Makes 4, Breaks (2As, 2Cs), 150 ohm #R405..................$1.25
55569 RBM, 24VDC, DPST n.o. (2As), 300 ohm, #R245 ....$1.25
55836 G.E. 24VDC, SPDT, (2As), 250 ohm, #R402 ....ea. $1.25
55837 G.E. 24VDC. Double Make, 300 ohm, #R108G $1.03
55837 RBM, Same as #R108G, #R108R....$1.25
55837 Allied, Same as #R108G, #R108...$1.59
23012-0 RBM, 24VDC, SPDT, 250 ohms, #R172 ....$1.25
7251 ARC 24VDC, SPDT, 300 ohm #R406.$1.25
7252 ARC, 24VDC, DPST, n.o. (2As) 300 ohm, Anti-Capacity Arms, Ceramic Insulation, #R354 ....$1.25

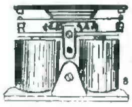
A.C. TELEPHONE TYPES



Clare B19553* 24VAC, 2C, 1A #R582.....$3.49
Clare Type C* 110VAC, 2A, 1B #R161.... 3.25
Automatic F Type RA 110VAC, 4PDT, #R159 .... 4.49
Automatic F type RA 110VAC, DPDT, #R160 .... 3.49

* Octal type plug base

DIFFERENTIAL

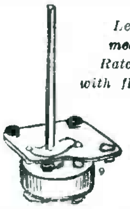


Dual 8000 coils, Armature pivoted between poles, all contacts normally open. High-speed. Suitable for P.P. bridge or balanced circuits where differential action is required.

COOK 11710/613 DPDT, 6 ma., #R605....$5.95
Allied 803476 SPDT, 2.5 ma., #R418...... 4.95

ROTARY RATCHET RELAYS

Ledex D.C. Impulse operated mechanisms rotate in 30° steps. Ratchet mechanism has ¼" shaft with flats for standard switch wafers.



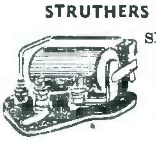
#33 **Mechanism only, 24V,** 200 ohm, #R597 ....$1.50
#76-2945 **Mechanism & Ratchet & 3" long shaft, 6V, ½** ohm, #R598 ....$3.50
#75-3576 Mechanism & Ratchet & 4" long shaft, 6V, ½ ohm, #R599.....................$3.75
#25 Mechanism Only, 12V, 4.5 ohm, #R824 ....$1.50
#26 Mechanism Only, 6V, 2 ohm, #R825 ....$1.50
Miniature Mechanism Only, 12V, 35 ohm, #R826 ....$1.50
Miniature Mechanism Only, 6V, 10 ohm, #R827 ....$1.50

D.C. SENSITIVE

RBM 23025 6 ma, SPDT, 8000 ohm, #R428.$1.50
RBM 23025 6 ma., SPDT, 8000 ohm, #R428 1.50
W.E. (Wheiock) KS9665 9 ma, 1A, 1B, 1C, 2000 ohm, #R426 .... 4.95
Kurman Midget 12 ma., SPDT, 1500 ohm, #R427 .... .98
Clare Type J (K102) 6 ma., SPDT, 3500 ohm, #R30 .... 3.50
Automatic 5035A7 8 ma., 1A, 1300 ohm, #103 .... 1.25
Cooke Type C 4 ma., 1A, 6500 ohm, #R596 3.50
Clare B11613 (K101) 2 ma., SPDT, 6500 ohm, #R588 .... 4.95
Clare A8053 8 ma., 3A, 6500 ohm, #R408.. 3.95

POWER

STRUTHERS DUNN CX 1535-A



SPST n.o. (1A), 24VDC, makes at 12 volts 50 ma.; breaks at 6 volts 25ma., 240 ohm coil, contacts rated at 20 ampere, Power relay R604 ....$2.95

324 CANAL ST., N. Y. C., 13, N. Y. • WAlker 5-9642

Universal general corp.

YOUR RELAY HEADQUARTERS

NEW YORK'S RADIO TUBE EXCHANGE

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OA2	$2.00	2J21	17.95	4J41	199.00	307A	4.95	722A	3.95	866A	1.79
OA3	1.50	2J22	17.95	C5B	3.95	310A	7.95	723A/B	17.95	869B	37.50
OB2	2.00	2J26	27.75	5BP1	6.95	311A	7.95	724A	4.95	869BX	35.00
OC3	1.75	2J27	29.95	5BP4	6.95	312A	3.95	724B	6.95	872A	3.95
OD3	1.50	2J31	29.95	5CP1	6.95	323A	25.00	725A	9.95	878	1.95
C1A	4.95	2J32	69.95	5D21	27.50	327A	3.95	726A	6.95	884	1.95
C1B	6.95	2J36	105.00	5JP1	27.50	328A	9.95	726B	56.00	885	1.75
1B21A	2.75	2J38	17.95	5JP2	19.50	350A	7.95	726C	69.00	889R	199.50
1B22	3.95	2J42	150.00	5JP4	27.50	350B	5.95	728AY	27.00	914	75.00
1B23	9.95	2J49	109.00	WE6AK	2.50	357A	20.00	730A	28.95	931A	6.95
1B24	17.95	2J50	69.50	6C21	29.50	368AS	6.95	801A	1.00	954	.35
1B26	2.95	2J61	75.00	C6A	3.95	371B	2.95	802	4.25	955	.55
1B27	19.50	2J62	75.00	C6J	10.95	385A	4.95	803	7.95	956	.69
1B32	4.10	2K25	37.50	7BP7	7.95	388A	2.95	804	13.50	957	.29
1B38	33.00	2K28	37.50	7DP4	10.00	393A	8.95	805	5.95	958A	.69
1B42	19.95	2K29	37.50	12AP4	55.00	394A	7.95	806	25.00	959	1.69
1B51	9.95	2K41	150.00	15E	2.95	MX408U	.75	807	1.69	991	.65
1B56	49.95	2K45	149.50	15R	.95	417A	27.95	808	3.50	E1148	.35
1B60	69.95	2V3G	2.10	NE16	.68	434A	19.95	810	11.00	1280	1.95
1N21	1.35	3B24	5.50	FG17	6.95	446A	1.95	811A	3.15	1611	1.95
1N21A	1.75	3B24W	7.50	RX21	3.95	450TH	45.00	813	8.95	1613	1.38
1N21B	4.25	EL3C	5.95	FG33	12.95	450TL	45.00	814	3.95	1616	2.95
1N22	1.75	3C24	1.95	35T	4.95	464A	9.95	815	3.50	1619	.89
1N23	2.00	3C31	5.95	45 Special	.35	471A	2.75	816	1.45	1622	2.75
1N23A	3.75	3DP1A	10.95	RK39	2.95	527	15.00	829	12.95	1624	2.00
1N23B	6.00	3E29	15.50	VT52	.25	WL530	3.50	829A	13.95	1625	.45
1N26	8.00	SN4	5.50	RK72	1.95	WL531	22.50	829B	15.95	1851	1.85
1N27	5.00	4A1	1.75	RK73	1.95	700A/D	25.00	830B	11.50	2050	1.85
1N43	2.50	4B26	10.95	100TH	9.00	701A	7.50	832	7.95	2051	1.80
1N48	1.00	4C27	25.00	FG105	19.00	703A	6.95	832A	9.95	8012	4.25
1S21	6.95	4C28	35.00	F123A	8.95	705A	3.95	833A	49.95	8013	2.95
2B22	4.95	4E27	17.50	203A	8.95	707A	17.95	834	7.95	8013A	5.95
2B26	3.75	4J25	199.00	211	.95	707B	27.00	836	4.95	8020	3.50
2C34	.35	4J26	199.00	217C	18.00	714AY	17.95	837	2.95	8025	6.95
2C40	20.00	4J27	199.00	242C	10.00	715A	7.95	838	6.95	9001	1.75
2C43	27.00	4J31	199.00	244A	12.95	715B	18.00	845	5.59	9002	1.50
2C44	.90	4J32	199.00	249C	4.95	715C	25.00	849	52.50	9003	1.75
2D21	1.75	4J33	199.00	250TL	19.95	717A	1.95	851	80.50	9004	1.75
2E22	3.75	4J37	199.00	274B	3.00	718AY/EY	48.50	860	4.95	9005	1.90
2E30	2.75	4J38	89.00	304TH	15.00	719A	29.50	861	39.50	9006	.35
		4J39	199.00	304TL	14.50	721A	3.95				

Minimum Order $25.00

ATTENTION PURCHASING AGENTS AND BUSINESS MANAGERS

WE PURCHASE COMPLETE INVENTORIES AND ELECTRONIC PARTS AND TUBES FOR CASH.
CAN WE HELP YOU TO OBTAIN URGENTLY NEEDED ELECTRONIC MATERIALS?
OUR ORGANIZATION IS DEDICATED TO SERVE THE ELECTRONIC FIELD.
YOU CAN REACH US ON TWX NY1—3235

TEST EQUIPMENT

TSK1-SE
TVN3EV Bridge
RF4
APA10
TS10
TS12
TS15
APA28
TS33
TS34
TS34A
TS35
TS36
TS62
TS69
CY94
TS100
TS102
PE102
TS110
TS126
TS127
TS146
TS155
TS168
TS174
TS226
TS270
LZ Sets
BC1277
BC1287
WE 1-147
Hazeltine 1030
RADAR Sets & Parts, APS 3, APS 4.

ATTENTION:

OIL COMPANY ENGINEERS, SHIP SUPPLIERS, USERS OF SHORAN

We have for immediate delivery, tested and guaranteed perfect, new,

4C28

SPECIAL PRICE

$35.00

LIBERTY ELECTRONICS, INC.

PHONE WORTH 4-8262 — 135 LIBERTY ST., NEW YORK 6, N.Y.

Buy TOP Radio-Electronic *Values!*

TRANSMITTING MICAS

Stock No.	Cap.	Test Volts	Type No.	Price Each
5493A*	.01	1000	1445	.35¢
5494A	.02	1000	144T	.40¢
5495A	.006	1200	A 2	.40¢
5496A	.001	1500	BE 15	.20¢
5498A	.004	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	.0008	5000V	F2L	1.00
5606A	.000025	10,000	PL-341	1.95
5607A**	.00015	10,000	PL-315	7.95

* Supplied with Meter Bracket
** D.C. Working Voltage

OTHER TYPES AND SIZES AVAILABLE

MICA CAPACITORS

Sizes from 10 to 7,000 MMFD in CM20, CM30, CM35 and CM40 case sizes. Tan mica and silver mica.

Complete lists with prices available upon request

FT-255 Shock Mount Assembly
95¢ ea.

ART/13 COMPONENTS

G.E. pressure switch
Collins No. 260457000

Stock No. 5730A $6.50 ea.

Autotune Motor. 1/20th HP. 28 Volt; 4.2 Amp.; 3600 RPM. Collins No. NY818CB.

Stock No. 5731A $7.50 ea.

CRYSTAL OVEN

X-Thermotrol Plug-in Crystal Oven. Mfg. by Gasket Engineering Co., Inc. Model XT-200. 6.3 Volts A.C.-D.C. 12 Watts. Temperature 75° Centrigrade. Holds Crystal with ½" Pin Spacing having Maximum Case Size of ⅜" x ⅞" x 1⅛" High. Complete Oven measures 1½" Diam. x 3½" High. Standard Octal Base.

Stock No. 5283A Price Each **$2.50**

G. E. SATURABLE REACTOR

15 K.V.A. #67G469 **$100.00**

HIGH VOLTAGE TRANSFORMER

21,000 volt 100MA. Half Wave oil filled. Maloney Electric Co.

Stock No. 5728A $300.00

BC939 Antenna Tuning Units. Open Wire Line Type.

Stock No. 5729A $7.50 ea.

WESTERN ELECTRIC C-114

Loading coils $2.95 ea.

TOGGLE SWITCHES

Stock No.	Mfg.	Action	Rating	Price
5443A	H & H	S.P.D.T.	6A-125V	35¢
5281A	Carling	S.P.S.T.	10A-125V	39¢
5444A	C-H,(B6B)	S.P.S.T.	5A-125V	25¢

OTHER TYPES AVAILABLE

OIL FILLED CONDENSERS

.045 MFD 18,000 Volt Vitamin "Q". One Ceramic Insulated Screw Terminal 1¾" x 3½" x 4¾" High Can. Stock No. 5399A. **$4.95**

Standard Brand. Mfr. Name on Request

Oil Filled Condenser 10 Mfd. 220 V.A.C. Round Can, 2-½" Diameter x 3-⅞" High. Stock No. 5658A. **$.95 each**

WRITE FOR COMPLETE BULLETIN

OUR FULLY ILLUSTRATED BULLETIN OF ELECTRONIC PARTS IS MAILED AT REGULAR INTERVALS TO MANUFACTURERS AND WHOLESALERS. IN THE CATALOG ARE LISTED AND PICTURED HUNDREDS OF ITEMS OF INTEREST TO PURCHASING AGENTS OF ELECTRONIC PARTS. WE SHALL BE PLEASED TO PLACE YOUR COMPANY'S NAME ON OUR MAILING LIST. PLEASE REQUEST ON YOUR COMPANY LETTERHEAD.

ECLIPSE VOLTAGE REGULATOR

5603A Bendix Eclipse V.R. 1365 volts set Model 2 Style A at 115

Stock No. 5608A $2.95 ea.

HIGH FREQUENCY RESISTOR

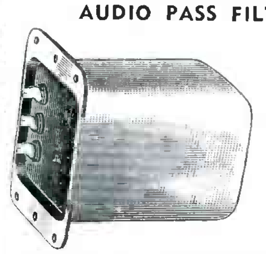
Type MPO-7
50,000 ohm 30 watt

Stock No. 5625A $1.95 ea.

LARGE STOCKS OF FERRULE RESISTORS AVAILABLE. Write for list or specify your requirements. We also have mounting clips.

WRITE FOR SPECIAL LISTING OF SIGNAL CORPS AND NAVY TRANSFORMERS, CHOKES AND SPECIAL ITEMS.

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.

STEEL CABINETS

Unpainted. 11" wide x 9" high x 5" deep. Panel space 10" x 9".

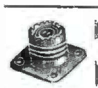
Stock No. 3197A Price Each **$1.00**

PRICE EACH IN LOTS OF 48, 75¢

AN/APQ-13 MODULATOR UNIT

Signal Corps # 2CK2637-13 W.E. NNO. D-151754. Oil filled modulator containing a pulse amplifier and associated rectifier.

$125.00 ea.



83-1R COAX CONNECTOR

Stock No. 5657A $.60 ea.

W.E. TYPE 400D VARISTOR

Stock No. 5102A Price Each **$2.50**

RESISTORS

1/2 Watt 10% AB Type EB Resistors.

Stock No.	Resistance Ohms	Price Per 1000
5472	100,000	$50.00
5473	470,000	50.00
5474*	680,000	40.00
5475	820,000	50.00
5476	1.5 Megohm	50.00
5477	2.2 Megohm	50.00
5478	3.3 Megohm	50.00

* Type BTS

72 OHM COAX

Plastoid RG-59/U Coax.

Stock No.		Price
5324A	1000 Ft. Spools	$60.00
5325A	100 Ft. Coils	7.00

PLATE CIRCUIT RELAY

G.E. No. CR2791-B109L39 D.P.D.T. Plate circuit relay. 8000 Ohm coil.

Stock No. 5677A Price Each **$1.50**

JONES CONNECTORS

Stock No.	Jones No.	Price Each
2090A	P-308-AB	10¢
5093A	P-310-FHT	18¢
3541A	S-408-EB	15¢
5072A	S-404-SB	30¢
5097A	P-406-FHE	25¢

J-38 KEYS

Signal Corps Type J-38 Keys.

Stock No. 5293A Price Each **85¢**

10" PM SPEAKERS

Permoflux 10" PM Speaker with 2.15 oz. Magnet. Packed 18 to a carton.

Stock No. 5335A Price Each **$3.35**

Carton Lot $52.00

2 VOLT BATTERY

Signal Corps Type BB-54A 2 Volt 27 Ampere Hour Storage Battery. Non-Spillable Transparent Acid Proof Plastic Case has Built-in Ball Type Hydrometers. 3" x 4" x 5" High. Shipped Dry with Acid in Separate Container. Made by Willard.

Carton of 12 @ $1.60 Each

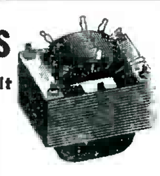
Stock No. 5458A Price Each **$1.95**

ELECTRO-VOICE—602 DIFFERENTIAL DYNAMIC MICROPHONE

A close talking, noise-cancelling Speech Microphone. 150 Ohm Impedance Dynamic Unit comes complete with press-to-talk switch and 5 Ft. Shielded Four Conductor Cable. Brand New. Individually boxed.

Stock No. 5282A Price Each **$15.00**

6.3 VOLT FILAMENT TRANSFORMERS



Primary 115 Volt 60 Cycle 1600 Insulation Three 6.3 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.5 Amps.
6.3 Volts @ 1.1 Amps.

Horizontal Half Shell Mounting. 2¼" x 2 13/16" Mounting Centers. 2 13/16" x 3⅜" Core Size 2½" above Chassis. Solder Lug Terminals—All Terminals Marked.

Stock No. 5251A Price Each **$2.65**

Terms: Open Account to rated or acceptable referenced accounts. Others Pre-payment or 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject prior sale.

Radio Surplus Corp.

732 South Sherman Street
Chicago 5, Illinois
Phone: HArrison 7-5923

COMMUNICATIONS EQUIPMENT CO.

10 CM RESEARCH EQUIPMENT

COAXIAL WAVEMETER, W.E. Transmission type, using type "N" fittings. Calibrated between 3400-4500 MC....$99.50
LHTR. LIGHTHOUSE ASSEMBLY, Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27. Tunable APX 2400-2700 MCS. Silver Plated....$49.50
BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice....each $47.50
MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated....$45.00
SIGNAL GENERATOR, using 417A klystron. 2700-3300 mc. Output approx. 50 mw. 115 vac power supply. With tubes, new....$425.00
REGULATED POWER SUPPLY for GL 446 type lighthouse tubes (2C40, etc.) 115 vac. 60 cycles. Panel Mounting. Less tubes....$32.50
RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (2C40, 2C43, 1B27 lineup) w/Tubes.
721A TR BOX complete with tubes and tuning plungers....$12.50
McNALLY KLYSTRON CAVITIES for 707B or 2K28. Three types available $4.00
TS 268 CRYSTAL CHECKER....$35.00
F 29/SPR-2 FILTERS, type "N" input and output....$12.50
WAVEGUIDE TO 7/8" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE SILVER PLATED BROAD BAND....$32.50
AN/APR5A 10 cm antenna equipment consisting of two 10 cm waveguide sections, each polarized, 45 degrees....per set, $75.00
POWER SPLITTER: 726 Klystron input dual "N" output....$5.00
MAGNETRON COUPLING FOR TYPE 720 MAG. to 1½" x 3" Waveguide....$35.00
S BAND SIGNAL GENERATOR, complete with calibrated attenuator, W. E. coax. wavemeter, McNally Klystron Cavity. Regulated power supply operates from 115 V.A.C., 50-1200 Cycles. Manufactured by W. E.....$650.00
OAJ ECHO BOX, 10 CM, TUNABLE....$22.50

7/8" RIGID COAX—3/8" I. C.

RIGHT ANGLE BEND, with flexible coax output pickup loop....$8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple....$3.00
RIGID COAX to flex coax connector....$3.50
STUB-SUPPORTED RIGID COAX, gold plated 5' lengths. Per length....$5.00
RT. ANGLES for above....$2.50
RT. ANGLE BEND 15" L. OA....$3.50
FLEXIBLE SECTION, 15" L. Male to female....$4.25
FLEX COAX SECT. Approx. 30 ft.....$16.50
7/8" RIGID COAX. BULKHEAD FEED-THRU....$14.00

1.25 CM RESEARCH EQUIPMENT

COMPLETE 24,000 MC RF HEAD, including 2K33 Klystron 3J31 Magnetron and Magnet, all plumbing, and associated circuitory in standard A-N pressurized housing. New....$1100.00
Low Power Load....$20.00
Waveguide Lengths, 2" to 6" long, gold plated with circular flanges and coupling nuts....per inch, $2.25
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

3 CM Research Equipment
1" x ½" Waveguide

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover..per length, $7.50
Rotating Joints supplied either with or without deck mounting. With UG40 flanges....each, $17.50
2J42 Magnetron Pulse Modulator. 14kw max. rating 7kw min. Plate voltage pulsed 5.5kv 6.5 Amp. .001 duty cycle. 2.5 usec pulse length max. filament 6.3V .5 Amp. Includes magnetron mtg. and blower. Requires 3C45 and 2-3B24. New....$75.00
TS 268 Crystal Checker....$35.00
Bulkhead Feed-Thru Assembly....$15.00
Pressure Gauge Section 15 lb. gauge and press nipple....$10.00
Pressure Gauge, 15 lbs....$2.50
Dual Oscillator-Beacon Mount. P/O APS 10 Radar for mounting two 723A/B klystron with crystal mts. matching slugs, shields....$42.50
Dual Oscillator. Mount. (Back to back) with crystal mount, tunable termination attenuating slugs....$18.50
Directional Coupler. UG-40/U Take off 20 DB....$17.50
2K25/723 AB Receiver local oscillator Klystron Mount, complete with crystal mount. Iris coupling and choke coupling to TR....$22.50
TR-ATR Duplexer section for above....$8.50
CU 105/APS 31 Direction Coupler 25 DB....$25.00
723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder....$12.00
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/press nipple....$6.50
Waveguide Sections 2½ ft. long silver plated with choke flange....$5.75
Rotary joint choke to choke with deck mounting....$17.50
3 cm. mitred elbow "E" plane unplated....$12.00
UG 39 Flanges....$ .85
UG 40 Chokes....$1.00
90 degree elbows. "E" or "H" plane 2½" radius....$12.50
90 degree twist 6" long....$8.00
45 degree twist....$8.00
40KW X BAND Radar, complete as described and illustrated in July 1951 PROC IRE
APS-4 Under Belly Assembly, less tubes....$375.00

1¼" x 5/8" WAVEGUIDE

Mtred Elbow H Plane UG51-UG52....$12.00
6" St. sect. choke to choke....$3.50
CG 98B/APQ 13 12" Flex. Sect. 1¼" x 5/8" OD....$10.00
X Band Wave GD. 1¼" x 5/8" O.D. 1/16" wall aluminum....per ft., 75¢
Slug. Tuner Attenuator W.E. guide. Gold plated....$6.50
Bi-Directional Coupler, Type "N", Takeoff 24 d.b. coupling....$27.95
Bi-Directional Coupler, UG-52, Takeoff 25 d.b. coupling....$24.95
Waveguide-to-Type "N" Adaptor. Broadband....$22.50

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp). Duty Ratio: .001 max. Pulse duration: 5. 1.0, 2.0 microsec. Input voltage: 115 v 400 to 2400 cps. Uses: 1-715B, 4-829-B, 3-'72's, 1-'73. New....$110.00
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
APS-1C MODULATOR DECK. Complete, less tubes....$75.00

PULSE NETWORKS

MULTI SECTION PULSE NETWORK:
ALL RATINGS 8KV Z=50 OHMS, "E" CKT.

Pulse Length	PRR	Sections
.25	1600	2
.50	800	2
2.6	400	4
5.20	200	4 + 4

Physical Size: 2" x 10 3/8" x 5 3/8"....$47.50

15A—1-400-50: 15 KV. "A" CKT. 1 microsec 400 PPS. 50 ohms imp. $27.50
G.E. #6E3-5-2000-501P2T. 6KV. "E" circuit, 3 sections .5 microsecond, 2000 PPS, 60 ohms impedance....$6.50
G.E. #3E (3-84-810) (8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit: Unit 1, 3 sections. 0.84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS, 50 ohms imp....$6.50
7.5E3-1-200-67P. 7.5 KV, "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance, 3 sections....$7.50
7.5E4-16-60, 67P, 7.5 KV. "E" Circuit, 4 sections 16 microsec, 60 PPS, 67 ohms impedance....$15.00
7.5E33-200-6FT. 7.5 KV, "E" Circuit. 3 microsec 200 PPS, 67 ohms imp. 3 sections....$12.50

PULSE TRANSFORMERS

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.-KS 9800 Input transformer. Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s., Permalloy core....$6.00
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 100KW 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 UX 7361....$5.00
PHILCO #352-7250, 352-7251
UTAH #9262, 9332, 9278

MICROWAVE TEST SETS

X BAND POWER METER

Consists of thermistor mount and bridge, microammeter, rough attenuator. X-Band Waveguide thru-out. For power measurements anywhere in the 9000 MC band.

BROADBAND TEST OSCILLATOR

Freq. coverage 50-3000 MC. By direct calibration and interpolation anti-blacklash gear drive, compact, portable. Operates from any 115V source or battery source. New, with all tubes....$425.00

TS 102/AP	TS 226	TS 56A/AP	CS60-ABW
TS 47/APR	TS 250/APN	CW60-ABM	I-58
TS 36/AP	TS 89	LU-I	I-222
TS 12 UNIT 2	I-203-A	LU-3	I-185
Q. METER	TS 11/AP	TS 159	TS 268/U
TS 69/AP	BC 438		

Send for Further Information and Prices

POWER EQUIPMENT

STEP DOWN TRANSFORMER: Pri. 440/220/110 volts a.c. 60 cycles. 3KVA. Sec. 115v. 2500 volt insulation. Size 12" x 12" x 7"....$40.00
PLATE TRANSFORMER: Pri.: 117 v. 60 cy. Sec. 17,600 @ 144 ma. with choke. Oil immersed. Size: 26" x 29" x 13" American....$120.00
FIL. TRANS. UX6899. Pri.: 115 v. 60 cy. Sec. Two 5 v. 5.5 amp. wdgs. 29 KV test....$24.50
VOLTAGE REG. Transtat. Amertran type RH 2 KVA load, input: 90/130 v. 50-60 cy. output 115 v....$40.00
UX 6301 (Raytheon): Pri.: 110 v. 60 cy. 1 ph. Sec.: 22,000 v. 234 ma., 5.35 KVA., Dim.: 23" x 24" x 10¾". Low capacitance....$185.00
FIL XFMR: Kenyon: Pri.: 210/215/220/225/230/235/240 vac. 60 cy. Sec.: 11 v., 35 amp., 10 1., 35 amp ct; 7.5 v., 35 amp ct; 5 v., 35 amp ct #S-10768..$37.50
FIL TRANS. KS8767: Pri.: 115 v., 60 cy. Sec.: 2 wdgs.: v. @ 5 amps each 15 KV test....$15.00

RADAR SETS

APS-2, Airborne. 10 CM. Major Units, New
APS-4, Airborne, 3 CM, Compl.
APS-15, Airborne, 3 CM, Major Units New
SD-4, Submarine, 200 MC, Compl., New
SE, Shipboard, 10 CM, Compl., New
SF-1, Shipboard, 10 CM, Compl., New
SJ-1, Submarine, 10 CM, Compl., Used
SL-1, Shipboard, 10 CM, Compl., Used
SN, Portable, 10 CM, Compl., Used
SQ, Portable, 10 CM, Compl., Used
SO-1, Shipboard, 10 CM, Compl., Used
SO-7, Portable, 10 CM, Assualt
SO-8, Shipboard, 10 CM, Compl., Used
Mark 4, Gunlaying, 800 MC, Less Ant., Used
Mark 10, Gunlaying, 10 CM, Compl., New
CPN-3, Beacon, CM, Major Units, Used
CPN-8, Beacon, 10 CM, Compl., Less Ant., New
SCR-533, IFF/AIR, 500 MC, New

VARISTORS

D-167176....$ .95
D-172155....$2.25
D-168687....$ .95
D-171812....$ .95
D-171528....$ .95
D-162356(308A)....$1.50

THERMISTORS

D-166283....$1.50
D-167332 (tube)....$1.50
D-170396 (bead)....$1.50
D-167613 (button)....$1.50
D-164699 for MTG. "X" band Guide....$2.50

MAGNETRONS

2J27	2J38 Pkg.	5J30
2J31	2J39 Pkg.	718DY
2J21-A	2J49	720BY
2J22	2J61	725-A
2J26	2J62	730-A
2J32	3J31	700 A, B

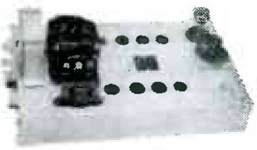
All merch. guar. Mail orders promptly filled. All prices, F.O.B. N.Y.C. Send M. O. or Chk. Only shipping chgs. sent C.O.D. Rated concerns send P. O.

COMMUNICATIONS EQUIPMENT CO.

131 Liberty St., New York, N. Y. MR. CHAS. ROSEN **Dept. E-2** **Phone Main 4-8373**

— THE BEST IN ELECTRONIC SURPLUS —

GENERAL ELECTRIC VOLTAGE REGULATOR & POWER SUPPLY MODEL 3GVD14B3



Output 750 volts up to 100 ma; complete power supply using 8 tubes, with selector switch for regulating or non-regulating. Operates from 110 V., 60 cycles AC. NEW units, less tubes, with operational data and diagram. **EACH** **$24.50**

ECLIPSE PIONEER TYPE C-14 MAGNESYN UNIT

Per W.E. Spec., KS-5899-L01 excitation 26 volts 400 C.P.S. current drawn 200 to 500 MA. Shaft locking arrangement overall dim. 2¼" dia. 2¼" long. .812" x 2.562" Mtg. centers. NEW Units.
Price, EACH **$7.50**

INDUSTRIAL CAPACITORS

TYPE 18F75

50-50-50 mfd., Delta connected, 90 V. AC, 60 cps. All NEW, packaged capacitors. For power-factor correction, etc. Large quantity available.

EACH **$7.00**

REVERSIBLE ½ HP AIRCRAFT MOTOR

GE Model 5BA50-L.157, 4,000 RPM. Volts—27 Field and 60 V. Armature. Wt 13 lbs. NEW units, individually packed, Approx. 300 available, at.............**$10.00 EACH**

Capacitor-Transformer, GE Model 69-G-210, 132/200 Volts, Kva 1.42/.23, 140/10 Watts, 60 cycles. NEW units, packaged.
EACH **$10.00**

Overload Relay, GE type CR-5882-C1G, rated at 250 V. max. NEW, individually packaged.

Low Pressure Switches, GE type 2927D100-J1. NEW. **EACH** **$3.00**

Radar Fil. Transf. WE. Spec. D-122882, RMS Test 30 Kva. Pri.—115 V., 50/70 cycles. Operating max D.C. 15 Kv., Sec. #15V. at 10 amps., #2 5V. at 10 amps., #3 5V. at 20 amps. New Units, cased. **EACH....$15.00**

"SNOOPERSCOPE" TUBES, British-Infra-Red Image Converter Tubes, with matching Bausch & Lomb front-end Lens. **TUBE, EACH $5.50; LENS, EACH $10.00.**

1-KW—FM 88-108 MC BROADCAST POWER AMPLIFIERS

Latest design and production, mfd. by G.E. Model BF-1-A. Not War Surplus! RF AMPLIFIER includes full Power Supply in modern, streamlined cabinet, 75" high 30-¼" wide, 25-¼" deep. Operates from 208/230 volts, 50/60 cycles 1-phase A.C. With tubes; 2-GL-8008, 2-GL-7C29, and 1-6H6. All NEW equipment—export packed. **PRICED AT A FRACTION OF ORIGINAL COST!!**

WRITE FOR COMPLETE DESCRIPTION AND PRICES

TRANSMITTERS

T4/FRC, with Modulator
MD 1/FRC, and
PP-1/FRC, Power Supply.
RCA-ET 4332 and 4336.
TDE, TBK, 8010, 8003, for Ships.
ATD, for Aircraft.
BC-319, BC-604, BC-684, etc.
RCA-2.5 KW. Converted to R. F. Heater, 2.5 KW- output. Freq. range 10.7 to 14.4 mc. Consists of 2 cabinet units; Oscillator unit uses two 827R tubes forced air-cooling; Power supply uses six 872A rectifiers, with requisite meters and relay controls. Operates from 230 or 460 V., 50-60 cycles, 3 phase A.C. **PRICE AS IS**..............**$1,400.00**
TSI 500W, Simultaneous Radio Range and Telephone Transmitter. Frequency 200-400 KC. Mfd. for CAA by Federal Tel. Co.
BC-797, 50 Watt AM Transmitter. Freq. 110 to 130 MC, Xtal Control. Operation—110V. 60 cycles AC.
TDQ Transmitters, 100-156 MC, 45 watts AM output. Reconditioned to like new.

MANY OTHERS!

TRANS-RECEIVERS

SCR-509 & 510, SCR-511, SCR 669 & 610, SCR-522, LINK Model 1498, TCS with 12/24/230 DC and 110V, AC Power Supplies, SCR-508/528/668/628.
Jefferson Travis, Model 350-A, Transmitter-Receiver, 50 W. output, 1.5 to 12.0 mc, 5 channels operation—1 VFO and 4 X'tal—both transmitter and receiver. Power Supply operates from either 12/24/32/115 V.D.C., or 115 V. AC, 60 cycles. With Ant. Loading Coil unit, handset, key, & instruction book. Complete.

AUDIO SOUND

Beachmaster 250 W.; Western Elec. Model HLAS—500W.; RCA 25W. (12V.) Mobile; RCA MI-2817-E Amplifier, 1,000 Watts (2—500 Watt Channels); **W.E. Speaker Units** D-173246. (25-30 Watts) and D-173232A (50-60 Watts), considerable quantity available.

TEST EQPT.

BC-221, I-222-A Signal Generator, 100-156 MC, with crystal calibrator, for 115 V. 60 cycles AC.
TU-56, TU-57, TS-45, TS-143, I-148, TS-305, TS-143/CPM - 1 Synchroscope. Others.

RADAR

SCR-545-A, Complete in Trailer Trucks, with or without 25 KVA Gas-Engine Generator Unit.
Hundreds of radar components, plumbing, magnets, tubes, transformers, etc.

RECEIVERS

RBM, RBS, DZ-2 Direction-Finders with Loops, **SCR-206** Direction Finders with Loops, **SCR-291 Indicators** and Accessories. Others.
CRV-46136, 100 to 1500 KC, part of DP-13 Radio Eqpt.
R-89/ARN-5A Glide-Path Receiver, with crystals. NEW.
RT-3/ARN-1 Radio Receivers, New. **Model ZB-3, Aircraft Homing Adapters,** with plugs and accessories. New Eqpt.

Wilcox 36A Rectifier-Power Supply, for 3 KW modulated transmitter. Designed for use with 4 or more 96C 3 KW Transmitters and 50A Modulator. New, Unused. **WRITE FOR PRICE.**

RADIOSONDE AN/AMQ-1, Meteorological Balloon transmitter with self-contained instruments. New Units, with slide-rule temperature evaluators and spare (sealed) humidity elements. Large quantity available. Receiving and Recording supplementary eqpt. also available. Type AN/FMQ-1. **WRITE FOR PRICES.**

32V. DC to 110V. AC KATO Converters, NEW, good to 300 watts.

115V DC to 115V. AC., 60 cycles, Motor-Generators. 500 Watts output; mfd. by Esco, and Holtzer-Cabot.

RC-163 Radio Beacon Eqpt., designed for use with SCR-508 / 608 / 528 / 628 / 510 / 610 Transmitter-Receivers, 20 to 40 mc. Complete, export-packed, NEW equipment.

TE-54A & TE-55A Cable Vulcanizing Units. AT-49/APR-4 Antennas.

Tuned Filter Chokes, 120 cps, 40 H., D.C. res. 410 ohms, with 0.177 mfd (600 w.v.) capacitor. N. Y. Transf. type T-OD-8035. New. Hermetically sealed. Dim: 5¼H x 4¾" x 3½". **EACH**..................**$2.95**

Amertran Filter Chokes, type W, 0.04 Henries at 3.4 amps, 10 kv RMS test. New units. **EACH** **$3.95**

Screw Plug Heating Elements, Chromolux SCB, Metal encased, 150 W. 110 volts. 5½" long, 1⅝" dia. New. **EACH**..........**$0.75**

GE D & W Oil Fuse Cutouts, Model 9F2D2, rated 50 amps/5,000 V. or 100 amps/2,500 V. grd. Y. New Units. **WRITE FOR PRICE.**
BD-72 Switchboards, Excellent Condition. **EACH** **$55.00**

Dynamotor DM-28, for BC-348 Receiver. New. **EACH**.......................**$7.25**
MP-22A Mast Base, w/insulator spring-loaded for swiveling and quick return. New units. **EACH** **$4.95**

T-9/APQ-2 Radio Transmitters. Noise-modulated Jamming Transmitter, using Electron-Multiplier Photocell. For Jamming certain types radar eqpt. New unused transmitters only, with Electron-Multiplier tube, less other tubes. **EACH**............**$32.50**

SB-23/GTA-2 & SB-14/GY Switchboards & Power Supply, for operation from 110V. 60 Cycles AC (with storage batteries). Each in individual metal cabinet. NEW. **Price, Each Set** **$300.00**

Deck Entrance Insulators, bowl and flange type, 8⅞" dia. with heavy galvanized metal flange and bell. Top bell 6¼" dia. x 11"; brass feed-thru rod, very high voltage insulation. Individually packed in cartons, all NEW. **12 FOR**..................**$24.00**

TS-48AP Echo Boxes. UNUSED. **EACH** **$20.00**

SCR-584 Sector Scan Units. Unused. **EACH** **$9.00**

QBE-3 Control Rectifiers, Type CBM-20223. Unused. **EACH** **$27.50**

BC-689A Radio Transmitters. Unused. Less tubes. **EACH** **$22.50**

Remote Antenna Drive RM-55, Hand-crank driven assembly, with illuminated azimuth scale, couples to any directive antenna by means of flexible drive shaft and permits remote control. NEW units, in wooden chests.

Aircraft—High Pressure Axial Flow Fans, 24-28 V. DC, capacity 200 cfm, 1/15 HP. Model 4581A2A. NEW units, packaged.

Purchasing Agents! We have thousands of oil condensers, transmitting micas, resistors, transformers, transmitting tubes, etc. Check with us for any special requirement.

EXTRA—SPECIAL!!! GE JAN 872A Rectifier Tubes, packed 25 to each carton. NEW, original cartons. 25 for $75.00, while they last.

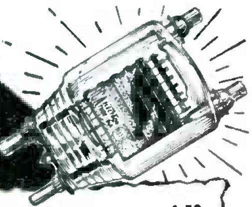
Immediate Delivery from Stock — All Prices F.O.B. N.Y.C. — All Material Offered Subject to Prior Sale

Cable: Telemarine, N. Y.
Tel. LOngacre 4-4490-1

TELEMARINE COMMUNICATIONS CO.

540 W. 27th St.
N. Y. 1, N. Y.

TUBES for: INDUSTRY COMMUNICATIONS RESEARCH



ALL NATIONALLY ADVERTISED BRANDS—IN STOCK! Thousands of satisfied customers have found there's a *difference* when you buy new, factory-guaranteed tubes from TERMINAL!

R.C.A. RADIOTRONS	
OA2	1.70
OA3/VR75	1.56
OA4G	1.70
OB2	1.88
OC3/VR105	1.56
OD3/VR150	1.56
1P21	50.00
1P22	14.75
1P29	2.95
1P37	2.85
1P39	1.75
1P40	1.95
1P41	2.80
2AP1-A	10.55
2A4G	1.88
2BP1	9.60
2BP11	11.00
2C21/1642	1.90
2C22	1.60
2C43	25.50
2D21	2.00
2D21W	3.15
2E24	4.65
2E26	3.85
2J50	192.00
2V3G	3.09
2X2A	2.56
3A4	1.20
3A5	1.95
3B28	8.85
3AP1-A	14.25
3BP1-A	16.50
3C33	21.25
3E22	8.30
3E29	20.25
3FP7A	23.00
3JP1	19.00
3KP1	14.50
3KP4	15.00
3KP11	16.50
3RP1	14.50
4B26/2000	12.20
4-65A	20.00
4-250A/5D22	41.25
4E27/8001	24.50
4X150A	48.00
4X500A	121.00
5BP1-A	22.50
5CP1-A	23.25
5CP7-A	27.25
5CP11-A	27.50
5CP12	27.00
5FP4-A	41.75
5FP7-A	30.25
5FP14	30.25
5R4-GY	1.85
5TP4	45.00
5UP1	17.75
5UP7	20.25
5UP11	22.00
5WP11	70.00
6AG7-Y	1.75
6AS6	3.65
6AS7G	4.53
6C24	60.00
6SJ7-Y	1.00
6SN7GTY	1.40

6V6-GTY	1.03
7BP7-A	48.50
7CP1	30.75
7CP4	33.00
7JP1	23.50
7MP7	39.50
7MP14	39.50
7QP4	39.50
7TP4	52.00
10BP4-A	23.00
10FP4-A	29.50
10KP7	61.75
10-Y	2.29
12A6	1.62
12DP7-A	72.50
12KP4-A	31.30
12L8GT	2.50
12LP4-A	26.25
12SP7	47.40
12SW7	1.10
12SX7GT	1.40
14CP4	26.25
14EP4	18.95
16ADP-7	55.00
16AP4-A	38.00
16GP4-A	30.00
16GP4-B	30.00
16RP4	28.00
16TP4	28.00
17BP4-A	27.20
17CP4	26.50
17GP4	26.50
19AP4-A	45.00
19AP4-B	45.00
20CP4	41.00
21AP4	42.50
26A6	3.10
26A7GT	5.95
26C6	2.10
26D6	2.85
89-Y	1.10
172	65.00
203-A	13.75
204-A	130.00
211	13.75
217-C	21.17
559	5.35
629	13.00
672-A	35.00
673	21.00
677	55.00
715-C	63.00
800	11.50
801-A	4.85
802	4.75
803	24.25
804	17.50
805	13.50
806	34.25
807	2.50
808	10.75
809	4.00
811-A	5.00
812-A	5.00
814	14.25
816	1.65
826	12.50
827-R	172.50
828	13.75
829-B	16.25

830-B	11.50
832-A	12.90
835	19.50
836	9.00
837	5.80
838	13.75
841	4.35
842	4.05
843	2.60
845	13.75
846	250.00
849	138.00
857-B	209.00
861	178.25
862-A	1322.00
866-A	2.10
868	2.50
872-A	8.20
874	3.10

1616	8.65
1623	4.05
1624	4.00
1625	2.65
1629	1.40
1631	3.10
1632	3.25
1633	1.95
1634	1.40
1635	2.15
1644	3.10
1654	4.55
1945	135.00
1947	9.75
1949	11.30
1950	7.80
2050	1.85
5527	49.90
5550	50.00

NEW TUBE OF THE MONTH!
RCA 6146

This new, small-beam power tube is a "natural" for amateur and mobile radio use up to 175 Mc. Combines higher frequency range of the 2E26 with the higher power capability of the 807. **4.90**

878	12.75
884	1.85
885	2.00
886	4.60
889R-A	295.00
902-A	12.50
905-A	65.25
908A	16.50
912	155.00
914-A	93.50
917	3.50
918	3.10
919	3.50
920	4.15
921	2.05
922	1.95
923	2.05
924	3.30
925	2.40
926	2.90
927	2.50
928	2.85
929	1.50
930	1.65
931-A	9.75
934	3.40
935	7.80
954	5.65
956	7.00
957	3.75
991	.75
1608	7.90
1610	2.50

5551	80.50
5552	121.00
5553	265.00
5554	190.00
5558	14.00
5563	47.00
5581	2.25
5582	2.65
5583	3.05
5584	3.95
5618	3.60
5652	6.55
5763	1.75
5819	55.00
5820	1200.00
5822	143.00
5826	1300.00
5879	1.75
5893	19.40
5915	1.20
5963	1.40
5964	1.50
6026	2.95
6146	4.90
8000	14.50
8003	14.00
8005	8.40
8008	8.20
8012-A	15.50
8013-A	10.30
8020	8.40
8025-A	11.30
9001	3.40

9002	2.50
9004	2.30
9005	3.45
9006	1.60
VICTOREEN (THYRODES)	
1B67/VG-10A	75.00
VG-10A Special	67.50
1B68/VG-13	17.00
1B85	7.50
1B86	8.00
1B87	8.00
1B88	5.00
1B102	60.00
1B106	60.00
1B124	30.00
1B125	40.00
1B126	100.00
VICTOREEN (SUB-MIN.)	
5799/VX-21	3.75
5800/VX-41A	12.50
5801/VX-33A	6.75
5802/VX-32B	6.75
5803	6.75
5828	6.75
5841	6.50

232-C	560.00
233	500.00
237-A	435.00
241-B	115.00
242-C	15.00
249-B	9.00
249-C	9.00
251-A	300.00
255-B	145.00
258-B	11.00
266-B	210.00
267-B	22.00
270-A	194.70
279-A	355.00
284-D	17.50
308-B	100.00
311-CH	19.00
315-A	38.60
319-A	22.00
321-A	38.60
322-A	50.00
342-A	582.00
343-A	370.00
343-AA	435.00
492	260.00
492-R	260.00
498	450.00
501-R	100.00
502	80.00
502-R	130.00
504-R	125.00
508	500.00
575-A	24.00
673	24.50
725-A	250.00

TERMINAL RADIO CORP.

is exclusive distributor in New York for Victoreen radiation measuring equipment, counter tubes, subminiature electron tubes and Hi-Meg resistors. Write for complete VICTOREEN catalog.

5950	6.50
6119	6.50
6143	6.50
VX-10	5.00
VXR-130	5.00
AMPEREX	
4B32	12.00
203-A	13.75
203-H	25.00
207	242.00
211-C	19.00
211-D	17.50
211-H	19.00
212-E	102.00
212-F	102.00
220-C	365.00
221-A	20.00
222-A	300.00
228-A	325.00

810	14.50
813	16.00
833-A	49.50
834	14.50
849-A	135.00
849-H	135.00
851	253.00
858	500.00
859	500.00
866-AX	2.50
869-B	132.00
880	510.00
889-A	210.50
891	223.00
891-R	362.00
892	223.00
892-R	362.00
893-A	630.00
893-AR	1150.00
5604	540.00

5619	390.00
5666	225.00
5667	302.50
8002	132.00
8002-R	160.00
AB-150	20.00
AGR-9950	25.00
AGR-9951	110.00
AX-9900	22.00
AX-9901	33.00
AX-9902	60.00
AX-9903	19.00
AX-9904	150.00
AX-9904-R	225.00
AX-9905	6.00
FG-105	48.00
HF-60	12.50
HF-100	15.00
HF-120	17.50
HF-125	25.00
HF-130	19.00
HF-140	17.50
HF-150	19.00
HF-175	20.00
HF-200	28.50
HF-201-A	28.50
HF-250	30.00
HF-300	35.00
HF-3000	400.00
ZB-120	17.50
ZB-3200	300.00
TUNG-SOL	
5687	5.10
5881	2.95
SYLVANIA	
OA5	4.40
OB3/VR90	1.65
3D24	7.50
6AN6	3.50
6D4	2.85
6SJ7WGT	2.45
6SL7WGT	3.00
7AK7	6.50
807W	12.85
1280	1.56
5642	1.29
5933	12.85
HYTRON	
2E25A	5.50
2E30	2.45
3D21A	10.70
5514	4.95
5516	7.95
5812	3.10
HY75A	4.70
HY615	2.25
WESTINGHOUSE	
KU-618	15.75
SR-53	10.50
TAYLOR	
211-C	12.50
T-20	4.00

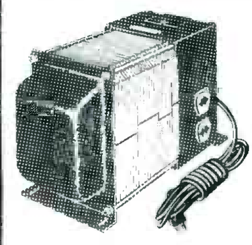
T-40	4.50
T-55	9.50
T-100	12.50
T-200	25.00
TT-17	7.00
TUF-20	5.50
TZ-20	4.00
TZ-40	4.50
RAYTHEON	
IAE5	12.65
2C34/RK34	3.50
2E26	3.85
CK501AX	3.15
CK506AX	1.88
CK512AX	1.88
CK522AX	1.88
CK523AX	1.88
CK524AX	3.15
CK525AX	1.88
CK528AX	1.88
CK529AX	2.41
CK553AXA	1.85
CK556AX	3.65
CK569AX	2.50
CK570AX	6.75
CK605AX	7.50
CK608AX	2.41
CK619AX	6.80
CK1007	1.20
CK5517	3.40
CK5676/CK556AX	3.65
CK5678/CK569AX	2.50
CK5697/CK570AX	6.75
CK5702/CK605AX	7.50
CK5703/CK608AX	2.41
CK5744/CK619AX	6.80
CK5784	7.50
CK5995	7.50
RK-3B24W	11.75
RK-6D22	55.00
RK-72	11.75
2051	1.90
EIMAC	
2C39A	36.50
4-65A	20.00
4-125A	30.25
4-400A	60.50
4X100A	48.00
4X150A	48.00
4E27A/5-125B	35.75
25T	9.00
35T	10.50
35TG	11.00
100TH	18.25
100TL	18.25
250TH	33.00
250TL	33.00
450TH	77.00
1000T	137.50
KY21A	13.25

SPECIAL! OIL-FILLED CAPACITORS

These condensers are new and perfect, manufactured by radio industry's most famous names!

Capacity	*D.C.W. Volts*	*Net Price*
4 mfd.	10,000	49.50
10 mfd.	6,000	39.75
2 mfd.	5,000	9.95
4 mfd.	4,000	13.95
2 mfd.	4,000	8.95
4 mfd.	3,000	8.95
12 mfd.	1,000	6.95

SPECIAL! 2KW STEP-DOWN TRANSFORMERS



Westinghouse #2F127 2,000 watts EXPORT ADAPTER AUTOTRANSFORMERS. Reduce 230 volts to 115 volts, 50/60 cycles AC. Famous Westinghouse 2F127 autotransformers rated 230V to 115V 50 cycles 2,000 VA. Ideal for air conditioners, electric machinery, commercial refrigerators, transmitters, etc. Fully shielded. 9-foot heavy duty rubber cord and plug, two 115 volt outlet receptacles. Individually export-boxed. Net: 52 lbs., Shipping weight: 63 lbs. Quantity limited. *Special,* **29.95**

Transformers for all radio applications in stock! We carry complete lines of U.T.C., KENYON, STANCOR, THORDARSON

GUARANTEE

All items sold by Terminal Radio Corp. are fully guaranteed. Prices subject to change without notice.

TERMINAL RADIO CORP.

Distributors of Radio and Electronic Equipment

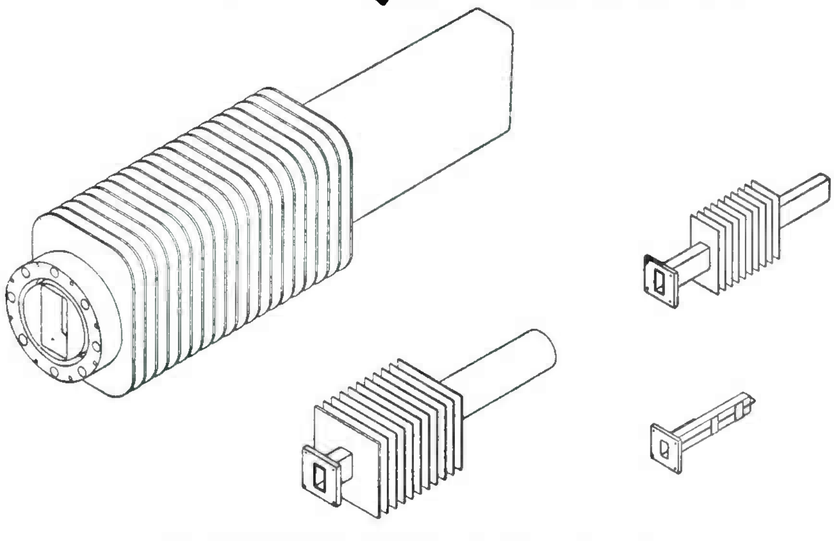
85 CORTLANDT STREET • NEW YORK 7, N. Y.

Phone: WOrth 4-3311   Cable Address: TERMRADIO

MINIMUM MAIL ORDER, $10

Prices are FOB, N.Y. Open account to rated firms.

TEST EQUIPMENT



HI-POWER DUMMY LOADS

X Band. 1¼" x ⅝" guide, choke or plain flange, dissipates 350 watts average power continuously in still air. VSWR less than 1.15 between 7 and 10 KMC, weight 5¼ pounds.

X Band. ½" x 1" guide, choke flange, dissipates 250 Watts average power continuously in still air. VSWR less than 1.15 between 8.2 x 12.4 KMC, weight 3¼ pounds.

X Band. 1¼" x ⅝" guide, plain flange, dissipates 200 watts average power continuously in still air. VSWR less than 1.15 between 7-10 KMC, weight 3¼ pounds.

X Band. 1¼" x ⅝" guide, plain flange, dissipates 150 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band. 1½" x 3" guide dissipates 1,200 watts average power in still air. VSWR less than 1.15 between 2.5 to 3.7 KMC, choke flange, weight 13 pounds.

TS-30. X Band Power Meter, measures 1 milliwatt to 1 watt of X Band average power for ⅝" x 1¼" wave guide.—$200.00.

TS-155 S Band Signal Generator and Power Meter.

X Band Frequency Meter, 8,500 to 9,600 megacycles, direct reading within 25 megacycles; within 4 megacycles with correction chart. Transmission type for ⅝" x 1¼" wave guide.

X Band Power and Frequency Meter for 8,500 to 9,600 megacycles measures 1 to 1,000 milliwatts average power. The frequency meter is direct reading within 25 megacycles and within 4 megacycles with correction chart; commercial equivalent of TS-230 B/AP.

TS-33/AP X Band Frequency Meter, 8,700 to 9,500 megacycles.—$150.00.

TS-62/AP X Band Echo Box.—$150.00.

TS-110/AP S Band Echo Box.—$150.00.

TS-89 Voltage Divider.—$30.00.

TS-12/AP (Unit 2) X Band slotted line with adapters and probes—$175.00.

TS-100 Synchroscope

T-85/APT-5, 300-1,600 megacycles Noise Modulated Transmitter, 40 watts C. W.

Waveguide Below Cut-Off Attenuator L 101-A, U. H. F. Connectors at each end, calibration 30-100 db.—$25.00.

Amplifier Strip AM-SSA/SPR-2 contains I. F. amplifier, detector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2 bandwidth 10 megacycles, center frequency 30 megacycles, sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac, 60-2, 600 cps 1.3 amps. Send for schematic—$65.00 less tubes.

Tuning Units for APR-4 Receiver

TN 16 30- 80 megacycles	TN 18 300-1,000 megacycles
TN 17 80-300 megacycles	TN 19 1,000-2,200 megacycles
TN 54 2,200-4,000 megacycles	

ELECTRO IMPULSE LABORATORY

62 White Street Red Bank 6-0404 Red Bank, N. J.

COLUMBIA ELECTRONICS LTD.

SCR 300

WALKIE-TALKIE normal range 3 miles or more depending on operating conditions. Frequency range: 40.0 to 48.0 mcs. Brand new. Complete.

HEADSETS

HS-38 & HS-33 BRAND NEW

R-4/ARR-2 RECEIVER

34-58 mcs. Brand new. COMPLETE WITH RACK AND CONTROL BOX.

AN/CRT-3

EMERGENCY RADIO TRANSMITTER. T-74/CRT-3 DUAL FREQUENCY OPERATED TRANSMITTER. Operates on both 8280 kc. and 500 kc. Power output 2½ W. on 500 kc and 2 W. on 8280 Kc. BRAND NEW. COMPLETE WITH PARACHUTE, KITES, LAMP, BALLOON and GENERATOR.

TEST EQUIPMENT

Complete Line!

Signal Generator 804-C
DuMont 224-A Oscilloscope
1-77 Hickok Tube Checker
1-208 FM Signal Generator
RPC Model 644 Multimeter
Ferris Microvolter Mod. 18-C

IE-36 (New)	TS-100/AP
I-122	TS-102A/AP
I-139 METER	TS-111/CP
I-212	TS-126
I-222	TS-127/U
TS-3/AP	TS-170/ARN-5
TS-5/AP	TS-175/UP
TS-10B/APN	TS-182/UP
TS-19/APQ-5	TS-184A/AP
TS-24A/APR-2	TS-204/AP
TS-34/AP	TS-250/APN
TS-36/AP	UPM-1
TS-61/AP	(Complete)
TS-62/AP	WE 1 193
SL-1 Slotted Line Test Set	Range Calibrator 1-146

MODULATOR UNIT BC-1203-A
With Coupling Heads BC--1201 & BC-1202

RC-184 IFF EQUIPMENT
Complete. Brand new.

APS-4 Complete Radar
Mark 16 Complete Radar
APS-6 Complete

RECEIVERS
APR-4 APR-5

SCR-720 Equipment | MG-19A New

MK-20A/UP
Brand new. Individually boxed.

SEE COLUMBIA ELECTRONICS AD ON PAGE 382

All items subject to prior sale.

Note! We have moved to our own, larger quarters. Note new address below:

COLUMBIA ELECTRONICS LTD.
7460 N. VARNA AVENUE
NORTH HOLLYWOOD, CALIF.
Cable Address: COELECT

• SELENIUM RECTIFIERS

Full-Wave Bridge Types

Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	110/100 Volts
1 Amp.	......	$1.98	......	......
2 Amps.	$2.40	3.75	$6.95	$10.50
4 Amps.	3.85	7.00	9.00	13.00 (2½ A.)
6 Amps.	5.65	9.00	......	33.00
10 Amps.	6.95	10.95	......	48.00
12 Amps.	7.50	14.00	......	58.00
20 Amps.	13.25	20.50	......	......
24 Amps.	14.00	26.00	......	......
30 Amps.	19.00	30.00	......	......
36 Amps.	25.50	35.00	......	......

All our Rectifiers are new & Guaranteed one year. We manufacture special types of rectifiers and rectifier supplies to your specs . . . FAST DELIVERY. LOW PRICES.

• Selenium Rectifier Transformers

Pri: 110 V, 60 cycle in. / Sec: 18, 24, and 36 volts.
- 4 amps. $8.75
- 12 amps. 16.75
- 24 amps. 35.75

Designed for bridge or center-tap use. These transformers are not surplus, but are made to our specs by a leading m'fr.

- 110V. Pri—36V. 50 amp second XFMR. Special $39.95
- 115 V Pri—5 Volt. 190 Amp Secondary Xformers $75.00
- 110 V. Selenium Rectifier Specials
  ½ wave..........65 ma..........only 59¢ ea.
  ½ wave.........450 ma..........only $1.65 ea.
- Carter, 6 V. Dynamotors, in orig. Factory Cartons.—400 VDC @ 375 ma List Price $71.40—Special $28.00

QUALITY, TESTED TUBES

"Standard Brands—Fully Guaranteed"

New and guaranteed in stock now, many others not listed—complete line of receiving tubes at low prices. Submit your requirements on any types for our quotation. Call us on WESTINGHOUSE Industrial & Special-purpose Tubes.

OA2	$1.00	15-E	1.45	814 (G.E.)	3.50
OB2	1.10	12AT7	.95	815	2.50
OZ4-A	.65	12AU7	.75	816	1.25
1B22	2.25	12AY7	3.00	829-B	13.50
1B23	8.00	35-TG	3.00	832-A	9.75
1B26	2.50	35-T. ION	4.00	837	1.50
1B27	15.00	101-D(WE)	1.25	866-A	1.55
1L21 (G.E.)	4.00	101-F(WE)	1.25	892-R	199.50
1N21	.85	101-L(WE)	1.25	954	.27
1N21B	3.50	102-D(WE)	1.25	955	.40
1N23	1.45	102-F(WE)	1.25	956	.37
1N23A	2.50	102-L(WE)	1.25	958-A	.65
1N23B	4.00	104-D(WE)	1.25	1613	.90
1N34	.65	211	.65	1616	.75
1N34A	.85	242-C	4.00	1622	2.50
1P24	1.60	274-B(WE)	3.50	1625	.40
2E24	4.75	275-A(WE)	4.50	1626	.40
2E26	3.25	310-A(WE)	6.50	1629	.30
2E30	2.35	311-A(WE)	7.50	1631	.75
2J32	35.00	313-C(WE)	1.25	2050	1.49
2J61	35.50	359-B(WE)	2.50	5528	15.00
2K25	27.50	373-A(WE)	5.00	5608-A	5.00
2K45	"WRITE"	374-A(WE)	5.50	5654	3.00
3AP1	10.75	387-A(WE)	2.50	5656	6.95
3BP1	7.25	400-A(WE)	2.50	5686	3.95
3BP11	10.00	403-A(WE)	1.75	5910	.75
3C23	9.75	403-B/5591	2.95	8016/1B3	.85
3DP1-A	5.95	407-A(WE)	7.25	9004	.44
3S4	.90	408-A(WE)	3.00	9005	1.50
4X150A	39.50	559	1.25	9006	.44
5D21	19.00	700-A, B, C,		304-TH	9.95
5FP7	1.95	or D	20.00	304-TL	9.95
5JP1	22.50	705-A	2.00	C6L	15.00
5LP7	15.75	707-A	7.95	F-123A	7.95
5V4-G	1.10	713 (WE)	1.00	FG-17	4.75
6AJ5	1.50	715-A	6.50	FG-172	40.00
6AK5	.95	715-B	9.00	RK-28-A	5.00
6AN5	3.95	715-C	22.95	RK-34	.27
6B4-G	1.25	723A/B	19.95	RK-47	5.00
6AS7-G	3.95	725-A	6.95	RK-59	.75
6BQ6GT	.90	807 or 807-A	1.65	RKR-72	1.25
6C4	.65				
6J6	.95	812	2.75	VR-105	1.25
10-Y	.45	813	7.85	KU-676	25.00

"NOTE: COLLEGES, UNIVERSITIES, INSTITUTIONS, LABS, M'FRS., INDIVIDUALS — OR ANYONE HAVING NEW TUBES IN LARGE OR ANY SMALL QUANTITIES—SUBMIT DETAILED LIST FOR OUR CASH OFFER."

• RG 59/U—73 OHM. CO-AX. CABLE....$55.00/M FT.

- The AR-11, 35 Watt Transmitter and Superhet Rcvr. Complete with 110 and/or 220 V.A.C. pwr. supply—With all Accessories. New: Export packed (orig. cost $550.00)—Ten Sets in Stock. Write for price and further information. See our Dec. Ad for details.
- ART-1—Compact, New, Aircraft 3105 KC. Transmitter—6" x 6"—Complete.........@ $25.00
- Pair of BC-611 Walkie-Talkies in new condition—Complete ....@ $150.00 pair
- Supreme-AF-100 Transmitter—New, Complete $300.00
- 115 Volt—300 Watts A.C. Compact Gas—Generator—Export Packed. New.............$165.00

Terms: FOB-NYC — 25% Deposit with order — or send full remittance to save COD charges—Rated Firms (D.&B.) Net 10 days — All merchandise guaranteed. Wherever possible, extend D.O.

Phone: REctor 2-2563

Cable: Barrylect, N. Y.

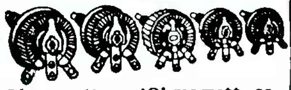
BARRY ELECTRONICS CORP

136 Liberty Street New York 6, N. Y.

BRAND NEW GUARANTEED

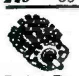
U. S. GOV'T. SURPLUS

POWER RHEOSTATS



Ohms	watt	ea.	Ohms	watt	ea.
.5	25	1.98	250	25	2.23
.5	50	2.81	250	50	2.53
.5	150	5.93	300	50	2.53
1	50	2.81	300	100	4.27
2	50	2.81	350	25	1.98
2	100	4.68	350	100	4.26
2	300	8.42	370	25	1.98
3	100	4.67	378	150	6.59
3	225	6.58	400	25	1.98
3x3	300	29.95	400	75	3.90
4	225	6.60	500	25	1.98
5	25	1.97	500	75	3.95
5	100	4.68	500	50	2.53
6	25	2.23	500	100	4.39
6	75	3.90	500	150	4.68
7	25	1.98	500	300	8.49
8	50	2.53	585	150	6.60
10	25	2.23	750	25	2.23
10	100	4.27	750	150	5.95
12	25	2.23	1000	25	1.98
12	50	2.53	1200	225	7.20
15	25	1.98	1250	50	2.66
15	75	3.90	1250	150	6.59
15	100	4.38	1500	25	2.53
20	50	2.53	1500	50	2.65
25	25	2.23	1800	150	6.24
25	25	1.98	2000	25	2.23
50	50	2.53	2000	50	2.53
60	25	1.98	2250	150	6.24
75	25	1.98	2500	150	6.24
75	75	3.90	2500	50	2.53
75	100	4.39	2500	100	4.68
88	500	12.46	3000	25	2.39
100	25	1.98	3000	100	4.68
100	50	2.53	5000	25	2.53
100	100	4.39	5000	50	2.85
125	25	2.53	7500	50	2.85
150	50	2.53	7500	100	5.31
175	25	2.53	10000	50	3.12
185	25	1.98	10000	100	5.51
200	25	1.98	15000	25	3.29
200	100	4.27	20000	150	8.43
225	50	2.53			

SELECTOR SWITCHES



Pole	Pos.	Deck	Type	Each
1	11	1	Bak-n/shtg	.60
1	21	3	Bak-n/shtg	.89
2	2	1	Cer-shtg	.50
2	6	2	Bak-n/shtg	.60
2	11	2	Cer-shtg	1.25
3	4	2	Bak-/shtg	.58
5	3	2	Cer-n/shtg	.98
6	11	6	Bak-n/shtg	1.95
10	5	5	Cer-shtg	2.25
16	2	4	Bak-n/shtg	1.35

Many other types in stock

"AN" CONNECTORS

Large Variety Available At Great Savings

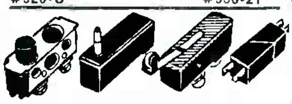
Send your specs and let us quote

BIRTCHER TUBE CLAMPS

#926-A, #926-A1, #926-A14, #926-B, #926-B1, #926-B7, #926-B22, #926-C

FROM **35c**

#926-C5, #926-C10, #926-C24, #929-1, #930-12, #930-18, #930-19, #930-21



MICROSWITCHES

MISCELLANEOUS

A. MOSSMAN LEVER SWITCHES
B. NOISE FILTERS
C. GLASS FERRULE RESISTORS
D. MALLORY SERIES 2000 PUSH SWITCHES
E. WE-1—PRECISION RESISTORS

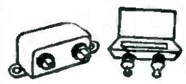
See Dec. Issue for Complete Listings of above.

OIL CONDENSERS

Mfd.	Voltages Avail
.1	3-6-20K
.25	2-3-3¼-4-5K
.5	600-1½-3K
1	600-1-1½-2-5-6K
2	400-600-1-1½-2 3-4K
4	600-700-1-1½ K
6	400-600-1½-2 K
8	600
10	600-2½K
15	600-1K
30	90-vac. 3-ph
100	230-vac. 3-ph
3x4	500
3x8	600
4x3	600
4x8	600
3x10	90-vac.

Special Prices on Request

BATHTUBS



Mfd.	Voltages Avail.
.033	400
.05	2-4-600
.1	4-6-1K
.15	600
.25	2-4-600
.35	400
.5	4-6-1K
.75	600
1	1-2-4-6-1K
2	4-600
4	50-100
8	500
25	25-50-75
40	25
50	25
100	15
200	12
300	6
2x.01	2-400
2x.02	6-1500
2x.045	600
.046x.055	600
.2x 05	6-1500
.1x.05	200
.1x.5	400x50
2x.1	4-600
2x.16	600
2x.2	600
2x.25	4-600
.3x.5	500
2x.5	4-600
1.x.05	500
1.x.1	300
1.x5	200
2x1	600
2x10	25
2x200	9
3x.001	600
3x.05	600
3x.1	4-600
3x.25	4-600
3x.5	100-600
015x.03x.045x.06x.12/ 600	

Also available CHANNEL Types. Special Price on request.

TERMINAL BOARDS

5 terminal	98¢
8 terminal	1.67
12 terminal	2.49

SHOCKMOUNTS

100P-1.....	1 lb.	.15
100P-2.....	2 lb.	.15
100PR-2...	2 lb.	.15
100P-3.....	3 lb.	.15
100P-6.....	6 lb.	.20
150P-4.....	4 lb.	.20
150PH-8...	8 lb.	.45
100PL-1...	1 lb.	.15
150P-7....	7 lb.	.25
156P-6....	6 lb.	.35
200PD-15..	15 lb.	.59
200PHN-35	35 lb.	.75
204P-112...	112 lb.	.98

HIGH POWER TR. MICA

G-1 TYPE

.0001	5KV
.00015	5KV
.0002	6KV
.0008	6KV
.0047	6KV
.005	5KV
.01	4KV
.032	2KV
.04	1KV
.08	1.5KV
.09	1.5KV

G-2 TYPE

.0001	10KV
.00015	10KV
.0002	10KV
.000247	12KV
.0003	10KV
.000375	10KV
.0004	5KV
.0005	10KV
.00065	10KV
.001	6KV
.003	8KV

G-3 TYPE

.0001	20KV
.003	20KV
.0004	20KV
.00045	15KV
.0005	20KV
.001	20KV

.0011	20KV
.00124	15KV
.1	12KV
.25	1.6KV
.25	6KV
.001	20KV
.00047	20KV
.015	3KV
.0012	20KV

G-4 TYPE

.0002	30KV
.0025	25KV
.005	8KV
.01	15KV

TYPE #5S

.000155	30KV
.000533	30KV
.0004	30KV
.001	30KV

TRANSMITTING MICAS

mfd.	wv	type	ea.	mfd.	wv	type	ea.
.0001	600	4	.36	.0015	600	4	.36
.0003	600	4	.36	.00162	600	4	.42
.00005	600	4	.29	.002	600	4	.39
.00005	2500	9	.57	.002	1200	4	.72
.0001	600	4	.29	.0025	600	4	.39
.0001	2500	9	.57	.003	600	4	.43
.00015	600	4	.36	.004	600	4	.45
.0002	600	4	.29	.005	1200	9	.99
.00025	600	4	.29	.0047	600	4	.47
.0005	600	4	.29	.005	2500	9	1.86
.0005	2500	4	.75	.006	600	4	.54
.0005	2500	9	.77	.01	600	4	.65
.0006	2500	9	.85	.01	1200	9	1.41
.0007	600	4	.36	.02	600	4	.92
.00075	600	4	.36	.02	1250	9	2.12
.0008	600	4	.36	.025	600	4	1.08
.0009	600	4	.36	.03	300	4	.99
.001	600	4	.36	.03	600	4	1.34
.001	1200	4	.54	.043	600	4	1.75
.001	1200	9	.57	.05	300	4	1.19

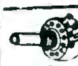
(Many other sizes in stock)

"UG" and "UHF" CONNECTORS

UG-9/U	UG-22/U	83-1H
UG/10U	UG-24/U	83-1J
UG-12/U	UG-25/U	83-1AP
UG-14/U	UG-27/U	831RTY
UG-15/U	UG-58/U	83-1SP
UG-16/U	UG-87/U	83-1R
UG-18/U	CW-123/U	83-1D
UG-19/U	UG-206/U	83-1SPN
UG-20/U	83-1AG	83-22R
UG-21/U	83-1F	CN 49151

PRICES ON REQUEST

TYPE "J" POTENTIOMETERS



TYPE "J" $1.50
TYPE "JL" $1.75 TYPE "JJ" $2.95

ohms	ohms	ohms	ohms	ohms
65 *†	4000†	75 K†	500-500 *†	130K-130K *
300†	5000†	80 K†	600-600†	150K-150K†
400 *†	6500†	100 K *	1500-1500†	250K-250K†
500†	10 K *†	100 K†	2000-50K *	350K-5K†
600 *†	12K†	125 K *	2200-24K†	350K-25K†
750†	15 K *†	250 K *	6K-45K†	300K-300K†
1000 *†	20 K *†	2meg *	20K-2000†	350K-350K *
1400†	25 K *†	2meg†	25K-10K†	800K-75K *
1500 *†	30 K *†		35K-5000†	2meg-2meg†
2000 *†	50 K *†		50K-25K†	4meg-4meg†

TYPE "JJJ" $4.95

ohms	ohms
20K-200K-20K†	750K-750K-750K†
45K-27K-2500†	800K-800K-800K†
700K-700K-700K†	1meg-1meg-1meg†

* 1/8" screwdriver slotted shaft.
† Knob type shaft.

JONES Connectors — Jones BARRIER STRIPS

P-101-1/4	P-504-DB	S-504-DB
P-101-3/8	P-506-DB	S-504-CE
P-306-AB	P-508-CE	
P-306-CCTL	P-510-CE	2-140-Y
P-308-FHTL	P-512-CE	3-140
P-310-CCT	S-101-D-MOD	10-140-3/4W
P-312-AB	S-302-AB	10-240
P-312-CCTL	S-304-CCT	18-240
P-315-CCT	S-306-CCT	3-141
P-315-CCE	S-306-CCTL	4-141-W
P-315-EB	S-308-AB	4-141-3/4W
P-318-CCE	S-308-CCTL	6-141
P-321-AB	S-315-EB	7-141-Y
P-324-AB	S-315-CCT	10-141-Y MEL
P-324-EB	S-318-AB	12-141-Y
P-324-CCT	S-321-CCE	15-141-Y
P-330-SB	S-330-AB	20-141-3/4W MEL
P-402-SB	S-404-AB	2-142-Y
P-406-AB	S-406-CCT	4-142-Y
P-408-LAB	S-408-CCT	3-150
P-410-CCE	S-408-LAB	5-151
P-2410-SB	S-2408-SB	4-152
P-412-DB	S-410-AB	20-160-R
P-412-CCE	S-410-CCE	20-161-AR
P-2412-SB	S-2412-CCE	
P-502-DP	S-502-DB	

ALEXANDER MOGULL COMPANY

WO rth 4-0865

Our new address **50 W. Broadway, N. Y. 7, N. Y.**

Specialists in Test Equipment

It is not generally known but Weston Laboratories specializes in the recreation of military electronic test equipment, many pieces of which are produced in quantity as new merchandise. One such piece is the TS-125-10CM power measuring radar test set. This self-contained, water-proof portable unit covers the range 2400-3335 MC with a sensitivity of 2 milliwatts full scale and an accuracy of + 0.5DB. Calibration is both DBM and milliwatts.

Other pieces available include:

TS-1ARR
TS-3A/AP
TS-8A/U
TS-10A/APN-1
TS-11/AP
TS-12
TS-13
TS-14
TS-15B/AP
TS-16/APN
TS-19
TS-23/AP
TS-27/TS
TS-32A/TRC-1
TS-33/AP
TS-34/AP
TS-34A/AP
TS-35/AP
TS-36/AP
TS-24/APM-3
TS-46/AP
TS-47/APR
TS-51/APG-4
TS-56/AP
TS-60/U
TS-61/AP
TS-62/AP
TS-69/AP
TS-76/APM-3
TS-87/AP
TS-89/AP
TS-96/TPS-1
TS-98/AP
TS-100/AP
TS-101/AP
TS-102/AP
TS-108/AP
TS-110/AP
TS-111/CP
TS-117/GP

TS-118/AP
TS-125/AP
TS-127/U
TS-131/AP
TS-144TRC-6
TS-153
TS-155A/AP
TS-170/ARN-5
TS-173/UR
TS-174/U
TS-175/U
TS-184/AP
TS-197/CPM-4
TS-203/AP
TS-204/AP
TS-205/AP
TS-220/TSM
TS-226A
TS-233/TPN-2
TS-251
TS-263
TS-268
TS-270A/UP
TS-281/TRC-7
TS-301/U
TS-314/FSM-1
TS-323
TS-324/U
TS-389/U
TS-421/U
TS-487/U
I-56
I-95/A
I-106/A
I-122
I-130A
I-145
I-177
I-178
I-208/A

I-212
I-222/A
I-225
I-233
IE-21/A
IE-36
IF-12/C
IS-185
AN-PNS-1
BC-221(*)
BC-376
BC-638
BC-906/D
BC-949/A
BC-1060/A
BC-1066/A
BC-1201/A
BC-1203
BC-1236/A

BC-1255/A
BC-1287/A
BC-1277
BE-67
LAD
LAF
LAG
LM13
LU2
LU3
OAA-2
P4E
TAA-16EA
TSS4SE
TSX3SE
TSX4SE
TTS-4BR
TTX-10RH
TUN-9HU

OUR GUARANTEE

Each piece is laboratory tested to assure compliance with the original specifications.

Don't forget, we buy Test Equipment too!

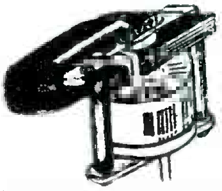
Cable: WESLAB — **Tel. Boston: WE 5-4500**

Weston Laboratories
Weston 93, Mass.

Westinghouse ELAPSED TIME METERS **$15.50**

General Electric Round Case Smaller Numerals **$11.50**

Genuine TELECHRON Motors



2 RPM	$2.90
3 RPM	3.90
3.6 RPM	3.15
1 RPM	3.95
60 RPM	4.30

One of each $15.00

ZENITH 1951 TV Remote Control Motor Units

Reversing control switch at end of 17 foot cable. Powerful 4 RPM clutch motor.

Will drive anything

Can be used for door opener, window raiser, model RR turntable. Complete with transformer. **$12.90** 6 for $70.00

MARKTIME 5 HOUR SWITCH

A 10 amp. timing device. Pointer moves back to zero after time elapses. Ideal for shutting off radios and TV sets when you go to bed. Limited supply at this special PRICE... **$4.90**

Also available in 15 min., 30 min., 1 hr. at $5.90

Veeder-Root Counter, Rotary..................$ .90
Veeder-Root Counter, Ratchet.................. 2.25
No. 18 Enameled Copper Wire, 1¾ lb. coil.. 2.00
Solenoid, works on 24v. D.C. and 115 v. A.C. 1.50
4½ amp. sealed 6 v. Transformer............ 2.75
MU and ACRO Switches assorted........4 for 1.00
115 v. A.C. Motor, for fan or experiment...... 1.50
Guardian, No. 4, 115 v. A.C. Solenoid......... 3.50
Guardian No. 2 6 volt DC Solenoid........... 1.90
Price Bros. No. 1A, 115 v. A.C. Solenoid..... 1.50

ALNICO — LUCKY PURCHASE ENABLES US TO OFFER YOU THESE MAGNETS — 7% COBALT — Actual Size

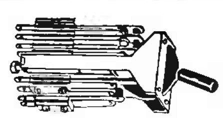
39¢ EACH — 3 FOR $1.00

Eby bakelite Binding Posts.................. .12
TELETYPE 1/40 H.P. 110 v. D.C. Motor.... 2.90
Arrow-H & H. DPDT Toggle Switch......... .65
C/H Off center, SPDT Toggle Switch......... .35

ANTENNA ROTATOR or DOOR OPENER

Geared down 24v. universal motor with transformer **$7.50**

GE Argon Glow Lamps...................4 for $1.00
100 for $20.00



Mossman Lever Switch $1.50

10 Amp. Heavy Duty Silver Contacts. Contacts can easily be re-stocked and changed to suit your needs. Now momentary OFF CENTER but can be changed by user to stay either side. Removed from un-used Government Surplus Equipment.

EST. 1923 **BLAN** EST. 1923

64 Dey St. — New York 7, N. Y.

JAN-C-25 CAPACITORS

YOU NAME IT — WE HAVE THEM

DELIVERY FROM STOCK . . . FACTORY CLEAN CONDITION

CHANNELS—YAB CP69 • YAT CP67 • WAB CP65 • WAT CP63
UPRIGHT TYPES—CP40, 41 • CP61 with universal brackets • CP70 series
BATHTUB TYPES—CP53 side term. CP54 top term. CP55 bot. terminals
CHANNELS & BATHTUB TYPES AVAILABLE IN SINGLE, DUAL OR TRIPLE UNITS
CAPACITY VALUES—.01-.02-.05-.1-.25-.5-1.0-2-4-6-8-10-15 MFD
VOLTAGES AVAILABLE—50-100-200-400-600-1000-1500-2000-2500-3000 etc.

MOST TYPES IN VERY LARGE QUANTITIES • LET US QUOTE ON YOUR REQUIREMENTS

RELAY SPECIALS

Type	Coil	Contacts	Features	Price
Sigma #5	65(2)	SPDT	2-24 VDC	$2.45
Sigma #5	65(2)	SPDT	CASED	3.45
Sigma #5	5000(2)	SPDT	1⅓ ma plate	4.75
Leach 1077BF	160	DPDT	CERAMIC	2.45
G. E.	2000	SPDT	4 ma plugin	2.95
Clare SK-5032	32	DPDT	6VDC plugin	3.45
W. E KS-9665	2000	1A, 1B, 1C	9 ma	4.45
A-B B5	100	SP solenoid	50 A 24 V	1.85
A-B B6B	65	SPST	100 A 24 V	2.95
Hart B5	100	SP solenoid	50 A 12-24 V	1.95
Allied BOD35	200	4PDT	10 A cont.	3.25
Allied DO9D 28	14	3PDT	6 VDC	2.15
GM 13016	200	4PDT	10 A cont.	3.75
GM	5000(2)	4PDT	8 ma plate	5.75
Allied BL	42	SPNO	6 VDC miniature	.85

1 RPM 110 V 60 cy MOTOR HI GEAR RATIO 1.85

SPECIAL • • • TRANSFORMER LAMINATIONS • • • SPECIAL
F-12 MUMETAL UI-312..........$3.35 — L-12 SILICON..........35¢

ELECTRONIC SPECIALTY SUPPLY CO. 56 Lispenard St. Barclay 7-2684 New York 13, 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.

V&H RADIO & ELECTRONICS SUPPLY

Compare These Surplus Bargains!

TEST EQUIPMENT

Now in Stock for Immediate Delivery!

TS-3	APR-1	I-144
TS-10	A-58	I-198
TS-12	A-60	I-222
TS-13	ASD or AIA	I-223
TS-16	Watt & Wave-	IE-56
TS-19	meter CS-60	LS-1
TS-34	ABW, SWR	LU
TS-45	Unit, CS-60	20A-1
TS-51	ABS Oscillo-	Triplett 1183
TS-67	scope CS-60	Tube Tester
TS-69	ABX	Espey 105 Tube
TS-74	BC-376	Tester
TS-75	BC-725	RC-252
TS-127	BC-905	LZ
TS-170	BC-906	
TS-202	GR-P496	BC-221AK
TS-226	I-122	BC-1016

WANTED—WE PAY TOP DOLLAR FOR: All Types AIRCRAFT, RADAR, RADIO SETS, COMPONENTS, DYNAMOTORS and Associated Equipment such as ART-13's BC-611's, Test Equipment, Etc. Prompt Replies to all Inquiries!

NEW STANDARD BRAND CHOKES

Hy	Mils	Ohms	Price	Voltage	Case	Wt.
SWINGING CHOKES						
8–40	175	100	$2.75*	3KV	Closed	3.5
8–30	200	80	3.25*	3KV	Closed	4.5
5–25	200	100	4.95*	2KV	Closed	5
5–25	300	90	9.95*	5KV	Closed	18
8–25	300	80	5.95*	5KV	Open	8½
5–25	500	60	12.95*	7KV	Closed	28
8–40	1 amp.	50	39.95*	10KV	Closed	58
SMOOTHING CHOKES						
5	500	600	4.95*	2KV	Closed	4
7	150	200	1.25*	2KV	Open	2
10	500	60	12.95*	7KV	Closed	28
12	300	80	5.95*	5KV	Closed	9
12	400	400	6.95*	2KV	Closed	15
15	200	120	2.95*	3KV	Open	4.5
20	300	80	5.95*	4000	Closed	9
20	400	85	6.95*	5KV	Closed	14
20	300	125	12.50*	15KV	Closed	40
16 Ser.	175	96	5.95*	2.5KV	Closed	15
4 Par.	350	24				
26 Ser.	200	112	6.95*	3.5KV	Closed	15
6.25 Par.	400	28				

BC442 ANTENNA RELAY. Contains 50 Mmfd. 5000 Volt vacuum condenser and 0 to 10 amp RF meter. With Antenna transfer switch, transmitt to receive. Brand new..............$3.95*
Used.............. 2.95*

CONDENSOR 5-5 Mfd. 400 V. DC Type KS-8976C. 3⅝" high x 3-5/16" wide x 2" deep. Shipping wt. 2 lbs. Brand new............75¢*

BD77 DYNAMOTOR. 12 V. input, 1000 V. 300 MA DC output. Brand new..................$19.50*

BC348 Antenna Tuning Cans. Contains band switch and coils. Brand new...........$2.49*

CD318A CCRD for connecting Throat Mike. Has JK48, PL68 Plugs and SW141 V Switch..$1.95*

NON-INDUCTIVE RESISTORS. IRC type MPB. 100-watt. All brand new, 18½-inches long, complete with lug terminals. Available in quantity in 95, 72 and 120 ohms............$3.00 ea.*

RC266 RADAR ANTENNA. Part of SCR-717. Brand new, crated and ready to ship. Approx. wt. 335 lbs. $49.50*

MO 149F INVERTOR. Brand new........$74.00*
Used, but completely reconditioned......$40.00*

NEW SCR-720, 717, Components.

AN/APG-13 Radar. Complete new Installations.

NEWLY MFG'D. I-100 ADF Test Unit & also modification for use on AN/APN-6.

ATTENTION PURCHASING AGENTS: We have thousands of items in stock not listed here. Send us your requirements and we'll reply promptly.

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!

IMPORTANT: Send 30% deposit with all orders. All merchandise and prices subject to prior sale or change at any time.

ALL ITEMS AVAILABLE IN BIG QUANTITIES. ASK FOR GENEROUS QUANTITY DISCOUNTS!

V & H RADIO
Dept. E-12
2033-37 W. Venice Blvd.
Los Angeles 6, California

TUBE REBUILDING

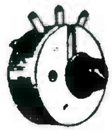
Large Transmitting and Power types

Economical • Guaranteed

FREELAND PRODUCTS CO.
700 DRYADES ST., N. O., LA.

SURPLUS EQUIPMENT

POWER RHEOSTATS



Standard Brands: 5 Ohms; 100 Watt; 4.48 amps 100 Ohms; 100 Watt; 1.0 amp.

Boxed, Brand New with Knob $2.50 each—or—$25.00 per Doz.

G. E. MOTOR AMPLIDYNE

Mod. 5AM45DB15. Input: 115 volts, single phase, 60 cycle, 4.5 amp. Output: 250 volts DC, .6 amps, 3450 RPMS......$79.00 ea.

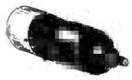
PIONEER TORQUE UNITS

TYPE 12604-3-A: Contains 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 12606-1-A: Same as 12604-3-A except it has a 30:1 ratio between output shaft and follow-up Autosyn....$70.00 ea.

TYPE 12602-1-A: Same as 12606-1-A except it has base mounting type cover for motor and gear train............$70.00 ea.

ALNICO FIELD MOTORS



(Approx. size overall . . . 3¾" x 1¼" diameter)
Delco-Type 5069230: 27.5 volts; DC; 145 RPM $19.95 ea.
Delco-Type 5068820: 27.5 Volts; DC; 250 RPM ....$19.95 ea.

PIONEER AUTOSYNS

AY-1......26 Volt—400 Cycle.......$4.95
AY-5......26 Volt—400 Cycle.......$5.95
AY27D $25.50
AY6—26 Volt—400 cyc...........$4.95 ea.
AY30D—26 Volt—400 cyc.......$25.00 ea.
AY38D—26 volt—400 cyc., shaft extends both ends ....$19.95 ea.
AY20—26 volt—400 cyc.........$12.50 ea.

TACHOMETER INDICATOR

SINGLE

Sensitive Type, Kollsman Mark V; Range 0-3500 RPM in 3⅓ revolutions of the indicating pointer.
$9.95 ea.

SMALL DC MOTORS

(Approx. size . . . 4" long x 1¼" dia.

General Electric-Type 5BA10AJ37: 27 volts, DC; .5 amps, 8 oz. inches torque; 250 RPM; shunt wound; 4 leads; reversible
$12.50 ea.

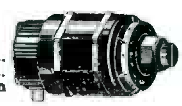
G. E. Type 5BA10FJ215, 24 volts DC, .77 amp. 30 lbs. in. torque, 4 RPM...$15.00 ea.

General Electric-Type 5BA10AJ52C: 27 Volts. DC; .65 amp; 14 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible
$12.50 ea.

MICROPOSITIONER

Barber Colman AYLZ 2133-I Polarized D.C. Relay: Double Coil Differential sensitive; Alnico P.M. Polarized field. 24 V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc.
$12.50 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

PIONEER GYRO FLUX GATE AMPLIFIER

Type 12076-1-A, complete with tubes
$27.50 ea.

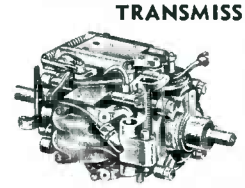
PIONEER TORQUE UNIT AMPLIFIER

Type 12077-1-A. A single tube amplifier designed for autosyn take off signal. Contains magnetic amplifier assembly. With tube ....$24.50 ea.

SERVO MOTOR 10047-2-A: 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

WESTINGHOUSE HYDRAULIC TRANSMISSION

BRAND NEW



Ideal as hydraulic torque converters. Contains hydraulic pump and hydraulic motor; 10 ball bearings; has reversible controls. High quality precision workmanship . . . made to exacting specifications for use on 2-ton 40 mm anti-aircraft guns. Overall dimensions: 12" long x 5½" wide x 6½" high. Shipping weight: 20 lbs. Government cost more than $300. **BRAND NEW** ....$29.95 ea.

400 CYCLE MOTORS

AIRESEARCH: 115V; 400 CPS; Single phase; 6500 RPM; 1.4 amp; Torque 4.6 in. oz.; HP .03 ....$10.00 ea.

EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles; 6000 RPM ....$12.50 ea.

EASTERN AIR DEVICES, TYPE J31B: 115 V, 400-1200 Cycle, Single Phase
$12.50 ea.

INVERTERS

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.

12116-2-A PIONEER

Output: 115 VAC; 400 cyc; single phase; 45 amp. **Input:** 24 VDC; 5 amp. $90.00 ea.

10563 LELAND ELECTRIC

Output: 115 VAC; 400 cycle; 3-Phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. ....$80.00 ea.

16486 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.

SENSITIVE ALTIMETERS

Pioneer Part #1556-2K-A Sensitive altimeters. 0-35,000 ft. range . . . calibrated in 100's of feet. Barometric setting adjustment. No hook-up required.
$12.95 ea.

SYNCHROS

IF Special Repeater (115V-400 Cycle
$15.00 ea.

2J1F3 Generator (115V-400 cyc)..$7.50 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.

5SDG Differential Generator (90/90 volts —400 cyc.) ....$30.00 ea.

5DG Differential Generator 90/90 volts 60 cycle ....$50.00 ea.

TRANSMITTER, BENDIX C-78248: 115 Volt. 60 Cycle..................$25.00 ea.

REPEATER, BENDIX C-78410: 115 Volt, 60 Cycle ....$37.50 ea.

METERS

AMMETER: DC; 2" 100-0-100, complete with external shunt..............$5.95 ea.

AC Volt, Westinghouse, Type NA-35—3-inch round. F.S.-10 MA..........$6.95 ea.

FREQUENCY, 57-63 cycles per second, 125 volts, mfg. Aero. mod. 7007. 3-inch round
$8.95 ea.

PLEASE ENCLOSE FULL AMOUNT WITH ORDER

EQUIPMENT FULLY GUARANTEED

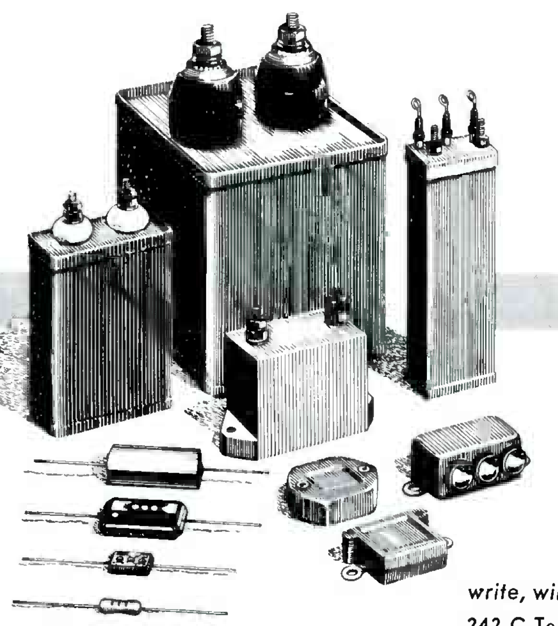
ALL PRICES F.O.B. PASADENA UNLESS OTHERWISE SPECIFIED

C and H Sales Company

BOX 356-E EAST PASADENA STATION • PASADENA 8, CALIFORNIA

Harmar has the Nation's Largest Stock of Condensers . . . All Types

DID YOU KNOW—that you can use top quality metal cased condensers from HARMAR stock for nearly the same price as you are now paying for paper tubulars? And delivery is from stock! Remember . . . when you deal with Harmar you deal with principals — Harmar owns every item it offers for sale!



HARMAR Company

write, wire or phone:

242-C Territorial Rd.
Benton Harbor, Mich.
● Phone: 5-7271

1003-D Union Trust Bldg.
Cincinnati 2, Ohio
● Phone: Main 3155

refer to our rating in Dun & Bradstreet

NOTE: We have developed special facilities for keying our stock to manufacturer's part numbers or Armed forces stock number. For quickest possible service, please request quotations by these numbers.

FOR SALE

(NEW) HEAT CONTROL AND RECORDERS

3 Wheelco Capacilogs—Model #702

1—Range 0—600 Degrees C
1—Range 0—1000 Degrees C
1—Range 0—1200 Degrees C
New in original crates

Spot Delivery—No Priority

KINGS COUNTY MACHINERY EXCHANGE
408 Atlantic Ave. Brooklyn 17, N. Y.
Phone—Tr 5-5237

SPECIAL PURPOSE TUBES ALL JANS
ALL NEW & GUARANTEED

CE1C	$2.25	814	$3.50
C6J	5.95	954	.45
F123A	7.75	955	.50
F127A	17.75	957	.55
RK72	1.50	958A	.65
VR105	1.40	1005	.75
VR150	.95	1616	.90
1B29	4.75	1619	.29
2K25/723AB	19.75	1625	.45
2X2	.65	1626	.45
3A4	.85	1629	.45
3B24	4.75	2051	1.15
6AR6	2.75	9002	.99
10Y	.45	9003	1.25
211	.50	9004	.65
310A	6.95	9005	1.50
446A	4.50	9006	.45

CRYSTAL DIODES

1N21B	$3.2[illegible]	1N23A	$2.75
1N23	1.4[illegible]	IN23B	3.7[illegible]

ALLIED ELECTRONIC SALES
136 Liberty Street New York 6, New York
Telephone COrtlandt 7-4320

Sell Your Surplus to Gould Green

We buy and sell every type of electronic materiel, including war surplus. Let us submit our bids for your surplus inventory; large or small quantities. When you buy from us you save plenty — here are a few of our bargains:—

DYNAMOTOR-DC input, 28 v. @ 1.3 A; output 240 v. @ .08 (frame 414) for RL-24A interphone equip. by Telephonics Corp.; with base; **$3.85**

COIL-TELEPHONE, induction, C-158 holding; single winding inductance not less than one measured w/lv. @ 1000 cyc; resist. 100 ohms P/M 5% AC 500 V. rms. price, **15c ea., $100 per M***

AUDIO TRANSFORMER; input, Class 1A; Spec TC-45 (C-280-A) .006 watts; response 400-3000; 0-250-4000 ohms; 150 ohms; 600 ohms C.T.; made by Controls Corp. size 1¾ sq. x 2" H., price . . . . **95c ea.; $75 per C**

PHONO-AMPLIFIER; 2-tube for hi-gain pickups; chassis only includes cord & plug, filter cond., dropping resistor, vol. contr. etc.; less tubes but ready to use & mount in phono cabinet. Price . . . . **$1.35 ea., $14.50 per Doz.**

AIR TRIMMERS; screw driver adj't but can take a slip-over shaft; six capacities available; Ceramic base with brass mtg bushings; gov't surplus. APC type. Price . . . . **25c ea., $22.00 per C**

CABLE; 3-wire with spade lugs; 10 ft. long; red, blk., & yellow with overall rubber jacket (CC-343A); 10¢ ea. . . . . **$9.00 per C; $8.50 per M**

CABLE; 30" long, single shielded with black cotton covering & spec. plug on one end . . . **$3.00 per C**

SOCKET; 2-prong batt type; laminated Price . . . . **$3.00 per M***

TRANSFORMER; bell-ringing type; black, fully shielded; 6 ft. cord & plug (115 AC); binding post term. with thumb nuts size 2½ x 2½ x 3" long; output 6-8 volts. **$1.00 ea., $9.00 per Doz.**

RESISTANCE WIRE; approx. 2½ ohms per ft.; nickel .020" dia. with heatproof composition covering & Deltabeston Braid in red, black, green, blue, orange, yellow, brown & twisted pairs; G.E.: price . . . . **$8.75 per 1000 ft.***

VIBRATOR, plug-in; syn. 12, V.—19 cyc.; 3½" H. x 2½" dia.; 4-prong . . . . **$20 per C***

VIBRATOR, plug-in; Syn. 12 V.—3 A.; hermetically sealed; 7-prong; No. V-6485, Oak Mfg. Co. No. SC 3H6694.2, price . . . . **$17.50 per C***

VIBRATOR, plug-in; non-syn.; 100 cyc-12 V.—.5 A. input; herm. sealed; standard 4-prong base; SC-71-2202; price . . . . . . **50c ea., $40.00 per C**

TRANSFORMER, input; WEco No. D-162483A; 5¼ x 5¼ x 4" H.; vapor proof; potted in gray case; price . . . . **$3.00 ea.**

CHOKE; navy No. NCP-4-1E-11; imp. & herm. sealed; glass-insulator terminals; gray metal case 3¼ x 2¾ x 4½" H.; invert. mtd. . . **$1.75**

TRANSFORMER, POWER; fila. & pl.: Pri. 100 V. @ **10,000** cycles; Hi-V. sec. 600 V-1 ma; Lo-V. sec.—1¼ V. @ 0.2 A; sealed metal case 3" h. x 2⅛" dia. UTC No. 84257; price . . . **$2.00 ea.**

TELEGRAPH SET, TG-5 (A & B); new gov't surplus; complete includes key, bell, buzzer (hi-freq.); adj. sensitive relay for incoming signals (BK-7-B); canvas carrying case with strap; portable; army-green metal case (front folds down, key is attached to the front); single headphone & long cord with PL-55 plug is inserted in jack of instrument; size 7 L. x 5 H x 4 deep; made by Kellogg Switchboard & Supply Co. **$14.50 ea.**

VARIABLE Cond.; 2-gang, super.; with both trimmers; ¼ shaft; 1⅝ x 1⅞ wide x 2¼ long; part of shaft near cond. is ⅜" dia. **$20.00 per C***

JUMPERS, BONDING: AMP "midget" NAF No. ABJ-E2: alum. with flat perforated lugs; flex.: 2" bet. cts. . . . . **$8.50 per M***

COIL FORMS, PIGTAIL, br. bakelite (looks like carbon one watt resistors): Speer: two sizes; price . . . . **$4.00 per M***

SILVER MICA & MICA CAPACITORS at attractive prices.

DRIVE SHAFTS with br. bush. for dial cord operation; ¼" dia.; price . . . . **$14.50 per M***

SOCKETS, LOCKTAL, molded: . . . . . **$22.00 per M***

SOCKETS, WAFER, bakelite; two types—7-prong, 1⅛" bet. cts; 9-prong, miniature, ⅞" bet. cts.; either type . . . . **$26.50 per M***

TELEVISION REPLACEMENT PARTS

list of standard items (surplus from TV mfrs) **mailed upon request.**

CONDENSERS, tubular; .05-200 V. **$30.00 per M*** .01-400 V. @ **$30.00 per M***, .0005-600 V. @ **$17.50 per M***, .02-200 V. upright metal-enclosed, oil, special @ . . . . . . **$20.00 per M***

CERAMIC CAPACITORS; write for list of sizes, prices & free samples.*

KNOBS: transparent, 1¼" dia., with spring; also, 1" dia. mahog. mlded, knurled slip-on type; each . . . . **$20.00 per M***

RESISTOR, two watt; molded Micamold pigtails; **5 ohm; $25.00 per M*;** also, 4700 ohm-2 watt @ . . . . **$22.50 per M***

CHASSIS, three tube, ampl. for phono; partly assembled, has 50L6 output transf.; 3 sockets, Filt. cond. 40-30 @ 150 V., 10-25 V.; five carbon resistors; four tubulars; no vol. contr. no cord, no tubes. . . . . **$10.00 per Doz.**

TUBE CARTONS FOR SALE

OIL-CONDENSERS; 1 mfd @ 400 V. 2 mfd @ 400 V, 1½ mfd @ 100 V.; size 2½ x 1½ x 3¼ high, three top terminals, 4 tapped holes for side mount . . . . **$20.00 per C***

SEE OUR 'AD' IN JANUARY ELECTRONICS

Terms:—Net cash, o/a to est. firms; MINIMUM ORDER $25.00: FOB/NYC, If you would like to see the mdse. before paying for it, specify "**Privilege of Inspection**" (Express only). *FREE SAMPLE.*

SELL US YOUR SURPLUS

GOULD GREEN

252 Greenwich Street, New York 7, N. Y.

Modification, Development & Production of Radar Equipment. Radar sets SCR-717, SCR-720, APS-3, APS-4, APS-13, APS-14, APS-15 & APS-16 available. Micro-wave test equipment for all frequencies. Our personnel and facilities guarantee performance and service.

Tel.
Terhune 5-2765, 6

LERU LABORATORIES INC.

Black Oak Ridge Rd., Wayne, N. J.
Mailing Add.: RD 4, Paterson, N. J.

-CONNECTORS-

AN
"3100"
"3101"
"3102"
"3106"
"3108"

Black and Mellomyne Inserts in Stock

101 & 102
A & B
Shell Types
In Stock

Catalog On Request **CLAMP—ALL SIZES**

FOR TYPES AVAILABLE SEE ELECTRONICS BUYER'S GUIDE

QUICK SERVICE OUR SPECIALTY

WILGREEN

99 Murray St., New York 7, N. Y.
For Immediate Delivery
Write or Phone - WORTH 2-7423-4-5

TELEPHONE RELAYS

Large Stock of

CLARE, TYPES C, D & E
COOKE, AUTOMATIC—ELECTRIC
ALL TYPES of COILS and PILE-UPS

Send Us Your Specs. for Our Quote

SIGMA SENSITIVE RELAYS
Type 5RJ, Hermetically sealed coil—10,000 ohms Contacts—S.P.D.T. Closes at 0.5 Milliamps. Price........................$5.50 ea.

CLARE TYPE C SENSITIVE TELEPHONE RELAYS

Coil	Contacts	Will Close At	Price
1) 6500 ohms	1C	2.8 MA	$2.75 ea.
2) 6500 ohms	1B-1C	3.2 MA	2.75 ea.
3) 6500 ohms	3A	4.0 MA	3.00 ea.
4) 6500 ohms	3A-1B	4.0 MA	3.00 ea.
5) 6500 ohms	1C	1.5 MA	3.25 ea.

CLARE TYPE G SENSITIVE HALF-TELEPHONE RELAYS

1) 6500 ohms	2A	5 MA	$2.50 ea.
2) 5800 ohms	3A	5 MA	2.50 ea.
3) 5800 ohms	2B-1C	5 MA	2.50 ea.
4) 4850 ohms	1C	3.5 MA	2.50 ea.
5) 3600 ohms	1C	6 MA	2.00 ea.

All above Relays may be used for continuous duty operation on 110V. D.C.

OTHER TYPE G RELAYS

1) 1300 ohms	1A-1C	24 or 48V.	2.50 ea.
2) 700 ohms	2A-1C	24V.	2.50 ea.

Legend (A) Normally open set of contacts.
(B) Normally closed set of contacts.
(C) Single pole double throw set of contacts.
MA = Milliamps.

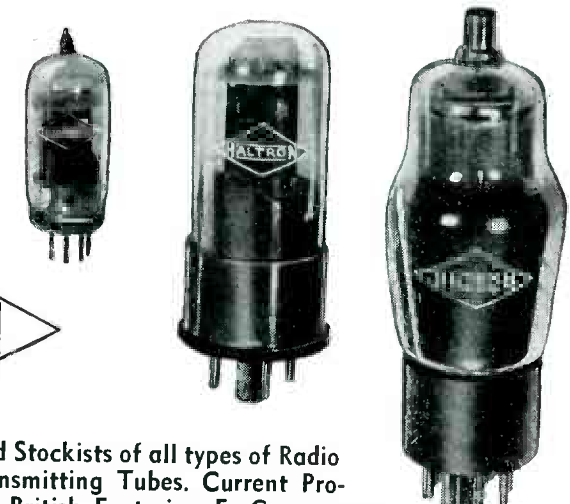
Chase

Electronics Supply Co.
222 Fulton St.
New York 7, N. Y.
HOllis 4-5033
DIgby 4-3088

American & Canadian enquiries to our Agents:

POLAS MERCANTILE

115 Broadway
New York, 6
Telephone: Rector 2-8595



ALL OTHER ENQUIRIES
TO LONDON

HALTRON

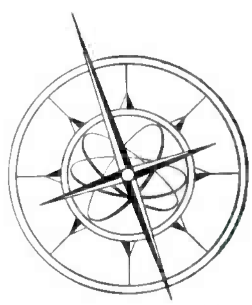
Leading Exporters and Stockists of all types of Radio Receiving and Transmitting Tubes. Current Production of main British Factories. Ex-Government Surplus, American, Canadian and British Tubes in Original Brands. Suppliers to Foreign Governments, Airlines, etc.

HALL ELECTRIC LTD

89, CHARLOTTE ST., LONDON, W.I.

Phones: MUSEUM 9661 (5 lines)
Cables: HALLECTRIC, LONDON

OUR EXPORT DEPARTMENT AVAILABLE FOR SPECIAL SERVICE TO OVERSEAS CUSTOMERS



COMPASS

COMMUNICATIONS COMPANY

393 GREENWICH STREET
NEW YORK 13, N. Y.

BEekman 3-6510

CABLE ADDRESS: COMPRADIO

WE MAINTAIN OUR OWN FULLY EQUIPPED TESTING LABORATORY IN THE SAME BUILDING AS OUR MAIN WAREHOUSE TO TEST ANY ITEM WE SELL

• RADAR

MARINE, GROUND & AIRBORNE

AN/APS-2	SA-2	SF
APS-3	SL	SG
APS-4	SN	SL
APS-6		SCR-545
APS-13	SO	SCR-720
APS-15	SQ	
	SJ	

• BEACONS

AN/CPN-6- 3 cm.
AN/CPN-8-10 cm.
YJ and YG for shipboard use

• LORAN

AN/APN-4 and AN/APN-9

• TELEPHONE EQUIPMENT

Portable and Stationary Switchboards and Supplies
BD-71, six-line portable switchboard
BD-72, twelve-line portable switchboard

• CONVERSION EQUIPMENT

—MOTOR GENERATORS
—CONVERTORS
—DYNAMOTORS
—INVERTORS
—POWER SUPPLIES
—RECTIFIERS

• TEST EQUIPMENT

SELECTED EQUIPMENT

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.
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.

TRANSMITTING STATIONS

1 KW—200-500 kcs, complete with 220/440 volt, 3 ph. 50-60c. power supply—Price $2,500.
800W—(400 watt phone) Western Electric 10-channel, automatic dial selection, 2.0-20.0 mcs, with 220 volt, 1 ph, 50-60c, power supply. SAME TRANSMITTER AS USED ON S.S. "QUEEN MARY"—Brand New. Price $4,000.00.
1 KW—FM Broadcast station, complete with monitor, all tubes, antenna and waveguide. Mfr. G. E. $1,500.00—at location, N. Y. C.

★ *All equipment new or reconditioned, checked in our laboratory and ready for operation.*

• TUBES

New, Standard Brands Only
—MAGNETRONS
—KLYSTRONS
—TRANSMITTING

and other Special Purpose Tubes

This is a sample listing. Write for prices.

707B	$17.50	304TL	$13.00
723A/B	24.60	2J26	25.00
2K25	37.50	2J27	25.00
2K26	150.00	2J31	25.00
2K28	35.00	2J32	47.50
2K29	27.50	2J36	100.00
2K41	95.00	2J38	40.00
2K45	150.00	2J39	40.00
2K54	150.00	2J42	135.00
2K55	150.00	2J50	75.00
707B	25.00	2J61	75.00
715C	32.50	2J62	75.00
724B	5.00	4J52	335.00
829B	15.00	5J23	25.00
304TH	13.00	5J26	400.00

Special: 889R $195.00
892R 195.00

CATHODE-RAY TUBES

5BP1	$6.00
5CP1	6.00
7BP7	6.00
12DP7A	39.50

WE GUARANTEE EVERYTHING WE SELL

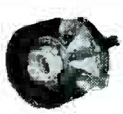
26 CONDUCTOR CABLE made up by Western Electric in 50 foot lengths with S324CCT connectors on each end. Each conductor is #22 standard and rubber covered. Although the O.D. is only 9/16 inches there is a heavy live rubber jacket.
Per length, only............$9.95

VITAMIN Q TUBULAR CONDENSERS

Cat. No.	Mfd.	Volt	Qu.	Price
774-606A*	.0033	600	231	$.95
G191P10391	.01	100	60	1.50
G91P10392	.01	2 0	250	1.60
G88P10394	.01	400	180	1.65
G191P22391	.022	100	20	1.65
G191P68352	.068	200	454	1.65
G91P82394	.082	400	48	1.65
G91P15491T	.15	100	199	1.65
G191P22491	.22	100	49	1.65
G191P27491	.27	100	23	1.65
G191P4791	.47	100	140	1.75
G91P56492	.56	200	28	1.75
G91P68492	.68	200	30	2.19
G91P10592	1	200	78	2.20
XFC 1889 *	1	600	20	2.20

* not Vitamin Q but similar

THESE ULTRA HIGH QUALITY CONDENSERS ARE MADE BY LEADING MANUFACTURERS.
Feature
- 20,000 Megohm or More
- Subminiature
- Glass Seal Terminals
- Up to $7.70 regular



25 WATT POTENTIOMETERS

Ohm	Bush	Shaft	Cat #	Price
2	5/8s	1/8sd	O-H	$1.04
3-3	1/2	1/2	I	1.04
15	3/8	1"	C	1.04
15	3/8	1-1/8	D-245	1.04
15	1/2	1-1/4	1	1.04
20	1/2	1/2F	D-245	1.04
25	3/8	1	D-245	1.04
30	3/8	1	C	1.04
50	3/8	1-1/8	D-245	1.04
50	5/8	1/8sd	O-H	1.04
75	1/2	7/16	O-H	1.04
100	3/8	1	D-245	1.04
350	3/8	1-1/8	O-H	1.04
500	3/8	11/16	D-245	1.04
4K	1-2	1/2	O-H	1.17
3K	3/8	1-3/16	D-245	1.20
5K	1/2	1/8sd	I	1.24
5K	3/8	7/8f	D-245	1.24
20K	1/2	1/8sd	D-245	1.40

These excellent wirewound controls are manufactured by the leading companies and are in the original cartons. Priced ridiculously low, only 20% of list. SATISFACTION GUAR.

50 & 100 WATT POTENTIOMETERS

Ohm	Watt	Cat. #	Price
75	100	O-K	$2.19
500	50	O-J	1.41
500	50	D	1.41
500	100	O-K	2.19
800	50	O-J	1.48
1.5K	100	O-K	2.34
2.5K	50	O-J	1.48
5K	50	O-J	1.56

Widely Known for Fair Dealing and Good Service

HAROLD H. POWELL
2104 MARKET STREET
PHILADELPHIA 3, PENNA.
PHONE LOcust 7-5285

WIREWOUND POTENTIOMETERS

Leading Makes — Clean New

Ohm	Bush	Shaft	Cat #	Watt
10	3/8	1-5/8	I	2
10	3/8	2	C	2
20	1/2s	1/8sd	CTS	2
20	3/8	3/8	M	4
20	3/8	1-1/4	CTS	4
50	3/8	3/8sd	M	4
100	5/8	3/8f	I	2
100	3/8	5/16	CTS	4
200	3/8	7/8	CTS	2
200	5/8s	1/8sd	CTS	4
200	3/8	2-1/16	CTS	4
255	1/2s	1/8sd	CTS	2
350	3/8	1-1/8	I	2
350	3/8	1/2	CTS	2
400	3/8	1-1/4sd	CTS	4
750	3/8	1/8sd	CTS	4
1K	3/8	3/8	I	2
1K	3/8	3/8	CTS	2
1K	3/8	3/8sd	CTS	4
2K	1/4	1/8	CTS	2
2K	1/2s	5/16sd	CTS	2
2K	3/8	1-1/16	CTS	4
2K	1/2	1-1/2	TRF	4
3K	3/8	1/2	CTS	4
3K	3/8	1-1/2f	C	4
5K	3/8	7/16sd	CTS	2
5K	1/2	1/2sd	TRF	4
5K	1/2	1-7/8	TRF	4
5K	7/16	1-7/16	C	4
7.5K	1/2	3/8	CTS	4
10K	3/8	1/2sd	CTS	2
10K	3/8	3/8f	I	2
15K	3/8	1/2sd	CTS	4
20K	5/8	3-3/16	CTS	4
20K	5/8	5/8	CTS	4

ONLY 45¢ ea

REVERSIBLE REMOTE CONTROL DRIVE

A.C. motor driven unit designed for 'lazy man' control of 1951 Zenith TV. Operates from 115 volts 60 cycle; but, self incorporated transformer permits low voltage control leads. Includes attractive plastic hand grip switch with black & white control buttons. one for each direction. Motor drives worm gear which is moved against a nylon gear by solenoid. Made this way so that TV set could be tuned manually. Output to ¼ inch shaft is approximately 4½ RPM. Intermittent duty. Includes 17 feet three wire control cable with plug. Brand New. ACT NOW! Our limited supply going fast at $10.95

COAXIAL CONNECTORS

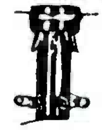
Type	Price
UG9/U	$1.20
UG10/U	1.20
UG12/U	1.29
UG13/U	1.20
UG18B/U	1.95
UG21/U	1.20
UG22/U	1.30
UG23/U	1.50
UG24/U	1.30
UG25/U	1.25
UG27/U	1.30
UG29/U	2.15
UG30/U	2.50
UG58/U	.80
UG85/U	2.25
UG87/U	1.50
UG88/U	1.50
UG97/U	4.00
UG97A/U	4.20
UG98/U	2.25
UG104/U	1.80
UG105/U	1.50
UG106/U	.10
UG107/U	3.50
UG131/U	4.50
UG167/U	2.00
UG173/U	.43
UG175/U	.17
UG176/U	.17
J-201	4.50
UG203/U	.85
UG224/U	1.45
SC-239	.40
SO239/Y	.60
UG245/U	2.95
UG255/U	2.25
PL258	.95
PL259A	.55
FL259	.60
UG260/U	1.50
UG262/U	1.50
UG274/U	4.50
FL274	1.35
UG275/U	4.50
UG290/U	1.80
UG296/U	3.75
UG306/U	3.50
UG335/U	3.75
UG342/U	2.25
M359	.35
49547	1.20
UG422/U	3.25

PULSE FORMING

DELAY LINE 15-E4-.91-400-50P. Sprague #S92-5245, H623, 4x5x7 inch oil filled with 3½ inch insulators. 0.91 Microsecond, 15KV $9.90

AN CONNECTORS
COMPLETE STOCKS. SEE JANUARY ELECTRONICS FOR FULL LISTING WITH PRICES.

TURRET SOCKETS



SAVE TIME
BETTER CIRCUIT

Socket	Height	Stock	Price
Octal	2 1/2"	10-0-9T	5.59
Octal	2	8-0-9T	.57
Octal	1 1/2	6-0-9T	.54
Min.	3"	12-MB-12	.73
Min.	2"	8-M-9T	.63
Min.	1 1/2	6-M-6T	.60
Min.	1"	4-M-6T	.59
Noval	3"	12-NB-12	.78
Noval	2"	8-N-9T	.66
Noval	1 1/2	6-N-6T	.65
Noval	1	4-N-6T	.63

DO'S Speed Delivery

UTAH 9287D

SELENIUM RECTIFIER — Full wave bridge, G.E. model 6R5FB3, up to 54 V. AC, 150 Mill. Cont. Duty, 12-1" plates 1500 ea. available.

DRIERITE — THE VERSATILE INDICATING DESICCANT—size #8 mesh in 6 oz. bottles, 24 bottles to a case. In case lots $4.80 per case, minimum order 6 bottle for **$1.50**

Eastern Air Device J50E Dual Centrifugal Blower, 115 volt 60 cycles 0.1 amp. 1 PH 20 C.F.M. Continuous duty 1.0 M.F.D. Capacitor start with Capacitor **$18.75; without** Capacitor **$18.25**

Miniature lamp T1¼, 3 volt .19 amp. Airplane Indicator, Amb. Ctd.
10 for **$1.00**
100 for **$8.50**

A5 Automatic pilot Directional Gyro made by SPERRY'S Part # 656029.

AMMETER, 150/300 dual range Triplet 341A 3½" rectangular flush bakelite 5 amp Movement @ $4.95 with external current transformer for 150 amp.
Only $7.50

Square D Circuit Breakers Push Type AN3161-35 35 amp. @ 30 volt D.C.
$1.15 each

Square D Bat Handle Circuit Breaker. Type AN3160-15 30 volt @ 15 amp.
$1.25 each

SEND FOR FREE BULLETIN
DIgby 9-2188-9

A. Cottone & Company
Electronic Mechanical & Optical Components
336-340 CANAL ST., NEW YORK 13, N. Y.
ALL PRICES F.O.B. N. Y. CITY

COMPONENTS • TUBES • UNITS

1A5gt	.65	3DP1-S2	3.95	6L6G	1.50	807	1.35
1B22	2.75	3HP7	2.75	6L6GA	1.35	814	3.75
1B24 Syl	12.50	3S4	.65	6L7	.93	830B	2.95
1C6	.45	307A	2.95	6L7G	.85	866A	1.35
1G6gt	.57	310A	5.25	6R7gt	.83	923	.90
1H5gt	.65	311A	5.95	6SC7	.90	954	.19
1J6G	.75	394A	3.95	6SF5	.65	955	.45
1LH4	.89	5BP1	4.95	6SH7	.75	10Y	.35
1LN5	.77	5D21	14.00	6SJ7	.65	19	.35
1N5gt	.72	5FP7	1.65	6SL7gt	.70	35/51	.35
1L4	.55	5T4	1.50	6SN7gt	.70	39/44	.29
1R4	.55	5U4G	.55	6SQ7	.65	VT-52	.45
1R5	.72	5Y3G	.49	6V6	1.65	1616	.75
1T4	.77	5Y3GT	.49	6V6Y	1.95	1619	.29
2AP1	7.95	5Z3	.60	6V6gt	.65	1642	.40
2C26A	.17	6AC7	.75	6X5gt	.49	REL-21	2.00
2E22	1.95	6AG7	1.55	6Y6G	.65	12SG7	.85
2J22	4.50	6C5	.60	7BP7	6.25	12SL7	.65
2J31	17.50	6C6	.39	7C5	.75	CK1005	.55
2J32	27.50	6C8G	.59	7C7	.75	CK1006	2.25
2K41	67.50	6F6	.75	7E6	.70	HY65	2.95
211-VT4C	.49	6H6	.59	707B	11.00	VT158	135.00
3AP1	10.00	6H6gt	.73	714AY	4.50	VR105	.90
3BP1	4.95	6J5gt	.55	720BY	45.00	VR150	.85
3B26	2.75	6K7	.70	723A/B	9.50	2051	.95
3B27	2.75	6K8G	.70	725A	6.50	8020	1.00
3DP1	2.95	6K8gt	.75	801A	.45	24G	1.45

INDUSTRIAL PILLAR INSULATORS

Glazed ceramic with heavy metal mounting base. Ideal for high voltage & high freq. applications.

Height overall	Pillar Dia.	Price ea.
3"	1"	.45
3"	1½"	.65
4"	1⅛"	.95 metal cap
5"	1"	.75
6"	1"	.85
Bee-hive white ceramic.		
1½"	2"	.21 6 for $1.00

POWER TRANSFORMERS

Thord. #T—51378 TV. Power, etc. H.V. ct. 410-0-410 V. @ 325 Ma.
Fil. #1. 6.3 V. @ 12.5 Amp.
Fil. #2. 6.3 V. @ 4 Amp.
Fil. #3. 5 V. @ 2 Amp.
Flush mtg. completely shielded. New $8.75

BC-312 POWER TRANSFORMER

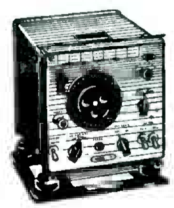
Sym. C-228 C.T.C. 110-220 V. 60 cyc Prim. 700 V. Ct. @ 100 Ma., 5 V. 3A., 12.5 V. 2A., & 12.5 V. @ 3A. Open Frame. New $6.75

HIGH FREQUENCY COAXIAL CABLE

A water proof fabric covered double shielded low loss cable developed by Bell Labs. All lengths have PL-259 male connectors on each end. Electrical characteristics: Impedance at 1Mc.—65 ohms min., 75 ohms max., Attenuation at 1Mc. = .6Db. per 100 ft. Capacity per ft. 22 uuf. (approx.), Voltage rating: 6,000 A.C. Available in 24', 36½' and 60' lengths. New—8½¢ per ft.

FREQUENCY METER—LM 14

A compact version of the famous BC-221. Built-in modulation, voltage regulation and variable output control. With original tubes, xtal, Cal book and Manual. New..$134.50



T-19/ARC 5 TRANSMITTER
3 to 4 MC. complete with tubes & crystal. While they last!! New $24.50

VINYL TUBING—Black 5/16" I.D. x 7/64" Wall. Fresh stock. 40 ft. lengths. Per 1000 ft. $9.85

RUBBER TUBING—5/16" I.D. x 7/64" Wall. New 80 ft. lengths. Per 1000 ft. $9.85

V.H.F. TRANSMITTER & RECEIVER—BC-800. Range: 160—186 Mc. Rec.: 2-956 R.F., 956 Mxr., 955 Osc., 5-6AC7 I.F. (30 Mc.), 6H6 Det. Lim. 6AC7 Vid., 6V6 Video Amp. Trans.: 6SN7 Mod. Amp., 2C26 OSC., Pwr. Sup.: 2x2 H.V. & 5U4 LV., 80-115V @ 400—2600 Cyc. and 24 V.D.C. Ideal for conversion to Mobile Service or Video Applications. Equipment new, complete with tubes, cables, align, tools, shock-mounts, wood chest and Tech. Manual. WHILE THEY LAST! $39.50

Material subject to prior sale. 25% dep. with all orders. Bal. C.O.D. Orders received less postage, shipped express. Minimum tube order $15.00; minimum general order $3.00.

FOREST SALES CO., INC.
701 MADISON ST. EU. 6-1663 OAK PARK, ILL.

BRAND NEW STANDARD BRAND TUBES

OA2	1.45
OA3/VR75	1.47
OB2	1.49
OB3/VR90	1.19
OC3/VR105	1.25
OD3/VR150	.89
C1A	9.75
1A3	1.10
1A4P	.69
1A6	1.25
1B4P	.79
1B5/25S	.89
1B7GT	.89
1B22	6.95
1B26	2.75
1B27	18.75
1B29	4.75
1B36	14.75
1B56	34.95
EL1C	2.69
1C6	.69
1C7G	.79
1D5GP	.89
1D7G	.79
1D8GA	.79
1E5GP	.79
1E5	.89
1E7GT	.89
1F4	.59
1F5G	.69
1F6	.79
1G4GT	.79
1G5G	.79
1G6GT	.69
1H4G	.79
1H6G	.69

1J6G	.69
1J6GT	.69
1L4GT	.65
1LA4	.89
1P5GA	.69
1R4/1294	.89
1T4	.69
1T5GT	.89
2A4G	.89
2A6	.59
2A7	.59
2C21/1642	.65
2C22/7193	.30
2C26	.19
2C26A	.39
2C34/RK34	.59
2C40	9.95
2C44	1.00
2E5	.89
2E22	2.95
2E24	4.85
2E26	3.49
2J22	7.50
2J26	24.50
2J27	24.50
2J30	69.50
2J31	24.50
2J32	37.50
2J33	37.50
2J36	89.50
2J40	37.50
2J61	47.50
2J62	47.50
2K25/723AB	29.25
2V3G	.98

2X2	.59
3B7/1291	.59
3B22	2.69
3B24	5.25
3B26	3.50
3C24	1.75
3C28	4.95
3D6/1299	.59
3D23	4.75
3E29	13.95
3Q4	.69
4B28	4.45
4E27/257B	14.95
4J22	139.50
4J26	159.75
4J42/700A	24.95
5C30/C5B	3.75
C6A	5.75
6A3	1.25
6AC5GT	.89
6AK5	1.35
6C8G	.79
6D8G	.79
6K7G	.59
6L7G	.89
6R7G	.99
6S7G	.79
6SA7GT	.89
6SR7GT	.69
6T7G	.79
6U7G	.59
6ZY5G	.79
7C4	.69
7E5	.89
7E6	.79
10Y	.75

12A6	.79
12A7	.89
12F5GT	.69
12H6	.79
12J7GT	.89
12K8	.89
12Z3	.79
19	.59
20	.89
22	.89
24G	1.75
25AC5	1.19
34	.59
RK34	.59
35/51	.79
36	.50
38	.49
39/44	.49
45 Spec/VT52	.29
46	.79
49	.69
EF50	.89
CRP72	1.25
FG17	5.95
RK72	1.25
CRP73	1.25
RK73	1.25
REL5	75.00
FG81A	3.50
VT90	.98
VT98	75.00
100TH	7.95
HY114B	.75
VT127	2.50
205B	3.95
211	1.75

217C	8.75
250R	8.95
250TH	20.95
250TL	18.95
257B	14.95
285A	10.95
286A	18.95
304TH	10.95
304TL	10.95
307A	3.95
310A	6.50
316A	1.39
329A	8.95
331A	8.95
353A	4.95
371B	.89
388A	1.49
417A	8.49
450TH	44.50
530	16.95
531	6.75
533	75.00
559	3.95
HY615	.22
700A	24.95
701A	4.95
702A	3.19
703A	5.75
704A	.95
705A	2.75
707AY-GY	44.50
707A	9.95
707B	17.25
710A/8011	.75
713A	.98
714AY	5.75

715A	5.95
715B	9.50
715C	24.10
721A	4.95
722A	2.39
723AB	17.95
724B	3.25
725A	6.25
730A	20.95
800	1.95
801A	.75
803	4.95
805GE	4.95
807	1.60
808	2.95
809	2.39
810	12.75
811	3.25
812	3.25
813	8.50
814	3.75
815	2.89
828	11.95
829	10.95
829B	14.95
830B	3.25
832A	9.50
833A	48.75
836	4.75
837	2.49
838	3.95
843	.25
846	49.95
851	48.75
860	6.50
861	23.25

864	.75
865	1.25
866A	1.35
869B	39.50
872A	3.95
874	1.25
876	.59
879	1.43
931A	5.95
954	.35
955	.45
956	.69
957	.45
958A	.59
CK1005	.75
CK1006	3.49
E1148	.33
1608	4.95
1613	.89
1616	.89
1619	.75
1624	1.49
1625	.40
1626	.40
1629	.35
1636	2.95
1642	.98
1851	1.69
2051	1.09
7193	.35
8001	14.95
8011	.75
8012	2.75
8013A	4.75
8020	1.25

8025A	7.95
9001	1.50
9002	1.25
9003	1.75
9004	.75
9005	1.75
9006	.29
C5B	3.75
C6A	5.75

CATHODE RAY TUBES

3CP1/S1	1.95
3DP1	4.75
3FP7	1.85
4AP10	4.50
5AP1	3.49
5FP7	3.95
7BP5	18.95
10BP4	17.95
12LP4	20.95
12LP4A	22.25
14BP4	26.50
16DP4A	34.00
16RP4	35.00
17BP4A	35.00
19AP4A	61.25
19AP4B	61.25
20CP4	49.95

TUNGAR BULBS

6 Amp. Rectigon Westinghouse 4.75

MARITIME INTERNATIONAL COMPANY

11 State Street, New York 4, N. Y. Cable Address "Foxcroft" Phones: Digby 4-3192-3

DEPENDABILITY IN ELECTRONICS

Attn: Industrial Purchasing Agents . . .

Our new Radio Master Catalogue is available to you at no charge upon receipt of your request on your letterhead. We are National Distributors of General Electric, Sylvania, Ohmite, Amphenol, Sprague, Aerovox, Sangamo, Stancor, Merit, A. H. & H., Simpson and many others. All telegrams, cablegrams, and inquiries acknowledged and promptly answered.

NORMAN RADIO DISTRIBUTORS INC.
94-29 MERRICK BOULEVARD JAMACIA, N.Y.- REpublic 9-4651

TIME DELAY

RELAY, 115v. 60cy adjustable 10 sec. to 2 minutes Cramer TD2-120S. Also TD60S 10 to 60 sec. $12.95
MOBILE XMTR, LINK 25UFM w/6v dynamotor & tubes, 30-42mc 15KC FM 9x17x8¼" H. Used, excellent $59.50
SYNCHRO MOTOR 1F SPECIAL 115/90v 400cy $11.95
BLOWER MOTOR 400-1800cy 115v. EAD J31C $9.95
BATHTUB COND. .5-400vdc side term. 100 for $29.00
RELAY 3PDT 24vdc 250 ohm Clare Type K..$1.55
FIL. XFRMR 6.3@1.3A (other sizes avail).. .99
SILVER CER. TRIMMER TS2A 1.5-7, 7-45, 3-12 etc. 39
AN3106-10S-2S, PL-259AJAN, PL-68, JK33&34, 83-1H OIL COND. CP65,67,69,70;50,52 BATHTUBS, MICAS SPARE PARTS FOR: AN/TRC-1, AN/TPN-2, BC/1296A, BD-AO-83, SO134 & mate, JPOTS, FLEX, CER, COUPLINGS, XFRMRS, CHOKES, SWITCHES, 6&12 vdc relays, MIKES, etc.

INQUIRIES WELCOME

EMPIRE ELECTRONICS CO.
Box 41, Midwood Station Brooklyn 30, N. Y.
Cloverdale 2-2411, Bryant 9-1220, 1221

SAVE ON TUBES BRAND NEW TUBES GUARANTEED TUBES

OA2	$1.50
OA3/VR75	1.35
OA4G	1.49
OB2	1.58
OB3/VR90	1.20
OC3/VR105	1.35
OD3/VR150	1.00
VS-2	8.50
1B22	3.25
1B23	8.95
1B24	8.50
1B27	17.95
1B32	3.75
1B35	12.50
1B38	29.95
1B42	12.50
1N22	1.25
1N23	1.49
1N23A	2.75
1N23B	4.50
1N38	1.50
1N43	1.40
1N54	.89
1N55	2.75
1N56	.39
1N60	.60
1P42	5.50
2AP1	9.95
2C39	28.50

2C40	$16.00
2C43	24.50
2C51	5.95
2E30	1.89
2J22	7.95
2J26	19.95
2J27	19.95
2J31	29.50
2J32	29.50
2J33	29.50
2J34	29.50
2J36	89.50
2J40	27.50
2J48	22.95
2J56	169.50
2J62	32.95
2K22	
2K25	29.95
2K28	33.95
2K39	99.50
3AP1	9.95
3B24	4.50
3B26	3.50
3C22	64.50
3C23	9.95
3C24	1.75
3C33	13.50
3C45	16.50
3E29	14.50

4C22/HF100	9.95
4C27/CV92	$5.95
4C35	34.00
4E27	16.50
4J21	149.50
4J22	149.50
4J23	149.50
4J26	149.50
4J27	149.50
4J28	149.50
4J29	159.50
4J30	249.50
4J31	89.50
4J32	89.50
4J33	89.50
4J34	89.50
4S35	89.50
4J52	299.50
4X150A	35.00
4X500A	85.00
5BP1	3.95
5BP4	3.95
5CP1	3.95
5D21	22.50
5FP7	1.95
5FP14	16.95
5GP1	4.95
5JP1	19.95
5JP5	19.95

5J23	$59.50
5J26	59.50
5R4GY	2.25
6AN5	5.50
6AS6	3.30
6C5	.79
6C21	17.50
6F4	4.95
6F8G	1.15
6J4	6.50
6K4	4.40

6SU7GTY	$2.95
RK47	4.95
RK48A	8.95
EF50	.95
RKR72	1.25
RKR73	1.25
VT127A	4.95
VT158	11.95
201C	10.95
203A	5.95
211	.75

YOUR SURPLUS WANTED
We Pay Highest Prices!

7B4	5.79
7BP7	5.95
7C23	65.00
7V7	.89
9LP7	6.95
10Y	.49
12A6	.69
12DP7	16.50
15E	.98
15R	.45
28D7	1.59
32L7GT	.99

217C	$7.75
250R	8.95
304TH	12.50
304TL	9.95
307A	4.95
316A	.59
327A	4.50
350A	6.95
388A	1.50
394A	4.95
417A	8.50
446A	1.25

446B	$3.50
450TH	30.00
464A	4.95
WL530	7.50
700A/B/D	16.50
702A	2.75
703A	4.95
705A	1.95
706BY	29.50
706CY	29.50
706FY	47.50
706GY	47.50
707B	14.95
708A	3.95
713A	.95
714AY	5.00
715B	8.95
715C	22.50
717A	1.39
721A	1.95
722A	1.95
723A/B	14.50
724B	2.75
725A	5.50
726A	5.90
726B	24.95
726C	59.50
803	3.75
805	3.75

807	$1.59
808	2.25
809	2.95
810	9.50
811	2.95
813	8.50
829	9.95
829B	12.50
830B	3.25
832	5.50
832A	9.95
833A	43.50
836	3.75
837	1.49
838	2.95
845	3.95
851	39.50
852	19.95
860	3.95
872A	2.75
874	.69
878	1.75
884	1.75
921	1.75
923	1.00
927	1.50
931A	5.95
955	.49
956	.49

959	$.49
991/NE16	.39
1616	.90
1619	.39
1624	1.50
1625	.45
1629	.39
1632	.89
2050	1.75
2051	1.50
5611	
5647	4.50
5651	3.30
5654	4.50
5670	5.00
5676	3.35
5702	6.50
5744	6.00
5751	5.00
5814	4.50
8005	4.95
8012	2.50
8025	4.95
9001	1.75
9002	1.50
9003	1.75
9004	.49
9005	1.50

All Prices F.O.B. Los Angeles, subject to change without notice. Minimum order $3.00.

1000's of other types in stock. Send us your requirements.

J. S. H. SALES CO.

Dept. E-9, 7552 Melrose Ave.
Los Angeles 46, California

Special: VACUUM CAPACITORS
12-20, $6.50 12-32, $9.50 50-32, $12.50

Special! RCA AUDIO CHANALYST
Type 170-A $195.00

GRAPHIC RECORDING INSTRUMENTS

A. C. VOLTMETER, for 440 VOLT Systems, Range of 360 to 520 Volts, Suppressed zero type, gives exceptionally good readings, a portable unit which can be switchboard mounted, Westinghouse type U Graphic Voltmeter. The synchronous Telechron motor chart drive can be furnished for operation on 110, or 220, or 440 volt, for either 50 or 60 cycle. Complete with charts, ink, accessories, instructions, etc. (Specify voltage and frequency desired.)
List Price $113.00 **Your Cost Only $65.00**

A. C. VOLTMETER, DOUBLE RANGE, for 220 and 440 Volt systems, Ranges of 180 to 260 volts and 360 to 520 volts, Suppressed zero type, gives exceptionally good readings, a portable unit which can be switchboard mounted, Westinghouse type U Graphic Voltmeter. The synchronous Telechron motor chart drive can be furnished for 220 and 440 Volt, or 110 Volt, 50 or 60 cycle operation. Complete with 3 charts, ink, accessories, instructions, etc. (Specify voltage and frequency desired)
List Price $131.00 **Your Cost Only $75.00**

A. C. AMMETER, 0-5 AMP, Can be used with external current transformers for higher ranges, Westinghouse type U Graphic Ammeter, a portable unit which can be switchboard mounted. The synchronous Telechron motor chart drive can be supplied for operation on 110, or 220, or 440 volt, either 50 or 60 cycle. Complete with 3 charts, ink, accessories, instructions, etc. (specify voltage and frequency desired)
List Price $107.00 **Your Cost Only $65.00**

A. C. VOLTMETER, 0-500 VOLTS, A Highly accurate wide range instrument, Westinghouse type GY-40 Direct Action-Strip Chart Recorder, The synchronous Telechron motor chart drive can be furnished for operation on 110, or 220, or 440 Volt, either 50 or 60 cycles. Complete with 3 charts, ink, accessories, instructions, etc. (specify voltage and frequency desired)
List Price $221.00 **Your Cost Only $125.00**

RECORDING POLYPHASE WATTMETER, Dual Voltage, 230/460 Volts, 5 Amps. Can be used with external transformers for higher current ranges. A highly accurate versatile instrument, Westinghouse type GY-40 Direct Action-Strip Chart Recorder. The synchronous motor can be furnished for operation on 110, or 220, or 440 Volt, either 50 or 60 cycle. Complete with 3 charts, ink, accessories, instructions, etc. (specify voltage and frequency desired)
List Price $247.00 **Your Cost Only $150.00**

A.C. VOLTMETERS

15 Westinghouse 3½" rd .... @ $5.50
150 Simpson 3½" rd .... @ ** 9.60
300 Simpson 3½" rd .... @ ** 9.60
300 Triplett 2½" rd metal .... @ 6.00

A.C. AMMETERS

100 milliamp Weston 3½ rd 400 cycles .... @ $7.50
5 Simpson 3½" rd .... @ ** 8.10
50 Simpson 3½" rd .... @ ** 9.30
200 Simpson 3½" rd. 5 Amp less transformer @ ** 8.10
Current Transformer Weston 200/5 .... @ 7.50

D.C. MICROAMMETERS

50 Simpson 3½" rd. 2000 ohms .... @ ** $11.85
100 Weston 643, 4½" rd. approx. 1500 ohms @ 21.00
200 Simpson 3½" rd. 1000 Ohms .... @ ** 9.60

R.F. AMMETERS

1.5 Weston, 2½" rd. metal case, bl. sc .... @ $4.50
2.5 Simpson, 3½" rd .... @ 5.50
2.5 Weston, 3½" rd .... @ 8.50
3, Westinghouse, 3½" rd .... @ 6.50
3, Westinghouse, 3½" rd. with ext. couple ... @ 9.50
5, General Electric, 3½" rd .... @ 7.50
8, General Electric, 2½ rd .... @ 5.50
8, Westinghouse, 3½" rd .... @ 7.50
10, Weston, 3½" rd. JAN .... @ 9.50

D.C. MILLIAMMETERS

1, McClintock, 3" square .... @ $6.00
2, Westinghouse, 3½" rd .... @ 5.50
5-0-5, Western Electric, 3½" rd. spec. sc. concentric mtv .... @ 4.00
15, Simpson, 3½" rd .... @ 6.00
100, Simpson, 3½" rd .... @ ** 8.70
150, General Electric, 3½ rd .... @ 5 50
150, Gruen, 2½" rd .... @ 3.95
200, Simpson, 3½" rd .... @ 5.95
300, Simpson, 3½" rd .... @ ** 8.70
400, Triplett, 3½" rd. made for Garfield Med. App. Co .... @ 4.50
500, Simpson, 3½" rd .... @ ** 8.70
500, Dejur, 3" square .... @ 5.00
800, General Electric, 3½" rd .... @ 5 50
800, Dejur, 3½" rd .... @ 4.50

D.C. AMMETERS

1, General Electric, 3½" rd .... @ $5.50
30-0-30, General Electric, 2" rd. metal .... @ 4.50
200, Weston, 2½" rd. with shunt .... @ 7.50

D.C. VOLTMETERS

15, Simpson, 3½" rd .... @ ** $8.85
150, Hoyt, 3½" rd. metal case .... @ 4.50
300, Simpson, 3½" rd .... @ ** 8.85
500, Weston, 2½" rd. 1 MA, with resistor .. @ 9.50
4 KILOVOLTS, Dejur Amsco, 3½" rd. 1 MA, less multiplier .... @ 4.50

PORTABLE TACHOMETER

Multiple Range Continuous Indicating

This unit is of the centrifugal mechanical type and is designed to show INSTANTANEOUSLY and CONTINUOUSLY the speed or change in speed of any revolving shaft or surface. No stop watch or other mechanism required.

- Three ranges in R.P.M. and three in F.P.M.
  LOW RANGE 300—1,200 (Ea. division equals 10 R.P.M.)
  MEDIUM RANGE 1,000—4,000 (Ea. division equals 10 R.P.M.)
  HIGH RANGE 3,000—12,000 (Ea. division equals 100 R.P.M.)
- Large open dial 4 diameter
- Ruggedly constructed for heavy duty service
- Ball bearing and oilless bearings
- Readily portable—Fits neatly into hand
- Gear shift for selecting low, med., high ranges.

Made by Jones Motorola, Stamford, Connecticut
7⅛" L x 4" H x 5" W .... **YOUR COST $37.50**

SPECIAL METERS

Decibel. —10 to 6, Weston 301-61 3½" rd. .@ $11.50
Rect. Milliammeter, 1.1 MAAC Weston 545-81. sp scale .... @ $6.50
Micromhos meter, 1.4 MADC Simpson 3½" rd @ $6.50

TEST INSTRUMENTS

Simpson 260 Set Tester .... @ ** $38.95
Simpson 240 Hammeter .... @ ** 26.35
Simpson 230 V.O.M.A .... @ ** 24.95

WEATHER INSTRUMENTS

Friez Recording Microborograph Cat. # 792
Friez Psychrometer Cat. # 573
Friez Thermograph—20° to 120°F
Taylor Anemometer
Alnor Velometer
Used—Guaranteed
List over $1,400 **Net $400.00**

MISCELLANEOUS

Frequency meters. 58-62 cycles, 115 volt, switchboard type, Westinghouse HY .... @ $50.00
Gasoline Heater, GN-3-24 .... @ $22.50
Radio Receiver BC-1161-A .... @ $34.50
Radio Transmitter BC-1160-A .... @ $29.50

*** Includes New Factory Guaranteed Stock. All other items are Surplus New unless SPECIFICALLY indicated otherwise. All items are fully guaranteed.*

We specialize in electrical instruments. Over 75,000 meters in stock. Send for our latest circular showing our complete line of surplus-New-Guaranteed meters.

MARITIME SWITCHBOARD
INSTRUMENTS—ACCESSORIES
338 Canal St., N. Y. 13, N. Y.
Worth 4-8217

Orders accepted from rated concerns, public institutions and agencies on open account, others please send 25% deposit, balance C.O.D. or check with order. All prices FOB our warehouse, N.Y.C.

AT
Big Saving!
FERRULE-TYPE RESISTORS

Immediate delivery from our stock of over 250,000.

•

Wide assortment from 0.2 to 300,000 ohms.

•

ENAMEL—GLASS
FIXED—ADJUSTABLE

•

New and in perfect condition.

•

Nearly all made to JAN specification.

Write for Catalog

UNIVERSAL MARINE & MFG. CORP.
137 Alexander St. Yonkers 2, N. Y.

SATISFACTION GUARANTEED
KEY ELECTRONICS

ATTENTION INDUSTRIAL USERS ! ! !

We have large stocks of the following items and we invite your inquiries.

- Amphenol Connectors
- Allen-Bradley Potentiometers
- A M P Terminals
- Burndy Hylugs
- T & B "Sta-Kon" Terminals
- Dialco Panel Light Assemblies
- Superior Powerstats
- Ferrule Type Resistors
- Relays, Transformers and Chokes
- Synchros
- Tube Sockets
- Hardware
- Contactors
- Magnet Wire & Hook-up Wire
- Vacuum Condensers
- Gas-filled Condensers
- Oil-filled Capacitors
- High-voltage Mica Capacitors
- High-voltage Oil-filled Capacitors
- Mica & Silver Mica Capacitors
- Tubes
- Switchboard Meters
- Crystal Diodes
- Interlock Switches
- Key Switches
- Type FP Capacitors
- Type G Capacitors
- Fiberglass Yarn
- Contactors & Contactor Coils
- T & B "Wedge-On" Terminals, Glass-enclosed Relays
- Welding Rod; including Type 347
- Tube Crocks

We invite inquiries regarding items not listed above.

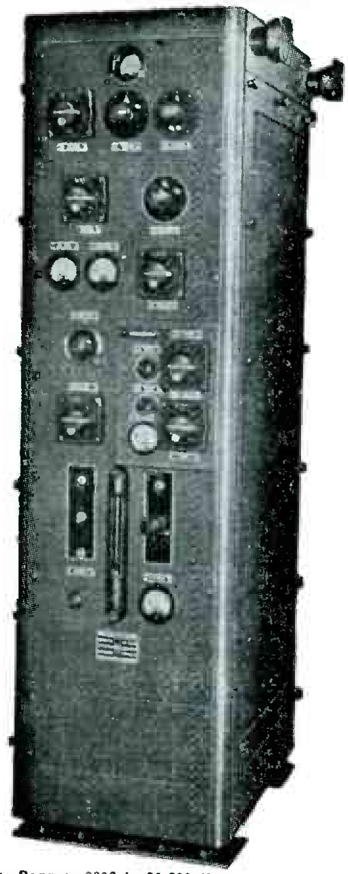
Replies will be made to your inquiries within twenty-four hours after they are received by us.

Key Electronics Division

1801 North Longwood Street **Baltimore 16, Maryland**

R.C.A. Model MI-8167 TRANSMITTERS

Point-to-point communications



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.

WHOLESALE ONLY

ELECTRONIC COMPONENTS
AIRCRAFT EQUIPMENT
HYDRAULICS

RADIO & ELECTRONIC SURPLUS
13933-9 Brush St. Detroit 3, Mich.
Phone Townsend 9-3403

Wholesale Dealers

IN GOVERNMENT SURPLUS
- electronic components,
- units, wire, etc.

LAPIROW BROS.
1649 Hoffner St. Cincinnati 23, Ohio
Kirby 1285

FOR SALE
Beryllium Copper Strip

.0071 x 3 x 96 inches 2000# available
Beryllium 2%, Cobalt .3%

J. C. LIMOZAINE
1423 Kanawha St., Hyattsville, Maryland

IN STOCK IMMEDIATE SHIPMENT

TUBES

6B8	.60	12F5GT	.48
6B8G	.55	12K8GT	.50
6J8G	.65	50	.65
6L7G	.65	70L7GT	.85
6S7G	.60	85	.57
6U7G	.50	807	1.40
12A6	.50	1619	.40

Please Write for Up-to-Date Special Purpose Tube List with New Low Prices

All listings are Quality Guaranteed. Inquiries regarding these and other requirements given prompt attention. Usual discounts to manufacturers and jobbers.

PARTS

TRANSFORMERS

PLATE TRANSFORMER

5000 volt AC, center tapped, 350 MA. Primary 115 volt, 60 cycle. Unmounted and not potted, overall dimension 6½ inches x 6 inches x 7 inches, weight 37 lbs. ....New. $25.00

PULSE TRANSFORMER

68G828-G1 ....New. $5.50

PLUGS

TELEPHONE PLUG, Equivalent to PL-55, with Screw Terminals Inserted. Samples furnished to quantity users....New. $.30

BUTTERFLY CONDENSER (A-PR-4TN-17)

Antenna Tuning Unit Condenser (C-302) for TN-17, 74-320 MC, in original package $12.50

All items subject to prior sale. Shipments BEST WAY C.O.D. if desired. Rated accounts net ROG.

T. R. LOWENTHAL CO.
ELECTRONIC COMPONENTS
Technical Radio Since 1919
1205 West Sherwin Avenue, Chicago 26, Illinois
Phone: Rogers Park 4-0784

PHOTOCON SALES

1062 N. Allen Ave. *SY camore 4-7156*
Pasadena 7, Calif. *RY an 1-8271*

WRITE FOR OUR WINTER 24 PAGE
SURPLUS SALES CATALOG

WE WILL BUY YOUR NEW OR CLEAN USED ELECTRONIC SURPLUS: ARC-1, ARC-3, BC-224, BC-348, BC-312, BC-342, ATC, ART-13, APS-13, BC-221, LM's, TS-12, TS-13, TS-23, TS-34, TS-35, IE-19A, I-222, SCR-522, TS-100, I-100, or any BC, I, IE, TS, APR.

WRITE FOR PRICES.

APR5A, TS-34, 804CS2, BC-348, ART-13, ARC-1, APN-9, BC-610, TCS, 304TL, 889R.

TS-148/UP, Large Quantity BC-348's, TS-13, ID59/APA-11 Indicator. APR-4 Tuning Units.

Weston 769 Electronic Analyzer LIKE NEW $200.00
APN-1 Altimeter Indicator 0-1 ma. shunt, 250° dial ....NEW 2.95
1E36A Test Sets for SCR-522........NEW 35.00
TS100/AP Oscilloscope ....EXC. 99.50
DuMont 241 Oscillograph...........EXC. 300.00
DuMont 208 Oscillograph...........EXC. 225.00
G.E. CRO5Y Oscillograph...........EXC. 225.00
LM & BC-221 Frequency Meters xtal, tubes, cal. book ....EXC. 99.50
804 LX-1 UHF Sig. Gen. 8-330 mc. Complete 500.00
CRT-3 Two-channel Gibson Girl....NEW 75.00
Drafting Machine single scale 16" fulcrum less scale ....EXC. 35.00
BC-463 Target xmtr 5 channel control 68-73 with tubes ....EXCELLENT 100.00
TS-34/AP Portable Oscilloscope LIKE NEW 600.00
EXC. COND. 500.00

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.

REAL VALUES!

CATHODE RAY TUBES

3FP7	$1.95	5CP1	$4.95
4AP10	.95	5FP7	1.95
5BP4	3.95	5GP1	3.95
16DP4	$19.95	16JP4	$19.95

TUBES

9001	$1.39	304 TH	$8.95
9002	98¢	304 TL	$8.95
9003	$1.49	830 B	$2.95

RA 52—RECTIFIER

A transtat controlled rectifier to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 volts DC at 50 watts. Metered high voltage (0-15KV) and current (0-20 MA). New **$74.50**
Some available with small repair or minor part replacement, less tube..................only $49.50

SCR 625 Famous Army Mine Detectors for prospectors — miners — oil companies—plumbers—etc.,—etc.,—etc. **$59.50** WHILE THEY LAST

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) USED, LIKE NEW **$39.50**

T85/APT-S	MD38/APQ13	R18/APS3
BC638	TS16APN	R70/APS15
BC1287	TS27/TSM	AS18/APS15
BC1077	TS61	RC213
I-83G	TS89	RT34/APS13
I-86A	TS92	RT28/APG4X
I-114	TS131	RT19/ARC4
I-183	TS159	RT48/TPX
I-185	TS170	RT73/UPN
I-187	TS184	RT10/APS3
I-198	TS251	AN/APT4
IE36A	TA-2J24	APS4
MD4/APS2	R132/TPS10	TS51
MD5/APS3	R9/APN4	TS69
MD22/UPN2		

PRICES UPON REQUEST

ARROW SALES, Inc.
Dept. E6
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

! WANTED !

Any Quantity or Make **723A/B** TOP CASH PRICES

Also 3C45, 5C22, 6J4 & 393-A.

Please include our name on your mailing list!

NOTE: We must receive your quotation on 723 A/B *before* Feb. 29.

PHONE: LEHIGH 5-4731. WRITE:
Attn. S. J. DORSA
242 E. 77 ST., N.Y.C. 21

IF THERE IS

Anything you want

that other readers of this paper can supply

OR—

Something you don't want

that other readers can use, advertise it in the

Searchlight Section

QUARTZ CRYSTALS

Made from the finest Brazilian quartz and will provide a high degree of activity and frequency stability. It is made to a frequency of F.01 % in conventional amateur oscillator temperature coefficient is less than 3 cycles per megacycle per degree centigrade.

Price 1.15 each—25 for $25.00

Available in F-243 or CL16 in the following frequencies:—In K.C.

*2356 to 2358	6250	8026 to 8041
*2500 to 2581	6275 to 6350	8050
*2600 to 2674	6400	8051 to 8066
2800	6433 to 6475	8075
*3000 to 3078	6500 to 6600	8080 to 8083
3150	6625	8100
*3151 to 3200	6686 to 6783	8224 to 8888
3350	6815	9100 to 9300
*3615 to 3700	6830	9335 to 9399
3701 to 3799	6843 to 7000	9400 to 9499
3801 to 3890	7156 to 7299	9500
3912 to 3946	7312 to 7398	9501 to 9589
4000 to 4290	7400 to 7450	9608 to 9800
4300	7509 to 7597	10000 to 10010
4301 to 4366	7603 to 7618	10075
4400 to 4470	7625	12602 to 12699
4500 to 4595	7650	12700 to 12798
4600 to 4699	7675	12800 to 12899
4700 to 4799	7700	12902 to 12998
4800 to 4899	7701 to 7716	13001 to 13196
4900 to 4988	7725	13203 to 13299
5000 to 5092	7750	13302 to 13399
5100 to 5280	7759 to 7773	13400 to 13496
5317 to 5380	7775	13500 to 13598
5405 to 5450	7778 to 7794	13603 to 13698
5500 to 5558	7800	13702 to 13799
5605 to 5695	7825	13802 to 13897
5750 to 5760	7850	13903 to 13996
5800 to 5896	7875	14000 to 14099
5910 to 5965	7900	14102 to 14198
6000 to 6080	7925	14200 to 14298
6150 to 6162	7950	14300 to 14398
6175	7975	14400 to 14542
6200	8000	
6225	8025	

Type CR-1A/AR or XL11
Price .95 each 25 for $20.00

4000 to 4788	6500 to 6590
5000 to 5090	6600 to 6685
5100	6815 to 6890
5120 to 5180	6905 to 6980
5200 to 5230	7010 to 7080
5250	7218 to 7330
5270 to 5295	7440 to 7500
5300 to 5396	7560
5410 to 5648	7600 to 7675
5740 to 5780	7700 to 7790
5810 to 5891	7800 to 7880
5910	7900
5923 to 6000	7910 to 7990
6010 to 6080	8000 to 8094
6130 to 6181	8115 to 8194
6200 to 6275	8213 to 8298
6300 to 6375	8300 to 8370
6370	8405 to 8490
6400	8500 to 8567
6401 to 6464	8630 to 8650
6470	11677
6475 to 6499	

Type CRL-33
Price $1.15 ea.
25 for $25.00

5000
6000
8500

Type XL5 Crystals—
Price $1.35 ea.

920 to 1000
1300 to 1358
1616 to 1628
1705 to 2150
2200 to 2384
2410 to 2455
2561 to 2698
2704 to 2787
2801 to 2916
3105 to 3171
3232 to 3375
3410 to 3557

* Frequencies indicated above from and to, are to show that there are available crystals in small quantities in successive steps between these values, i.e., 14406 to 145452—available crystals are 14401, 14402, etc.

Where single frequency is shown, a quantity of 50 or more crystals are available in that frequency.

10 STATION INTERCOMMUNICATING SYSTEM

An unusual offering in a 10 station intercommunicating system for factory and interoffice communications.

Built for the U. S. Navy Type I-A for 115 volt 60 cycle operations with the following outstanding features:—

Operates individually, and separately, by push button control, 10 sub-stations.

Pilot light identification of each substation, on master unit.

Transformer coupled 6V6's in push pull to provide up to 10 watt output.

Amplification provided by 2-6SL's transformer controlled.

Rectification by 2-5Y3 tubes.

A high voltage test, power transformer providing filament and plate voltage to all six tubes.

Hayden 24 R.P.M. Motor, 10 VAC actuates the switch which blinks pilot light along each substation.

Jensen type NF 101 6½" high fidelity speaker, weatherproofed.

Tubes and audio transformers mounted, on a shock proof subchassis.

Entire unit mounted in a sturdy grey finished steel cabinet 15" x 11" x 10. Weight 48 lbs. net. Each packed in wooden crate.

This unit is priced at a fraction of original government cost.

Price $59.50 each

Substations for above consisting of a 4" 2.70Z magnet, Goodman, (British make) high fidelity speaker mounted in a handsome walnut, wood cabinet.

Price $6.50 each

We have substantially large quantities of desirable electronic materials at bargain prices listed in our catalogue #ED5. To obtain a copy please write to:

EDLIE ELECTRONICS, Inc.

154 GREENWICH ST.
New York, N. Y.
Telephone DI 9-3143

Your Best Buys in TRANSMITTING TUBES

Made By Nationally Known Tube Mfr.

NEW, BOXED, FACTORY PRE-TESTED GUARANTEED

IMMEDIATE DELIVERY

10% Discount on Orders Over $500

Type	Price Each	Type	Price Each
HF60	@ $2.65	343A	@ $115.00
HF100	6.00	450TL	39.50
111A	5.45	468	8.50
HF120	4.50	492	125.00
ZB120	4.50	502R	70.00
AX4-125A	15.00	504R	75.00
HF125	8.50	508	150.00
HF130	6.25	520MT	67.50
HF140	5.50	562A	85.00
HF150	6.25	673	12.95
HF175	7.25	807	1.49
HF200	12.95	813	7.00
HF201A	9.00	830	2.75
203A	7.50	833A	39.50
203WA	8.50	836	2.95
204A	40.00	837	1.25
211B	6.75	845	4.00
211D	6.75	846	100.00
212	37.50	849	17.50
212E	37.50	849A	24.50
217C	7.00	849H	45.00
221A	18.00	857B	90.00
222A	125.00	858	180.00
228A	100.00	859	175.00
HF250	12.00	866A	1.15
255B	85.00	869B	27.50
267B	8.95	872A	2.00
270A	45.00	889A	99.50
HF300	14.95	892	125.00
301A	5.00	1652	115.00
304B	4.50	ZB3200	155.00
308A	35.00	5331	7.50
311CH	7.95	5332	125.00
315AW	15.00	5666	125.00
331	4.50	8002R	77.50
332A	14.50	8011	1.00
333A	16.25		

Sold on money back guarantee

GET PACE PRICES ON OTHER TUBES BEFORE BUYING

ALL PRICES F.O.B. N. Y. MINIMUM ORDER $5
20% DEPOSIT (Check or Money Order)
Balance sent C.O.D.
Rated Companies—Send Purchase Order

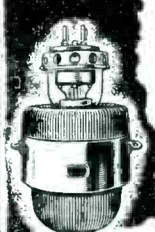
Cash for your surplus inventories

J.A.N.'s

Type	Price Each	Type	Price Each
OZ4A	@ $ .65	249C	@ $ 3.95
2J31	24.50	250R	6.00
2J34	25.00	267B	8.95
2J37	9.95	307A	3.50
2J39	39.50	371B	.70
2X2	.45	715A	4.95
3B7	.50	803	3.25
3D6	.35	805	3.25
5FP7	1.95	814	3.25
5HP1	7.75	830B	2.75
C6J	4.95	841	.35
10	.35	864	.35
10T1	.50	876	.49
RK34	.69	878	1.50
35T	3.50	957	.49
UH50	4.00	958A	.50
GAM/54	2.50	1616	.70
VR150	.90	1625	.30
218	45.00	1626	.30
227A	3.89	8012	2.25
231	.95	8019	1.75

Pace
ELECTRONICS CORP.

190 WASHINGTON ST. NEW YORK 7, N. Y.
Phone WOrth 2-1042-3



MANUFACTURERS! EXPORTERS! PURCHASING AGENTS!

- HONESTY
- INTEGRITY
- QUALITY OF PRODUCT

- Radio and Receiving Tubes
- Transmitting & Special Purpose Tubes
- Radio and Electronics Parts and Equipment
- All Types of Electrical Wire, Magnet Wire, and Cable

Write — Wire — Phone For Your Special Needs

We are also bonafide General Purchasing Agents.
CAN WE HELP YOU?
References: Dun & Bradstreet.

Electronic Expediters

225 N. Wabash Ave., Dept. E, Chicago 1, Ill.
Phone ANdover 3-0841

BRANCH OFFICES
9015 Wilshire Blvd., Beverly Hills, Cal., CR 4-6237
507 Fifth Ave., New York 17, New York, MU 7-0084

We're not eyeing! We're not trying!

WE ARE BUYING

all and any type of electronic parts or equipment that is surplus to your needs. Send us your listings and samples if possible. We promise a prompt reply in **23 HOURS** or less.

The following for sale:

Hi Voltage Plate Transformer and Choke Combination

(for the SCR 602)

Transformer specs.
Pri. 80V—1200 cycle. 2.5 amps. 200 VA.
Sec. 4000V @ .05 Amps.
Weight 21 lbs. 4 Oz.
Height 11 ins.
Width 6½" X 4".

Choke Specs.
Inductance 120 Henries @ .05 Amps. Insulated for 16000 VDC.

Condition, brand new. Price $22.50

GR Variacs Type 5 (5 Amp) Cond. used, good $15.95
Kenyon Type S-13377 5V @ 60 Amp. CT. Cond. good $10.95
Haydon Timer Motors 110V—25 cycle 2W 95 rpm. new .... $ 1.59
BC 706D Inertia Switches Brand New .... $ 1.75
BC 1073 Wavemeter and power supply less tubes $11.95
Westinghouse Type K31 Coaxial Cable (similar to RG 8U) .... .08¢ per FT.

Cadisco

CAROL DISTRIBUTING CO.
1005 W. NORTH AVE.
BALTIMORE 17, MD.
PHONE LA 4045

WANTED

WANTED

QUARTZ CRYSTAL UNITS

in holders, FT-171; FT-241; FT-243; FT-500. Any quantity. Advise condition.

W-2317, Electronics
330 W. 42 St., New York 18, N. Y.

WANTED

YOUR SPARE SURPLUS EQUIPMENT
DYNAMOTORS • SELSYNS • AUTOSYNS • INVERTERS • TRANSMITTERS
RECEIVERS • TEST EQUIPMENT
Please send list stating condition and lowest price.
No Quantity Too Small or Too Large!
C & H SALES COMPANY
BOX 356-SE EAST PASADENA STATION • PASADENA 8, CALIFORNIA

COLUMBIA ELECTRONICS LTD.

EQUIPMENT WANTED!

NOTE NEW ADDRESS BELOW

We want to buy all types of surplus electronic equipment. We are one of the largest buyers in U. S. We buy more because we give every seller top prices and a fair deal. TELL US WHAT YOU HAVE. USE COUPON BELOW—*AND MAIL TODAY!*

Use following numbers to indicate conditions: N-1, brand new; N-2, used, like new; N-3, used.

ITEM	CONDITION	PRICE WANTED

To: COLUMBIA ELECTRONICS LTD., 7460 N. Varna Ave., N. Hollywood, Calif.
Name ....
Address ....

SEE COLUMBIA ELECTRONICS AD ON PAGE 368

Additional Wanted Ad on page 378

TELEPHONE EQUIPMENT & PARTS

Brand New RM29 Remote Control Units, export packed, with carrying bag .... $16.00 Ea.
Reconditioned & Tested EE8 field Telephones $20.00 each
New TS9 handsets with flip switch .... $6.50 each
W. E. Receivers, D96554 .... $.60 each
Rebuilt like new Automatic Electric, Kellogg. Western Electric solid handsets with new 3 Conductor cords .... $4.95 each
New Receiver & Transmitter elements for the Telephone handset which are similar & interchangeable with the W.E.HAI & FI .... $1.00 each
New operators head & Chest sets .... $6.00 each
New W.E. Chest sets with FI T-26 .... $4.00 each
New W.E.T30Q throat mikes .... $.50 each
A.E. Type 41 receiver elements for TS13 .... $.75 each
New Cranks GC9 for EE8 .... $.25 each
New Capacitors CA355 for EE8 .... $.50 each
New TS9 switches .... $.30 each
New C-105 induction coils .... $.75 each
New C-158 holding coils .... $.45 each
Lever switches for EE8 .... $.30 each
C-161 Repeat coils .... $2.00 each
C-114 loading Coils .... $1.00 each
TM 184 terminal strips .... $2.00 each
New W.E.706A receivers less cord but with HAI receiver .... $2.00 each
New W.E.B-365 Relays .... $2.55 each
New 3A varistors .... $.90 each
New W.E.44A connector Blocks .... $.50 each
New W.E. Equalizers D164752B .... $7.00 each
New W.E.A2 switchboard lamps ... $10.00 per 100
New Kellogg 40 volt switchboard lamps $10.00 per 100
New Kellogg, white opal, lamp caps #79 $10.00 per 100
New A.E. Type 41 transmitters, low imp $1.50 each
W.E. Dial Blanks .... $.25 each
W.E. #26 protector blocks .... $10.00 per 100
A.E. Sound power transmitter elements .. $3.00 each
Rebuilt Sound power handsets with new cord $5.50 each
New 6' Kellogg 4 conductor telephone cords $.60 each ... 3 Conductor $.50
New Swbd. 2 Conductor CD-605 Rubber cords $.35 each
Upright desk telephones, for extensions, intercoms, etc. .... $5.00 each
Kellogg 83B receivers 48 ohms .... $1.00 each
5-Bar generators .... $4.50 each
Battery Eliminators NEW, for Intercoms, etc., 115A.C. to 8-12 Volts D.C. & 0-12 volts A.C. $29.50 each
New 82A induction coils .... $5.00 for 5
PLQ-103 .... $.90 each
Control Boxes BC-369 .... $1.00 each
New Allen Bradley relays 25V.-50 amps D.C. $1.00 each
New Electrolytic Condensers 250V.D.C.-0 to 65C. (.75MF-115MF.) .... $.90 each
New Capacitors 4MF. Paper .... $.40 each
Cook Relays—Turns 2200—Ohms 12—Spring bank—6 makes—1 break .... $2.50 each
TS-15A handsets with flip switch and rubber cord with PL68 & PL55 plug Capacitor .... $8.50 each
Kellogg—1 & 2 Mfd .... $.50 each
Canvas Carrying Bag (RM29) CS-76B W/leather bottom. Brand New .... $1.75 each
Ca-389 .50Mfd.-1MFD—600V. D.C. .... $.90 each
CA 275 4 MFD—50V. D.C. .... $.75 each
C-280 transformers .... $1.00 each
JK 34A .... $.50 each
JK 33A .... $.50 each
JK 37 .... $.75 each
New 41 inch rubber cords with either PL68 or P155 Plugs .... $1.00 each
Switch SW 175 .... $.80 each
Switch SW 185 .... $.90 each

Terms: Check with Order F.O.B. Brooklyn 5, N. Y.

EASTERN TELEPHONE CO.
323 Vanderbilt Ave. Brooklyn 5, N. Y.
MAin 2-3753

CONDENSERS OUR SPECIALTY

OIL FILLED & TRANSMITTING MICA TYPES
All Values and Voltage Ratings
We Invite Your Inquiries
TECHNICAL RADIO PARTS CO.
557 McDonald Ave., Brooklyn 18, N. Y.

ELECTRONIC TUBE-MAKING MACHINERY

For manufacturing radio tubes, electronic tubes, cathode-ray tubes, lamps. New and used. Reasonably priced, satisfaction guaranteed.

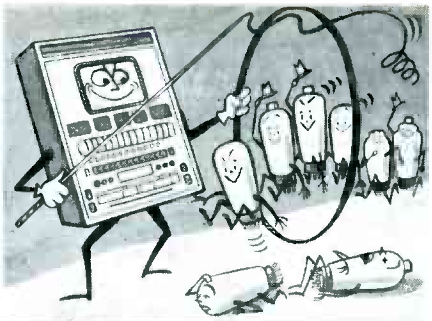
AMERICAN ELECTRICAL SALES CO.
67 E. 8th St. New York, N. Y.

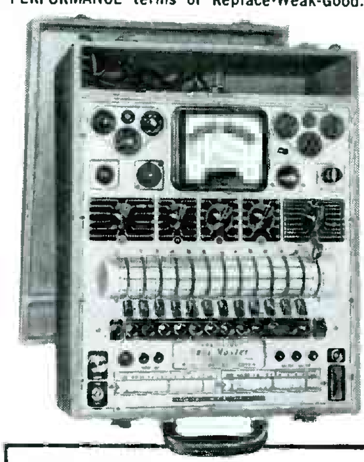
FOR SALE

General Radio Primary Frequency Standard Class C-21 Hld With Measuring Equipment New Syncronometer and Crystal

CHIEF ENGINEER
KENT ENGINEERING CO.
5743 W. NORTH AVE. CHICAGO, ILL.
Tuxedo 9-6569

INDEX TO ADVERTISERS





SEARCHLIGHT SECTION
(Classified Advertising)

H. E. HILTY - Mgr.

ADVERTISERS INDEX

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.

UHF-TV

TYPICAL TV POWER AMPLIFIER OPERATING CONDITIONS

Grounded-Grid Circuit, at 900 Mc, with 6.0 Mc. Band Width for Class B and Grid-Modulated Class C Service

DC Plate Voltage	1500 volts
Peak RF Grid Voltage	135 volts
DC Plate Current Synchronizing Level	0.350 amp.
DC Grid Current Synchronizing Level	0.030 amp.
Driver Power Output (Approx.) Synchronizing Level	75* watts
Output Circuit Efficiency	65%
Useful Power Output Synchronizing Level	[illegible]† watts

*This value includes [illegible] watts of RF circuit loss and 40 watts of RF power added to the plate input.

†This value of useful power is measured at load of output circuit having indicated efficiency.

Another RCA First... RCA-6161 forced-air cooled power triode for UHF services up to 2000 Mc.

Featuring forced-air cooling, and a coaxial-electrode structure, the new RCA-6161 is particularly suited to grounded-grid operation in circuits of the coaxial-cylinder type. In addition to its use as a power amplifier in UHF television transmitters, the RCA-6161 may be employed as an RF amplifier or frequency multiplier in Class C telegraphy and telephony at frequencies up to 2000 Mc.

The RCA-6161 has a maximum plate dissipation of 250 watts in CW or TV applications, and can be operated at full plate voltage and plate input at frequencies as high as 900 Mc... and at reduced ratings up to 2000 Mc.

The RCA-6161 is of the heater-cathode type, the heater drawing 3.4 amperes at 6.3 volts. The coaxial-electrode structure provides low inductance, large-area RF electrode terminals, and permits effective isolation of plate and cathode.

For complete technical data on the RCA-6161, write RCA, Commercial Engineering, Section BR42, Harrison, N. J., or your nearest RCA field office.

FIELD OFFICES: (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, Calif.

Another **new RCA tube**

RCA-6080 Twin Power Triode, intended for use as a regulator tube in dc power supplies. Similar to 6AS7-G, but with improved resistance to shock and vibration.

THE FOUNTAINHEAD OF MODERN TUBE DEVELOPMENT IS RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES — HARRISON, N. J.