OCTOBER · 1948

electronics

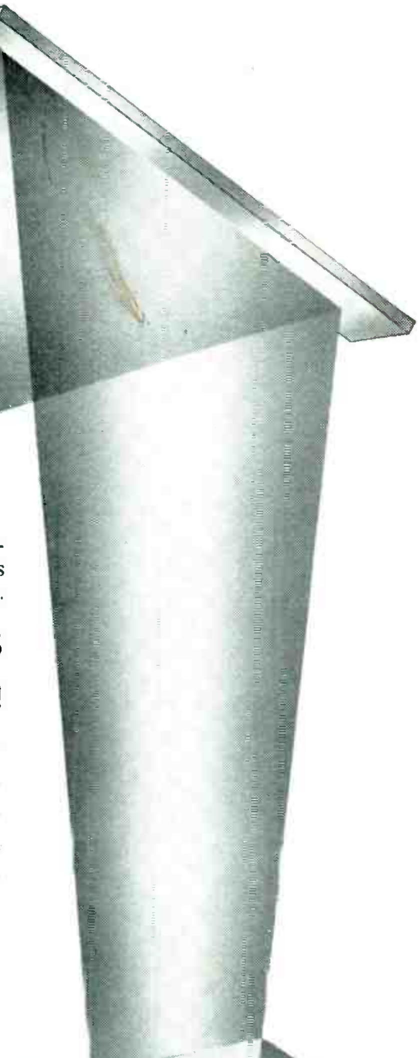
A McGRAW-HILL PUBLICATION

RADIO-CONTROLLED
JET FIGHTER

In This Issue...The Editors Report On ELECTRONICS PARK

PICTURE PROJECTION

Perfected by *Norelco*



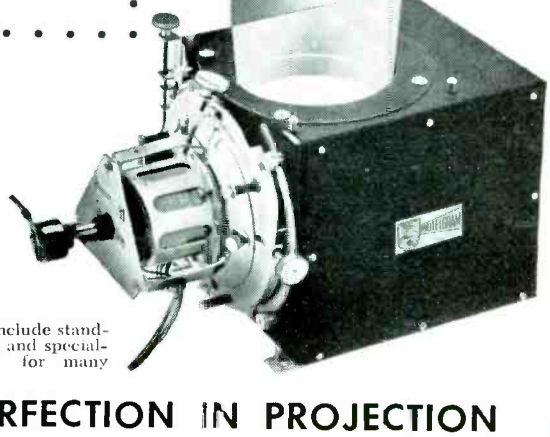
The 2½" magnetic projection triode 3NP4 has a face as small as a compact and is only 10½" long.

HERE'S THE OPPORTUNITY THAT MANUFACTURERS OF TELEVISION RECEIVERS HAVE BEEN AWAITING!

10 SIGNIFICANT FEATURES

1. Flat 16" x 12" non-reflecting picture provides fatigueless viewing from less than 5 feet and upward!
2. Wide-angle visibility — *square corners.*
3. True photographic black and white picture quality—no discoloration.
4. Compact unit—suitable for table model cabinets.
5. Long-life, low-cost picture tube.
6. Manufacturers can most economically extend their product range into projection television by adapting their 10" EM chassis for use with PROTELGRAM.
7. Easy to service.
8. High contrast ratio and broad gray tone range.
9. Simple optical adjustment system.
10. *Quality built* after more than 10 years of development.

NORELCO PROTELGRAM consists of a projection tube, an optical box with focus and deflection coils, and a 25 kv regulated high-voltage supply unit, making possible large-size home projection. More than ten years of exhaustive research resulted in this ideal system for reproducing a projected picture. The optical components are designed to produce perfected projection for a 16" x 12" image, the optimum picture size for steady, distant observation and also for *proper viewing at less than 5 feet.*



Other NORELCO products include standard 10" direct-viewing tubes and special-purpose cathode-ray tubes for many applications.

NORTH AMERICAN PHILIPS COMPANY, INC.

PROTELGRAM IS PICTURE PERFECTION IN PROJECTION

NORTH AMERICAN PHILIPS COMPANY, INC.

DEPT. TE-10, 100 EAST 42nd STREET, NEW YORK 17, N. Y.

IN CANADA: PHILIPS INDUSTRIES LTD., 1203 PHILIPS SQUARE, MONTREAL ★ EXPORT REPRESENTATIVE: PHILIPS EXPORT CORPORATION, 100 EAST 42ND STREET, NEW YORK 17, N. Y.

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TUBES ARE KNOWN BY THE COMPANY THEY KEEP

National · McMurdo Silver · Farnsworth · Remler · Triplett · Rauland · hallicrafters · hp · M · Harvey-Wells Electronics, Southbridge, Mass., U.S.A. · Kaar Engineering Co., Palo Alto, Calif. · FCI · Temco Radio Communication Equipment · Submarine Signal Company · Bendix Radio · Motorola · Federal Telephone & Radio FTR · Collins · DuMont · Preferred Link · Sickles · The Fisher · SC Setchell Carlson, Inc. · Sperry · GR · Curtiss Wright · Gon-Set · BL · General Communication Company · Har-Cam Harvey of Cambridge

"WHEN WE THINK OF V-R TUBES, WE THINK OF HYTRON."

When leaders automatically order their gaseous voltage-regulator tubes from Hytron, there must be a reason. Companies with top names can afford to select only top quality components. To have sold over 2,500,000, these Hytron OA2, OB2, OC3/VR105, and OD3/VR150 tubes must offer something special. They do! Better performance. Their advanced engineering — rigidly controlled processing and assembly — and tougher-than-JAN factory tests make these apparently simple tubes actually easy to make — better.

Yes, you are in good company if you instinctively associate V-R tubes with Hytron. Army, Navy, Air Force, AEC, famous university research laboratories — as well as industrial leaders — repeatedly order Hytron V-R tubes. Pick either the standard OC3/VR105 and OD3/VR150 or the space-saving OB2 and OA2; you, too, will prefer Hytron. That goes double, if you're "from Missouri." Find out for yourself why so many turn automatically to Hytron.

SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921

HYTRON

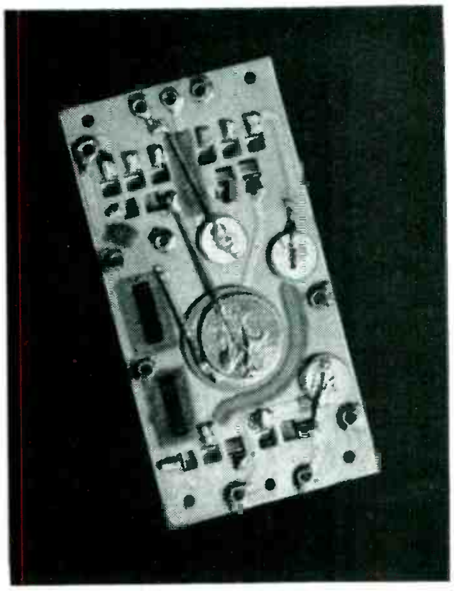
RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

PROGRESS REPORT ON P.E.C.*

How Allen-Howe — first to use "Printed Electronic Circuit" in hearing aids — depends on this Centralab development for smaller, finer units.

Models courtesy of Allen-Howe Electronics Corp.



TYPICAL "AMPEC" — (actual size, back view) shows how you can get complete electrical circuits—tube sockets, capacitors, resistors and wiring—in one miniature Centralab amplifier unit.

*Centralab's "Printed Electronic Circuit" — Industry's newest method for improving design and manufacturing efficiency!

SIZE and weight are vital to Allen-Howe, hearing aid manufacturers. That's why this firm's engineers chose Centralab's *Printed Electronic Circuit* to help them design and build smaller, lighter, more efficient units. Just as important to Allen-Howe is product dependability. Months of actual experience using *Printed Electronic Circuits* have proved to them how very rugged these miniature audio-amplifiers are . . . just how well they resist humidity and moisture. That's why they continue to use Centralab's revolutionary P.E.C.

INTEGRAL CERAMIC CONSTRUCTION: Each *Printed Electronic Circuit* is an integral assembly of "Hi-Kap" capacitors and resistors closely bonded to a steatite ceramic plate and mutually connected by means of metallic silver paths "printed" on the base plate.

This outstanding hearing aid development, illustrated above, was the result of close cooperation between Centralab and Allen-Howe engineers. Working with your engineers, Centralab may be able to fit its *Printed Electronic Circuit* to your specific needs. Write for full information, or call your nearest Centralab Representative.

LOOK TO **Centralab** *IN 1948!*

Division of GLOBE-UNION INC., Milwaukee

New vital link

ANNOUNCING THE GENERAL ELECTRIC S-T BROADCAST SYSTEM!

• With it—your signal from studio to transmitter now rides on air!

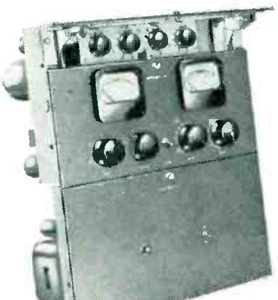
With it—your problems of outages due to weather or rugged terrain are solved! Sleet storms, fires or floods can damage studio to transmitter transmission lines or cables—but not micro-wave transmission from General Electric S-T broadcast system. There are no transmission lines or cables.

With it—you can select the best sites for your station and transmitter with increased assurance of reliable program service!

The new General Electric S-T Link equipment is easily installed and occupies remarkably little studio space. A product of the research and engineering skills assembled at Electronics Park, this system is another General Electric contribution to better broadcasting.

Broadcasters, station managers and engineers will want all the facts.

Your nearest G-E office can give them to you. Call there, or write: *General Electric Company, Transmitter Division, Electronics Park, Syracuse, New York.*



Limiting Amplifier designed by General Electric for *efficiency plus*. Like all G-E audio equipment, it fits into standard cabinet rack.

G-E two-studio Consolette contains all controls needed for split-second control of two studios, an announce booth, two turntables, and a total of eight remote lines.

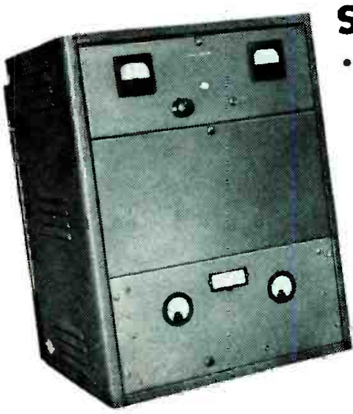
S-T TRANSMITTER

- Conservatively rated 10 watts output. Continuously adjustable 1 to 10 watts, for maximum tube life.
- Remarkably easy installation.
- Single unit. Entire transmitter is complete within its cabinet. All maintenance done under comfortable indoor conditions.
- Low power consumption: 675 watts total input.
- Can be tuned and adjusted without special test equipment.
- Instant accessibility. All meter and tuning controls immediately at hand when front doors are open.
- Rear doors interlocked for maximum safety to personnel.
- Simple and easy to change tubes.

WHAT THE SYSTEM DOES FOR YOU . . .

- Operates in band 920 to 960 MC. This includes the band permanently assigned by FCC for S-T broadcast service.
- Permits you to meet all FCC FM broadcast system requirements.
- Remote controlled over single-pair telephone line.
- Uses standard type "N" RF fittings throughout.
- Provides high fidelity performance:
  - —Less than 1% distortion from 50 to 15,000 cycles.
  - —Noise level better than 65 db.
  - —Frequency response well within ± 1 db from 50 to 15,000 cycles.
- Designed for unattended remote operation.

for dependable broadcasting



S-T RECEIVER

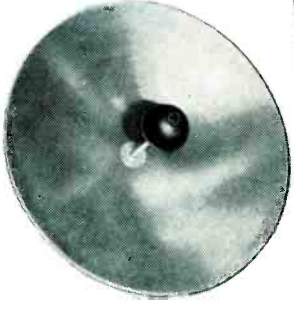
- Double-conversion superheterodyne circuit, fully crystal controlled for maximum long-term frequency stability.
- Standard receiver tubes throughout.
- Sensitivity — 95 db below 1 watt (for specified system performance).
- Total power input only 135 watts.
- Compactly assembled for mounting in standard 19-inch cabinet rack.
- All tuning adjustments are made from the front.

10-KW FM Transmitter. A famous member of a famous family. Skillfully engineered and sturdily built—a dependable unit that has helped to bring continuing FM leadership to General Electric.

Circular FM Antenna — provides high power gain with low wind loading. This strong "Doughnut" antenna is available in 1, 2, 4, 6 and 8 bay models.

S-T ANTENNAS

- 40-inch reinforced aluminum paraboloid, with dipole feed.
- Power gain each antenna 15.3 db over standard dipole. Total gain 30.6 db.
- Low standing-wave ratio over full frequency range (920-960 MC) without adjustment.
- Two-clamp mounting construction permits firm attachment to single structural member or pole.
- Easy to install and aim.
- Fully protected from adverse effects of icing.
- Designed for 100 m.p.h. wind loading.



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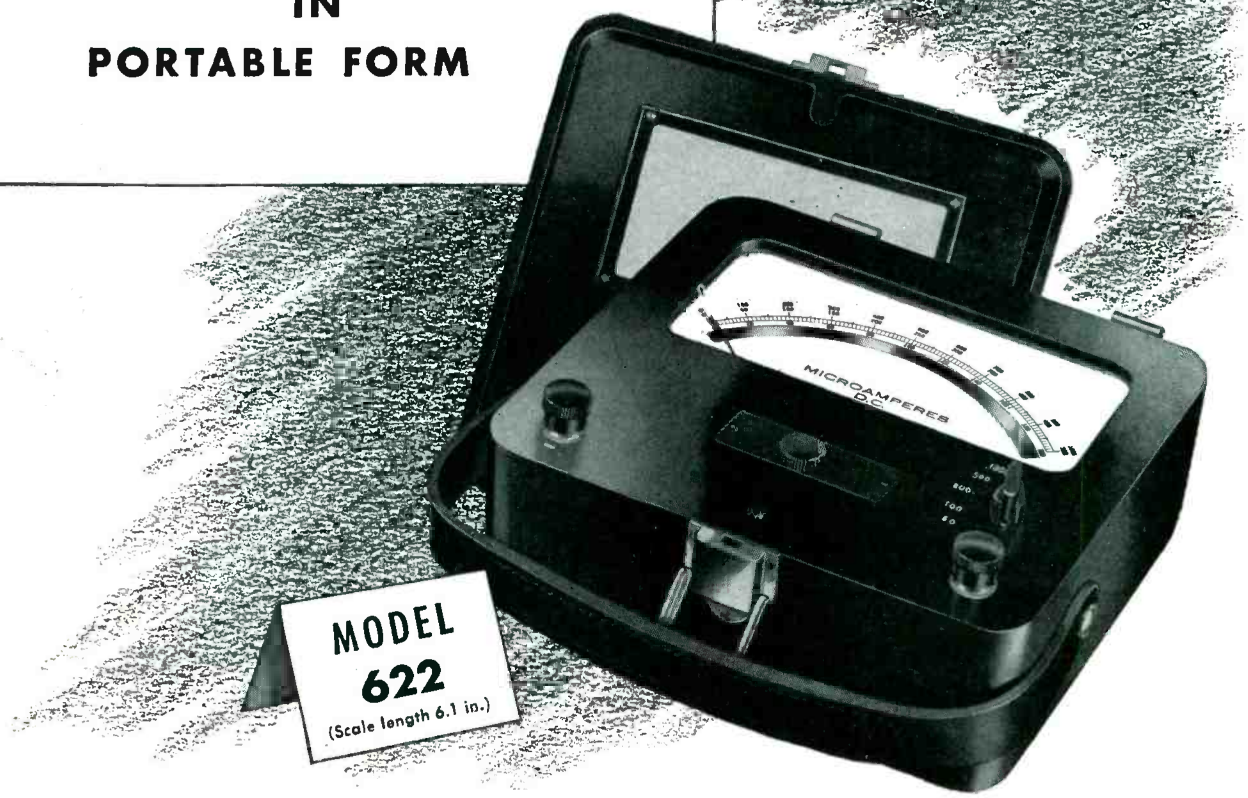
Ultra Sensitivity

IN

PORTABLE FORM



Designed for a wide variety of laboratory measurements, especially those where high sensitivity and a long scale arc are required. Electrostatically and magnetically shielded, Model 622 is ideally suited for precise measurements of potential and current at the very low energy levels frequently encountered in nuclear physics, electronics and electro-chemical research. Microammeters, milliammeters, millivoltmeters and voltmeters are available in single and multi-range D-C types; milliammeters and voltmeters in thermo and rectifier types for RF and A-C.

Complete information on Model 622 is available from your nearest WESTON representative, or by writing . . . WESTON Electrical Instrument Corporation, 618 Frelinghuysen Avenue, Newark 5, N. J.

WESTON *Instruments*

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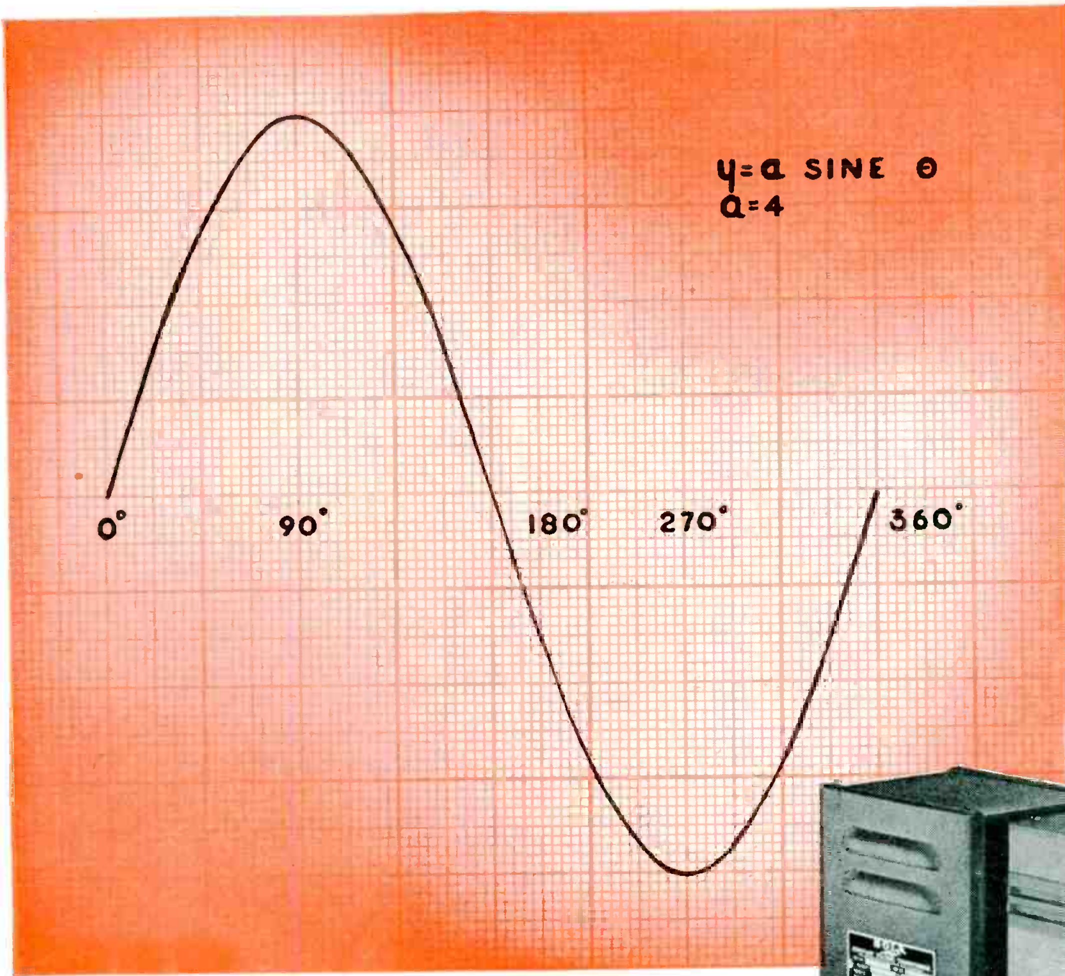

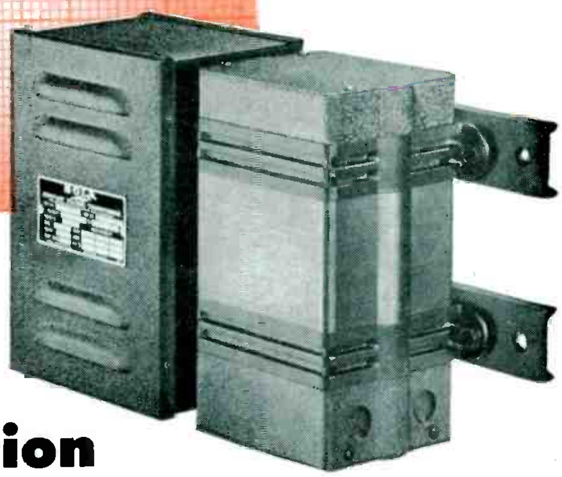

CONSTANT VOLTAGE
with low harmonic distortion

TYPE CVH, an important newcomer in a famous line—a SOLA CONSTANT VOLTAGE Transformer designed for use with equipment that requires a source of undistorted voltage. These new transformers, available in 250, 500 and 1,000 VA capacities, provide all of the voltage stabilizing characteristics of the standard SOLA Constant Voltage Transformer, with less than 3% harmonic distortion of the output voltage wave.

Since the output voltage wave is essentially sinusoidal, these transformers may be used for the most exacting applications such as general laboratory work, instrument calibration, precision electronic equipment or other equipment having elements which are sensitive to power frequencies harmonically related to the fundamental.

As in all SOLA Constant Voltage Transformers the regulation is automatic and instantaneous. There are no moving parts, no manual adjustments and every unit is self-protecting against short circuit.

Type CVH represents an outstanding advance in automatic voltage regulation and an important contribution to precise electronic equipment.

WRITE FOR THESE BULLETINS

DCVH-136—*complete electrical and mechanical characteristics of the new Type CVH Constant Voltage Transformers.*

DCV-102—*complete engineering handbook and catalog of standard Constant Voltage Transformers available for remedial or built-in applications.*

SOLA *Constant Voltage* TRANSFORMERS

Transformers for: Constant Voltage • Cold Cathode Lighting • Airport Lighting • Series Lighting • Fluorescent Lighting • Luminous Tube Signs
Oil Burner Ignition • X-Ray • Power • Controls • Signal Systems • etc. • **SOLA ELECTRIC COMPANY, 4633 W. 16th Street, Chicago 50, Illinois**

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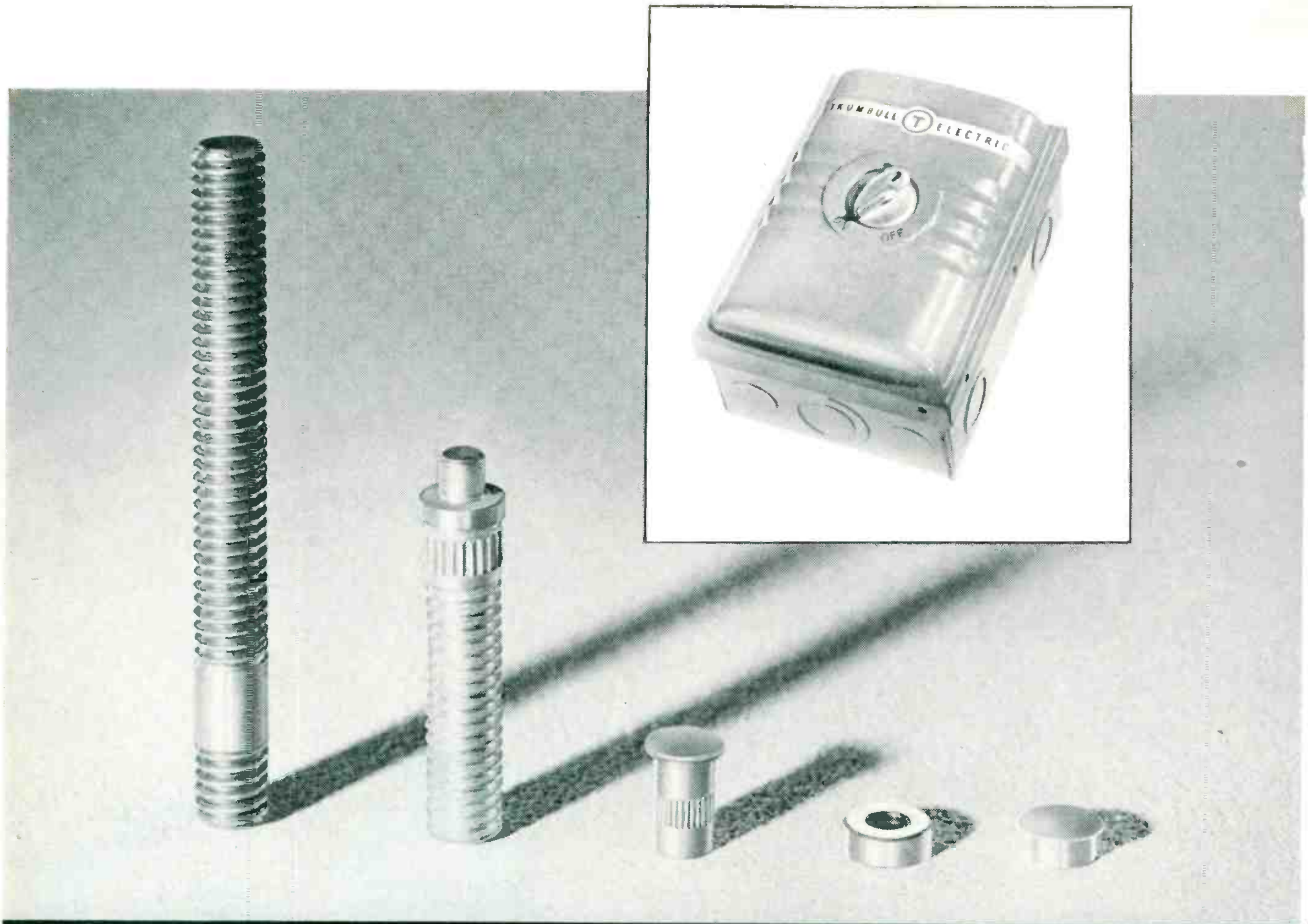
UCOA RADIO S.A., Buenos Aires, Argentina • M. C. B. & VERITABLE ALTER, Courbevoie (Seine), France



IF YOU MACHINE COPPER—

THIS REVERE METAL WILL SAVE YOU MONEY

REVERE makes Free-Cutting Copper Rod, and if you are making electronic devices requiring machined copper parts of high conductivity, it will pay you to investigate the savings made possible by this metal. We would suggest that you make trial runs to prove what it will do under your own shop conditions. That was the procedure followed by The Trumbull Electric Mfg. Co., Plainville, Conn., with these results:

Part #18107 and 18108, contacts for the Type D switch illustrated, were designed around this alloy. Trumbull states: "On both these parts we found we could make them in one operation instead of two. That is, due to the smooth free cutting of the metal, it was unnecessary to perform a facing operation . . . Our Screw machine foreman advises that, in his opinion, both these parts could be made four times as fast as out of ordinary electrolytic copper rod."

#3731, 60 amp. post stud.—5,760 pieces run in 19.6 hours with no machine down-time; 10,425 pieces of ordinary copper rod run in 66.6 hours with 11.8 hours machine down-time. In addition to the extra time required, three sets of dies were used for the regular rod. "The savings of the free-cutting material over ordinary copper were figured at $1.81 per thousand, including in these costs both material and direct labor."

#16552, space washer. "Savings per thousand over electrolytic copper were 77¢. This figure included the material difference and direct labor. In addition, there was an 18% saving in machine down-time."

#K-60-1A, 70-200 amp. stud. "The use of Free-Cutting Copper Rod on this part very definitely increased production and practically voided machine down-time.

In a letter to Revere, Trumbull added: "In general, at least for most of the parts we have used, we find that there is at least a 25% saving in machine time of free-cutting over regular copper. In addition, the workers are enthusiastic about this material, particularly when running studs, because of the fact that it is no longer necessary for them to keep a constant close watch on the machine to see that the turnings do not become tangled up with the moving parts of the machine."

The Trumbull experience is being duplicated in other machine shops. If you have not tried this Revere Metal, we suggest you get in touch with your nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

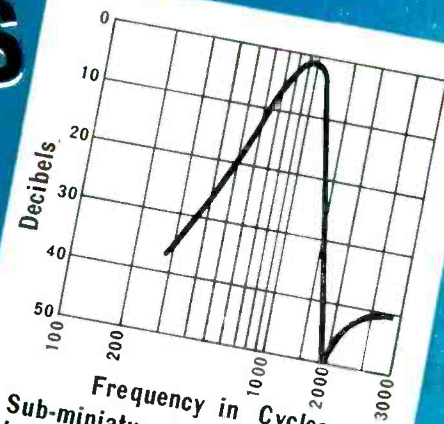
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in Principal Cities, Distributors Everywhere.

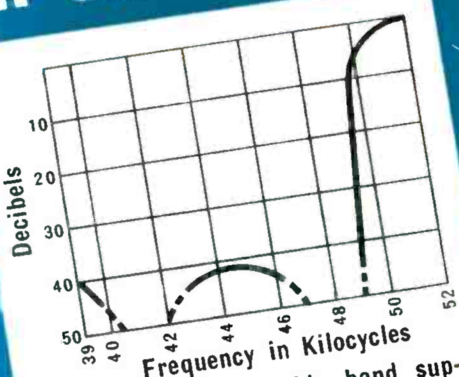
Exclusive Manufacturers of Communications Network Components

TOROIDAL COIL FILTERS

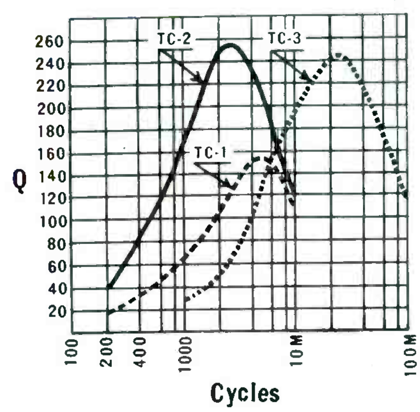
AND TOROIDAL COILS DESIGNED FOR CRITICAL APPLICATIONS



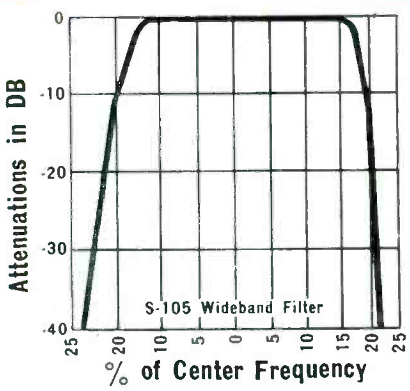
Sub-miniature band pass.
Includes 3 coils and 4 condensers.
Volume—4½ cubic inches.



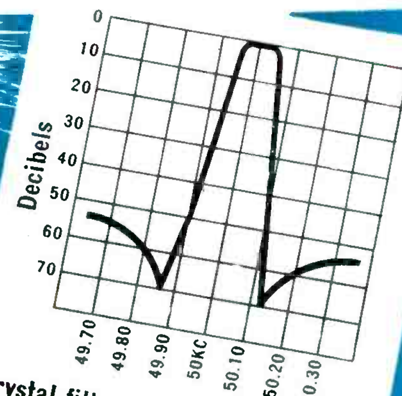
Extremely sharp side band suppression filter. Available in either low or high pass.
Size: 2½ x 4 x 2½.



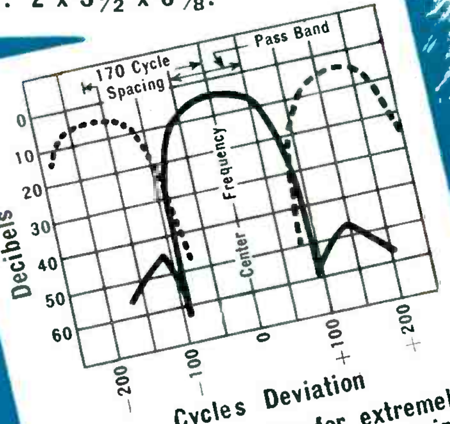
The big three out of 30 types of toroidal coils we are supplying.
TC-1 any ind. up to 10 hys.
TC-2 any ind. up to 30 hys.
TC-3 any ind. up to .750 hys.



Wide band sharp cutoff band pass.
Size: 2 x 3½ x 6⅝.



Crystal filter for narrow band pass applications too critical even for toroidal coils.



Tone channel filter for extremely high crossover attenuation requirement. Size: 2½ x 2½ x 5.

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

ALL INQUIRIES WILL BE PROMPTLY HANDLED . . . WRITE FOR TECHNICAL INFORMATION

Finest Cored Solder in the World

ERSIN Multicore

The only 3 core solder made with ERSIN FLUX...the original non-corrosive, extra-active flux

TECHNICAL ADVANTAGES

Multicore Solder

- Three separate cores of flux eliminate possibility of no flux in a portion of the wire, which may occur in single cored solder. Guaranteed continuity of the flux stream prevents "dry" joints, i.e. those having high electrical resistance.
- Although there are three cores of flux in Multicore, the total percentage of flux to solder is no greater than in single cored solder.
- Very rapid melting results from the multiple core construction which provides thinner walls of solder than are found in same gauge single cored solder.
- Multicore's unique properties make perfect joints possible on difficult metals and alloys, even if oxidized.
- Ability to tin rapidly produces perfect joints with less solder. Greater coverage per pound.

Ersin Flux

- Ersin Flux is an exclusive product of Multicore Solders Limited, and is only supplied as part of Multicore Solder. It is a high grade, water white rosin, homogeneously activated.
- Confers on rosin a vigorous fluxing action without affecting the non-corrosive and protected features of the original rosin.
- Soldered joints made with Ersin Flux do not corrode even after prolonged exposure to a degree of humidity.
- Reduces the surface tension of molten solder, causing it to wet metals rapidly, increasing speed of operation with resultant production economies.
- Free from objectionable odor. Non-toxic in use.
- Leaves nothing but pure rosin on the work after soldering, and may be used wherever plain rosin is specified.

ALLOY AND MELTING POINTS OF ERSIN MULTICORE SOLDER

Alloy Tin/Lead	Multicore Color Code	Solidus °C.	Liquidus °C.	Recommended bit temperature °C.	USES
60/40	Red	183°	190°	230°	High quality work requiring low melting point alloy.
50/50	Yellow	183°	212°	252°	Hand soldering. Radio, telephone and electrical equipment; batteries.
45/55	Crimson/Buff	183°	227°	267°	
40/60	Green	183°	238°	278°	
30/70	White	183°	257°	297°	Fuses, motors, dynamos.
20/80	Purple	183°	276°	316°	Lamps, motors, dynamos.

STANDARD GAUGES

Standard Wire Gauge	Diameter in Inches	Diameter in Millimeters	Approximate Number of Feet per lb. ALLOY 60/40	50/50	45/55	40/60	30/70	20/80
10	1.128	3.251	25.2	24.1	23.5	23.0	21.9	20.8
12	0.104	2.642	38.1	36.5	35.2	34.9	33.1	31.5
13	0.092	2.337	48.7	46.6	45.3	44.5	42.3	40.3
14	0.080	2.032	64.4	61.7	59.2	58.6	56.0	53.3
16	0.064	1.626	100.5	96.4	94.3	92.1	87.5	83.3
18	0.048	1.219	178.5	171.0	167.8	163.5	155.5	148.0
19	0.040	1.016	257.5	246.5	240.4	235.5	224.0	213.0
20	0.036	0.914	318.0	304.5	302.5	291.0	276.5	263.0
22	0.028	0.711	526.0	503.0	492.0	481.0	457.0	435.0

ERSIN MULTICORE SOLDER is made in a wide range of gauges, as shown. It can also be supplied in any intermediate size. For general radio and electronic production 13, 14, 16 and 18 S.W.G. are the most widely used gauges.

FEDERAL SPECIFICATIONS

ERSIN Multicore Solder meets all requirements of Federal Specification QQ-S-571-b September, 1947 entitled "Solders Soft Tin Lead" as certified by the New York Testing Laboratory Incorporated.

ALL GAUGES AND ALLOYS READILY AVAILABLE FROM NEW YORK STOCK.

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faster, cheaper

Electronic Controls

Speed Production . . . . . Cut Costs

Want to speed fabrication? Reduce handling and welding time? Get top-quality welds? Then investigate Westinghouse electronic resistance welding controls. You can select the basic patterns of controls you need—synchronous or non-synchronous. Each is a complete, unified, factory-assembled package that eliminates awkward, cumbersome equipment of the past. Every part has been especially designed for heavy-duty industrial use. Controls are within easy reach of the operator. Circuits have been simplified; troublesome gadgets eliminated; designs on-the-job tested and performance proved. Everything has been designed and built with one purpose in mind—to make resistance welding more practical . . . more efficient than ever before.

Check Westinghouse Electronic Welding Controls today. See their simplicity . . . their compactness. For complete detailed information, call your nearest Westinghouse representative or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-60681

Synchro-Trol . . . Synchronous-Precision A-C Control for Resistance Welding

All timing and sequence functions in one factory-assembled and tested unit.

Synchronous-precision timing . . . more uniform welds . . . fewer rejects . . . lower costs.

Easy operation—finger-tip control where you want it.

Less floor space required—saves up to 50% of that formerly required.

Locking doors protect controls against unauthorized tampering.

Less skilled help needed for installation and operation.

Weld-O-Timer . . . Non-Synchronous Control for Improved Welding

Unusual flexibility permits many combinations of standard sub-units in one factory-assembled unit for specific resistance welding requirements.

Installation is easy . . . units are supplied completely wired and factory-tested.

Tested, improved circuits provide timing consistency. Each sequence circuit is equipped with voltage regulating tubes.

Standardized Weld-O-Timers are alike in design . . . well suited to modern plant layouts. Circuits and terminal markings, regardless of combination, are similar for all units.

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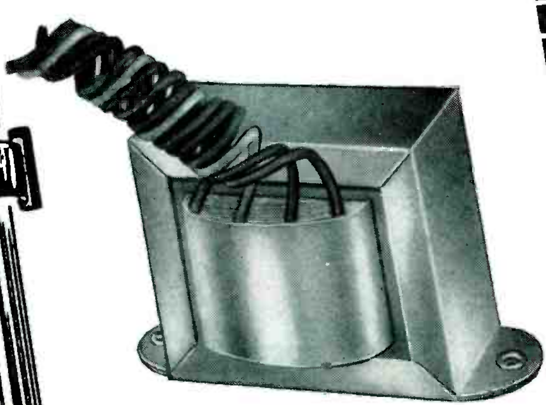
Electronic Control

Wherever There's a CORE and COIL

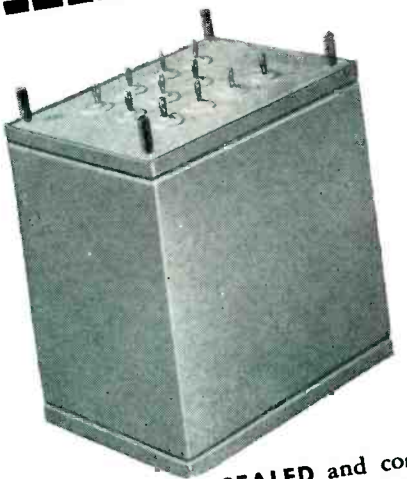
Choose FERRANTI Power and Audio Transformers Chokes • Filters

3 EXAMPLES OF OUR WIDE RANGE:



OPEN FRAME TYPE for mass production, minimum cost and weight for enclosed equipment.

ENCLOSED CASE, compound filled, for high moisture resistance. Standard cases up to 500 VA. Wide range of standard audio transformer units.



HERMETICALLY SEALED and compound filled cases. Glass or ceramic sealed terminals. Designed to meet JAN salt water immersion tests.

We offer ample modern facilities and intensive experience in up-to-date practice, including the latest core material developments, and components for 400 cycle power supplies. Our large accumulation of patterns, tools and dies often makes it possible to supply your specific requirements from standard parts, thus cutting your costs without sacrifice of quality. Whatever the type of unit, our bid will meet your needs. Submit your inquiries.

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• *Ferranti Electric, Inc.* •

30-A Rockefeller Plaza • New York 20, N. Y.

NOW! 10 cps to 10 mc

...with the New -hp- 650A RESISTANCE-TUNED OSCILLATOR

HERE IT IS . . . another *-hp-* "first" . . . a new resistance-tuned oscillator that not only covers a frequency range of 10 cps to 10 mc, but brings to the r-f and video field all the speed, accuracy and ease of measurement traditional to famous *-hp-* audio oscillators. And, this important addition to the *-hp-* line incorporates all the family characteristics of other *-hp-* oscillators . . . no zero setting, minimum adjustment during operation, virtual independence of line and tube characteristics, accurate calibration, and streamlined circuits for long, trouble-free performance.

The result is a highly stable, wide-band precision instrument which provides output flat within 1 db from 10 cps to 10 mc, and a voltage range of .00003 to 3 volts. Output impedance is 600 ohms or 6 ohms with output voltage divider.

LIKE OTHER *-hp-* resistance-tuned oscillators, the new 650A gives you the advantage of decade frequency ranges, a 94″ scale length, and a 6 to 1 micro-controlled vernier drive. A complete vacuum tube voltmeter, included in the 650A circuit, monitors output in volts or db at the 600 ohm level. A continuously variable output voltage is obtained by means of an output attenuator of 50 db, variable in 10 db steps and an amplitude control which adjusts the level to the monitor vacuum tube voltmeter.

Where it is desirable that the measurements be made with a low source impedance, an output voltage divider unit is supplied. This attachment consists of a cable, which may be extended to the point of measurement and provides an internal impedance of 6 ohms. It also reduces the output voltage 100 to 1.

THE COMPACT, efficient *-hp-* 650A is available now for making a wide number of measurements . . . testing television amplifiers, wide-band systems, filter transmission characteristics, tuned circuits, receiver alignments. And . . . it serves admirably as a power source for bridge measurements or as a signal generator modulator.

1495

For full information...write today

Hewlett-Packard Company • 1495A Page Mill Road • Palo Alto, Calif.

SPECIFICATIONS

FREQUENCY RANGE: 10 cps to 10 mc

FREQUENCY CALIBRATION: 0.9 to 10. Multiplying factors are:

MF	Freq. Range
X10 cps	9 to 100 cps
X100 cps	90 to 1000 cps
X1kc	900 to 10,000 cps
X10kc	9 to 100 kc
X100kc	90 to 1000 kc
X1mc	0.9 to 10 mc

STABILITY: ±2%, 10 cps to 100 kc; ±3%, 100 kc to 10 mc including warmup, line voltage, and tube changes.

OUTPUT: 10 milliwatts or 3 volts into 600 ohm resistive load. Open circuit voltage is at least 6 volts. 600 ohm reflected impedance. Output impedance of 6 ohms also available.

FREQUENCY RESPONSE: Flat within ±1 db, 10 cps to 10 mc.

DISTORTION: Less than 1% from 100 cps to 100 kc. Approx. 5% from 100 kc to 10 mc.

OUTPUT MONITOR: Vacuum tube voltmeter monitors output level in volts or db at 600 ohm level. Output response beyond monitor is accurate within ±5% all levels and frequencies.

OUTPUT ATTENUATOR: Output level attenuated 50 db in 10 db steps, providing continuously variable output voltage from +10 dbm to —50 dbm, 3 volts to 3 millivolts, or down to 30 microvolts with voltage divider.

HUM VOLTAGE: Less than 0.5% below maximum attenuated signal level.

POWER SUPPLY: 115 volts 50/60 cps. Consumption 135 watts. Plate supply electronically regulated.

MOUNTING: Cabinet or relay rack. Panel size 19" x 10½". Depth 13".

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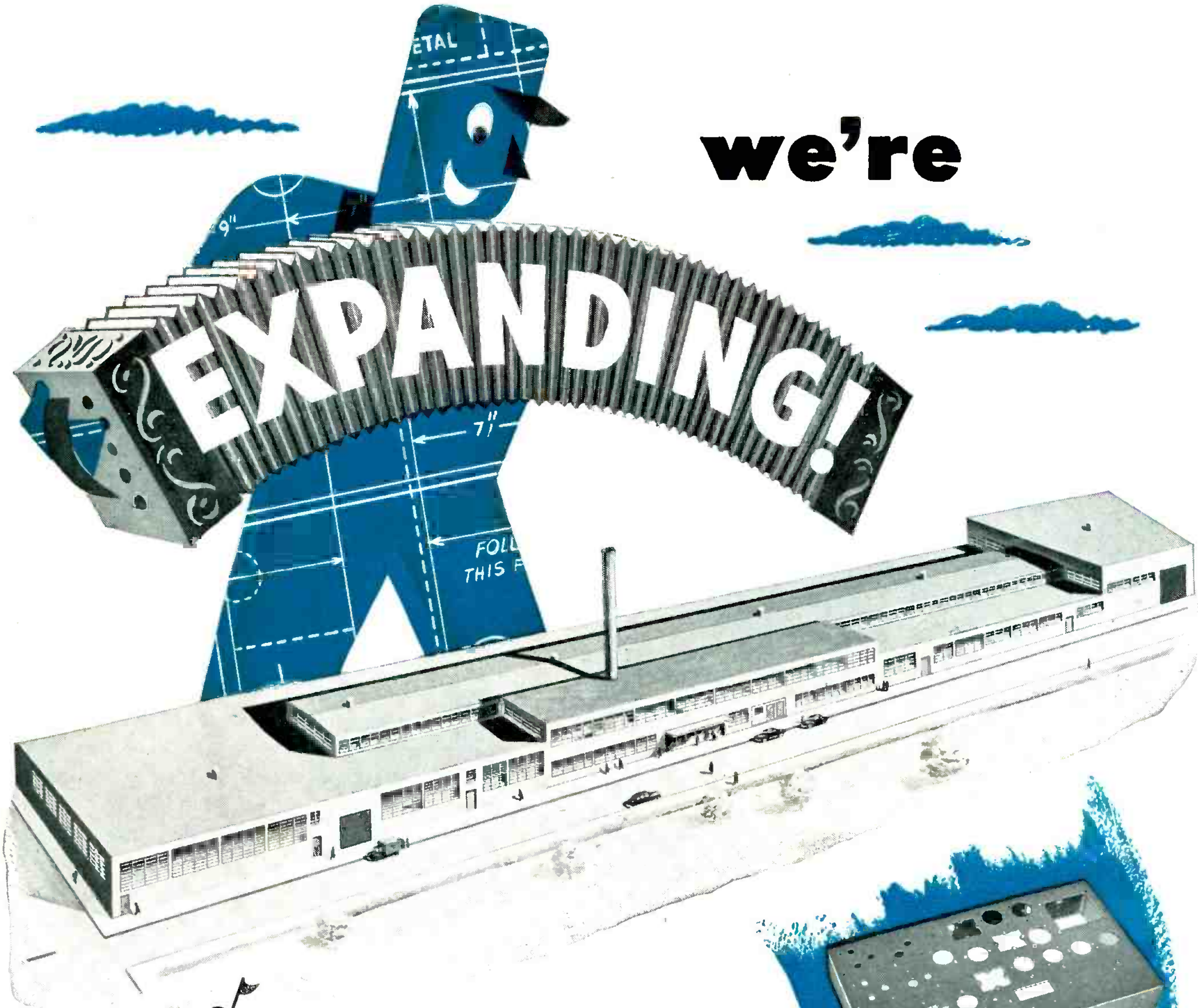
Full information on the new -hp-
FM TEST EQUIPMENT
Available on Request.
Write Today!

hp laboratory instruments
FOR SPEED AND ACCURACY



It's sweet music to us . . . and to our customers, we think, to know that Karp Metal Products Co., Inc., next month will move into a brand new streamlined building of 70,000 square feet of space, with a 600 foot frontage.

Our new plant will be the last word in modern manufacturing quarters, equipped with the newest and most efficient machinery and facilities, including the most complete and up-to-date paint and finishing department, scientifically air conditioned and dustproof. These advancements will enable us to extend the scope of the precision service we render the leaders of the radio and electronics industry.

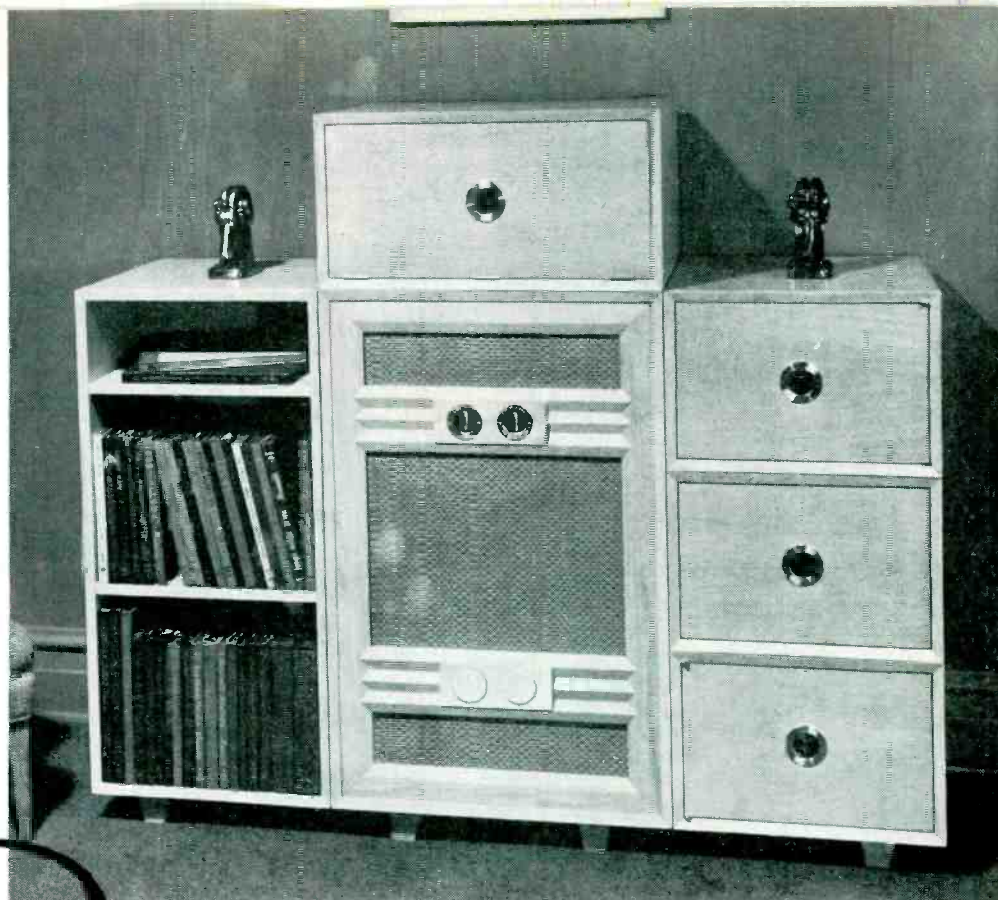
Your loyal patronage has helped make possible this expansion, and you may be sure the favor will be returned in the form of greater production and better-than-ever Karp service . . . from the simplest chassis to the most elaborate console.

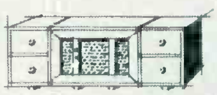
Ask For Our Informative New Catalog

KARP METAL PRODUCTS CO., INC.

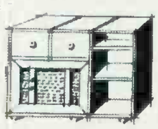
215-63rd Street, Brooklyn 20, New York

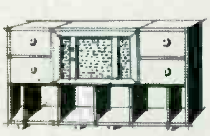
Custom Craftsmen in Sheet Metal





Jensen Customode





The answer to your HOME ENTERTAINMENT CENTER. Designed by leading furniture stylists and electronics engineers, CUSTOMODE custom cabinets give you hundreds of refined functional arrangements, enhancing all interior styles and requirements.

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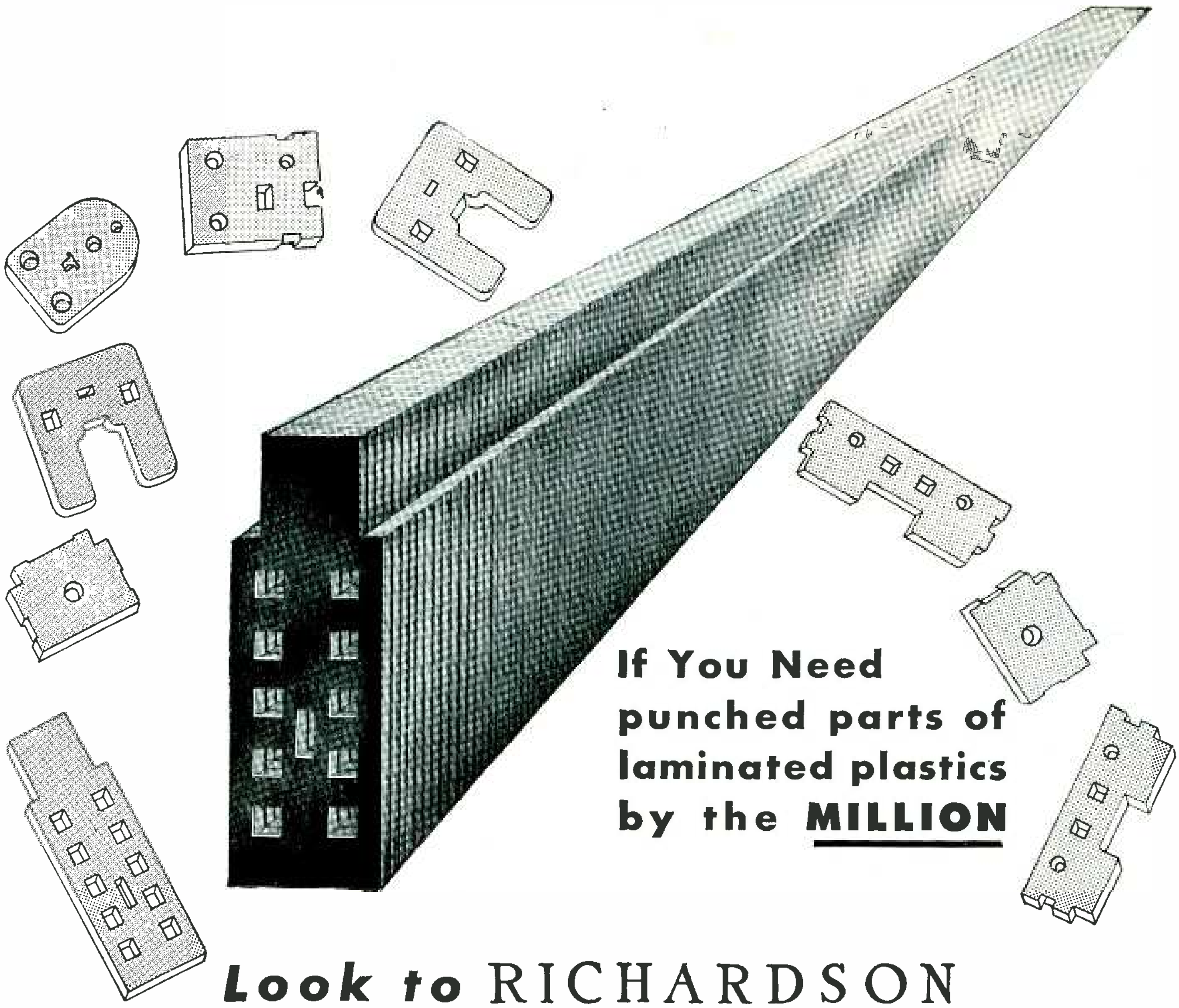
Customode's "building block" versatility enables you to create your own layouts as you wish, when you wish. Please accept our invitation to write today for free literature and scale cut-up illustration. Jensen Manufacturing Company, 6601 S. Laramie Ave., Chicago 38, Illinois.



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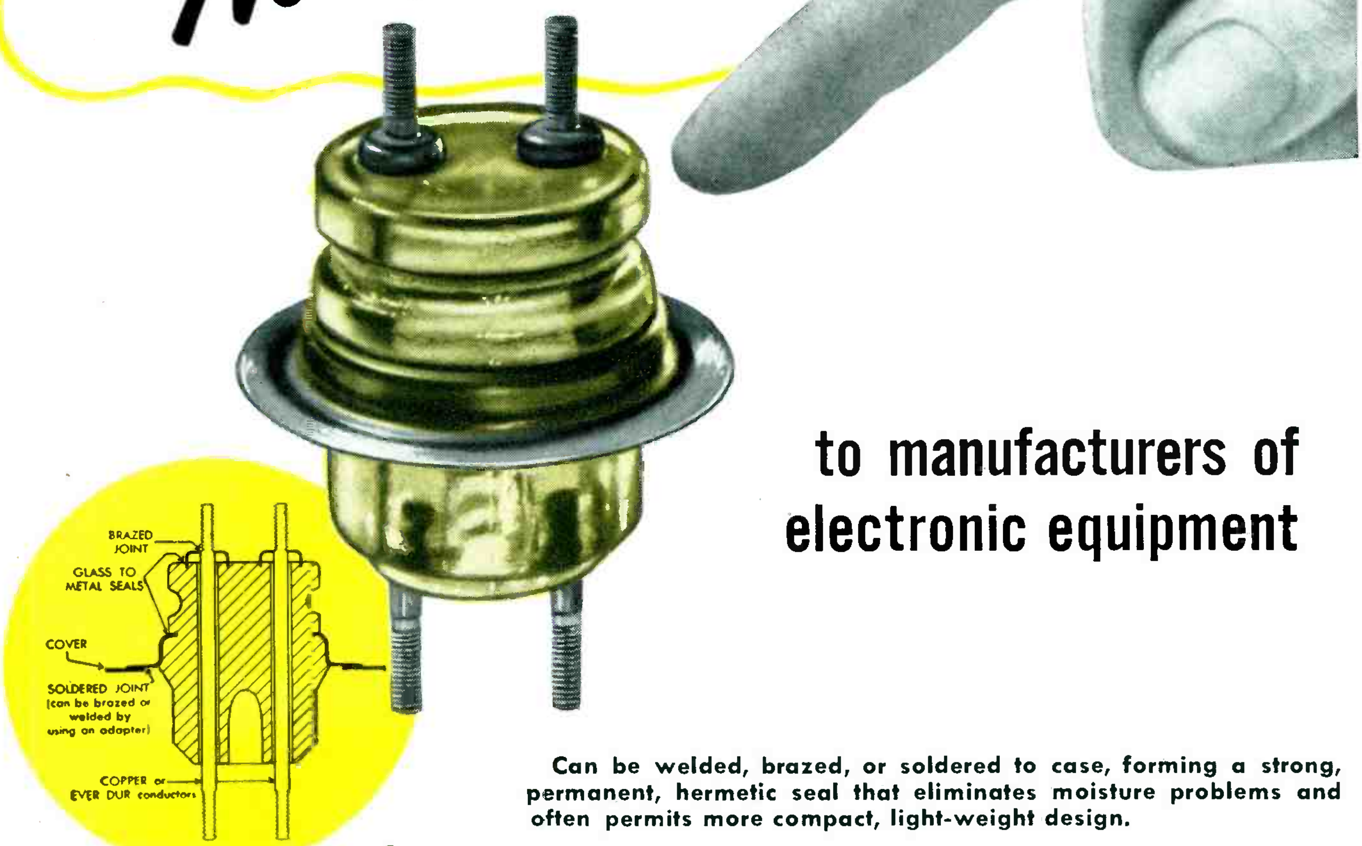
Glass bushings Now Available

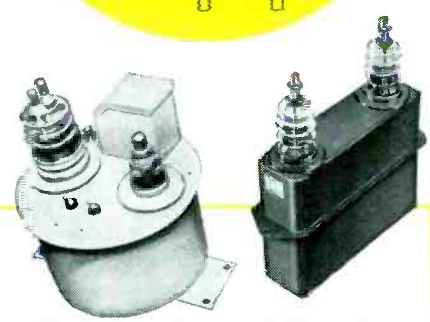


to manufacturers of electronic equipment

Can be welded, brazed, or soldered to case, forming a strong, permanent, hermetic seal that eliminates moisture problems and often permits more compact, light-weight design.

General Electric is now offering to other manufacturers the glass bushings that it has used so successfully on capacitors, rectifiers, modulator and instrument transformers, and other electrical equipment. These bushings are cast of an exceptionally stable, low-expansion glass. Metal hardware is a special nickel-alloy steel, fused to the glass in casting. Bushings are attached directly to the apparatus without gaskets—by soldering, welding or brazing the metal bushing flange to the metal case.

The resulting joint between bushing and equipment is permanent, vacuum-tight, and of high mechanical strength. It is especially desirable for equipment subject to vibration, shock, fungus growth or severe changes in temperature. These glass bushings are currently available to meet dry, 60-cycle, flashover values of from 10 to 50 kv, and in current ratings of 25 and 50 amperes (large sizes up to 800 amperes). They may be single or multi-conductor and can be provided with a top flange to permit mounting tube sockets directly on the bushings. Diameters range from $1\frac{5}{8}$ to $3\frac{3}{8}$ inches and weights from $2\frac{1}{2}$ oz. to 4 lb.



The best way to evaluate these glass bushings for capacitors, modulator transformers, and other electronic equipment, is to see them. If you will send us a sketch and ratings of bushings you are now using, we will furnish you with samples of one or more of our standard glass bushings. Or write for Bulletin GEA-5093 which contains complete listings of our standard designs, allowing you to select the particular bushing you require. ***Power Transformer Sales Division, General Electric Co., 16-215 Pittsfield, Mass.***

GENERAL ELECTRIC

401-53

Collins 3000A-1

vhf communication package

● The Collins 3000A-1 provides radiophone facilities for transmission and reception in the frequency range of 118 to 136 mc. It is expressly designed for airlines and airport tower vhf communications.

The installation consists of a Collins 242B-1 vhf transmitter (r-f, modulator, relay control, and high and low voltage power supply units), and a Collins 51M-2 vhf receiver, all compactly integrated in a Collins cabinet.

The r-f section permits transmission on either of a pair of frequencies not more than 1% separated, anywhere within the band, and has a power output of 50 watts. The number of channels can be increased by the addition of r-f units, each unit having two channels. By selection of vhf units and a Collins remote control unit the installation can provide transmission on as many as eight frequencies.

The transmitter units are designed for 19″ rack panel mounting. Convenience for maintenance has been an important design consideration. All tubes and adjustments are available from the front of the cabinet. Thorough engineering throughout insures dependable, uninterrupted performance at either a local or remote position.

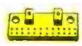
The 51M-2 is a fixed channel crystal controlled dual-superheterodyne receiver, and is highly sensitive and selective. It includes all modern circuit features, such as flat avc, noise limiter, and squelch. Write us for further information.

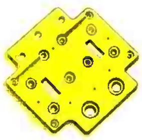
IN RADIO COMMUNICATIONS, IT'S . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 West 42nd Street, New York 18, N. Y. 458 South Spring Street, Los Angeles 13, California

If you want to get the electrical insulating material best suited to improve product performance, here's an engineering service worth investigating. Experienced Continental-Diamond engineers will welcome the opportunity of working with you from the start of a job to its completion. Backing them up is a *complete* line of insulating plastics with unusual combinations of electrical, chemical and mechanical properties. There's *Diamond Fibre* for toughness, wear resistance, and light weight, *Vulcoid* for superb arc resistance, toughness, good dielectric strength and fair moisture stability, *Dilecto* for structural strength and dimensional stability. All in all, there are five different C-D Plastics subdivided into grades to fit your specific application.





Take advantage of this complete plastics service designed to help you improve product performance, lower unit costs. For personal engineering help or prompt delivery of insulating plastics, call your nearest C-D office today.

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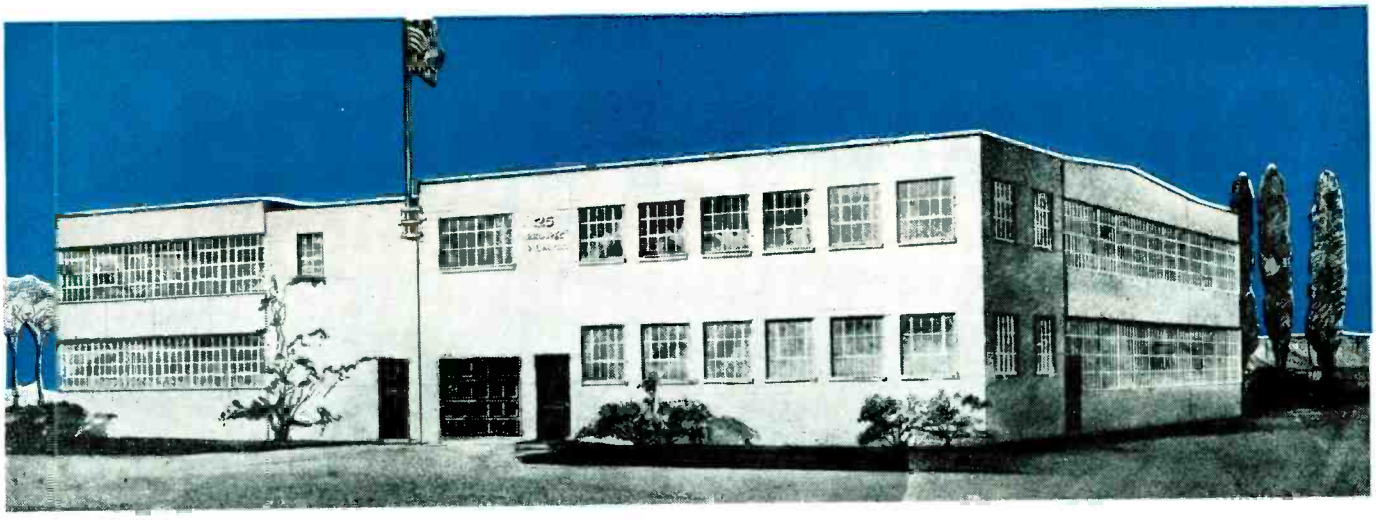

Designers and Manufacturers of
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PRESS WIRELESS MANUFACTURING COMPANY, INC.

(Combining Press Wireless Manufacturing Corporation and Milliken Machine Company)

A STATEMENT BY THE PRESIDENT

• To the many friends of Press Wireless Manufacturing Corporation and of Milliken Machine Company, we take pleasure in announcing that these two long established concerns are now united under the name Press Wireless Manufacturing Company, Inc.

• The new company has continued intact the exceptional engineering staffs and production facilities of its predecessors and now offers to government and industry a complete service for the design and manufacture of a wide variety of communication, microwave and electro-mechanical equipment.

• Press Wireless Manufacturing Company, Inc., places at your disposal a coordinated and experienced team, which has consistently delivered successful military and commercial equipment and which knows how to interpret intangibles and create efficient designs where no precedent exists.

WE WELCOME YOUR INQUIRIES

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First in "Packaged" Communications Equipment—from Antenna Tower to Operating Console

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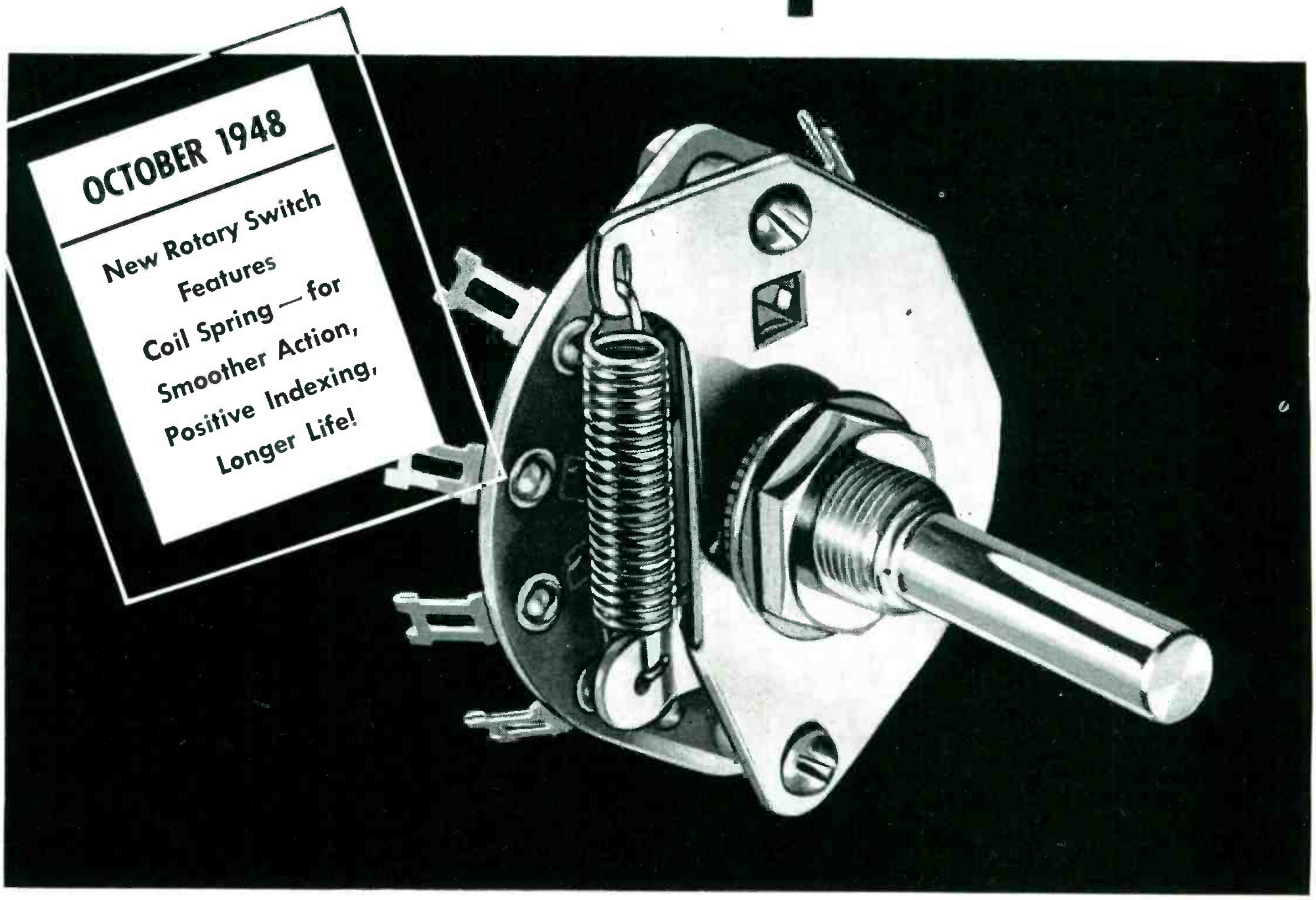
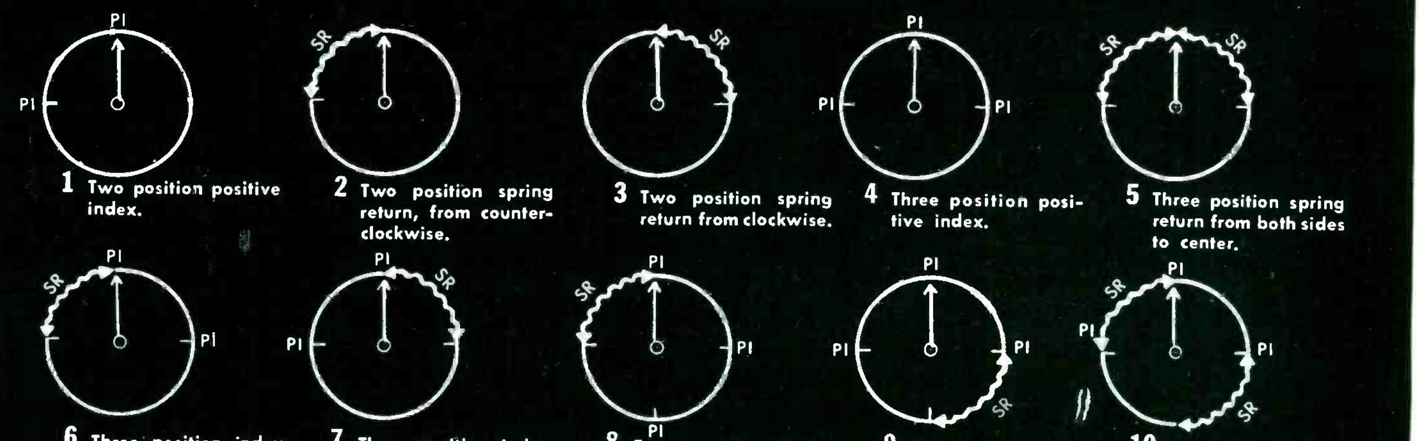
Centralab reports to



Check the features of Centralab's revolutionary new Rotary Coil and Cam Index Switch. You'll agree it's one of the most important switch developments of the year! (1) New tested step-strength of 48 inch pounds. (Standard RMA step-strength—only 24 inch pounds.) (2) Guaranteed minimum life — 150,000 cycles (RMA Standard — 10,000 cycles.) (3) Removable spring can be replaced without removing switch from chassis. Get all the facts. Write for Bulletin 995.

Four Positions Give You Wide Choice of Switching Combinations

PI — Positive Index SR — Spring Return



1 Two position positive index.

2 Two position spring return, from counter-clockwise.

3 Two position spring return from clockwise.

4 Three position positive index.

5 Three position spring return from both sides to center.

6 Three position index —two positive spring return from counter-clockwise.

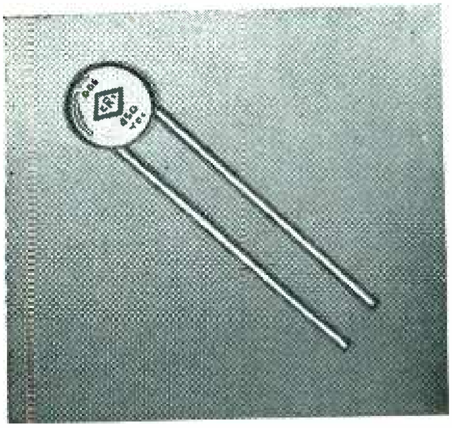
7 Three position index —two positive spring return from clockwise.

8 Four position, three positive, spring return from counter-clockwise.

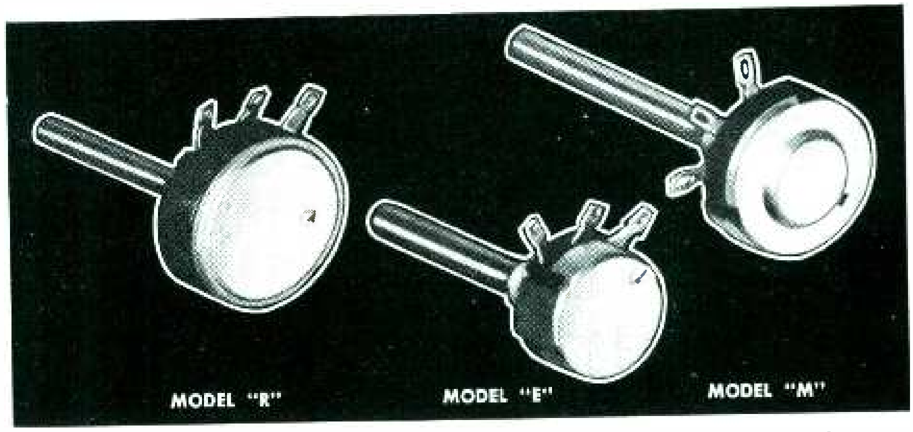
9 Four position, three positive, spring return from clockwise.

10 Four position, two positive, spring return from clockwise, counter-clockwise.

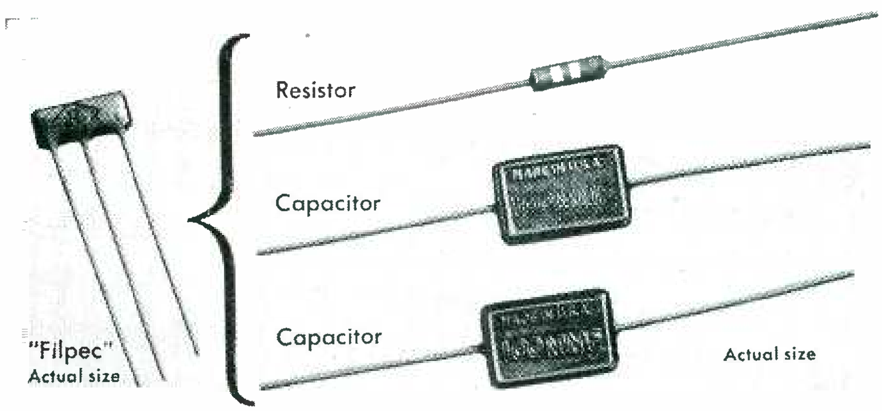
Electronic Industry

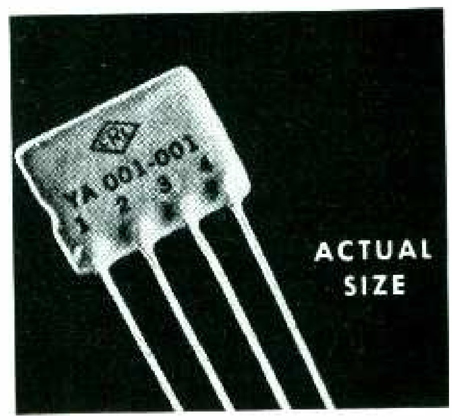


2 For utmost reliability in small physical size, low mass weight, use CRL *Hi-Kaps* — miniature ceramic disc capacitors. Write for Bulletin 933.



3 Let Centralab's complete Radiohm line take care of your special needs. Wide range of variations: *Model "R"* — wire wound, 3 watts; or composition type, 1 watt. *Model "E"* — composition type, 1/4 watt. Direct contact, 6 resistance tapers. *Model "M"* — composition type, 1/2 watt. For complete information, write for Bulletin 697.





4 Centralab's *Filpec* is designed for use as a balanced diode lead filter, combines up to three major components into one tiny filter unit, lighter and smaller than one ordinary capacitor. Capacitor values available from 50 to 200 mmf. Resistor values from 5 ohms to 5 megohms. For complete information write for Bulletin 976.

5 CRL's *Couplate* consists of a plate lead resistor, grid resistor, plate by pass capacitor and coupling capacitor. Write for Bulletin 933.

LOOK TO CENTRALAB IN 1948! ***First in component research that means lower costs for the electronic industry. If you're planning new equipment, let Centralab's sales and engineering service work with you. Get in touch with Centralab!***

Centralab

DIVISION OF GLOBE-UNION INC., MILWAUKEE, WIS.

IN THE BATTLE FOR THE LISTENER'S EAR...

Here's increased coverage for your station!

with the new

LIMITING AMPLIFIER

FITS neatly into your audio cabinet—attractive, sturdy, quiet. But what a *wallop* it packs when you want attention from Mr. Big—the listener!

Based on engineering developments by CBS engineers, the Limiting Amplifier has been designed by General Electric to give you greater coverage and more potential listeners without changing your present transmitter or antenna.

For more information, call your nearest G-E broadcast equipment representative, or write us. *General Electric Company, Transmitter Division, Electronics Park, Syracuse, New York.*

MEMO TO STATION MANAGERS:

- Increases modulation and thus makes signal reach farther, sound clearer.
- Raises effective signal strength—this means increased coverage.
- Low installation cost—quickly, easily mounted in G-E Audio Cabinet Rack.
- In FM, too—protect your listeners against receiver distortion caused by transmitter overswing. Dynamic range, so important in FM, is maintained.

MEMO TO ENGINEERS:

- Increases average level of modulation as much as 8 to 10 db.
- Anticipatory circuit prevents overmodulation—even on the first half cycle of the overmodulation peak. Automatic recovery time improves program fidelity!
- Prevents distortion and adjacent channel splatter.
- G-E popular hinged panel construction—easy to get at.
- Vertical mounted for better ventilation.

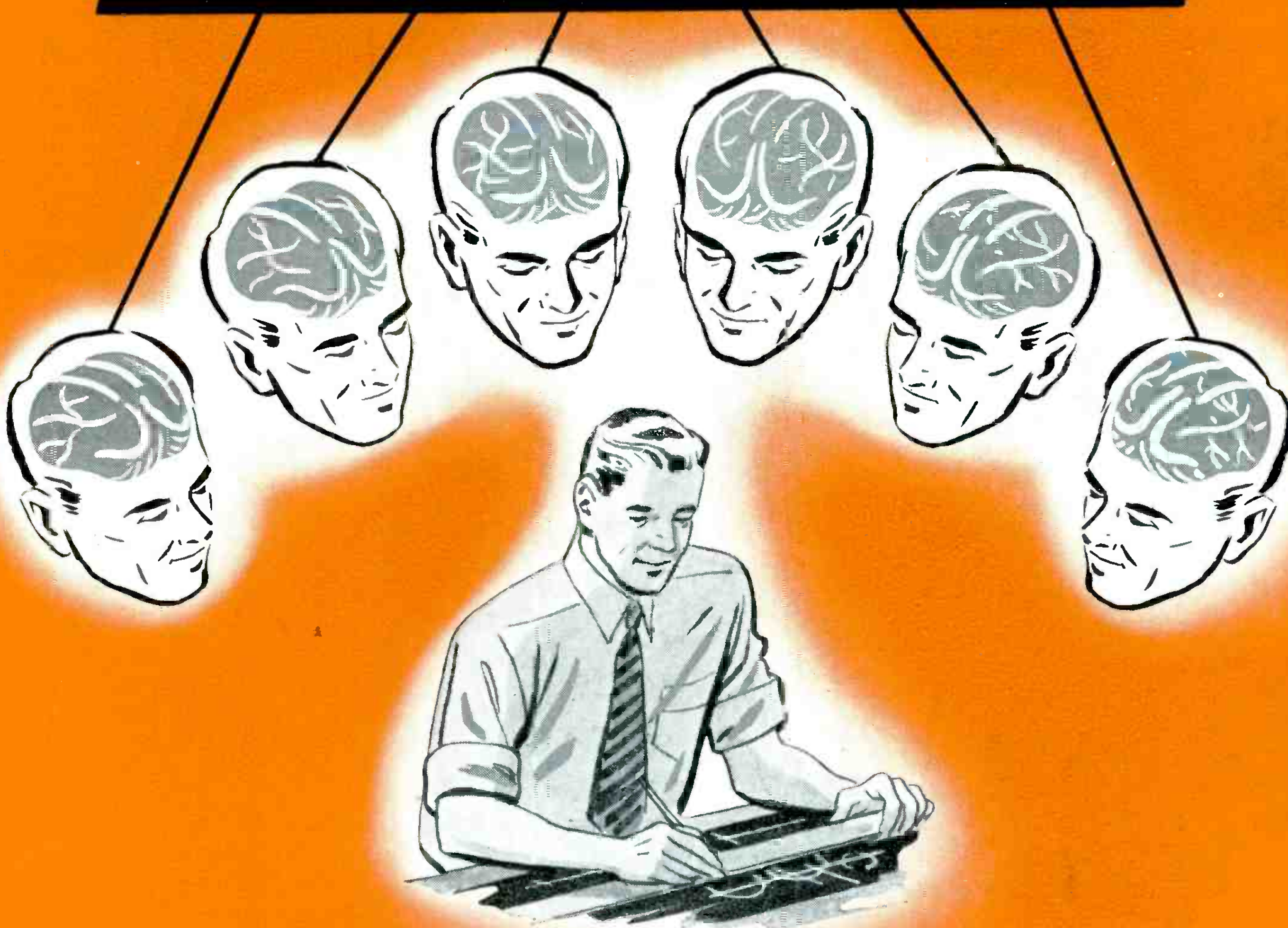
G-E Limiting Amplifier at the 50,000 watt transmitter of WTOP, Washington, D. C.

You can put your confidence in—

GENERAL ELECTRIC

160-G2A-6914

OHMITE Resistance "Know-How"



HERE'S A VALUABLE SOURCE OF DESIGN INFORMATION

IF YOU have a design problem involving rheostats or resistors, call on Ohmite for assistance. The accumulated experience of the entire Ohmite engineering staff . . . the combined thinking of its many resistance specialists . . . are all available to you for the asking. Ohmite engineers are well qualified to help analyze your requirements and select the correct units to fit your specific application. Years of experience in building dependable rheostats and resistors, in helping others solve specialized resistance problems, is your assurance that Ohmite "know-how" can help you. We invite you to submit your problems to us.

RHEOSTATS

RESISTORS

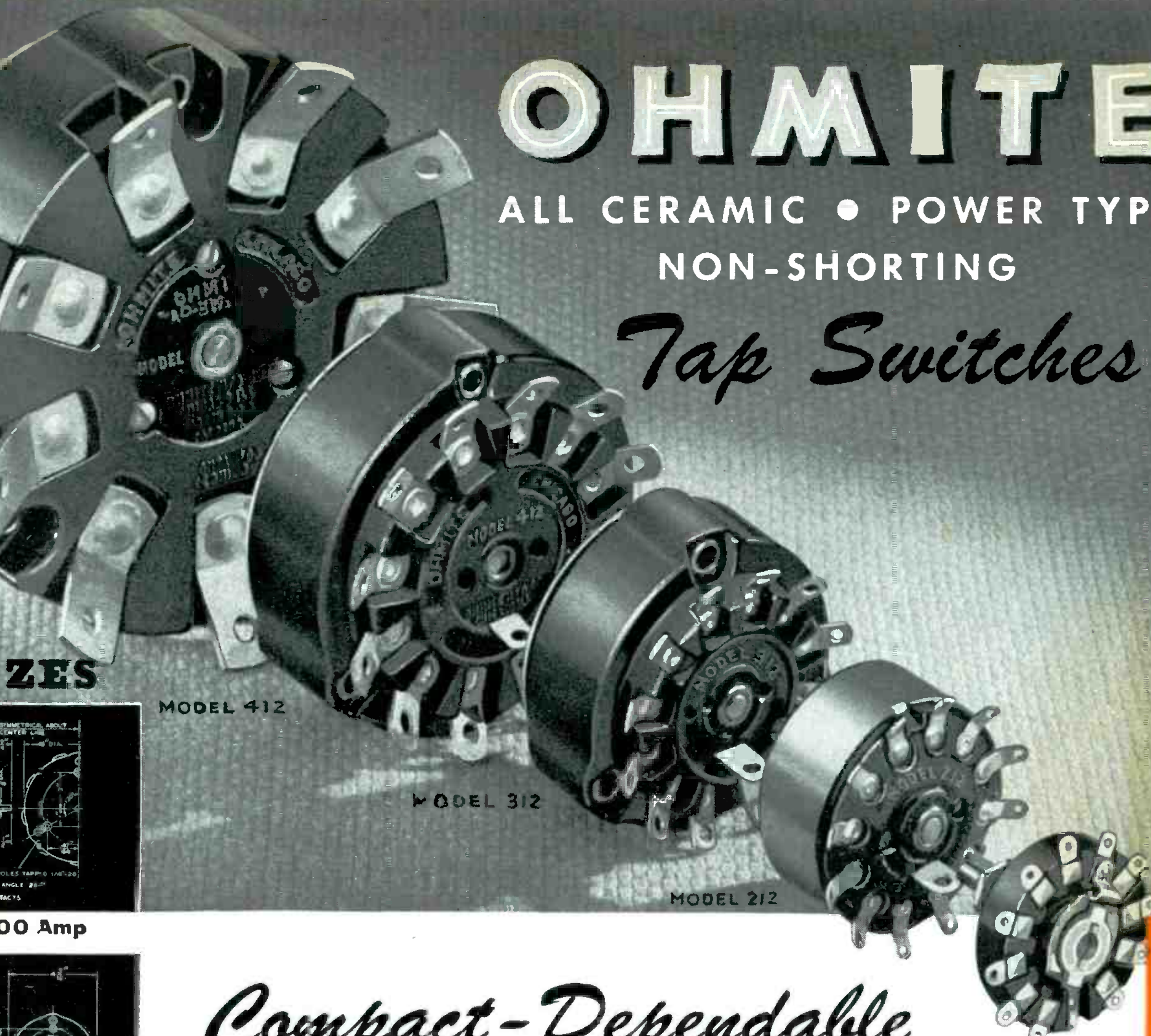
TAP SWITCHES

Be Right with **OHMITE**

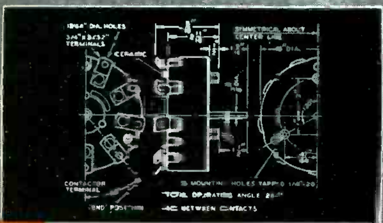
OHMITE

ALL CERAMIC • POWER TYPE NON-SHORTING

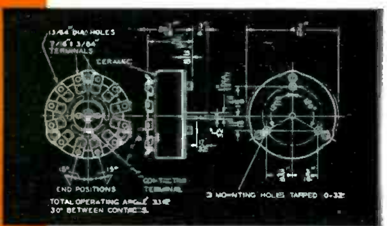
Tap Switches



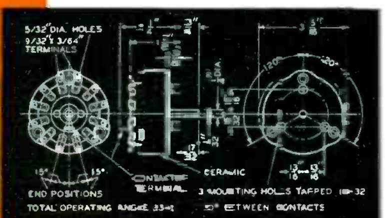
FIVE SIZES



Model 608—100 Amp

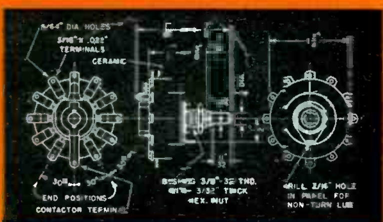


Model 412—50 Amp



Model 312—25 Amp

Model 212—15 Amp



Model 111—10 Amp

Compact-Dependable

Here's a line of non-shorting, rotary tap switches that combine high current-capacity and a large number of taps, with unusual compactness. Their sturdy one-piece ceramic bodies provide permanent insulation, as the ceramic is not affected by arcing. The heavy silver-to-silver contacts have a self-cleaning action, and (except for Model 111) are totally enclosed and protected. Switch shafts are electrically dead—insulated by strong ceramic hubs. A positive cam-and-roller mechanism provides "slow-break quick-make" action—particularly designed for alternating current use. Two or three of these Ohmite tap switches can be mounted in tandem to form multiple-pole assemblies.

Send for Catalog and Engineering Manual No. 40

Write now, on company letterhead, for your copy of this helpful 96-page Ohmite catalog.

OHMITE MANUFACTURING COMPANY
4817 Flournoy
Chicago 44, Ill.

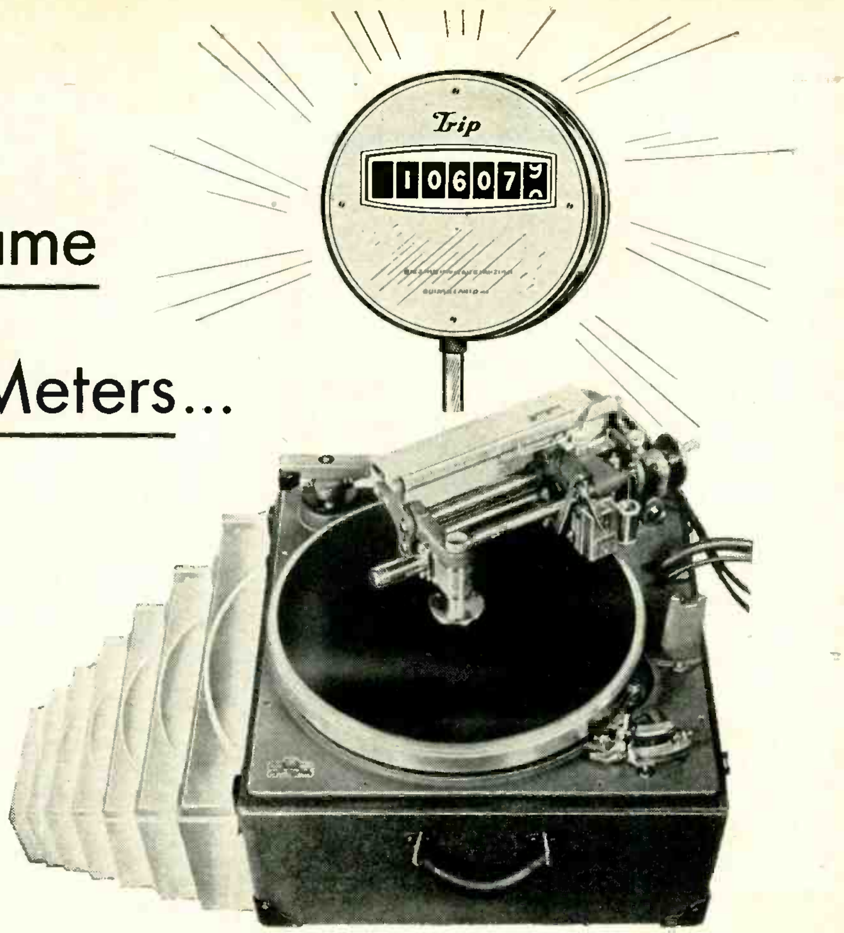
Be Right with...

OHMITE

RHEOSTATS • RESISTORS
TAP SWITCHES

Industry's First Choice

If Recorders came with Mileage Meters...



Presto 6N would be *MILES AHEAD*

Yes, day after day and year after year over 3,000 Presto 6N recorders are hard at work in broadcasting stations, recording studios, educational institutions and government agencies throughout the world.

6N recorders purchased ten years ago are performing as well today as when they were new. This outstanding record of the 6N recorder in action is proof again that Presto design is built for hard, continuous duty and Presto materials are the finest obtainable.

So when you're looking for a new recorder, remember: By actual test the best recorder for the most people is Old Faithful, the Presto 6N.

PRESTO RECORDING CORPORATION, Paramus, New Jersey • *Mailing Address:* P. O. Box 500, Hackensack, N. J.

In Canada: WALTER P. DOWNS, Ltd., Dominion Sq. Bldg., Montreal

World's largest manufacturer of instantaneous sound recording equipment and discs

MOLDED INSULATED TUBULAR GP CERAMICONS

Have extremely rugged, molded insulation, axial leads. Capacity range 10-5,000 MMF. Smallest size .250" x .562" max.

DIPPED INSULATED GP CERAMICONS

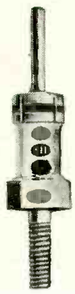
For use where space is at a premium and radial leads are desired. Capacity range 10-15,000 MMF. Smallest size .240" x .460" max.

NON-INSULATED GP CERAMICONS

Smallest size units. Have baked enamel coating, radial leads. Capacity range 10-15,000 MMF. Smallest size .200" x .400" max.

INSULATED STAND-OFF CERAMICONS

Rugged, molded insulated construction. Mounts with 6-32 nut. Style 323 mounts 19/32" high above chassis. Capacity range 0.5-700 MMF. Style 324 mounts 27/32" high. Capacity range 710-1,500 MMF. Available with 20 gauge wire lead or post type top terminal.



NON-INSULATED STAND-OFF CERAMICONS

Style 318 (left) mounts ½" high above chassis, has .032" diameter wire top terminal. Capacity range 1-560 MMF. Style 319 (right) mounts .520" high, has .067" diameter top terminal. Capacity range 2-1,000 MMF. Both styles have 3-48 thread.

SIDE-LEAD STAND-OFF CERAMICONS

Wire leads are correct height from chassis for shortest possible connection to tube sockets. Style 2322 (left) 45/64" high. Capacity range 5-2,500 MMF. Style 2336 (right) 15/16" high. Capacity range 6-5,000 MMF.

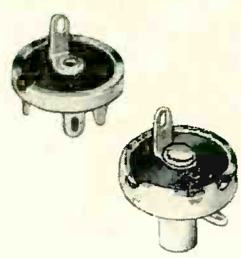
For Any and All By-Passing Requirements ERIE CERAMICONS®

Erie Ceramicons fulfil all the requisites for efficient by-passing—low inductance, compact design, 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.

Check the products listed on this page for your future designs. Full description and specifications will be sent on request.

FEED-THRU CERAMICONS

By-pass R. F. to ground when feeding through chassis or metal can. Body length ⅝"; mounted with 12-28 nut. Type 362 (above) has 20 gauge feed-thru wire. Capacity range 5-1,500 MMF. Type 357 (below) has 0.55" diameter hooked ends feed-thru wire; capacity range 5-1,000 MMF.



FOR UHF COMMUNICATIONS EQUIPMENT ERIE BUTTON SILVER MICAS

These extremely compact silver mica condensers have 360° current path from short, heavy terminals to ground, providing very low inductance. Made in Stand-off and Feed-thru styles. Capacity range 15-1,000 MMF in .447" diameter, 1,000-6,000 MMF in .651" diameter.

Electronics Division

ERIE RESISTOR CORP., ERIE, PA.

LONDON, ENGLAND • TORONTO, CANADA

WIRING

is the Life-Line of every electrical product

Whatever your product, you can more surely predict dependable performance-in-use when it is Rockbestos-wired.

For Rockbestos wires, cables and cords are permanently insulated with impregnated felted asbestos — the ageless, heat and flame resistant insulation that insures top wiring dependability under even the most gruelling conditions.

Protect *your* product's life line with the wire that does so much more for so little more . . . *Rockbestos.*

WRITE TODAY — for your copy of the new No. 10-F Catalog, sectioned for easy reference to Appliance, Aircraft, Electronic, Fixture, Switchboard, Lighting and Magnet Wires; Apparatus Wires and Cables; Power and Control Cables.

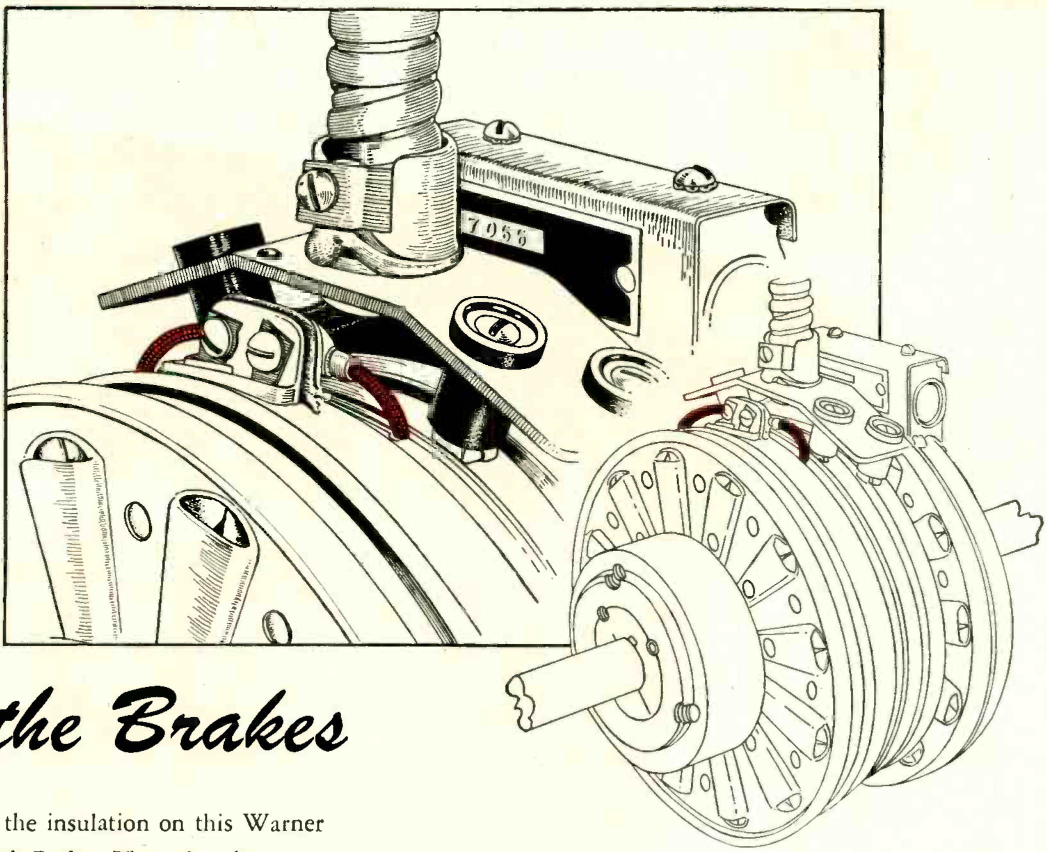
ROCKBESTOS PRODUCTS CORPORATION

464 NICOLL ST., NEW HAVEN 4, CONN.

NEW YORK CLEVELAND DETROIT CHICAGO PITTSBURGH
ST. LOUIS LOS ANGELES OAKLAND, CALIF.

ROCKBESTOS

THE WIRE WITH PERMANENT INSULATION



When Industry Puts on the Brakes

Take a close look at the insulation on this Warner "ICB" Electric Clutch-Brake. The wire that conveys the current from the collector ring to the magnet requires an insulation that is heat resistant to 300° F. at 110 v.

When the Warner Electric Brake Manufacturing Company put this problem up to Bentley, Harris, they got complete performance data on BH Extra Flexible Fiberglas Sleeving and samples for laboratory test. Here is what they found:

"BH Fiberglas Sleeving fully meets our requirements for insulation of electric brakes used on industrial machinery."

BH Fiberglas Sleevings are made to meet specific requirements — double-braided, triple-braided, heat resistant to 1200° F. if necessary. Remarkably flexible — can be spread to cover knobs or terminals, cannot dry out. Non-fraying — without use of hardening varnish or lacquer.

If you have a problem of insulation breakdown caused by high heat, extreme cold, harmful gases, grease or moisture, try BH Fiberglas Sleeving in your plant, in your product.

BENTLEY, HARRIS MFG. CO., CONSHOHOCKEN, PA.

BH *Fiberglas** SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

USE COUPON NOW

Bentley, Harris Mfg. Co., Dept. E27, Conshohocken, Pa.

I am interested in BH Non-Fraying Fiberglas Sleeving for ____________ (product)

operating at temperatures of ____°F. at ____ volts. Send samples so I can see for myself how BH Non-Fraying Fiberglas Sleeving stays flexible as string, will not crack or split when bent.

NAME ____________ COMPANY ____________

ADDRESS ____________

Send samples, pamphlet and prices on other BH Products as follows:

- ☐ Cotton-base Sleeving and Tubing
- ☐ Ben-Har Special Treated Fiberglas Tubing

FM LEADER!

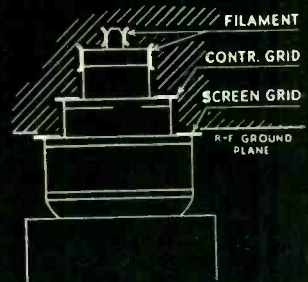
110-mc ring-seal power tetrode streamlined for new transmitters. Forced-air-cooled. A pair will put out more than 3 kw, with only 120 w drive required!

Also best for your final stage because...

1. **Tube installation or replacement takes only a few seconds (see sketch).**
2. **Wide terminal-contact areas greatly increase h-f efficiency.**
3. **Internal shielding is complete . . . tube inductance low . . . little if any neutralizing is needed.**

GL-7D21

RING-SEAL CONTACTS



Sketch shows how easily the GL-7D21 can be plugged into a coaxial socket. Ring-seal design also provides ample contact surface for all terminals.

CHARACTERISTICS

Filament voltage	6.3 v
current	30 amp
Interelectrode capacitances:	
grid-plate	0.4 mmfd
input	39 mmfd
output	14 mmfd
Frequency at max ratings	110 mc
Type of cooling	forced-air
Max plate ratings, Class C telegraphy:	
voltage	4 000 v
current	amp
input	3 000 w
dissipation	1 200 w

TAILORED to your needs as builder or designer of new broadcasting equipment, Type GL-7D21 is *the right tube for medium-power FM.* Check the low drive requirement of 120 w—real economy!—against an output (push-pull in open-line circuits with proper external shielding) of well over 3 kw. Note the convenience of forced-air cooling!

Study the tube's other advantages given above, then add plus-features like silver-plated contacts to reduce r-f losses; strong, lasting Fernico metal-to-glass seals; trim contour and compact construction to match the other advanced components of your ultra-modern transmitter.

One of a distinguished family of ring-seal power tubes for FM and television, the GL-7D21's brilliant all-around performance also marks these larger types:

GL-5513. A 220-mc forced-air-cooled triode, with typical Class C output (per tube) of 2.45 kw.

GL-5518. A 110-mc forced-air-cooled triode with typical Class C output (per tube) of 6.4 kw.

GL-9C24. A 220-mc triode, cooled by water and forced air, with typical Class C output (per tube) of 9 kw.

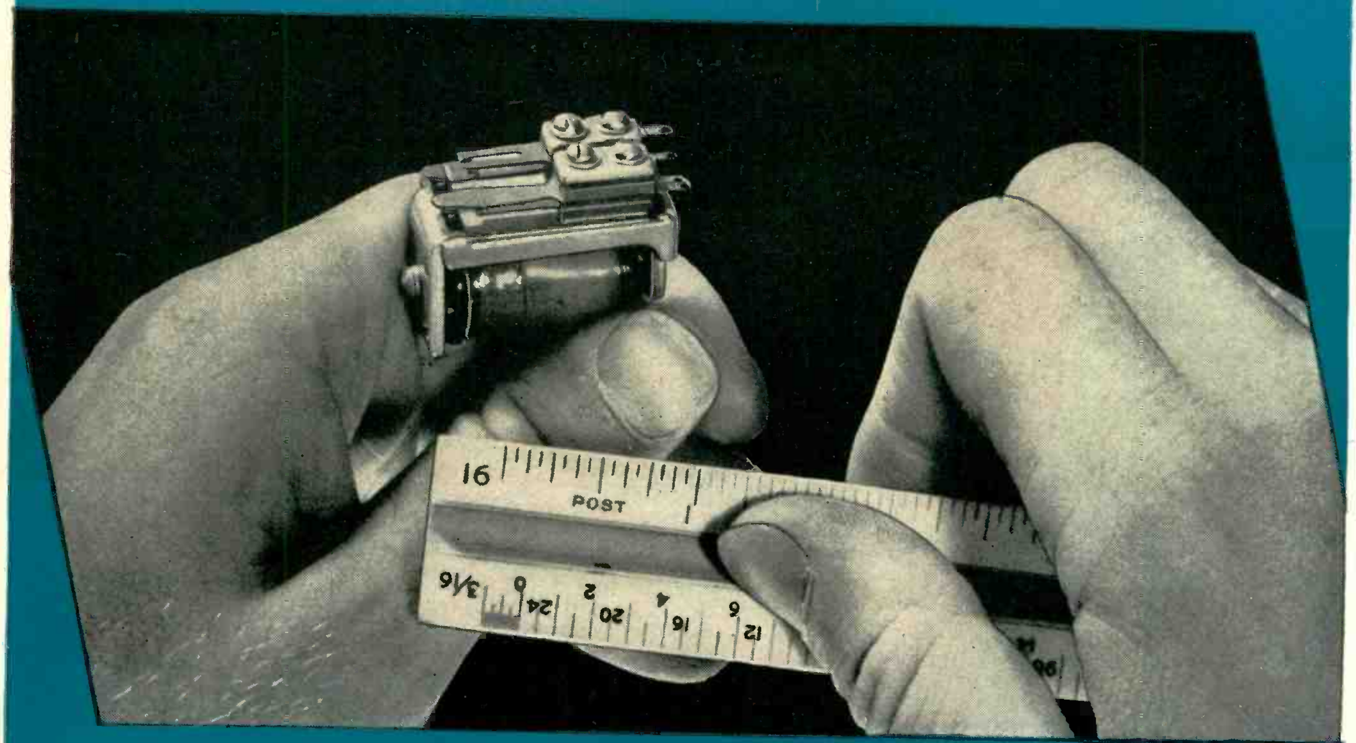
In this group is a tube directly suited to your requirements, no matter what type or size transmitter now is on your drawing-boards. For prices and detailed information phone your nearby G-E electronics office, or wire or write to: *Electronics Department, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

161-G6-8850

FIRST AND GREATEST NAME IN ELECTRONICS

Now—for AC operation
MIDGET AC TELEPHONE TYPE RELAYS!



POTTER & BRUMFIELD, foremost supplier of relays to industry, now makes available for the first time their Series MTA telephone type relays for AC operation up to 220 volts 60 cycles. "Smaller than your thumb", this midget relay, weighing only 1-1/4 oz., measures 1-1/2" x 1-7/32" x 11/16".

With the MTA series, rectification is no longer needed to obtain chatter free operation. This relay is the same size as the long famous MT series which is supplied for DC operation.

The MTA is fitted with twin palladium contacts which will carry approximately 2 amperes non-inductive load and is available in single or double spring stack with any contact combination up to 12 springs. The baked varnish impregnated coil will stand constant duty with dissipation of only .50 to .75 watts and will operate on varying line source within 18% of rated voltage without hum.

Either the MTA for AC or MT for DC meet UL and JAN specifications and are essentially shock or vibration proof. They are practicularly suited to aircraft application.

Developed to meet the requirements of today's exacting miniaturization program, the MTA relay is only one of POTTER & BRUMFIELD'S answers to the demand for reliable miniature component parts for control equipment.

150 standard basic models for power, telephone, plate circuit, motor starting and all general applications, or we will design and produce practical relays for special requirements. Tear-out this ad and pin it to your letterhead for *New Relay Catalog.*

Potter & Brumfield
SALES COMPANY

549 WEST WASHINGTON ST., CHICAGO 6, ILLINOIS • FACTORY PRINCETON, INDIANA
EXPORT 2020 ENGINEERING BLDG., CHICAGO 6, ILL. • CABLE ADDRESS ENOTS
Your Electronics Parts Distributor stocks many models of P & B relays

Follow the Leaders to

Eimac TUBES — The Power for R-F

OUTSTANDING

The Eimac 4-125A

Look about you . . . check the equipment shows . . . thumb through the trade magazines . . . talk to design engineers . . . yes, the Eimac 4-125A power tetrode is the standout vacuum tube, accepted in all fields of electronic endeavor for its stability, long-life and dependability.

Each tube is backed by the combined engineering resources of Eitel-McCullough plus over a million hours of proven field-service. It's Pyrovac* plate is highly resistant to momentary overloads and contributes to the tube's long life. Processed grids control primary and secondary emission, providing a high degree of operational stability. The tube is ruggedly designed to withstand abnormal physical as well as electrical abuse.

Detailed data and application notes are immediately available and statistics for unusual applications will be supplied on request.

EITEL-McCULLOUGH, INC.

204 San Mateo Ave., San Bruno, California

Export Agents: Frazer & Hansen, 310 Clay Street, San Francisco 11, California

*Reg. Trade Mark

Filament: Thoriated tungsten		
Voltage	5.0	volts
Current	6.5	amperes
Grid-Screen Amplification Factor (Average)	6.2	

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR — Class-C Telegraphy or FM Telephony. Maximum Ratings (Key-down conditions, 1 tube)

HIGH-LEVEL MODULATED RADIO FREQUENCY AMPLIFIER — Class-C Telephony (Carrier conditions unless otherwise specified, 1 tube)

Maximum Ratings	R-F Power Amplifier and Oscillator	High-Level Modulated R-F Amplifier
D-C PLATE VOLTAGE	3000 MAX. VOLTS	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS	400 MAX. VOLTS
D-C GRID VOLTAGE	-500 MAX. VOLTS	-500 MAX. VOLTS
D-C PLATE CURRENT	275 MAX. MA.	200 MAX. MA.
PLATE DISSIPATION	125 MAX. WATTS	85 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS	5 MAX. WATTS

Typical Operation (Frequencies below 120 Mc.)

	R-F Power Amplifier and Oscillator			High-Level Modulated R-F Amplifier		
D-C Plate Voltage	2500	3000	volts	2000	2500	volts
D-C Screen Voltage	350	350	volts	350	350	volts
D-C Grid Voltage	-150	-150	volts	-220	-210	volts
D-C Plate Current	200	167	ma.	150	152	ma.
D-C Screen Current	40	30	ma.	33	30	ma.
D-C Grid Current	12	9	ma.	10	9	ma.
Screen Dissipation	14	10.5	watts	11.5	10.5	watts
Grid Dissipation	2	1.2	watts	1.6	1.4	watts
Peak R-F Grid Input Voltage (approx.)	320	280	volts	375	360	volts
Driving Power (approx.)	3.8	2.5	watts	3.8	3.3	watts
Plate Power Input	500	500	watts	300	380	watts
Plate Dissipation	125	125	watts	75	80	watts
Plate Power Output	375	375	watts	225	300	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

MAXIMUM RATINGS	Class AB1 (Sinusoidal wave, two tubes unless otherwise specified)	Class-AB2 (Sinusoidal wave, two tubes unless otherwise specified)
D-C PLATE VOLTAGE	3000 MAX. VOLTS	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS	400 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA.	225 MAX. MA.
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS	20 MAX. WATTS

TYPICAL OPERATION

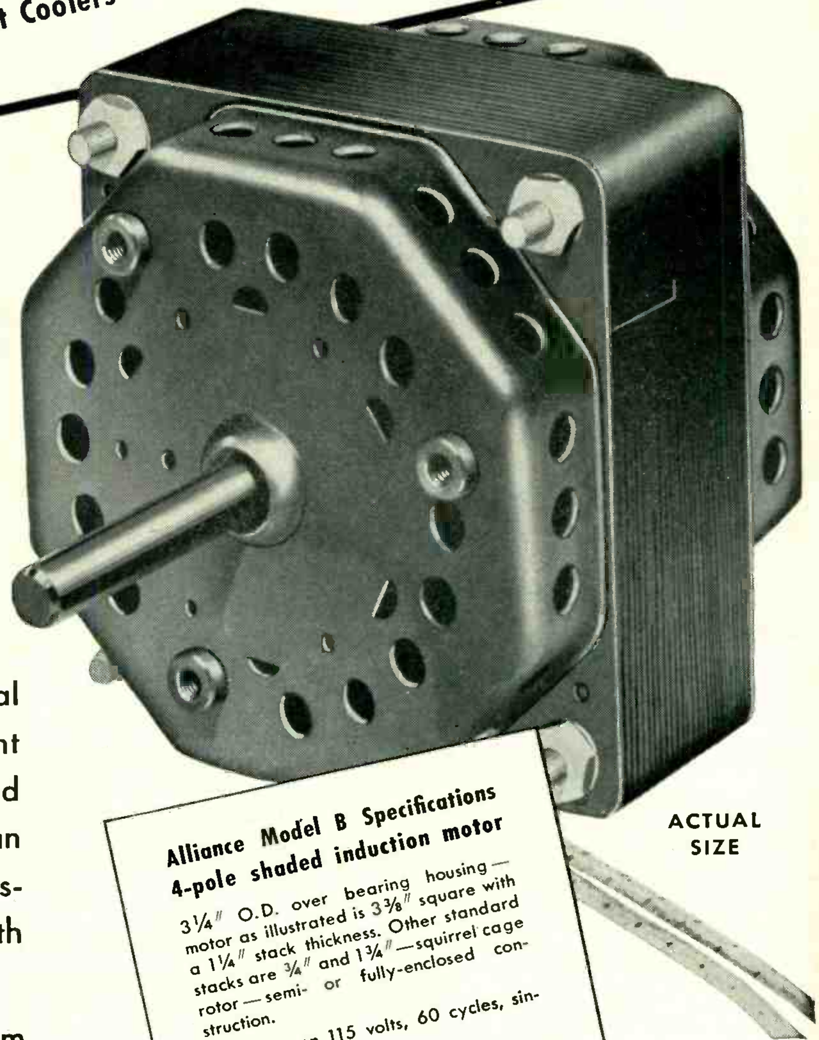
	Class AB1			Class-AB2		
D-C Plate Voltage	2000	2500	volts	2000	2500	volts
D-C Screen Voltage	600	600	volts	350	350	volts
D-C Grid Voltage	-94	-96	volts	-45	-43	volts
Zero-Signal D-C Plate Current	50	50	ma.	72	93	ma.
Max-Signal D-C Plate Current	240	232	ma.	300	260	ma.
Zero-Signal D-C Screen Current	-0.5	-0.3	ma.	0	0	ma.
Max-Signal D-C Screen Current	6.4	8.5	ma.	5	6	ma.
Effective Load, Plate-to-Plate	13,400	20,300	ohms	13,600	22,200	ohms
Peak A-F Grid Input Voltage (per tube)	94	96	volts	105	89	volts
Driving Power	0	0	watts	1.8	1	watts
Max-Signal Plate Dissipation (per tube)	125	125	watts	125	122	watts
Max-Signal Plate Power Output	230	330	watts	350	400	watts
Total Harmonic Distortion	2	2.6	per ct.	1	2.2	per ct.

NOW WITH . . . Pyrovac Plates · Processed Grids

RELY ON alliance motors

FOR

Fans • Room Heaters • Air Circulators • Air Conditioners •
Gas and Oil Burners • Unit Coolers • Window Ventilators • Recorders



Alliance Model B is another new, 4-pole shaded type induction motor. It is especially adapted to fan blades and other mechanical loads.

This motor is made in three standard stack thicknesses with variable horsepower ratings for particular operating conditions such as fan loads—other mechanical loads—continuous or intermittent duty. And to futher meet varied load requirements, Alliance Model B can be supplied semi-enclosed as illustrated or completely enclosed with oil tubes and oilers.

With a range of power ratings from 1/100 h.p. up to 1/25 h.p. and a speed of 1550 rpm, Model B, like all Alliance motors lends itself to mass production at low cost.

Alliance Model B Specifications
4-pole shaded induction motor

3¼″ O.D. over bearing housing—motor as illustrated is 3⅜″ square with a 1¼″ stack thickness. Other standard stacks are ¾″ and 1¾″—squirrel cage rotor—semi- or fully-enclosed construction.

Operates on 115 volts, 60 cycles, single phase.

Weight as shown 4½ lbs. Starting torque approx. 40% of torque at full load rating. Can be made with single or double 5/16″ shaft. Construction is simple but rugged throughout.

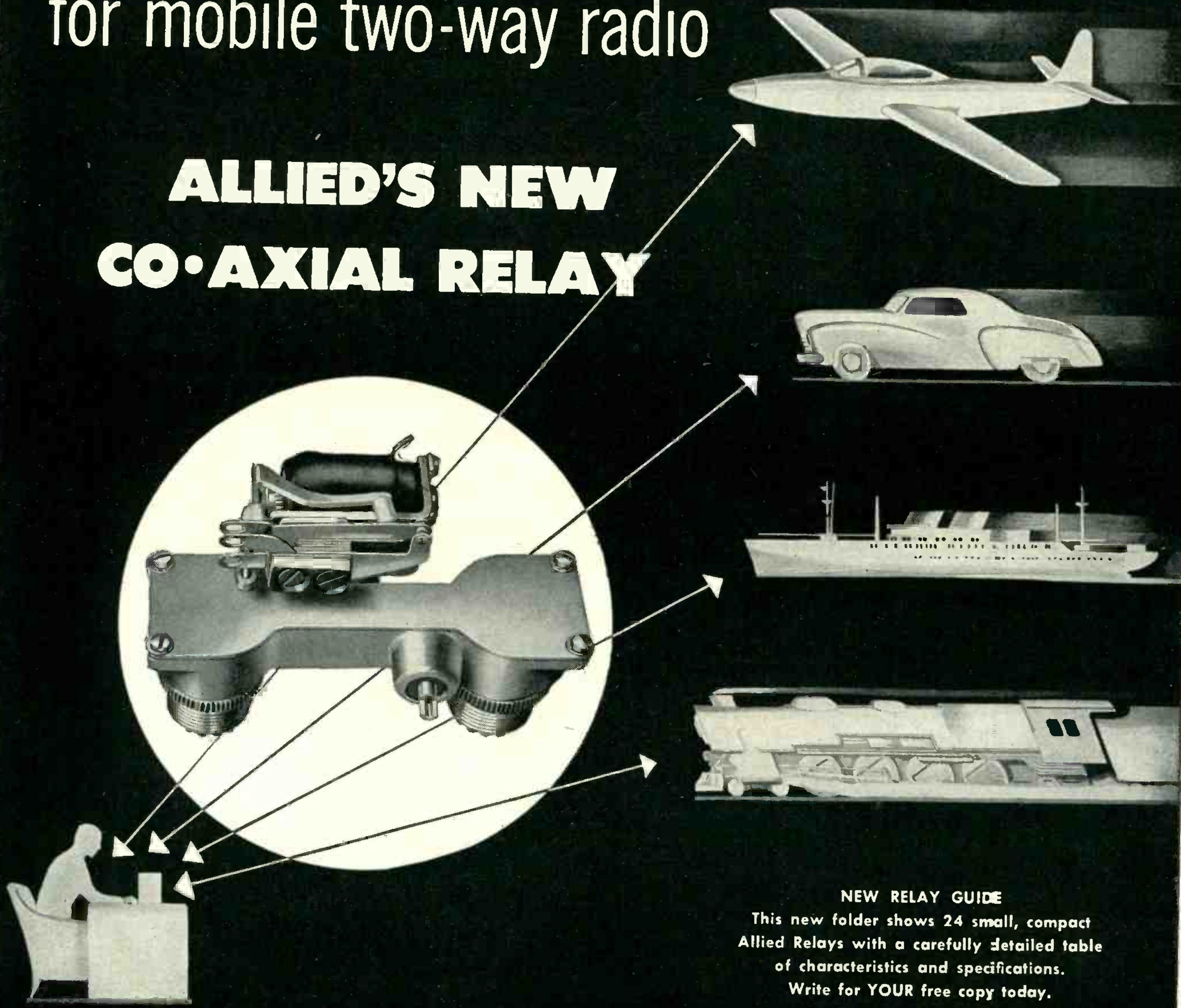
ACTUAL SIZE

WHEN YOU DESIGN—KEEP alliance MOTORS IN MIND

ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO
Export Department: 401 Broadway, New York 13, N. Y., U. S. A.

for mobile two-way radio

ALLIED'S NEW CO·AXIAL RELAY



NEW RELAY GUIDE
This new folder shows 24 small, compact Allied Relays with a carefully detailed table of characteristics and specifications. Write for YOUR free copy today.

The new Allied "RA" relay transfers 52 ohm antenna transmission line (type RG-8U Cable) from receiving to transmitting position. It is now used in police car radios and is highly recommended for both mobile and stationary applications.

This new relay is equipped with two Co-Axial cable fittings and one insulated transmitter line terminal. Co-Axial fittings for antenna and receiver connection are die cast as part of the metal housing. They will accommodate Signal Corps cable connector PL-259. Auxiliary double-pole, double-throw contacts can be supplied when specified.

ENGINEERING FEATURES OF THE ALLIED TYPE "RA" RELAY

Contact Rating: Antenna transfer contacts will handle a maximum of 75 watts of radio frequency up to 150 megocycles when inserted in a properly terminated 52 ohm line. Auxiliary contacts have a non-inductive rating of 1 ampere at 24 volts D.C. or 115 volts A.C.
Coil Rating: Up to 110 volts D.C. and 115 volts A.C. 60 cycles.

Coil No.	D.C. Volts	D.C. Current	D.C. Resistance
31	6.	.46	13.
34	12.	.22	54.
38	26.5	.083	320.
40	48.	.060	800.
43	110.	.026	4100.

(This table is based on an average power rating of 2.5 watts. Minimum operating voltages are 80% of voltages shown above.)

Dimensions: 2"x2⅞"x1¾". Weight: 4 oz.

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

NOW

A NEW FLUX FOR CORED SOLDER

"RESIN-FIVE"

"Resin-Five" Is More Active . . . More Efficient . . . More Stable . . . Than ANY Rosin Flux . . . And Yet

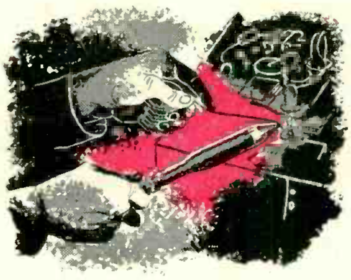
NON-CORROSIVE NON-CONDUCTIVE

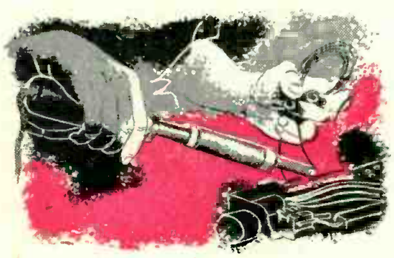
ODORLESS!

. . . Yes—"RESIN-FIVE" is virtually without odor at relatively high temperatures!

MOBILITY!

. . . "RESIN-FIVE" is so mobile it is *highly effective in sweating seams.* The activity and stability of "RESIN-FIVE" Flux make this an accomplished fact!





"Resin-Five is Available In 5 Core Sizes with Varying Percentages of Flux Content. Diameters ranging from .010" to .250"—All Practical Alloys!

ACTIVITY UNEQUALED!

. . . Just Think Of This—"RESIN-FIVE" will solder easily and readily such metals as Zinc, Brass, Nickel Silver, Nickel-Plate, Copper and Ferrous Alloys. REMEMBER "RESIN-FIVE" IS NOT CORROSIVE AND IS NOT CONDUCTIVE!

STABILITY!

. . . "RESIN-FIVE" is *STABLE* under the most extreme soldering temperatures and the Flux still does the job!

Contact Kester's Technical Department and get the facts on this unusual product.

NON-CORROSIVE • NON-CONDUCTIVE

KESTER SOLDER

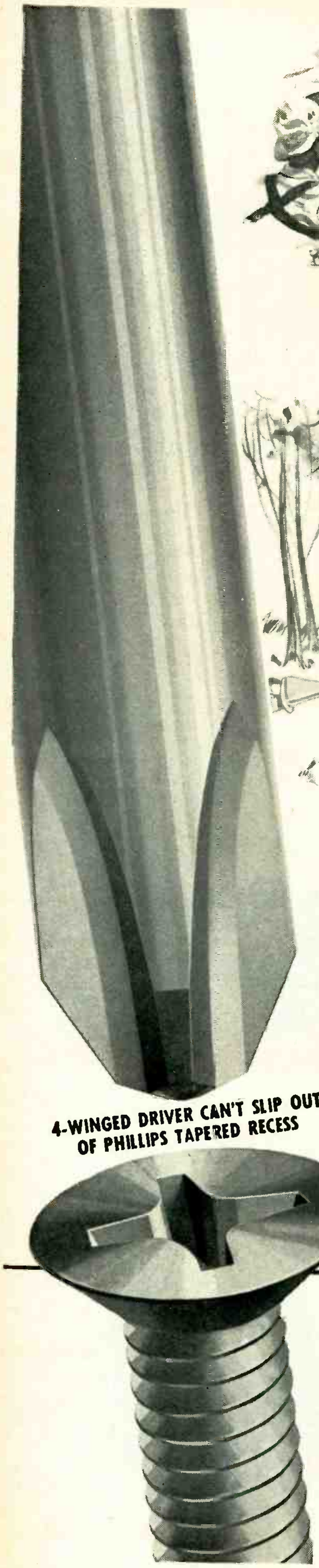
KESTER SOLDER COMPANY

4201 W. Wrightwood Avenue, Chicago 39, Illinois

Factories also at Newark, N. J. • Brantford, Canada

HOW American Phillips Screws "Make Better Sport"

both for Makers and Users of Sporting Goods



THEY MAKE WORK EASIER... in fact, American Phillips Screws make assembly a *pleasure* because, as one user says: *"They're 3 times faster to find and drive!"* And they're far easier to handle, to drive at angles, and into cranky inside corners. Any worker who "goes crooked" with slotted screws will "go straight" with American Phillips ... the only screw with the tapered, engineered recess. Fatigue is banished. Production stays up all day long. *And time-savings, too, stay up around 50%.*

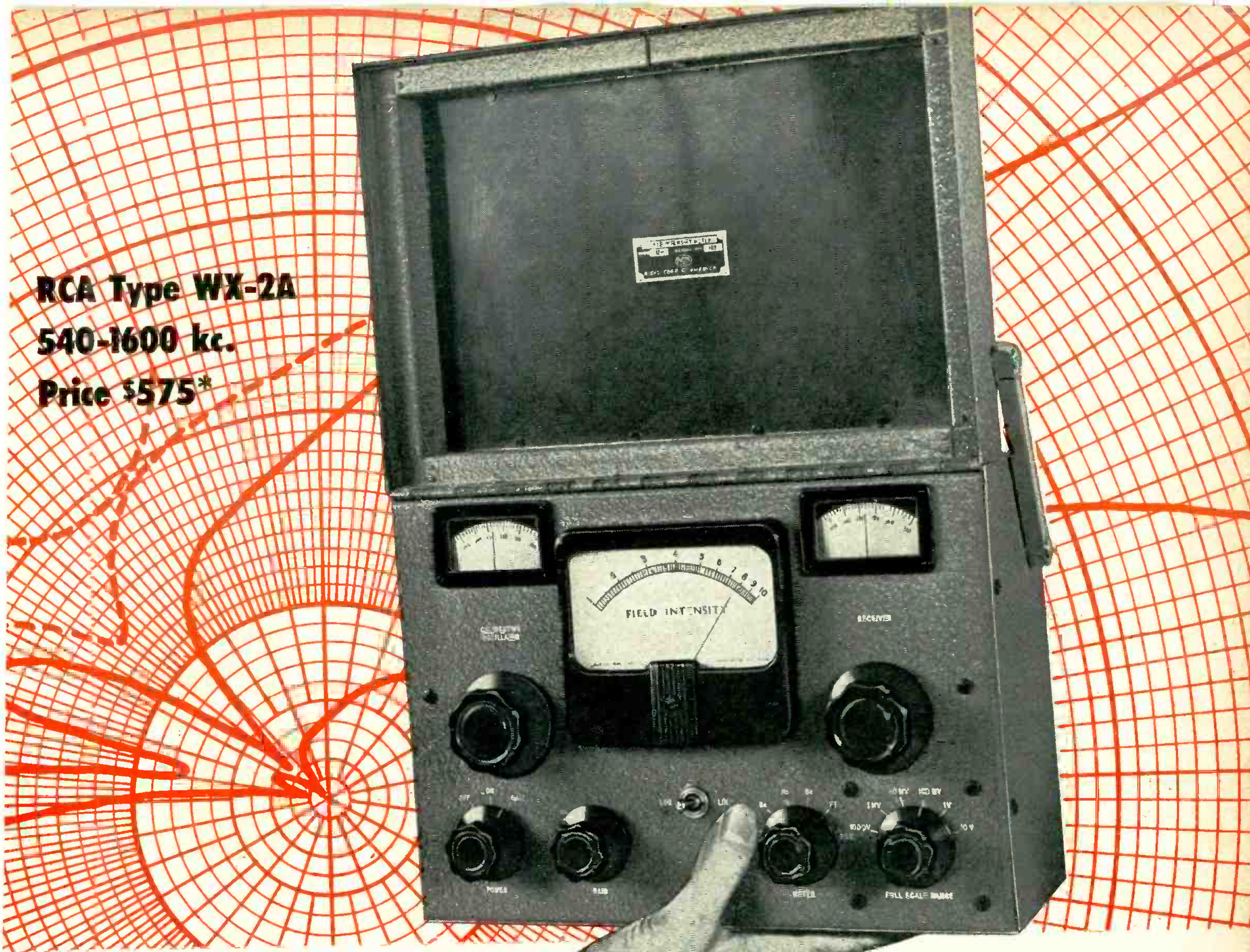
THEY MAKE SELLING EASIER... American Phillips Screws look new, modern, craftsmanlike... plainly say: *"Here's a top-quality product!"* And when your dealers sell the whole story of American Phillips *extra* holding strength, vibration-resistance, and greater dependability in strenuous use...then watch sales-resistance melt away. Get these double-barrelled production and sales advantages for *your* product. Write.

AMERICAN SCREW COMPANY, PROVIDENCE 1, RHODE ISLAND
Chicago 11: 589 E. Illinois St. Detroit 2: 502 Stephenson Building

AMERICAN PHILLIPS *Screws*

ALL TYPES
ALL METALS: Steel, Brass, Bronze, Stainless Steel, Aluminum, Monel, Everdur (silicon bronze)

RCA Type WX-2A
540-1600 kc.
Price $575*



The new *Portable Field-Intensity Meter, RCA Type WX-2*—*shown* one-third actual size. *A loop antenna is built right into the lid!*

At Last—
a truly portable Field-Intensity Meter

● Weighing only 12½ pounds—including batteries, here's a small, compact field-intensity meter of high accuracy that carries around like a portable radio . . . and operates almost as simply. You tune in a signal, adjust a *built-in* calibrating oscillator and receiver gain . . . and *read signal intensity directly in microvolts-per-meter.* No charts, curves, or correction factors to worry about. No computations to make.

Designed with a wide sensitivity range of 10 microvolts/meter to 10 volts/meter, Type WX-2A enables you to make field-strength readings anywhere—from the very shadow of your transmitter, to the toughest location "down-in-the-noise." Plenty of front-end selectivity, too. Loop antenna Q is approximately 100 at one megacycle; An r-f amplifier stage provides a very high order of image rejection.

Power supply; Ordinary flashlight dry cells for the quick-heating tube filaments—and a 67-volt battery of the size used in camera-type radios for the B supply.

A lot easier now to get the facts on your coverage, service area, and antenna efficiency . . . with RCA's new portable WX-2A. Ask your RCA Broadcast Sales Engineer for the facts. Or write Department 36-J, RCA Engineering Products, Camden, New Jersey.

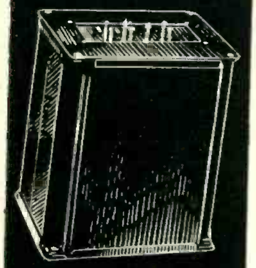
*Subject to change without notice.

RCA

BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

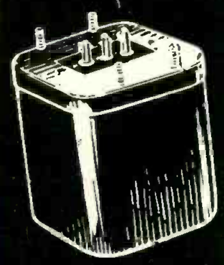
In Canada: RCA VICTOR Company Limited, Montreal

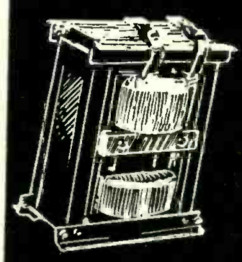
Now! Specify KENYON



KENYON one of the oldest names in transformers, offers high quality specification transformers custom-built to your requirements. For over 20 years the KENYON "K" has been a sign of skillful engineering, progressive design and sound construction.

KENYON now serves many leading companies including: **Times Facsimile Corporation, Western Electric Co., General Electric Co., Schulmerich Electronics, Sperry Gyroscope Co., Inc.**



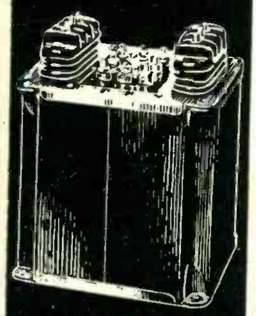


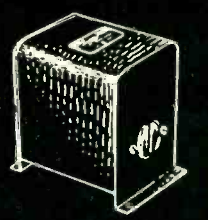
Yes, *electronification* of modern industrial machinery and methods has been achieved by KENYON'S engineered, efficient and conservatively rated transformers.

For all high quality sound applications, for small transmitters, broadcast units, radar equipment, amplifiers and power supplies — Specify KENYON! *Inquire today for information about our JAN approved transformers.*

Check Your Requirements

"T" LINE TRANSFORMERS
HERMETICALLY SEALED TRANSFORMERS
"A" LINE TRANSFORMERS





- ✓ PLATE TRANSFORMERS
- ✓ FILAMENT TRANSFORMERS
- ✓ REACTORS
- ✓ CHOKES
- ✓ MODULATION TRANSFORMERS
- ✓ INTERSTAGE TRANSFORMERS
- ✓ INPUT & OUTPUT TRANSFORMERS
- ✓ SPECIAL FREQUENCY TRANSFORMERS
- ✓ ISOLATION TRANSFORMERS
- ✓ AUDIO TRANSFORMERS
- ✓ HUMBUCKING TRANSFORMERS
- ✓ AUTO TRANSFORMERS

Now — for the first time in any transformer catalog, KENYON'S new modified edition tells the full complete story about specific ratings on all transformers. Our standard line saves you time and expense. Send for the latest edition of our catalog *now!*

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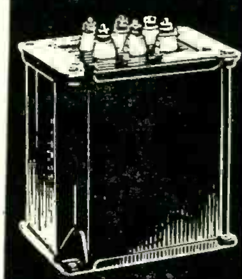

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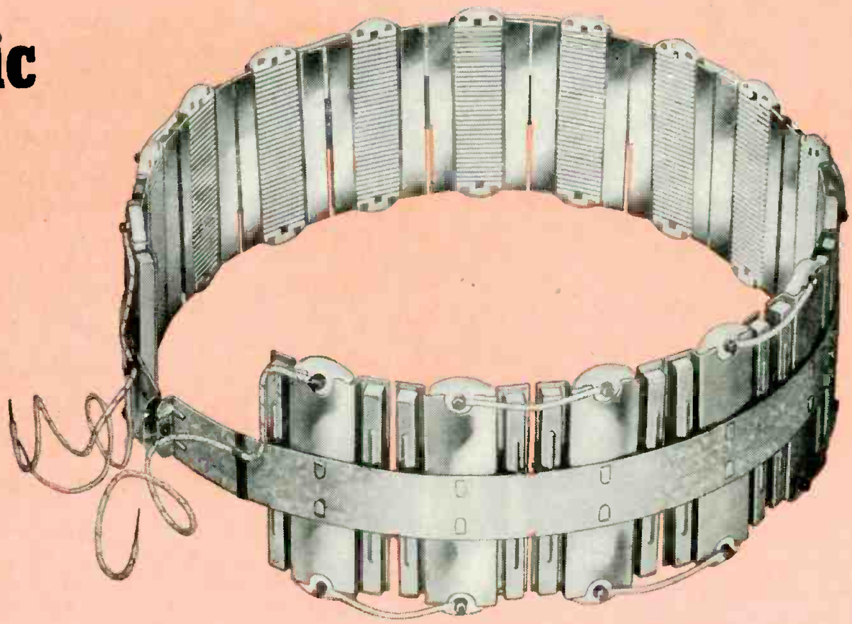
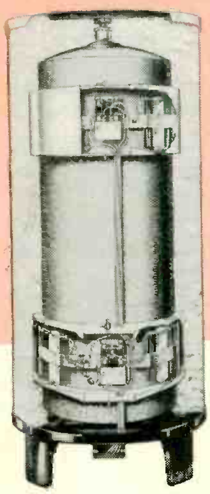
KENYON TRANSFORMER CO., Inc. 840 BARRY STREET NEW YORK 59, N.Y.

ELECTRIC "LIFE BELTS"

for domestic hot water heaters





When water in municipal systems contains dissolved minerals and chlorine, it becomes a fairly efficient electrolyte.

To avoid electrolytic corrosion which may occur if dissimilar metals are in contact with the water, the Toastmaster Water Heater employs "LIFE BELT" heating elements attached to the outside of the tank. In such an application, the ability of the elements to give long, trouble-free, economical service rests solely upon the quality of the electrical resistance material used. To assure top-level performance for a lifetime, the McGraw Electric Co., maker of the Toastmaster Water Heater, specifies Nichrome.*

The tank of the Toastmaster Heater is further protected by McGraw's new "Ionodic" system of corrosion prevention, where a magnesium rod anode, immersed in the water, saves the cathodic material of the tank from electrolytic attack.

Thus the manufacturers are able proudly to state: "We guarantee the Toastmaster Electric Water Heater for 10 years, and we deem this to be a conservative commitment. Many water heaters made by this company are still in daily use after several times this length of service, and elements in the old water heaters show little wear and no loss of efficiency."

Profit by the example of the McGraw Electric Co. and specify Nichrome. And remember, Driver-Harris manufactures over 80 alloys designed to fill the numerous requirements of the Electrical and Electronic industries . . . fully described in our catalog R-46.

Nichrome is Manufactured only by

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

Driver-Harris Company

HARRISON, NEW JERSEY

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

Manufactured and sold in Canada by

The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

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

Flexural and Compressive Strength

No. 9

in a series of advertisements on dielectric theory and testing — designed to help in the selection of electrical insulating materials.

Mechanical and electrical stresses encountered in electrical equipment confront the designer with many factors to weigh in selecting the insulating material which will provide optimum performance characteristics.

In some applications, what might seem conservative design from the standpoint of electrical stress is explained by other performance essentials. Why, for example, for insulating commutator bars in small dc motors, should a material of such high dielectric strength as mica segment plate be used, when electrical stress between bars is only a few volts? The reasons are found in other requirements that only mica satisfies: temperature resistance, moisture resistance, non-carbonization under poor commutating conditions, a uniform rate of compression and ability to stay in place under repeated temperature fluctuations.

In large rotating machines, peripheral speeds are high: extreme compressive, flexural, tensile and abrasive forces are encountered. Voltage may also be quite high. Because efficiency depends upon the amount of conducting (and *not* insulating) material in the slots, electrical insulation must be quite thin yet possess high dielectric strength.

WEIGH ALL FACTORS

Insulation performance requirements are as varied as the types of electrical equipment manufactured. Standard methods of testing established by the ASTM supply important values for comparison, specification and design.

FLEXURAL STRENGTH TEST[1]

This test determines the load in pounds required to break a test specimen of sheet or plate material loaded at the center as a simple beam. Supports and loading nose of the testing apparatus have contact edges rounded to a radius of 1/8″ for material 1/8″ thick or over, and to a radius of 1/16″ for thinner materials. Distance between the supports is 4″ for edgewise tests and eight times material thickness for flatwise tests.

Test specimens are 1/2″ in width, except for specimens over 1/2″ thick being tested flatwise, where the width is made equal to the specimen thickness.

Test reports include: (1) directions of cutting and loading the specimen; (2) thickness and width of each specimen to the nearest .001″; (3) the room temperature; (4) breaking load in pounds; (5) maximum fiber stress in pounds per square inch calculated from the formula:

$$S = \frac{3\,Pl}{2\,bd^2}$$

where S = maximum fiber stress, P = breaking load in pounds, l = distance between supports, b = width of specimen, and d = depth of specimen.

COMPRESSIVE STRENGTH TEST[1]

Apparatus for the compressive strength test is illustrated in Figure 1. Test specimen for sheets 1″ thick or over is a 1″ cube with faces flat and perpendicular to the axis. Where sheets are less than 1″ thick, the specimen consists of a pile of sheets 1″ square at least 1″ high.

Where material under compression fails by a shattering fracture, the compressive strength has a definite value. Where the material does not fracture, the value obtained for compressive strength is an arbitrary value, depending upon the degree of distortion allowed as indicating failure.

Test reports include: (1) significant dimensions of each specimen; (2) load on each specimen in pounds at time of failure; (3) ultimate compressive load strength in pounds per square inch calculated from measured area before load is applied; (4) description of material and how it acts under test; and (5) room temperature.

[1] ASTM Designation D229-46.

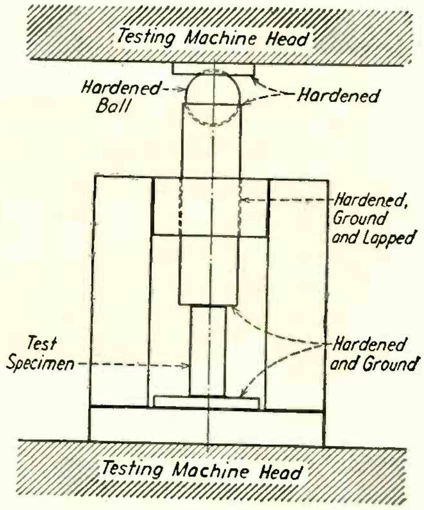


Figure 1 — Typical design of tool for making compressive strength tests.

LAMICOID SHEETS — AVERAGE VALUES

NEMA GRADE	Flexural Strength, psi 1/16″ to 1″	Compressive Strength Flatwise, psi 1/16″ to 1″	Dielectric Strength v/m, 1/16″ to 1/8″ Short Time
X	23000	35000	500
P	15000	22000	500
XX	16000	34000	500
XXP	16000	25000	500
XXX	15000	32000	470
XXXP	15000	25000	470
C	20000	38000	150
CE	17000	36000	360
L	20000	35000	150
LE	19000	37000	360
A	16000	36000	160
AA	20000	38000	50

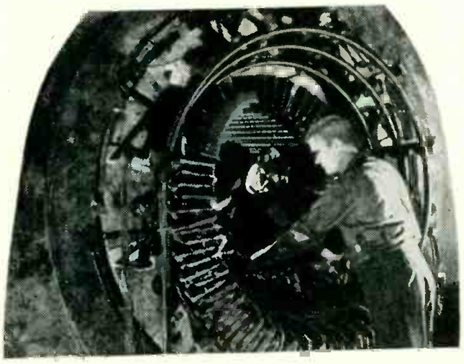
MICA

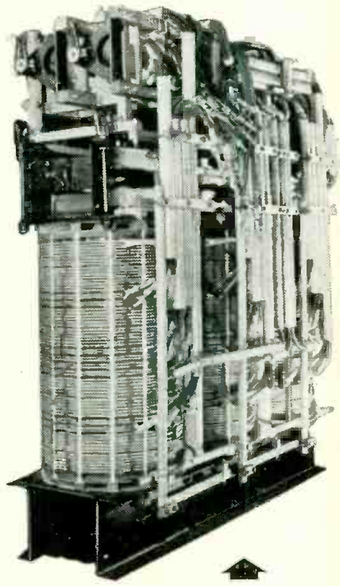
Tests—Keys to Insulation Selection

PERFORMANCE-PROVED ELECTRICAL INSULATION FOR EXACTING APPLICATIONS

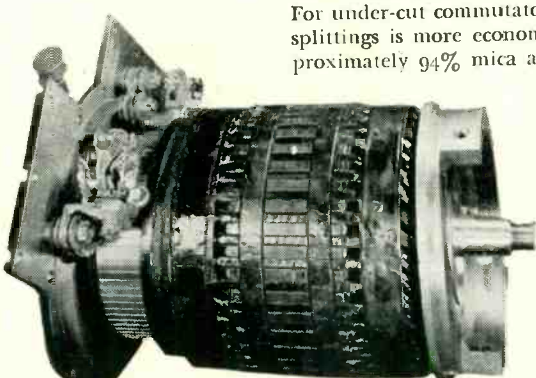
A limiting factor in performance efficiency and service life of electrical equipment is the dependability of the insulating materials used. Electrical, chemical and physical environments each demand performance standards that make the selection of the right material a difficult design problem. To meet varied needs, Mica Insulator Company has developed a complete line of products, each offering specific advantages depending upon requirements. Typical applications are illustrated.

LAMICOID brackets provide the high mechanical strength necessary for bracing end-windings against short circuit stresses. This thermosetting laminated material may be used for spacers placed at frequent intervals between coils, as well as for braces to which the coils are lashed with strong cords. Clamps or cleats of the same material may be attached to provide rigidity to prevent movement of the coils.





MICANITE segment plate composed of amber mica splittings, finds primary application in flush-type commutators, as in this dc motor, where mica and copper wear down uniformly. For under-cut commutators, Micanite composed of India mica splittings is more economical. Segment Micanite contains approximately 94% mica and 6% binder, and is manufactured for minimum compressibility under heat and pressure. Films do not slip or exude cement when properly assembled.



EMPIRE varnished Fiberglas provides high tensile strength, small stretch and flexibility needed when insulating leads to this 15,000 KVA, 3-phase, 60-cycle outdoor type transformer. Varnished Fiberglas is a Class B insulation which will withstand a "hottest-spot" temperature of 130° C (266°F). The impregnating varnish, from which electrical characteristics are derived, shows unusual resistance to corona and ozone, especially important for high-voltage applications. Varnished Fiberglas also resists moisture and most acids.

Fifty-five years of specialized experience in the development, manufacture and improvement of electrical insulating materials has enabled Mica Insulator Company to keep pace with the increasingly exacting requirements of electrical equipment builders. We welcome the opportunity to work with you in the selection and application of our complete line of materials. Consult our Technical Service Department on your insulating problems.

MICO ELECTRICAL INSULATION

Trade-mark

Insulator COMPANY

SCHENECTADY 1, NEW YORK

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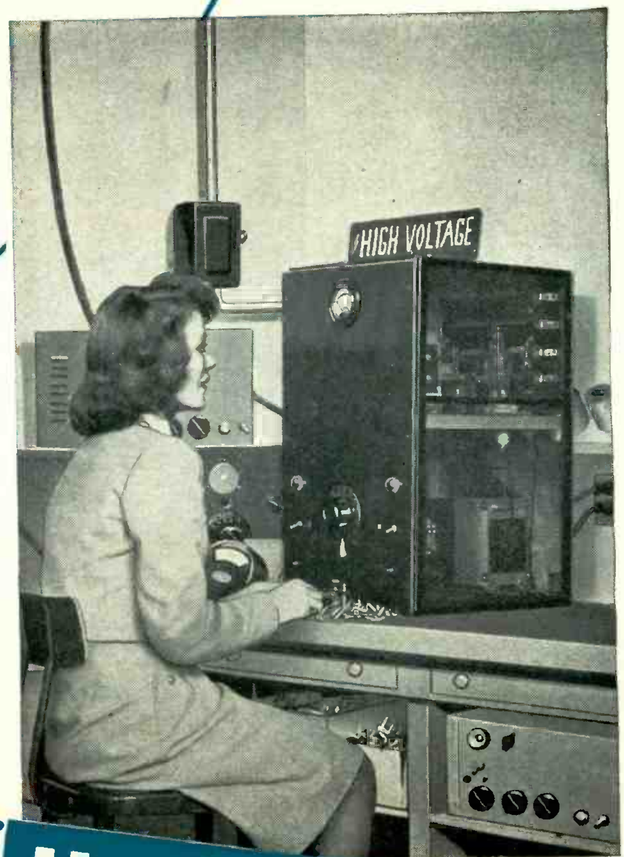
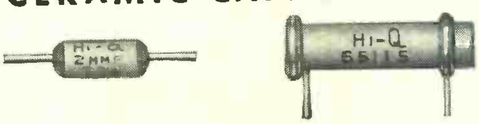
Los Angeles • Milwaukee • New York • Philadelphia • Rochester • St. Louis • San Francisco

Specify HI-Q COMPONENTS for DEPENDABILITY

The dependability of **HI-Q** components contained in your finished product will enhance your reputation as a manufacturer of *quality* equipment. The dependability of **HI-Q** components is the result of meeting exacting specifications which insure their conformance to your requirements...temperature coefficients within recommended tolerances, insulation resistances to minimum standards, capacities as specified. **HI-Q** dependability results from the use of highest quality materials and from constant surveillance throughout processing...your assurance of efficient, dependable service. Write for detailed information and engineering specifications.



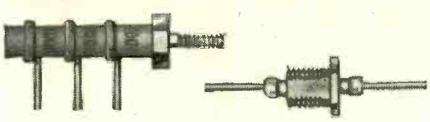
CERAMIC CAPACITORS



Hi-Q Ceramic Capacitors of unquestionable stability assure you the ultimate in performance for all electronic appliances. Let us assist you with your Ceramic Capacitor problems.

CHOKE COILS

STAND-OFF CONDENSERS



WIRE WOUND RESISTORS

HI-Q COMPONENTS BETTER 4 WAYS

PRECISION Tested step by step from raw material to finished product. Accuracy guaranteed to your specified tolerance.

UNIFORMITY Constancy of quality is maintained over entire production through continuous manufacturing controls.

DEPENDABILITY Interpret this factor in terms of your customers' satisfaction . . . Year after year of trouble-free performance. Our Hi-Q makes your product better.

MINIATURIZATION The smallest BIG VALUE components in the business make possible space saving factors which reduce your production costs . . . increase your profits.

HI-Q

Electrical Reactance Corp.

FRANKLINVILLE, N. Y.

Plants: FRANKLINVILLE, N. Y.—JESSUP, PA.
Sales Offices: NEW YORK, PHILADELPHIA, DETROIT, CHICAGO, LOS ANGELES

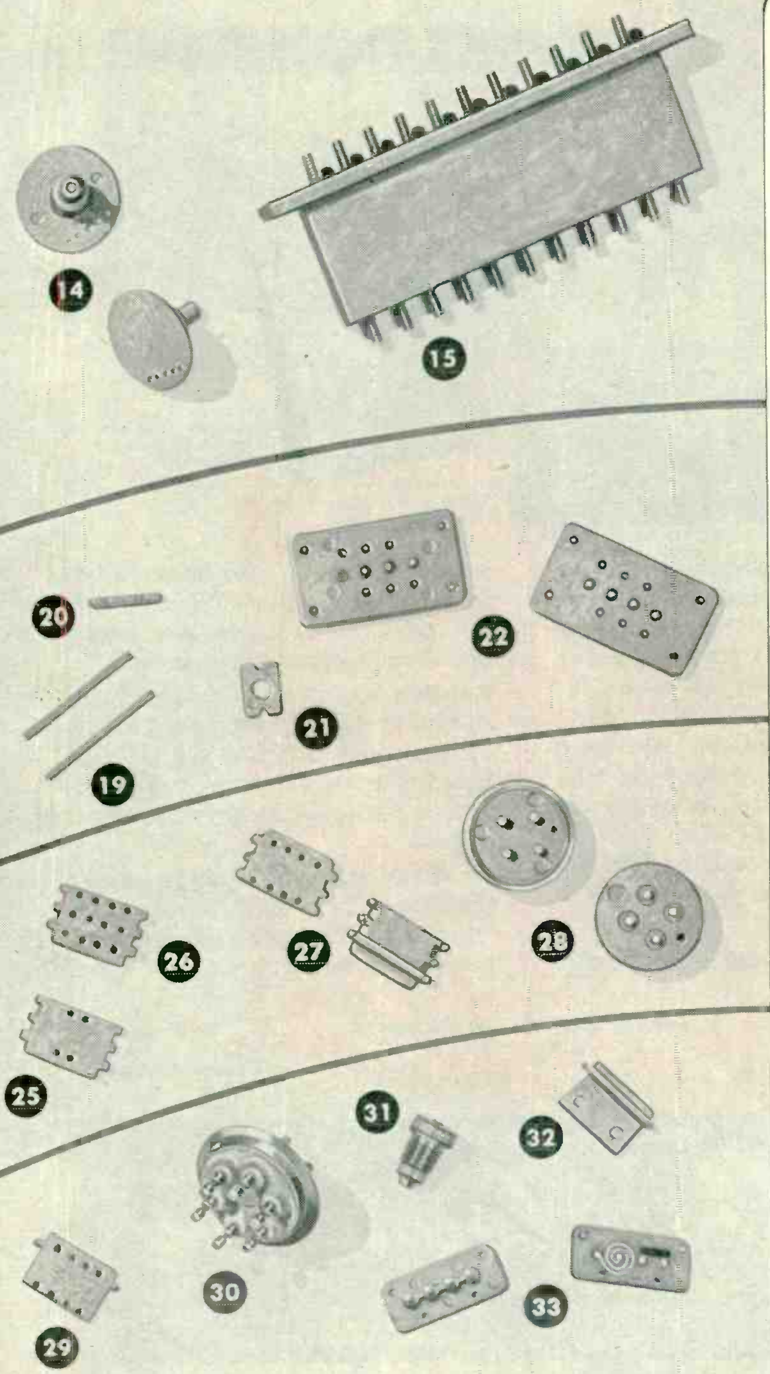
MYCALEX is today's improved insulation — designed to meet the exacting demands of all types of high-frequency circuits. MYCALEX is unusual in that it possesses a combination of peculiar characteristics that make it ideally suited for insulation in all types of electronic circuits. In tomorrow's designs for communications and industrial control equipment, MYCALEX 410 will be specified more than ever before because of its . . . Low dielectric loss · High dielectric strength · High arc resistance · Dimensional stability over wide humidity and temperature changes · Resistance to high temperatures · Mechanical precision · Mechanical strength · Ability to mold metal inserts in place. If you have any insulation problems, our engineers will be glad to help you in their solutions.

MYCALEX CORP. OF AMERICA

"Owners of 'MYCALEX' Patents"

Plant and General Offices: Clifton, N. J. Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y.

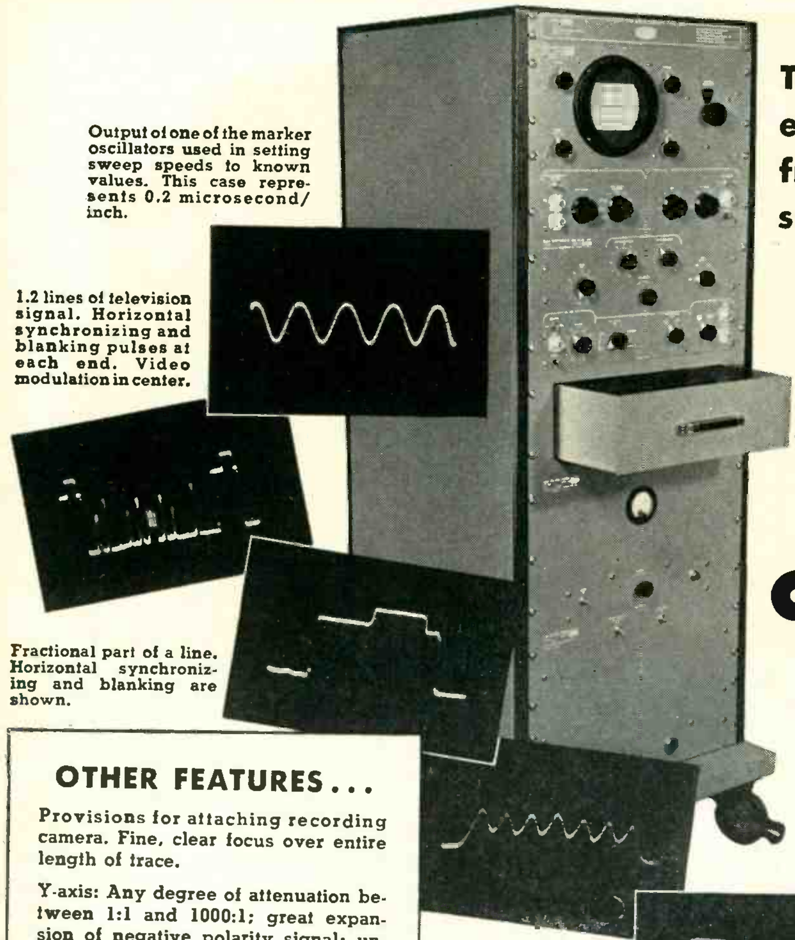
SINCE 1919
MYCALEX
THE INSULATOR
TRADE MARK REG. U. S. PAT. OFF.



PART NAME	APPLICATION	INSERTS	MAX. DIMEN.
1 Bushing	Motor Generator	None	1.75"
2 Insulator	Electrical Instrument	None	3.18
3 End Seal	Thermostat Shell	Stainless Steel	3.75
4 Insulator	Electrical Instrument	None	3.00
5 Hermetic Seal	Crystal housing	Nickel and Copper	0.88
6 Hermetic Seal	Crystal housing	Copper	1.09
7 Insulator	Automobile Antenna	None	1.06
8 Bushing	Ignitron	Steel	4.50
9 Stand-Off Insulator	Electronics circuit	Brass	0.56
10 Panel	Television Selector Switch	Silver	1.38
11 Switch Wafer	Television Selector Switch	None	2.31
12 Elbow	Aircraft ignition	Steel and Brass	2.75
13 Lead	Transformer	Monel	1.75
14 Insulator	Polarizing relay	None	1.09
15 Lead through block	Oscillator	Brass	4.69
16 Insulator	Telephone Transmitter	None	0.88
17 Dual Bushing	Oil Burner Transformer	None	3.00
18 Lead	Transformer	Monel	2.50
19 Actuating Bar	Telephone relay	None	1.44
20 Actuating Bar	Telephone relay	None	0.78
21 Spacer	Radio vibrator	None	0.56
22 Panel	Television Selector Switch	None	1.75
23 Spacer	Telephone relay	None	1.00
24 Spacer	Relay	None	0.91
25 Spacer	Telephone relay	None	1.00
26 Spacer	Telephone relay	None	1.00
27 Clamping Plate	Telephone relay	None	1.00
28 Electrode Mounting	Level Indicator	Brass	1.13
29 Spacer	Telephone relay	None	1.00
30 Six Terminal Header	Transformer	Monel	1.42
31 Test jack body	High Frequency Circuits	Monel	0.75
32 Clamping Plate	Telephone relay	None	1.00
33 Printed Circuit Base	Experimental	Silver	1.38

Television waveforms selected even to the scanning line and fraction of that line, for critical study or recording, with the new

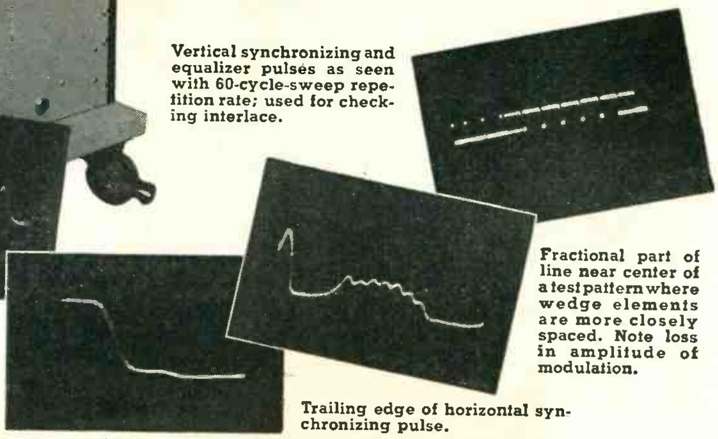
DU MONT
Type 280
Cathode-ray
OSCILLOGRAPH



Output of one of the marker oscillators used in setting sweep speeds to known values. This case represents 0.2 microsecond/inch.

1.2 lines of television signal. Horizontal synchronizing and blanking pulses at each end. Video modulation in center.

Fractional part of a line. Horizontal synchronizing and blanking are shown.



Vertical synchronizing and equalizer pulses as seen with 60-cycle-sweep repetition rate; used for checking interlace.

Fractional part of line near center of line. Video modulation produced by wedge, is shown.

Fractional part of line near center of a test pattern where wedge elements are more closely spaced. Note loss in amplitude of modulation.

Trailing edge of horizontal synchronizing pulse.

OTHER FEATURES . . .

Provisions for attaching recording camera. Fine, clear focus over entire length of trace.

Y-axis: Any degree of attenuation between 1:1 and 1000:1; great expansion of negative polarity signal; undistorted deflection of at least 2"; frequency response within 3 db. from 10 cps. to 10 mc.

X-axis: Time-base duration variable from 1 to 15,000 microseconds. Horizontal deflection of at least 4".
5RP-A Cathode ray Tube. 12,000 volt accelerating potential.

Time-base can correspond with any horizontal line in either or both interlaced fields. Calibrating generator for calibration of sweep-writing speeds by signals of 10, 1, and 0.2 microsecond/cycle.

Wide range of sweep-writing speeds; continuous variation between 0.25 and 3000 microseconds/in.

Delay ranges of 100 or 1000 microseconds selectable for linear time base.

Indication as to exact occurrence of time-base with respect to overall television picture.

Interval of 0.25 microsecond may be measured to plus/minus 0.01 microsecond.

DU MONT proudly announces the new Type 280 Cathode-Ray Oscillograph especially designed for television studio and transmitter installations. Here at last is a means for accurately determining the duration and shape of the waveform contained in the composite television signal, as well as the character of the picture-signal video in conjunction with transmitter operation, according to FCC standards and practices.

Excellent for research on all television equipment. Also for study of wide-band amplifiers. Well suited for industrial use wherever high-speed single transients are studied.

Consists of four units mounted on standard relay-rack type panels and chasses, and installed on mobile rack. Removable side and rear panels. Grouped controls for easy operation.

By virtue of its great range of applications, Type 280 becomes a "must" for television studio and research laboratory.

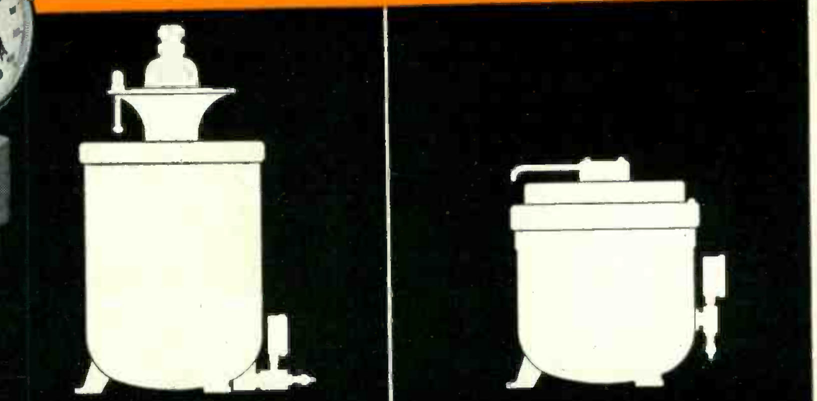
Further Details on Request!

DUMONT *for Oscillography*

ALLEN B. DU MONT LABORATORIES, INC., PASSAIC, N. J.
CABLE ADDRESS: ALBEEDU, NEW YORK, N. Y., U. S. A.

SMALLER DIMENSIONS...
HIGHER CURRENT RATINGS...
HIGHER EFFECTIVE VOLTAGE RATINGS...

IN THE NEW LAPP GAS-FILLED CONDENSERS



PREVIOUS MODEL
1000 mmf, 21 Kv peak, 40 amps RMS

NEW MODEL
1000 mmf, 23 Kv peak, 70 amps RMS

The new Lapp Gas-Filled Condensers save about 30% of space requirements as compared with previous units. Current paths are only one-third as long, with consequent lower losses. Current ratings, effective voltage ratings and safety factors have been increased. On variable models the tuning shaft is at ground potential, which eliminates need for special insulated tuning shafts. Puncture-proof. Constant capacitance without need for "warm-up," Lapp Gas-Filled Condensers are a source of proved dependability for capacitance at high voltages or high currents for radio or industrial electronic circuits. Write for bulletin No. 265.

Lapp

LAPP INSULATOR COMPANY, INC., LE ROY, NEW YORK

ELECTRONICS

Designers

a panel instrument for every need

These general-purpose panel instruments are particularly suitable for use in radio equipment and industrial applications where accuracy and quality are required and space is at a premium. Many of the instruments have been newly styled for better readability and for the smooth, modern appearance that will help give your panels a well-engineered look.

Thermocouple-type instruments, for measurements of high-frequency alternating current in radio or other electronic circuits, are available. There is also a complete line of rectifier types (a-f), for measuring alternating current or voltage at high frequencies or where the source is not sufficient to operate conventional a-c instruments. Typical applications include television transmitters, radar wave meters, testing equipment for electronic circuits. For a full story of G-E instruments, send for Bulletin GEC-227.

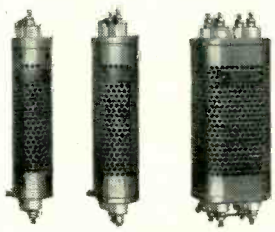
GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS

CAGED FOR PROTECTION

Suitable for wall or panel mounting, these cage-type, enameled resistor units employ a strong, high-heat-resisting silicate-compound body which withstands sudden and extreme temperature changes without weakening or in any



way being injured. The resistance wire has a low temperature coefficient so that the resistance remains nearly constant as the temperature increases. Ample protection to the units is provided by the perforated metal case. Each unit is rated at 85 watts and is available in resistance values from 0.5 to 100,000 ohms; one to four units in a cage. For more complete information please contact your G-E representative.

NEED A "LOW VA" VOLTAGE STABILIZER?

General Electric's latest additions to its line of automatic voltage stabilizers are three 115-volt, 60-cycle designs in 15-, 25-, and 50-va ratings. Check the low prices—you may now be able to utilize the advantages of an automatic voltage control for your application. The price consideration plus the low case height and small size will make these units especially applicable to radio chassis and other shallow-depth installations. Other features include totally insulated design, which is necessary where isolation is required between primary and secondary circuits, and universal lead construction which makes these units adaptable to various wiring and mounting arrangements. If you have an application problem, contact your G-E representative, or check bulletin GEA-3634B.

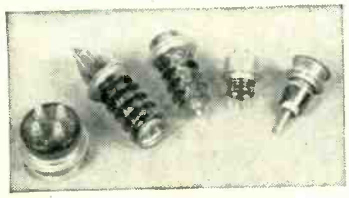
SOMETHING NEW IN CIRCUIT CONTROL DEVICES

Simplify your circuit designs by replacing complicated and costly components with simple, economical G-E Thermistors. These electronic semiconductors are unique in that the resistance changes rapidly with slight variations in temperature—electrical resistance decreases as temperature rises, and increases as temperature falls. G-E Ther-

mistors give you these five advantages: flexible in application, small in size, available in various shapes, indefinitely stable, and they are economical. These new circuit devices are especially adaptable as sensitive elements in flow meters, liquid-level gages, time-delay relays, vacuum gages, switching devices, and modulating thermostatic circuits. Check coupon for technical report CDM-9.

HERMETIC SEAL ELIMINATES MOISTURE PROBLEMS

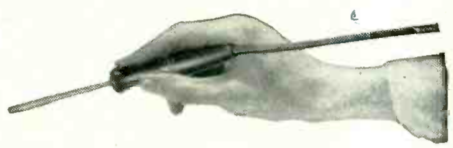
The new cast-glass bushings with their sealed-in metal hardware can be readily welded, soldered, or brazed directly to the apparatus, thus eliminating gaskets and providing a better seal than ever before. The small, compact structure of the bushings often makes it possible to



reduce the overall size and weight of the electric apparatus. Bushings are practically unaffected by weathering, micro-organisms, and thermal shock. Their great mechanical strength makes them well suited for use in airplanes, etc., where they are subject to continual vibration. Available in ratings up to 8.6 kv and for currents to 1200 amperes. Check bulletin GEA-5093.

MORE SOLDERING WITH LESS POWER

G.E.'s midget soldering iron can do a big job for you with only one-fourth the wattage usually used. This handy 6-volt, 25-watt iron is only 8 inches long (with ⅛" or ¼" tips) and weighs but 1¾ ounces. It was especially designed for close-quarter, pin-point precision soldering. The "midget" offers you all these advantages: low-cost soldering; "finger-tip" operation; quick, continuous heat; easy renewal; long life; low maintenance. The iron is a real aid in manufacturing radios, instruments, meters, electric appliances, and many other products requiring precision soldering. Irons and specially designed 115/6-volt transformers are available from stock. Check bulletin GES-3488.



GENERAL ELECTRIC COMPANY, Section E642-18
Apparatus Department, Schenectady, N. Y.

Please send me the following bulletins:

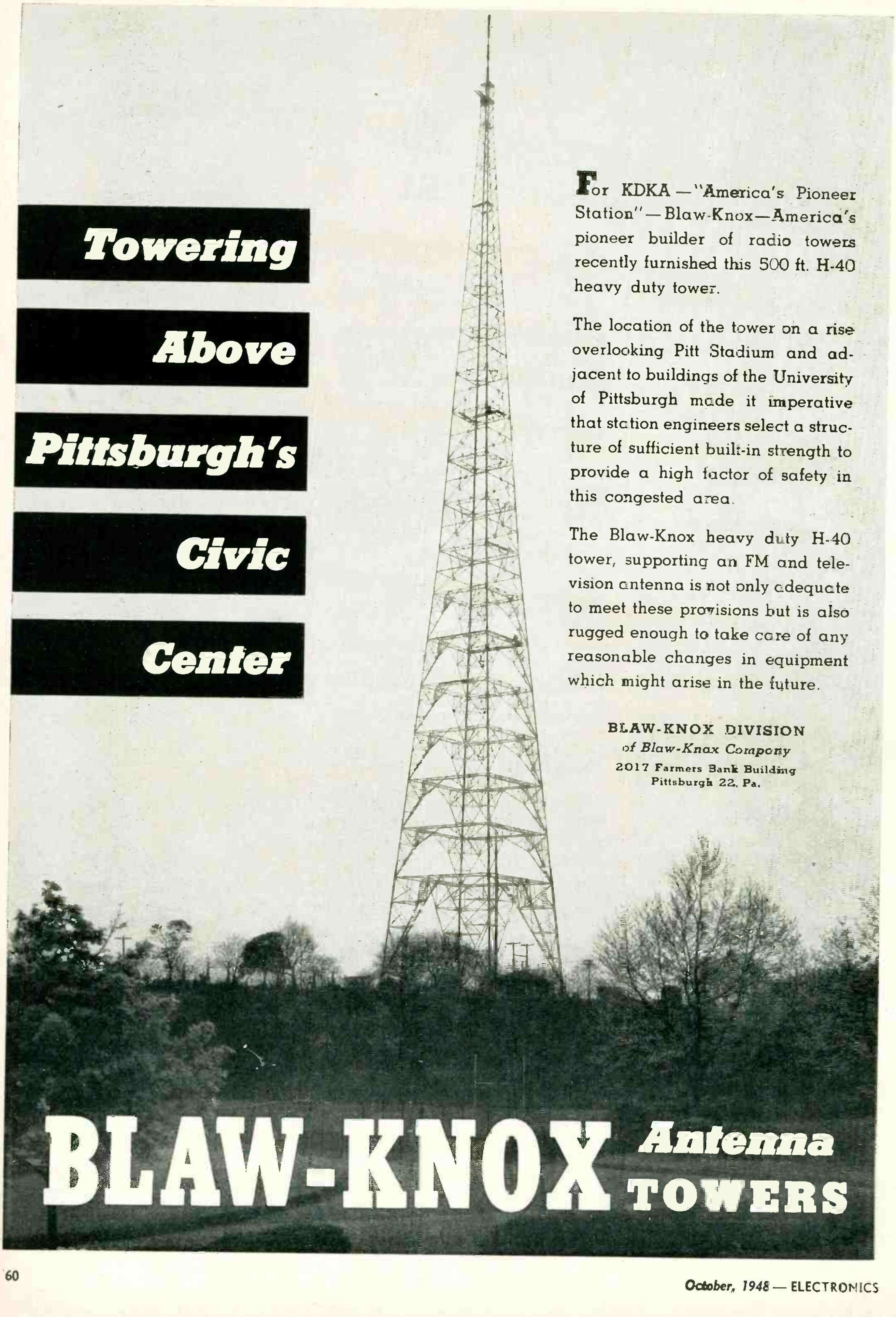
☐ GEC-227 Instruments
☐ GEA-5093 Cast-Glass Bushings
☐ GES-3488 Midget Soldering Iron
☐ CDM-9 Thermistors
☐ GEA-3634B Voltage Stabilizer

Name ....

Company ....

Address ....

City .... State ....


Towering
Above
Pittsburgh's
Civic
Center
For KDKA — "America's Pioneer Station" — Blaw-Knox — America's pioneer builder of radio towers recently furnished this 500 ft. H-40 heavy duty tower.
The location of the tower on a rise overlooking Pitt Stadium and adjacent to buildings of the University of Pittsburgh made it imperative that station engineers select a structure of sufficient built-in strength to provide a high factor of safety in this congested area.
The Blaw-Knox heavy duty H-40 tower, supporting an FM and television antenna is not only adequate to meet these provisions but is also rugged enough to take care of any reasonable changes in equipment which might arise in the future.
BLAW-KNOX DIVISION
of Blaw-Knox Company
2017 Farmers Bank Building
Pittsburgh 22, Pa.
BLAW-KNOX Antenna TOWERS

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AC-DC TELEVISION MADE POSSIBLE FOR THE FIRST TIME

Trend Is to New Low Prices for Lighter, Smaller 7" and 10" TV Sets

SMALL, COMPACT POWER SUPPLY HANDLES AM-FM-TV COMBINATION

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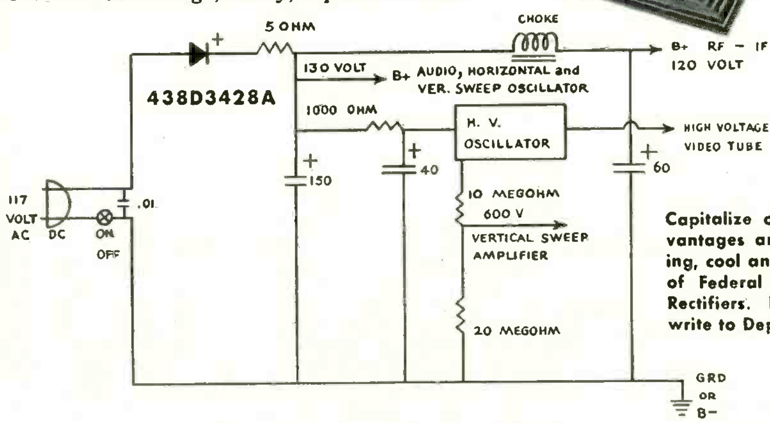
These important savings result not only from the small size of this new Federal Miniature Selenium Rectifier, but its elimination of large, heavy, expensive transformers and expendable rectifier tubes in the power supply. What's more, it can be used with smaller condensers with lower voltage ratings.

Here's the diagram of a suggested circuit for an AC-DC power supply for 7" and 10" electrostatic deflection tubes.



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In the 1948 electronics Issue of the BUYERS' GUIDE the following list of 270 manufacturers' advertising appears

This list is indicative of the all-inclusive scope of specifying, buying and reference advertising of products which appears in the Buyers' Guide — and is convincing evidence of the industry-wide acceptance of the issue for its advertising value.

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Advance Electric and Relay Co.
Aircraft-Marine Products Inc.
Airtron
Allen Co., Inc., L. B.
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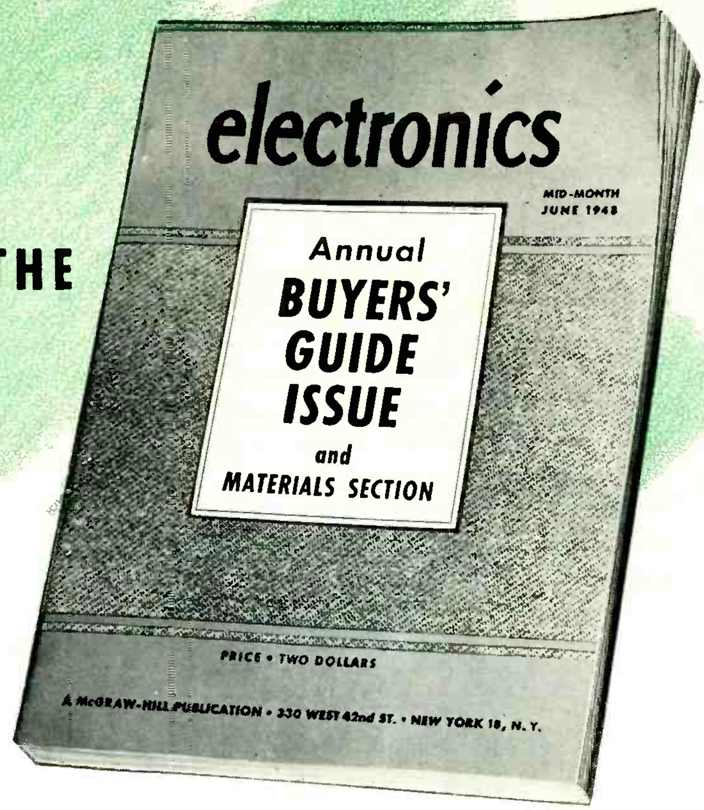
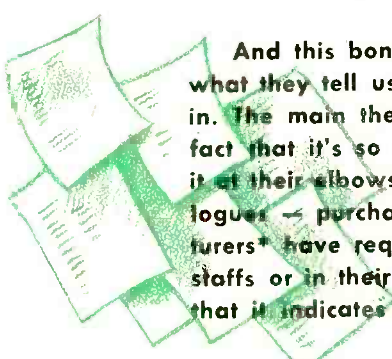
THE BUYERS' GUIDE is the 13TH ISSUE OF electronics . .

A REPORT

TO SUBSCRIBERS ON THE 1948 electronics BUYERS' GUIDE

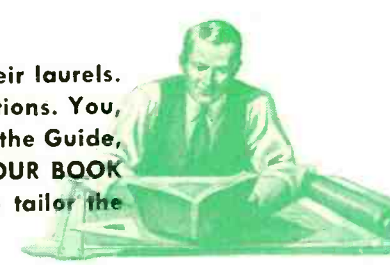


The ELECTRONICS Buyers' Guide, published annually for 5 years as a part of the regular June issue of ELECTRONICS, enters its 3rd year as an individual issue—a 13th issue included with every subscription. Like Topsy, it grew too big and too important to be included in the regular issue of ELECTRONICS. Therefore, every subscriber has for the past three years received this "extra" as a bonus issue.



And this bonus has proved a boon to subscribers—if we can believe only half of what they tell us. Letters from all over the country, and abroad too, have literally poured in. The main themes have been the technical value of the Guide, its usability and the fact that it's so much of a time saver. Design engineers tell us they use it daily—keep it at their elbows—no longer have to thumb through countless individual company catalogues—purchasing agents use it for product sources, etc. And many large manufacturers* have requested copies in lots of 25 to 100 to be used by their entire engineering staffs or in their reference libraries. Flattering? Yes, but more important to us is the fact that it indicates that it dovetails in with industries' needs.

That doesn't mean that our editors or researchers are going to rest on their laurels. Hardly. They look forward to and are now planning improvements and additions. You, the subscriber, can help by making suggestions, letting us know how you use the Guide, what we've omitted that you find necessary in your work. Remember it's YOUR BOOK—and your comments and suggestions are valuable yardsticks if we are to tailor the Guide more closely to your needs.



*Names on request

TO ADVERTISERS

In making your 1949 advertising and promotion plans, we urge you to include adequate use of the 1949 Mid-June Buyers' Guide issue of ELECTRONICS. Remember—it is a 13th issue and should be included in your 1949 budget. You can get the complete facts regarding the Guide from your ELECTRONICS representative or write direct.

ABC **electronics** ABP

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.....A BONUS ISSUE...FREE TO ALL SUBSCRIBERS

BUSINESS BRIEFS

By W. W. MacDONALD

Seems that a taxi equipped with radio came upon a car wedged between railroad tracks at a grade crossing. The cabbie called his dispatcher who called the telephone company, who called the railroad, who called the towerman, who flagged the oncoming fast freight in the nick of time.

TV set production continues to hold up while seasonal slump hits other lines. Six months production of TV among RMA member companies totalled 278,896, as against 659,313 fm-am sets, and 6,771,210 straight-am receivers. June video production was 64,353 for five weeks, a record high. The industry is now hoping to produce 850,000 units this year, and RCA predicts 1.6 million will be produced in 1949. Dollar volume in television will by then have outstripped income from sound-only sets, by a large margin.

A Correspondent wants to know who is making a predetermined electronic counter that will figure out a race horse's chances of winning from his past record. This is just one step from a predetermined horse race, which, we understand, is illegal. Anyone having such a gadget, please send us the plans in a plain envelope.

Now that High-Band television stations (channels 7 through 13) are getting on the air, there is a flurry of surveying to determine coverage compared with the low-band outlets. The N. Y. Daily News station, WPIX, on channel 11, reports 88.6 percent of set owners interviewed get station ok, other 11 percent cannot receive it.

Video in Hotels is having a big effect on the bell-boy business. A recent survey of New York Hotels shows that room service sales in video-equipped rooms increased from $35 to $175 per month following installation of telesets. Question: Has room service added crackerjack, popcorn or peanuts to the menu? Answer: At those prices, it's not peanuts.

Current slump in the phonograph business has convened many a pow-pow in record circles. Columbia-Philco development of long-playing records (p 86, September) is one attempt to blow life into the business, would have more effect if whole industry adopted the system for future releases. As it is, record boys predict a big fight between LP and standard disks.

It was only a matter of time, etc. The roadside circuit now has the tele-juke, a box with records *and* video. A record for a nickle, or three minutes of visual entertainment. You takes your pick. For those who want the whole ball game, the machine will take up to 25 nickles at a crack. A side panel gives the customer access to the tuning control with a choice of four stations, but experience teaches that this little door should be kept locked tight, with the key in the hands of the brawniest bartender.

Latest version of the electronic rat trap (selling for $198) is set over a rodent runway. An electric eye picks up the intruder, causes a pair of charged tongs to close, then lift sideways, depositing the lifeless body to one side. Whole cycle takes about 2½ minutes.

Technical writers with an engineering background, primarily communications, are needed by the Signal Corps. Salaries range from $3,727 to $5,232. Write Chief, Signal Corps Publications Agency, Fort Monmouth, N. J., or call Eatontown 3, 1060, ext. 767, S. S. Oliver.

Pulling power of "giveaway" radio programs was dramatically proved when Fred Allen's rating fell to an all-time low in competition with "Stop The Music." Many broadcasters, usually alarmed at FCC meddling with program content, have applauded the Commission's recently proposed action against "lotteries." Seems we are all in agreement on this one.

How Many People, in which industries, could use a complete industrial television package consisting of transmitter and receiver, for what specific purposes, if the cost was under $5,000? One of our readers thinks he can build a good rig for that price but wants to feel the water before jumping in. Any comment?

New Business tied in with the 70-group airforce is beginning to show in electronic circles. One concern reports new orders totalling $900,000 in recent weeks, all from aircraft manufacturers, calling for electronic, electrical and mechanical gadgets.

NAB group worrying out playing-time versus fidelity of magnetic tapes has tentatively decided on two standards, with tops of 7,500 and 15,000 cycles. They hope to limit high-fidelity speed to between 15 and 22.5 inches per second with minimum playing time of about half hour per reel.

Ten Years Ago, we were amazed at fact that there were then more radio tubes in use than there were people in the country. Today, more than that many tubes are sold in a year. Six months total reported by RMA was just over 100 million bottles. About three quarters of these were for new sets, 20 million for replacement, nearly 7 million for export. Government agencies took half a million. These are big figures. But radio tube sales are dwarfed by electric bulbs. Total sales of latter in 1947: 1.6 billion.

Hangover Cure for 12-inch surplus cathode-ray tubes (type 12GP7) replacing conventional 7-inch types in television receivers (p 66, August) is to stick a piece of blue cellophane over the screen. The big bottle uses two phosphors, blue for transients and yellow for persistency. An optical filter largely masks the latter.

Rates for television transcriptions (movies taken off picture tube screen suitable for rebroadcast, see p 68, this issue) have been issued by Paramount Pictures, Inc. They will record a ten minute show for $200, and sell release prints on 35-mm film, with sound track at $36.00 for 10 minutes in lots of 10 or more. Rates for an hour are $550 and $216 on the same basis. Also available at lower cost are 16-mm prints.

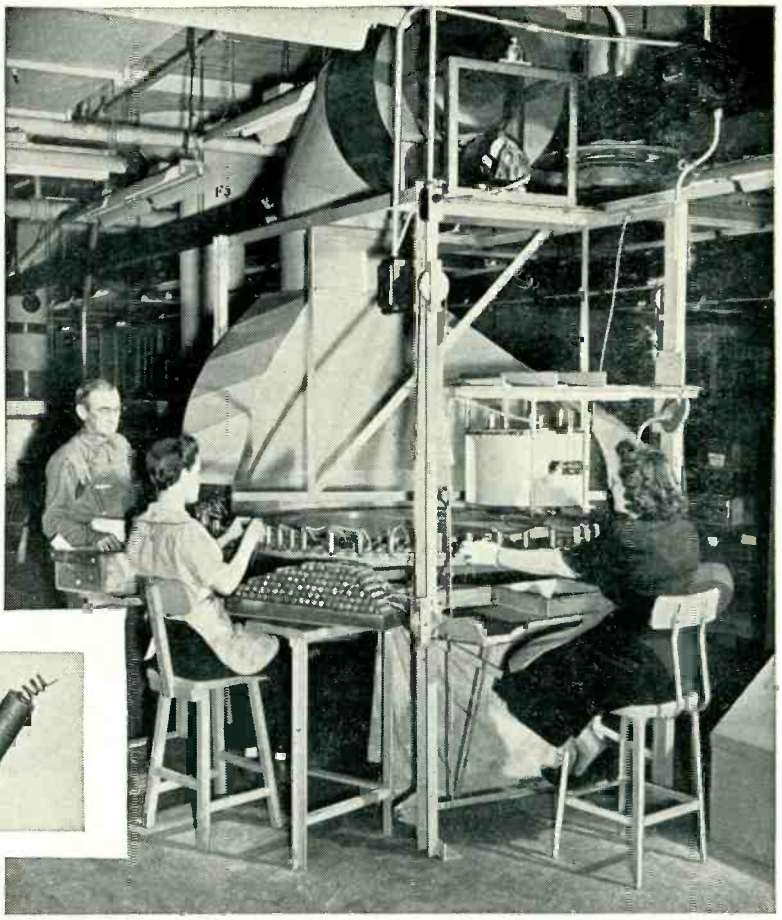
Designers Planning next year's radio cabinets may be interested in west coast reports from furniture buyers, indicating a strong swing to traditional styles, including French and American provincial. Darker finishes are in vogue in modern styles.

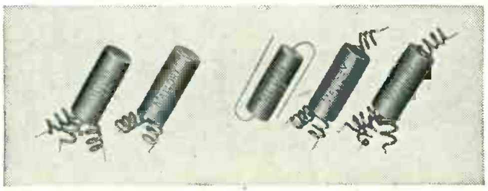
Nick Lefor (W2BIQ) says that 75 percent of the engineers employed by *Airadio* are amateurs, and that 75, 20 and 10-meter 'phone operators predominate.

Television in Great Britain is now dwarfed by Stateside industry. Licenses for television receivers, required of every set owner in England, totalled 54,850 at end of June, and are increasing at rate of 2,350 a month. Total sets in U.S.A. are now just over 500,000 and rate of increase is about 60,000 a month. All forms of broadcast set licenses in England now exceed 11,000,000. The British are bearing down on the license deal: 839 successful prosecutions for non-licensed reception in the month of June.

Among recent college graduates taken on by GE are 1046 electrical, mechanical and industrial engineers, 50 chemistry graduates, 15 physicists and 250 graduates of liberal arts and business courses. Looks like physics is still something of a specialty, despite big reputation physics majors got during the war at Radiation Laboratory and elsewhere.

Better Sealing Means Longer Life for MALLORY Cardboard Tubulars



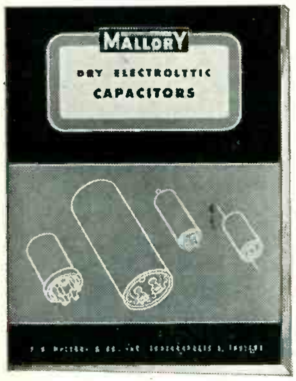


Careful pouring of end seals protects Mallory cardboard tubulars against impurities that cause deterioration.

MALLORY cardboard tubular capacitors come in the standard types shown above—but their service potential is far above standard—thanks to the extra care used in their manufacture.

In an electrolytic capacitor, quality depends largely on purity. At Mallory, controlled freedom from contamination in handling, plus the precaution of carefully applied inner seal and generous end seals, provide the extra measure of quality you expect in Mallory Approved Precision Products.

Mallory cardboard tubulars are made and priced for trouble-free operation in low cost equipment. The complete line of Mallory Capacitors includes units for every type of service—all made to the high quality standards of Mallory Approved Precision Products.



Send for the Mallory Capacitor Catalog which contains useful data on tubulars and on other Mallory electrolytic capacitors.

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CROSS TALK

► **BITS** . . . Claude Shannon's articles in the *Bell System Technical Journal*, explaining at length the important new concepts on the bandwidth required to transmit intelligence in the presence of noise, are destined to become classics in the literature of communications. While not claiming to have mastered the subtleties of the argument at the present writing, we do want to pass on the new word "bit", a contraction of "binary digit" suggested by J. W. Tukey. Binary digits, or bits, are important because pulse circuits, whether used in pulse code modulation or in electronic computers, are most reliable when they operate, flip-flop fashion, with only two states, on and off. So the discipline of such circuits is most easily analyzed in binary notation. It turns out that a decimal digit is 3.32 bits. Accordingly the value of a twenty-five cent piece, being expressible in two decimal digits, is expressible in 6.64 bits. We thought it was two bits, but we failed to reckon with Shannon and Tukey.

► **DECIMAL** . . . An old-time contributor to this journal, Walther Richter, in a recent speech coined a neat phrase when he said that electrical engineers could be divided into two groups, those working on the right side of the decimal point, and those working on the left. The communications engineer is, very largely, a microwatt-microvolt-microampere man. The power engineer is, in contrast, a kilowatt-kilovolt-kiloampere character. To Mr. Richter's apt division, we would add the group of decimal-point straddlers, the industrial electronic engineers who progress from the right to the left side, taking a microwatt impulse and bringing it to bear on a kilowatt system. These electronic universalists are familiar with the left and the right, and their number grows. More power (megawatts) to them.

► **MKS** . . . The growing acceptance of MKS units in electronic practice is not without important exceptions. The IRE technical committee on electroacoustics has recently discovered that this system of units has, apparently, never been used in the acoustical field and has urged that this omission be rectified forthwith. Fortunately, the conversion from the metric units commonly used to MKS units is accomplished simply in powers of ten. But, unfortunately, there are no simple names for acoustic quantities expressed in these units. The acoustical ohm, for example, is translated literally into emkayess-ese as "joule per stere per stere per second", than which we cannot imagine a less handy term. The committee is now searching for suitable short-form names for MKS acoustic units, and will recommend the same for the forthcoming revised ASA standard terminology on this subject. This is good work. Other committees might well examine their fields for similar omissions.

► **GEO-RESCUE** . . . Some months ago we related the story of the Bell Labs engineer who, lost on the way to a dinner party, was "talked in" to his friend's house through mobile radio installed in his car. Now comes the story of the geophysical exploration party which, roaming over the flatlands searching for suitable test sites, become completely lost. Having explained their predicament to the field office by radio, the members of the party were instructed to explode a charge of dynamite, which they carried for seismic exploration, at a pre-arranged time. The blast, traveling through the earth, was intercepted by a pattern of geophones connected with the field office, while an oscillograph recorded the times of arrival of the shock wave at several locations. A short computation, essentially the loran problem worked backwards, revealed the location of the lost geophysicists. Informed by radio, the party took a bearing for home and got there. Readers will recognize this technique as a solid-land version of the sofar system, which locates ships at sea by precisely the same technique (June, 1948 issue, p 98).

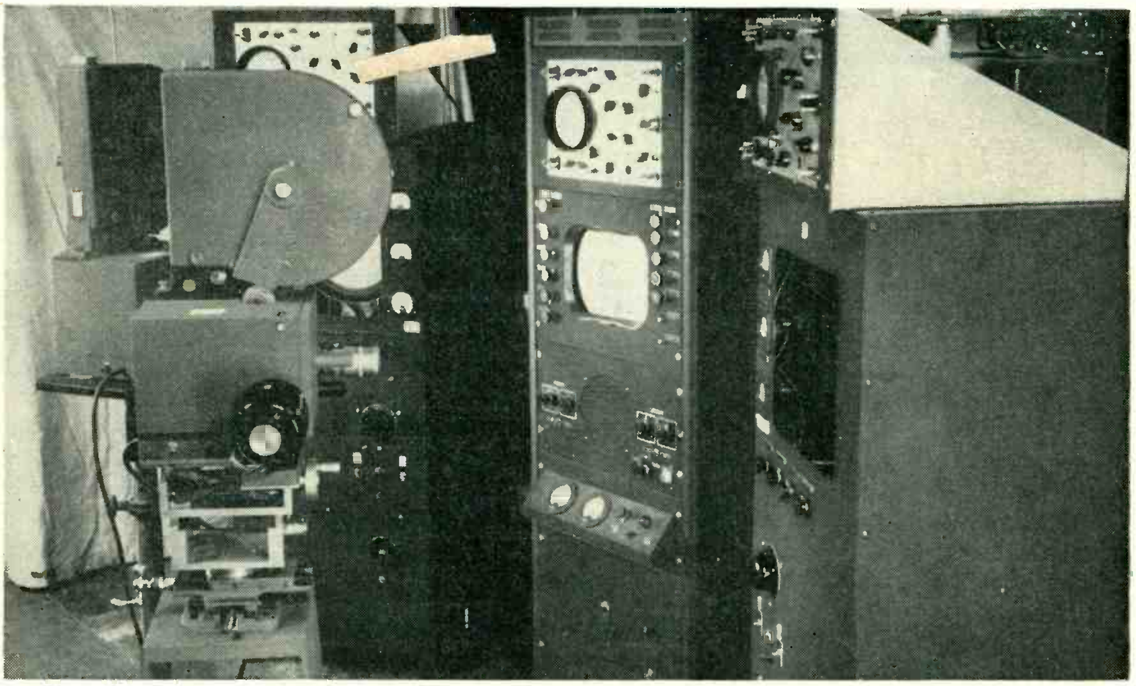

FIG. 1—General view of transcription equipment. Two units are used to provide uninterrupted recording of lengthy programs

TELEVISION

By THOMAS T. GOLDSMITH, JR. and HARRY MILHOLLAND

Director of Research *Senior Engineer*
Allen B. DuMont Laboratories, Inc.
Passaic, New Jersey

FOR MANY YEARS photographic recording has been employed by television engineers to preserve a record of station operation and outstanding programs. The staff of A. B. DuMont Research Dept. has been engaged in studying photographic recording for over ten years. The early efforts used still cameras or nonsynchronous movie cameras which produced results suitable for record purposes. But the quality of such recorded programs was not sufficient for rebroadcast because of insufficient detail and contrast range, as well as stroboscopic-flicker effects caused by lack of synchronization.

With the coming of network television, the need for broadcast-quality photographic transcriptions of television programs has emerged. To meet this need, DuMont Laboratories has developed a transcription system, with the results described in this paper. Teletranscriptions have already proved useful in providing delayed-broadcast network service beyond the limits of coaxial-cable and radio-relay circuits. For this purpose they will undoubtedly serve for many years, until network connections are more widely available and less expensive than at present. Transcriptions also serve many other purposes, such as promotional advertising, as aids to criticism of program techniques and content, and as legal records including documentation of station operation for the records of the FCC. Similar techniques, employing rapid development of film, serve for theater television.

Frame Synchronization

In setting up a teletranscription system, the choice between 35-mm and 16-mm film must be made. Ideally, 35-mm film is to be preferred since it imposes no limitation on the detail of the transcribed image. In practice, however, 16-mm film is preferable on the score of economy, not only in the cost of film stock, but also in the cost and main-

This article is based on a paper presented before the New York Convention of the S.M.P.E., October 1947.

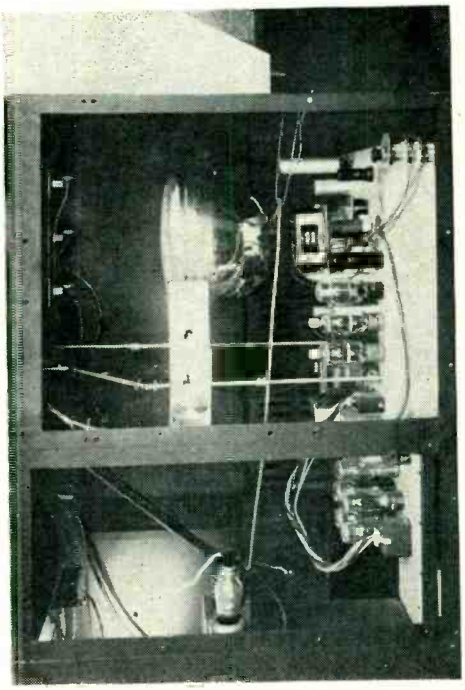

FIG. 2—Monitor with side panel removed to show mechanical arrangement

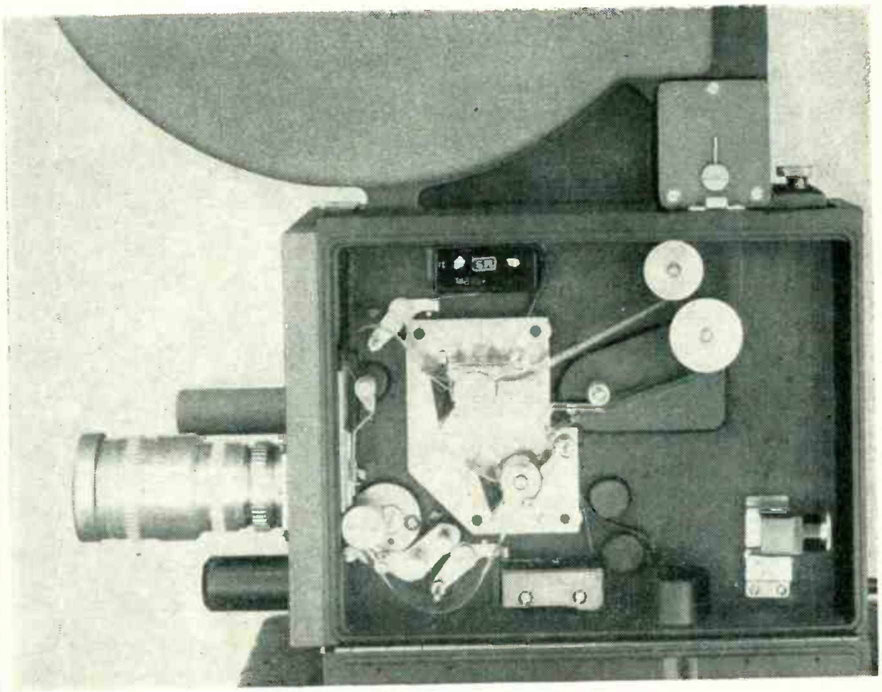

FIG. 3—Side view of the Eastman Kodak model of the camera. A rapid pull-down mechanism moves film between frames in less than 1/120th second

TRANSCRIPTIONS

Recording television images on film, directly from a cathode-ray monitor, preserves programs for rebroadcast, legal records, and network syndication. Broadcast quality is achieved in equipment which transfers from the 30-frame rate of television to the 24-frame movie standard

tenance of the camera equipment. Using fine-grain stock, the film can be exposed and processed so as to retain the full detail of the image. Accordingly, 16-mm equipment was adopted in the equipment described.

An early attempt to solve the frame-synchronization problem resulted in a camera which operated at 15 frames per second, that is, one-half the television frame rate. The exposure time and the pull-down time of this camera were approximately equal, so it photographed one complete television frame and skipped the succeeding one while the film was being pulled down. This system produced a nonstandard film which could not be used in standard 24-frame movie projectors. Moreover, the film could not be used for rebroadcast at 30 frames, because of the flicker and discontinuity of motion caused by the missing frames.

This project was abandoned in favor of building a camera which would record directly at 24 frames per second from 30-frame television images. The process is essentially the inverse of the projection system used in televising standard 24-frame film. The 24-frame film may be used in standard 16-mm sound projectors for nontelevision uses, or in television projectors. The prototype camera was constructed. When the principle was proved, the prototype was taken to the Eastman Kodak Company, which produced a commercial version of the camera.

The sound-recording aspect of teletranscriptions was also a matter requiring attention. Separate sound-on-film recording facilities are employed to assure high quality of reproduction. The two film records, one for picture and the other for sound, are processed separately, using process techniques best suited to each type of recording. The sight and sound portions are combined in a composite 24-frame film. For documentary purposes it may be satisfactory to employ a single camera with sound-recording facilities incorporated in it, the so-called single system, but the processing must then be a compromise between that for best picture and that for best sound reproduction quality.

Figure 1 shows a general view of the transcription equipment. Two identical cameras and monitors are used to permit uninterrupted recording if the program lasts more than one-half hour. Each camera has reels which hold 1,200 feet of stock, which allows about 33 minutes of recording. When switching from one monitor-camera to the other, care is taken to assure that the average brightness of the two monitors is closely the same. This measurement is performed with a photographic exposure meter held successively in the same position before the two screens when both carry identical test patterns. Records are kept of power-supply voltages and beam currents in the monitor picture tubes to assure reproducible results from day to day.

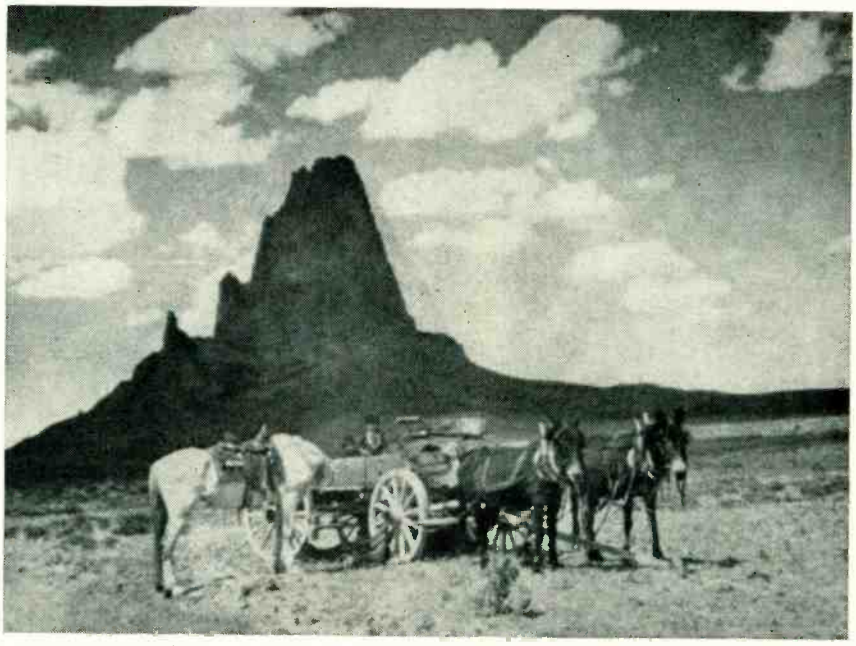

FIG. 5—Typical scene as reproduced on 35-mm movie film

Uniform Focus

The monitor circuits and picture tubes have been designed with particular care to remove imperfections that might be tolerated in a home receiver. For example, the high-voltage power supply has excellent regulation to avoid changes in picture size with changes in average brightness. The high-voltage supply is a 25,000-volt unit conservatively operated at 17,000 volts. The monitor picture tube is a 12-inch magnetically-focussed and deflected unit. The area scanned is 6 by 8 inches. This small area assures uniform focus and a flat field. The tubes are conventional, but are carefully selected to have uniform phosphors and good focus over the area scanned.

It is possible to operate the system with negative or positive images on the monitor, but experience has proved the positive image preferable. The film image is then a negative and the composite print (made from the negative picture film and sound film) is a positive. If time is very short, the negative film image may be transmitted without making the composite positive print, merely by reversing the polarity of the television camera output. But the best quality has been found to result consistently from a composite positive print made from a negative.

To assure that the film shall not limit the resolution of the system, very-fine-grain film is used, that is, positive stock ordinarily used for making projection prints. DuPont type 602A has been found highly satisfactory. This film, speed approximately Weston 8, is slow compared with negative stock and reversal film, but it has extremely fine grain and wide latitude. Also, it costs about one third as much as faster films, and this may be a very important factor in an extensive recording project. The same type of film is used for picture negative, sound negative and composite positive. A special processing technique, is used to develop the picture negative. Otherwise the processing is conventional.

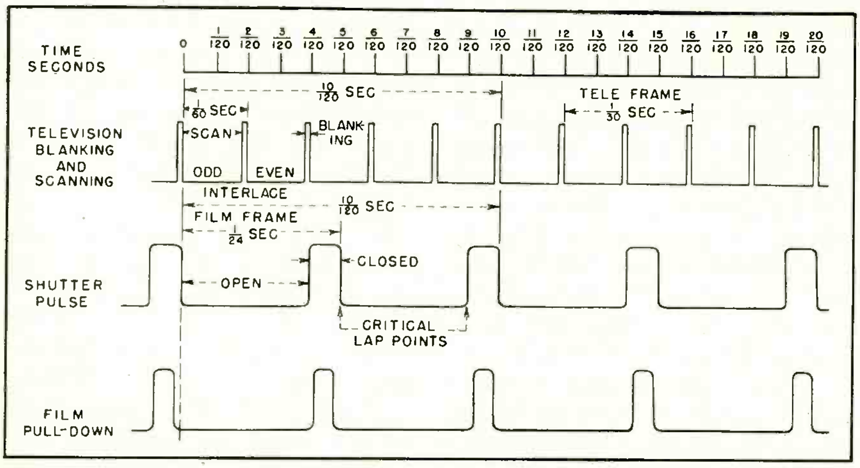

FIG. 4—Time relationships between television signal, shutter and pull-down mechanism. Accurate setting of shutter is essential to avoid overlapping or underlapping exposures

To assure adequate exposure using slow film, a bright monitor image and fast lens are required. The image, produced on the 6-by-8-inch rectangle, has a highlight brightness above 100 foot-lamberts. The lens is a standard Kodak camera lens of two-inch focal length and maximum aperture f1.6. The lens is operated at fixed focus of five feet and a fixed aperture of f2. The latter setting is not changed, since it would change the cone of light within the camera and would interfere with the proper operation of the shutter. If any change in the aperture is required, neutral-density filters are placed on the lens as required. Optical resolution of the lens is not critical. Any good

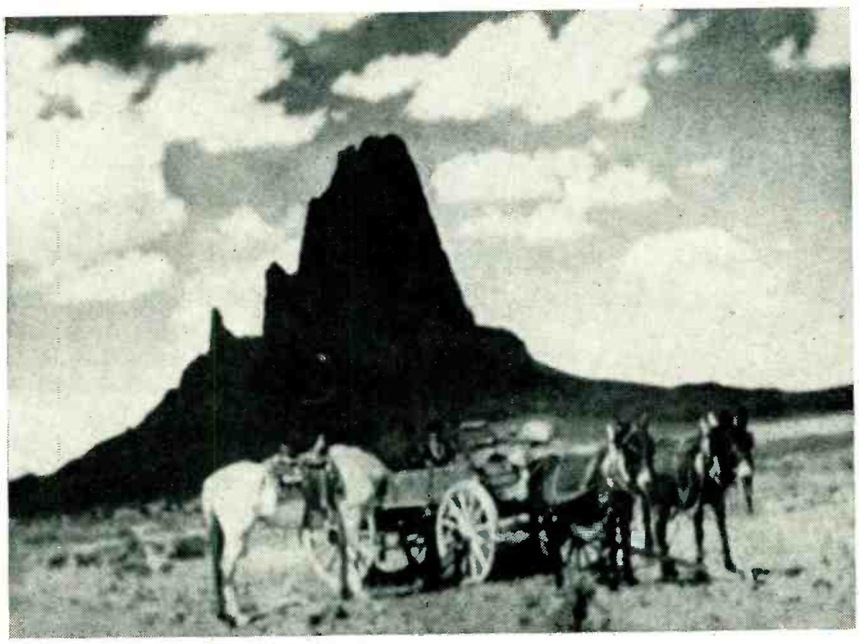

FIG. 6—Televised reproduction of scene shown in Fig. 5

taking lens is satisfactory but projection lens are to be avoided.

Using this optical system and film, the full horizontal resolution of the original television image is preserved in the film. In fact it is possible to identify in the film images the fine-structure noise present in the original television image. The contrast range of the system is likewise limited by the television image, not the film. Using a conventional photographic gray scale of 11 steps between black and white, the monitor has been found capable of rendering 7 steps of gray, plus black and white. The latitude of the film is sufficient to cover this range by a wide margin.

The monitor brightness and contrast controls are adjusted by eye to give the most even rendition of the gray scale, as viewed on the film after processing. This process matches the transfer characteristic of the television system to the gamma characteristic of the film. Electrical gamma-correction circuits are also available in the equipment. Particular care was taken in the design and adjustment of the scanning circuits in the monitor to preserve a high degree of linearity. Figure 2 shows an interior view of the monitor.

The camera employs a rapid pull-down mechanism and a specially designed shutter which exposes two complete fields of television scanning on each frame of motion-picture film. An interior view of this camera is shown in Fig. 3. The shutter closes for exactly one-half of a television field, and the pull-down takes place in something less than one fifth of the complete pull-down-plus-exposure cycle. This cycle occurs at a rate of 24 frames per second, at a shaft speed of 1,440 revolutions per minute.

Sequence of Operation

The timing sequence and phase relationships of the television signal, the blanking cycle of the shutter, and the motion of the film during pull-down are shown in Fig. 4. At the top is a timing indication expressed in intervals of 1/120 second. This interval is a subdivision of both the 30-frame-per-second television-picture interval and the 24-frame-per-second film picture interval. The next line indicates the television blanking interval and the useful television picture interval. Here the television field interval of 1/60 second provides one half of the interlaced picture, and the succeeding 1/60 second field interval provides the other interlaced half. Accordingly, two fields of television scanning constitute one complete frame of television picture in an elapsed time of 1/30 second. On the next line is shown the camera-shutter characteristic, which must be very carefully adjusted. On the bottom line the film pull-down cycle is illustrated.

The most critical characteristic in the recording camera is the timing of the shutter-blanking and exposure interval. The absolute intervals are the most important, and if they are appropriately adjusted the exact phase relationship is not very critical. As shown in Fig. 4, the phase relationship has been so adjusted that one of the points for opening (or closing) the shutter is placed directly under the television blanking interval. The other shutter-point occurs approximately in the middle of the television field interval. If this shutter is not adjusted correctly, a bar, caused by overlapping or underlapping exposures, is likely to appear in the recorded film picture. Such a bar is noticeable as a flicker of several lines in the picture.

It is customary to drive a recording camera by synchronous motor. If the television signal and the recording camera are controlled by the same power lines, the camera runs in exact synchronism with the television synchronizing generator. In many cases, however, it is necessary to record programs which have originated in a region beyond the limits of the synchronized power lines. On nonsynchronous power supplies, two regions of overlap may appear and move up or down the picture at a rate equal to the difference frequency between the 60-cycle supply controlling the synchronizing generator and the 60-cycle supply driving the synchronous motor of the camera.

Many films have been recorded in the nonsynchronous manner. To do so successfully it is desirable that the shutter angles be accurately adjusted so that the overlap bars are eliminated. It is better to have a slight overlap, rather than an underlap, to minimize the bar effect.

To show the quality of pictures obtainable, Fig. 5 is a blown-up print of an original photograph taken on 35-mm film, while Fig. 6 is a photograph of the same subject taken from the face of a cathode-ray tube. Very little difference exists between these two photographs.

The motion-picture film compares favorably with the results obtained with a still camera.

SERRASOID

Design data for an improved four-tube phase-shift type modulator that initiates 100-percent modulation with noise 80 db down and 0.25 percent harmonic distortion in broadcast service. Low relative cost suggests potentially greater utilization of the educational frequencies. Variations of the basic circuit open new fields of application

By J. R. DAY

Radio Engineering Labs., Inc.
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THE development of a simple f-m modulator has been one phase of a broad program to enlarge the technical horizons of f-m broadcasting. In particular, it was aimed at providing one solution to the problems of relay and chain broadcasting. Such service requires that the noise background and distortion be very low in the individual links so that the final signal may still meet the relatively high standards required for any f-m broadcasting system. Such chain systems have been operated satisfactorily using available equipment, but it cannot be said that, in the more extensive chains, the limiting noise rests with the audio facilities at the origin. This latter condition has always been regarded as a minimum requirement of a really good f-m broadcast setup.

Careful examination of the problems in a reasonably extensive chain yields the conclusion that an 80 db ratio of 100-percent modulation to noise in the modulator would be satisfactory. In addition, a maximum figure of 0.25-percent harmonic distortion for 100-percent modulation with single tones from 50 to 15,000 cycles was set as a correlative objective. Since a practical modulator involves accessory circuits such as an audio amplifier, which can be expected to make some definite though small contribution to the numbers above, the actual net requirements on the modulation process are somewhat more severe than the overall figures. It is evident that such performance will also be of significant application in a single f-m broadcast setup, apart from the special question of relaying.

Means of generating frequency-modulated currents fall into two general classes, the reactance-modulated type, and the phase-shift type. In the first, the frequency of an oscillator is caused to vary linearly with modulation through the agency of a reactance tube or its equivalent, which is an integral part of the frequency-determining circuit. Because of the modulation and linearity requirement such an oscillator in general is not stable enough for broadcast service. Automatic frequency control is therefore employed. In the phase-shift type of modulator the frequency of the carrier oscillator is not varied, and therefore a stiff control such as a quartz crystal can be used to secure the desired stability, which then is completely independent of the modulation process. Modulation of the frequency in such a system is secured by varying the phase of the frequency-stabilized wave. The frequency will be deviated from its controlled value only during the time the phase is changing, and the deviation, other things being equal, is proportional to the rate of change of phase.

The Serrasoid is the latter type. Although it is capable of broader

The first successful method of producing frequency modulation was the phase-shift method. Despite certain shortcomings in inherent noise, distortion at the lower modulating frequencies, and a tendency of the center frequency to drift, it carried the burden of launching the f-m system successfully.

• The invention of the double channel modulator, which was brought to a high degree of perfection through the work of John Bose, eliminated these difficulties. It, however, had the commercial disadvantage common to all frequency modulators of requiring a large number of tubes. This disadvantage is not of much importance in transmitters of powers above 1 kw, as the cost of the modulator then becomes a relatively small part of the total. For transmitters of low power, however, the modulator becomes a major item. Herein lies opportunity for great improvement.

• I have always felt that the phase-shift method of producing frequency modulation would be the surviving method and that someone some day would overcome its greatest weakness by finding the means of increasing the initial phase-shift without compromising any of the requirements of distortionless noise-free f-m.

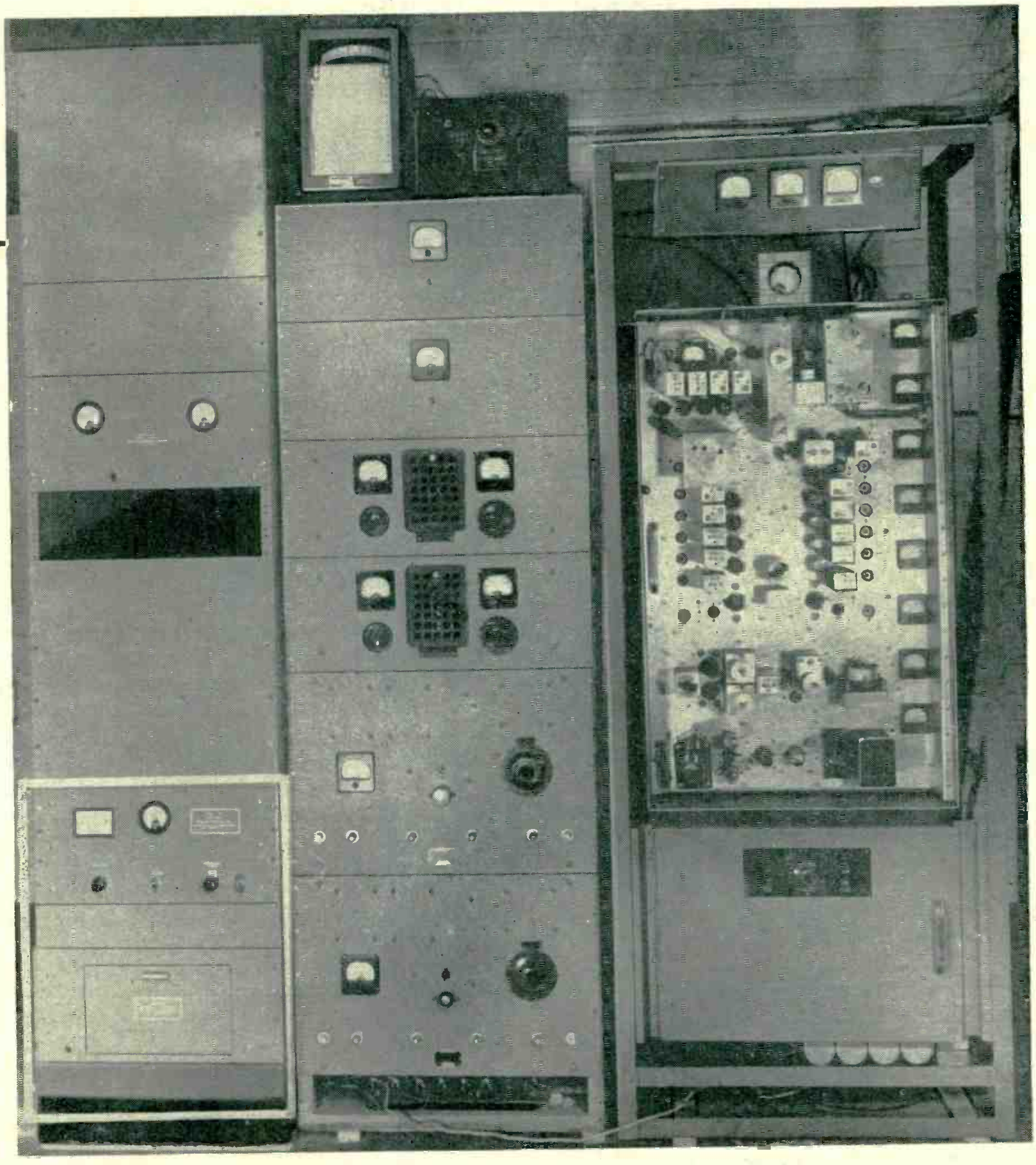
• This James R. Day has done. Not only has he done it without compromise, but he has in fact improved performance to hitherto unattained levels.

• The significance of this development is that by its simplicity and reliability it has opened up all sorts of new broadcasting possibilities. One can visualize the operation of unsupervised transmitters of a few watts power, controlled from pulpits, schoolhouse assembly halls, and similar places, the transmitter requiring no more attention than the common, everyday public address system.

• The invention has opened up some amusing possibilities. If, as seems likely, the Serrasoid becomes the accepted method of producing frequency modulation, the phrase-makers who have dubbed the phase-shift method the "indirect method" will find themselves in an awkward situation. Some of us have lived long enough to recall the days when the automobile was referred to as the "horseless carriage."

—E. H. ARMSTRONG

F-M MODULATOR



Size comparison between the Serrasoid modulator (outlined in white) and the original Dual-Channel modulator at the right. Center rack and upper section of left rack are used for other equipment. Photograph taken at the Armstrong f-m broadcast station W2XMN-W2XEA at Alpine, N. J. where the new modulator has been in service for six months

application, the numbers involved for the f-m broadcast case provide the clearest illustrative material. As noted above, frequency deviation is proportional to rate of change of phase. For sinusoidal modulation this is simply expressed by saying that the peak frequency deviation is equal to the product of the peak phase shift and the modulating frequency. The new circuit is conservatively capable of a peak phase shift of ± 150 degrees, but ± 90 degrees or $\pm 1\frac{1}{2}$ radians is used as the basis for 100-percent modulation at 50 cycles. For $1\frac{1}{2}$ radians and 50 cycles the peak deviation therefore will be ± 75 cycles. Since 100-percent modulation in f-m broadcasting is a deviation of $\pm 75{,}000$ cycles, a frequency multiplication of 1,000 is indicated. Actually, 972 is used since it can be factored into a convenient assortment of doublers and triplers. In all that follows we shall discuss a modulator for a frequency of 97.2 megacycles which starts at a base frequency of 100 kilocycles.

Figure 1 is a schematic diagram of the essential parts of a complete broadcast Serrasoid. Audio amplifiers and frequency multipliers have been omitted since they are conventional and employ small standard type tubes. Tube V_1 is a pentode oscillator controlled by quartz crystal Y. The crystal operates very close to its series resonant frequency. The net reactance of the crystal arm may be conveniently varied by a series capacitor for fine frequency adjustment of about ± 0.005 percent. This crystal is oven controlled in the broadcast case to a net stability of ± 0.0002 percent, which is also the stability of the final carrier frequency. The operation of the oscillator is such that plate current is drawn only during a small part of the cycle. Negative going pulses shown in Fig. 2A are generated at the plate of V_1. These pulses are differentiated by C_3, R_4, and grid-cathode conductance of V_{2A} to yield still shorter pulses several times the cutoff voltage of V_{2A}. The corresponding short positive pulses at the plate of this latter tube are bottom clipped (to clean the base line) by cathode follower V_{2B}. Resistor R_7 is selected so that this tube is biased beyond cutoff between pulses by the automatic grid bias of C_4 and R_6. The pulses at the cathode of V_{2B} appear as shown in Fig. 2B. The two halves of V_2 perform the functions of a single pentode that might have been used in the same place, with the additional advantage that the final waveform is developed in a lower impedance than is practicable with a pentode.

Linear Sawtooth Wave

According to the numbers of the illustrative case these pulses recur at a rate of 100 kilocycles, that is, corresponding points or events on consecutive pulses are 10 microseconds apart. Tube V_{3A} constitutes a nonoscillatory sawtooth generator timed by the pulses from V_{2B}. The slowly increasing portion of the sawtooth has a slope corresponding to the charging of C_7 through R_{10} to the relatively steady voltage at the junction of R_9 and R_{10}. This period coincides with the time between pulses at the grid of V_{3A}, cutoff bias having been developed on C_5 by previous pulses. The quickly decreasing portion of the sawtooth occurs at the time of positive pulses on V_{3A}, when C_7 is discharged nearly to cathode potential by the plate-cathode conductance. In round numbers the discharge point is about 5 volts from cathode or ground potential and R_{10} and C_7 are adjusted to give a rising rate of about 4 volts per microsecond to the increasing portion of the wave. As will be shown the whole linearity of the modulation process depends on the straightness of this sawtooth wave. In its simple form, it would have too much exponential curvature to be useful. This condition is corrected by the bootstrap connection comprising the cathode follower V_{3B}, R_{11}, C_6, and R_9. The normally constant voltage at the positive end of R_{10} has superimposed upon it the rising voltage on C_7 so that the drop on R_{10} and hence the charging current is maintained practically constant. Resistor R_9, as in other bootstrap applications could be a diode with its anode at plate supply potential, but for the voltage magnitudes involved here the resistor is more than adequate. The d-c voltage at the junction of R_9 and R_{10} is about +190 volts for a B+ value of 250 volts.

Pulses are Frequency-Modulated

The sawtooth wave thus developed is directly coupled to the grid of V_{4A}. This tube is cathode biased by its plate current so that conduction begins when the sawtooth is about half way up; the passage from the beginning of plate current flow to grid current consuming about 0.25 microsecond. Because C_8 is large and holds the bias constant during the sawtooth period, grid current stops the charging of C_7, and the latter half of the sawtooth rise is clipped. The resulting waveform is shown in Fig. 2C the dashed line indicating the waveform without the direct coupling to the grid of V_{4A}. Thus, the plate current of V_{4A} flows only during the

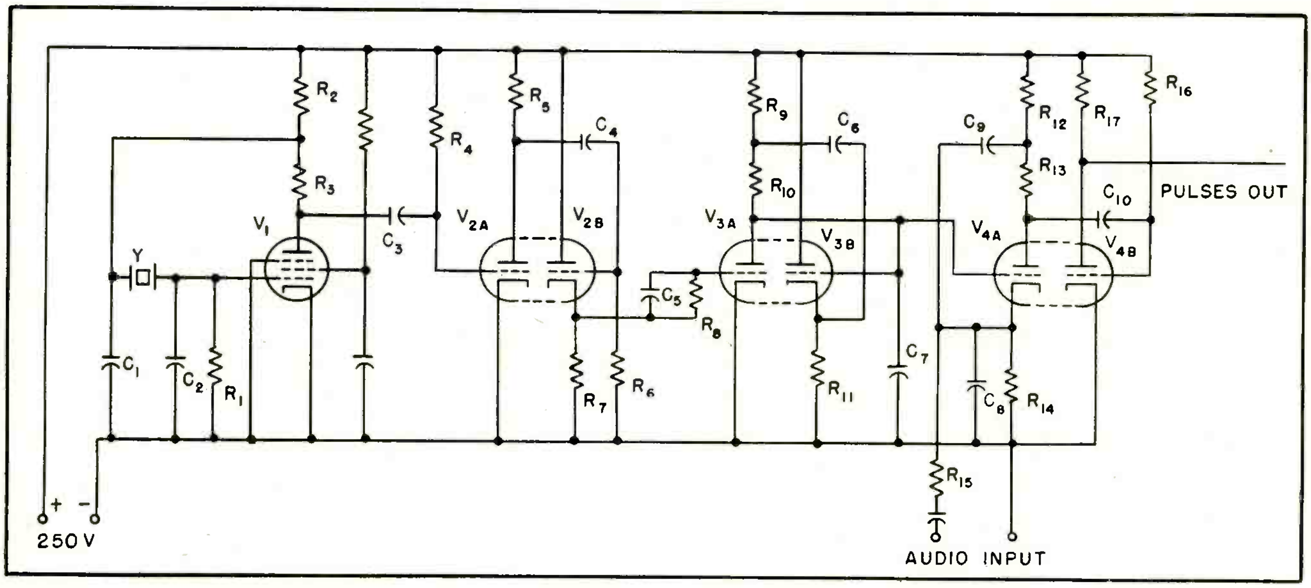


FIG. 1—The modulator proper showing the crystal oscillator, clipper, sawtooth generator and bootstrap cathode follower, and f-m pulse output tubes. The frequency multiplier stages that follow are conventional

latter half of the sawtooth wave. If the bias for V_{4A} is varied, the leading edge of this current pulse will vary in time or phase, an advance resulting from a lowering of the bias and a retardation from an increase. It is in this way that phase modulation in the unit is accomplished.

Audio or program is applied at the indicated terminals. Values of R_{15} and C_8 are so proportioned that for constant audio input amplitude versus frequency, the resulting amplitude at C_8 is inversely proportional to audio frequency over the range upward from 50 cycles. This circuit is included so that the peak phase shift shall be inversely proportional to modulating frequency and the resulting frequency response of the frequency modulation shall be flat. The function and the network are the familiar corrector present in all phase-shift type frequency modulators. In order that at 50 cycles the phase of the pulse edge be shifted $\pm 1\frac{1}{2}$ radians, approximately 50 volts rms is required at the input to the corrector. In the complete modulator a two-stage amplifier provides the gain to raise the standard input of ± 10 dbm to this level. Since feedback is used in this audio amplifier to provide linearity, the effective modulation sensitivity is also stabilized to a marked degree. This sensitivity depends only on the audio gain and the stability of R_{10} and C_7, and ordinarily is stable to within 1 percent for the standard ranges of temperature, line voltage, and tube changes.

Figure 2D illustrates the waveform at the plate of V_{4A}, the dashed lines showing the extreme positions of the leading or negative going edge during 100-percent modulation at 50 cycles. For 100-percent modulation at 100 cycles the excursion is one half that shown, and so on. This wave is differentiated by C_{10}, R_{10}, and the grid cathode conductance of V_{4B} so that the latter is cut off for a short time each cycle beginning at the leading edge. The resulting positive-going pulses at the plate of V_{4B} are shown in Fig. 2E. These pulses are frequency modulated approximately ± 75 cycles at 100-percent modulation. They are applied to the grid of the first of a string of frequency multipliers. The plate loads of this and subsequent multipliers are resonant at the various harmonics, and therefore, involve only sinusoidal c-w currents. In the broadcast version these multiplications are 3, 3, 3, 3, 2, 3, and 2, for a total of 972 times, yielding a carrier frequency in this illustration of 97.2 megacycles with a deviation of ± 75 kilocycles at 100-percent modulation.

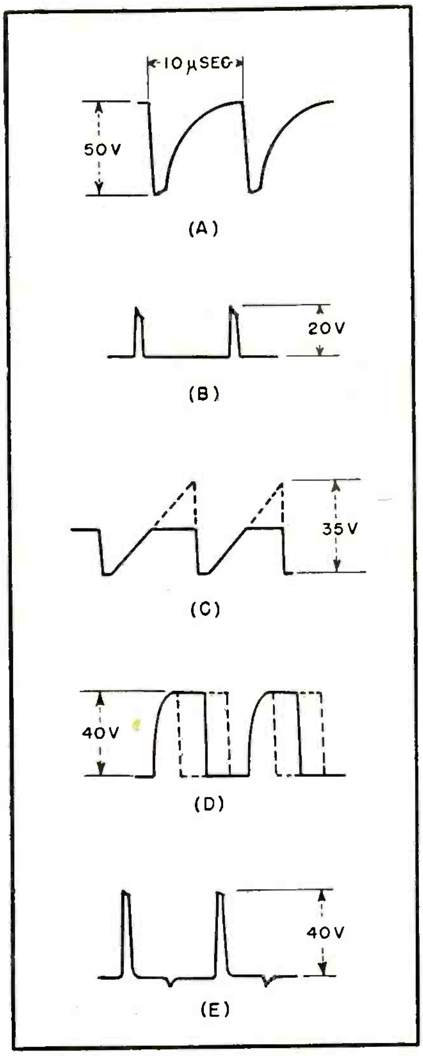


FIG. 2—Waveforms, oscillator to output

Circuit Design Factors

Before proceeding to a discussion of distortion and noise in a system of this sort several salient features may be pointed out. First, in common with all phase-shift modulators, there is no interaction whatever between the functions of modulation and carrier-frequency control, and the final stability is exactly that of well engineered crystal control. Exclusive of the frequency control the modulation process is accomplished in three standard receiving type tubes operating under cutoff to saturation or cathode follower conditions. As a result the process is remarkably independent of tube changes or aging. There are no resonant circuits and no reactances. Largely to eliminate the commercial tolerances of resistors and capacitors, C_3, C_7, C_{10}, and R_{11} are factory adjusted, and thereafter no adjustments even of a maintenance nature are necessary, except after outright component failure. Tubes V_1 through V_4 drain about 20 milliamperes at 250 volts.

Possible Variations

An interesting aspect of the development of this modulator lies in its apparent simplicity. Until certain special factors were fully appreciated performance was indifferent and the simultaneous attainment of low distortion and low noise hardly seemed practical without considerable elaboration. A good many detailed variations from the sample circuit shown are operative, and some yield high performance. But without the observance of certain principles, design can be surprisingly difficult. The important rules affecting linearity and noise are enumerated below.

Having selected the sawtooth waveform as the basic timing or phase-shifting mechanism, it developed that linearity could not be preserved if it was amplified or caused to appear as a current variation in a plate-loaded tube, no matter how attractive such a step may have appeared at first. Other means of straightening the sawtooth beside the bootstrap arrangement shown are entirely practical provided the sawtooth waveshape as such is not amplified. In particular, in the modulation process the tube performing the timing, V_{4A}, cannot carry currents of sawtooth shape and still preserve linearity in the timing process. It was found also that the amplitude of the current pulses in V_{4A} should be constant during the modulation cycle. To insure this condition the plate supply voltage is maintained constant by C_9. The supply voltage is low, about 30 volts, giving a small cutoff voltage.

Noise arises in such a system in the form of random variations in the time of occurrence of corresponding events in consecutive cycles. Such timing variations ordinarily are the result of superposition of noise voltages on the desired wave-form. The noise voltages originate either in tube current variations or as Johnson noise in resistors. The effects of both kinds of noise are reduced by increasing the time rate of change of voltage in the sides of the pulses, and by maintaining low circuit impedances at certain points. For instance, impedances controlled by R_3, R_7, and R_{10} are in a position to contribute to the residual modulator noise unless maintained below values appropriate to the pulse amplitudes appearing across them. This is another way of saying that the circuit bandwidth should be as great as possible so that the pulse rise-time is short. Noise originating from uniformly distributed random voltage variations causes frequency modulation noise with a triangular distribution spectrum, extending linearly up from zero at zero modulating frequency. For the band up to 15,000 cycles the integrated noise power from a given resistance is approximately 44 db greater than would be the case for a flat noise spectrum. The 75 microsecond de-emphasis in the f-m receiver reduces this effect by 13 db. The reduction factor is different if the original noise is other than triangular. For instance, Johnson noise in R_{10} is modified in its spectrum by C_7 before it can phase modulate pulses determined by the sawtooth. It is a straightforward matter to show by calculation that if the linearity were secured without the bootstrap or its low-voltage equivalent, that is, by making the supply voltage very high, the noise generated by the necessary large resistor would be excessive by a considerable factor. Thus it comes about that the bootstrap or its low voltage equivalent is uniquely essential to securing simultaneously low noise and low distortion. By similar reasoning it can be shown that the lowest noise is obtained when the corrector capacitor C_8, is directly at the modulator cathode. If the corrector were to be located at a lower level in the audio section, tube and Johnson noise originating after it would have a 31 db handicap and with practical tubes and circuit constants, this effect would be insurmountable. The possibility of noise phase modulation in the first tube after V_4 is minimized by making this a frequency multiplier so that the noise deviations are multiplied by a smaller factor than those originating in V_4 and earlier.

Performance

The general performance of the Serrasoid system in the particular case shown, and following the design rules noted can be summarized as follows. The linearity of the phase-shift process is readily made to be equivalent to less than 0.1-percent f-m distortion for peak phase shifts of ± 135 degrees. It should be noted that nonlinearity in the phase-shift process results in f-m distortion proportional to the order of the harmonic generated. Thus 1 percent third harmonic expressed as distortion of the phase shift is equivalent to 3-percent distortion measured as frequency modulation. In the commercial f-m broadcast modulator the distortion is largely controlled by the included audio amplifier, and the overall figure is held to less than 0.25 percent for 100-percent modulation at 50 cycles. At high frequencies where the peak phase shift is less the distortion falls until it is entirely accounted for in the audio circuits. At the upper end of the audio spectrum, distortion owing to tuned circuits in the frequency multipliers rises slightly, but by reasonable design is held below 0.25 percent, measured without de-emphasis. It is much easier to contrive that the distortion be this low than it is accurately to measure it once secured!

The f-m noise originating in the modulator and in the band from 50 to 15,000 cycles, measured with 75-microsecond de-emphasis is somewhat better than 80 db below 100-percent modulation. This noise is made up of approximately equal contributions from the crystal oscillator plate circuit and the plate circuit of V_{4A}. It can be reduced still farther by designing for greater pulse bandwidth and higher tube currents, and by the special artifices described below. Microphonism is no practical problem at all with non-selected ordinary tubes. Because of the simplicity of the circuits involved shielding and isolation by ordinary means serves to suppress the noise effects of r-f feedback from high-level sections of the transmitter.

Increasing Phase Shift

There are two ways by which the total phase shift can be increased over the practical maximum of ± 150 degrees. One of these is by cascading, or iterated modulation. The pulses at the plate of V_{4B} are similar in form and amplitude to those at the plate of V_{2A}. If, instead of coupling here to the grid of a multiplier, these pulses are fed to a duplicate of the circuit extending from V_{2B} to V_{4B} inclusive, another complete modulation process will have been encompassed. One stage of such cascading doubles the peak phase shift with the same percentage of f-m distortion and yet raises the f-m noise by less than 3 db. Thus the effective signal to noise ratio is improved by at least 3 db. The price paid for this iteration is two and a half additional tubes and a doubling of the audio power required to modulate. The process can be extended beyond two modulations. The other method involves generating two or more interlaced sawtooths at submultiples of the crystal frequency by means of a step-counter frequency divider; separately modulating pulses from each of the proportionately longer submultiple sawtooths; and recombining the sets of modulated pulses. The submultiple frequency, of course, must be more than twice as high as the highest modulating frequency involved.

In general, by the use of cascading and interlacing, as noted, by the use of a modification of the scheme employed in the Armstrong dual channel phase shift modulator, and by several other arrangements too detailed to describe here, the application of this system can be extended to cover a very wide field.

Commercial versions of the new modulator have been in use for the past six months at W2XMN-W2XEA, Alpine, New Jersey, and in the studio-transmitter link used to program KSBR, Mount Diablo, California.

BIRD'S-EYE VIEW—From a low-flying helicopter, here is how Electronics Park looks to a camera aimed due west and downward. All visitors are welcomed at the Reception Building (middle foreground), where they receive a marked map of the Park

The Editors Report on ELECTRONICS PARK

To build a combined headquarters, engineering heaven and de luxe manufacturing plant for its expanding electronics business, General Electric has invested heavily in a new plant at Syracuse. Here, along with the physical details, is the story of the people—the engineers, supervisors and workers—on whom hinges the future of Electronics Park

PART I—The Park and Its People

IN the rolling farmland near Syracuse, N. Y., has arisen an industrial phenomenon, a 155-acre campus combining research, engineering and production on a scale never before seen in the electronics business. This is Electronics Park, the headquarters of the Electronics Department of the General Electric Company. Nine buildings have been completed, stocked with machinery and equipment, and brought to operating status.

The Park is no idle experiment in bigness. When the war ended, GE had a greatly expanded electronics business located in 22 plants—with no headquarters plant. The company's long experience in the lamp business—and electronics closely parallels it in many respects—pointed the way to a headquarters plant for engineering, manufacturing, sales and marketing operations. And so Electronics Park may be said to be a modernized version of Nela Park. Both have the "campus" atmosphere, the last word in engineering facilities coupled with manufacturing operations and many satellite plants in various parts of the country.

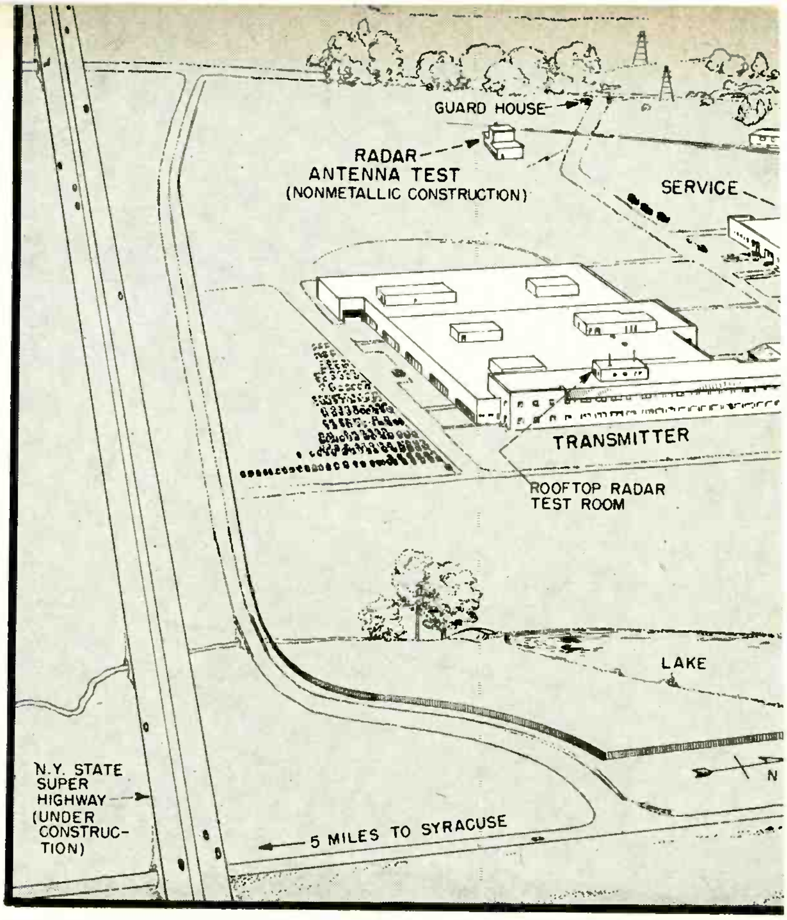
Compared to competitors' plant facilities, the Park undoubtedly appears to be a "luxury" operation to many industry visitors. Contrasted to this attitude is the GE philosophy as expressed by Dr. W. R. G. Baker, vice-president in charge, who explains that management merely has provided the best possible postwar facilities and atmosphere for its engineers, office and production workers, and salesmen—all of which has already resulted in improved productivity as compared to similar GE electronics operations before the war.

The editors of ELECTRONICS undertook some months ago to study the operations at the Park. This report results from weeks of interviewing the engineers, the executives and the production workers. Its purpose is to describe features of the organization, its systems, techniques, facilities and methods. Some of these ingredients of creative productivity are, of course, equally applicable to many another plant or laboratory in the industry, and may well be adopted with profit by others.

The genesis of the Park goes well back into GE history. Since the early experiments of Langmuir, Alexanderson, Hull, Dushman, White, Coolidge and Whitney, electronic theory and practice had an important place in the GE picture. But electronics manufacture never loomed large in dollar volume compared with the company's apparatus business, for example. For years GE was completely out of the radio receiver business and practically all other phases of the electronics industry with the exception of building transmitters and receivers for the government and a comparatively small amount of industrial electronics equipment.

This was the result of arrangements approved by the government under the consent decree of 1932 whereby GE voluntarily liquidated practically all its previous activities in the field, most of which went to RCA—patents, products, machinery and engineers. GE went back into receiver production in 1937 at Bridgeport, Connecticut, squeezing into the household appliance plant. Since then, the various divisions of the Electronics Department have been living in other peoples' attics scattered over the eastern half of the country.

The vast expansion of electronic production brought to GE by the war further decentralized production. Even before the war's end, it was clear that the scattered electronic manufacturing plants could not be brought back to Schenectady, which was already over-



THE PARK—155 acres of upper New York State farmland were converted into Electronics Park, headquarters of GE's Electronics

crowded with nonelectronic activities. Planning for the Park began, in fact, as early as 1942.

Why Syracuse Was Chosen

The first big decision was to find a site that would serve as headquarters and an engineering center for the Electronics Department, and have a large enough manufacturing plant to take care of practically all business in a normal year. The four major considerations in choosing a location were: (1) availability of labor to support contemplated production; (2) availability of air, rail and highway transportation, hotels and other community facilities; (3) reasonably central location with respect to sources of raw materials and markets for finished goods; (4) sufficient nearness to the research centers of GE to permit frequent contacts.

For the NEWS STORY with facts and figures, read

PART I—The PARK AND ITS PEOPLE .... *pages 77-84*

For the picture of ENGINEERS at work, read

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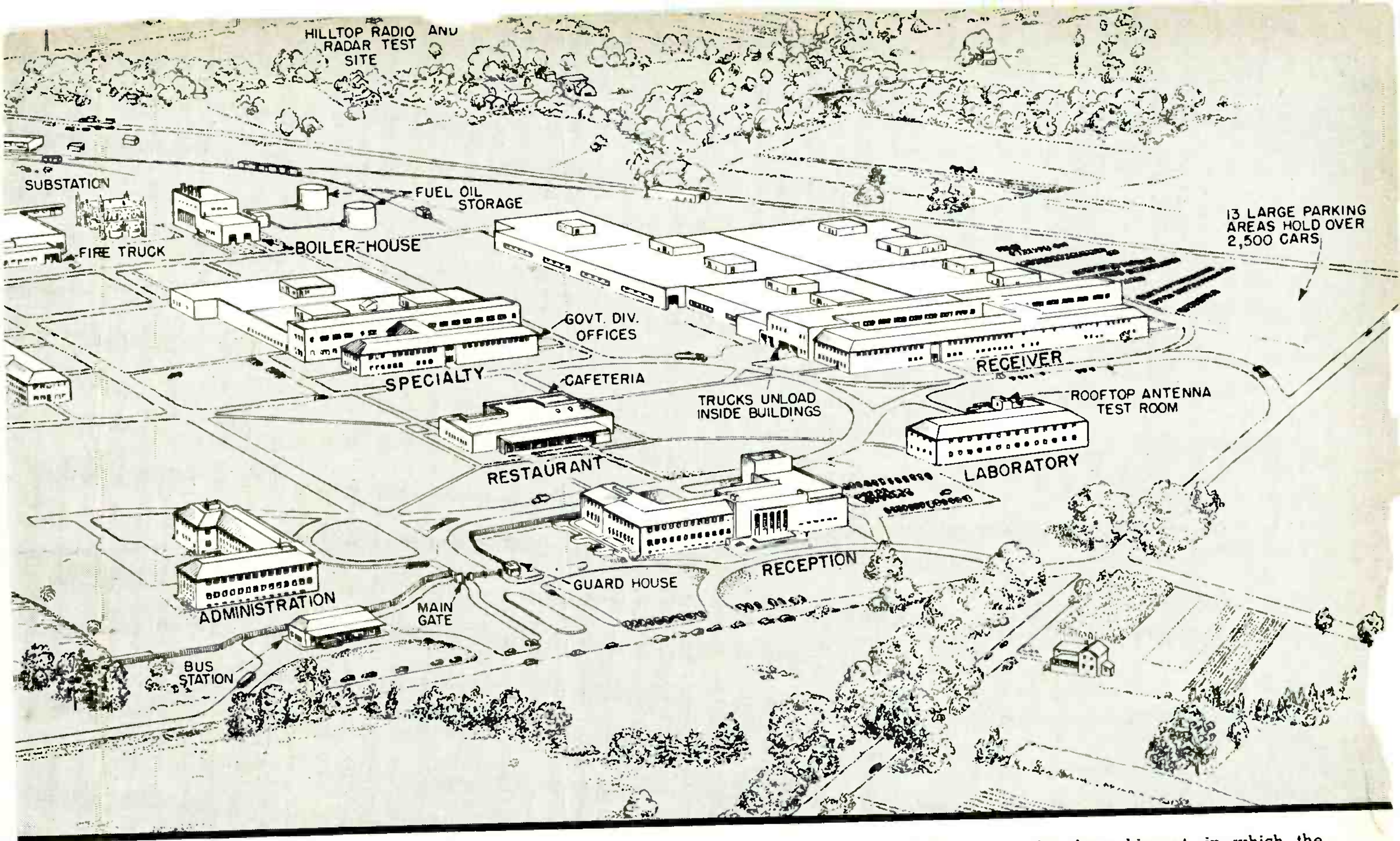


Department. Location is five miles northwest of heart of Syracuse and a half-mile from Liverpool. Of the nine buildings in the Park, one commands and five serve the three biggest, in which the actual manufacturing is done

Over a hundred communities were considered, some of which met all of the above requirements. Syracuse, however, had two plus values—a large group of employees that had operated the GE war plants at Thompson Road and Wolf Street, and convenient means for graduate study by engineers and other employees at Syracuse University. Therefore, Syracuse was chosen.

The 200,000 population of Syracuse is large enough and its industry sufficiently diversified so the Park's activities will not seriously affect the economy of the community. The city has a record of favorable union relations, and careful analysis shows that the Park can take a maximum of about 6,000 workers from the area without disrupting labor conditions in other Syracuse industries.

The site was picked next—155 acres of farmland about 5 miles northwest of the heart of town, on good roads and within the freight yard limits of Syracuse. Architects were engaged and commissioned to give GE a modern plant designed specifically for its electronics business.

Construction Problems

No job of this size could be undertaken without running into the usual labor difficulties. For example, the building design called for 1,800,000 bricks—presenting a tremendous job to get from the area enough bricklayers to finish the project. It was necessary, in fact, to obtain men from surrounding cities to handle the job.

Grading for Electronics Park was started in the fall of 1944, but the contractor worked only a few days before snow came. The ground was not seen again until the end of March, 1945. Construction started in September, 1945. In spite of difficulties of obtaining material as well as labor, the contractor started setting steel for the Transmitter Building in April, 1946. One year later this building was in operation, and production was humming. By early 1948 all main units were completed.

Units of the Park

The three largest units, the Receiver Building, Transmitter Building and Specialty Building, are combined engineering and sales offices and manufacturing plants devoted to their respective products. The remaining six buildings provide services and staff functions common to all activities. They include the Administration Building, Reception Building (which also includes an auditorium, the main hospital, employee relations offices, company store, classrooms, and a photo laboratory), the Laboratory Building, Service Building, Boiler House and Restaurant. Smaller units are available for special purposes, such as a hilltop test site for radar, and a nonmetallic building for testing radar antennas.

Construction of this plant required 500,000 blueprints, and over 100 engineers worked for a full year designing the layouts. Over 7,000 tons of steel were used in erecting the framework of the buildings and over 70,000 cubic yards of concrete were poured, much of it in bitter winter weather.

All offices and factory areas are air-conditioned. Fluorescent lighting and attractive tile floors are used in the offices and in all the factory buildings. The flooring in offices and labs is laid on concrete over a system of six-inch floor ducts. This permits obtaining a new power or telephone outlet within a few inches of a desired new location anywhere on the floor. Partitions are the Hauserman metal type that can be set up, moved or removed almost overnight to accommodate the continually shifting office and lab requirements.

There are 57,000 square feet of windows in the Park. Supplementing the natural lighting are 28,000 lighting fixtures of the fluorescent troffer type, with 100-watt units in the factory areas and 40-watt units in office areas.

The roofing, except for copper flashing on the office buildings for appearance, is of precast concrete slabs and standard built-up tar felt and slack. A tunnel approximately a mile and a half in length interconnects all buildings and carries domestic water, steam, a condensate return and telephone lines.

At seven points in the Park there are driven grounds tied together by a ¼-inch by 2-inch copper bus that runs through the tunnel system. Less than an ohm of resistance can be measured between any two of them. Each steel column in each building has its own copper conductor running to this ground system, as also do all water mains and all of the external shields for each shielded room.

The Boiler House has three 60,000 lb per hour oil-fired boilers which provide heating as well as process steam at an operating pressure of 75 lb. At present two 400,000-gallon fuel oil tanks are provided. Inasmuch as this huge project depends on a single 16-inch water line from Syracuse, a 1,200,000-gallon water reservoir will be installed to insure a continuous water supply for production needs and fire protection.

Power is received from the Central New York Power Corporation over two 115-kv lines. This voltage is reduced to 13.8 kv at a substation in the Park, for distribution to 35 unit substations located in penthouses on factory roofs and in basements of office buildings.

Within the Park there is a total of 3½ miles of track and interconnecting switches, arranged so that incoming material can be unloaded at the receiving dock in the desired building while other freight cars are being loaded at outgoing platforms. One GE 50-ton Diesel-electric locomotive handles traffic after receipt from the railroad.

Because the winters in this part of the country have low temperatures and occasional heavy snows, the service group has 3 V-plows, 2 Snogos that pick up and blow snow to the side of the road, a Jeep sidewalk plow, and several bulldozers. Adequate space surrounds each building and the roads so that snow will never have to be hauled away by trucks. Inside the Park are over 5½ miles of road, all paved with concrete and blacktop, plus about a mile of concrete walks going across the lawns.

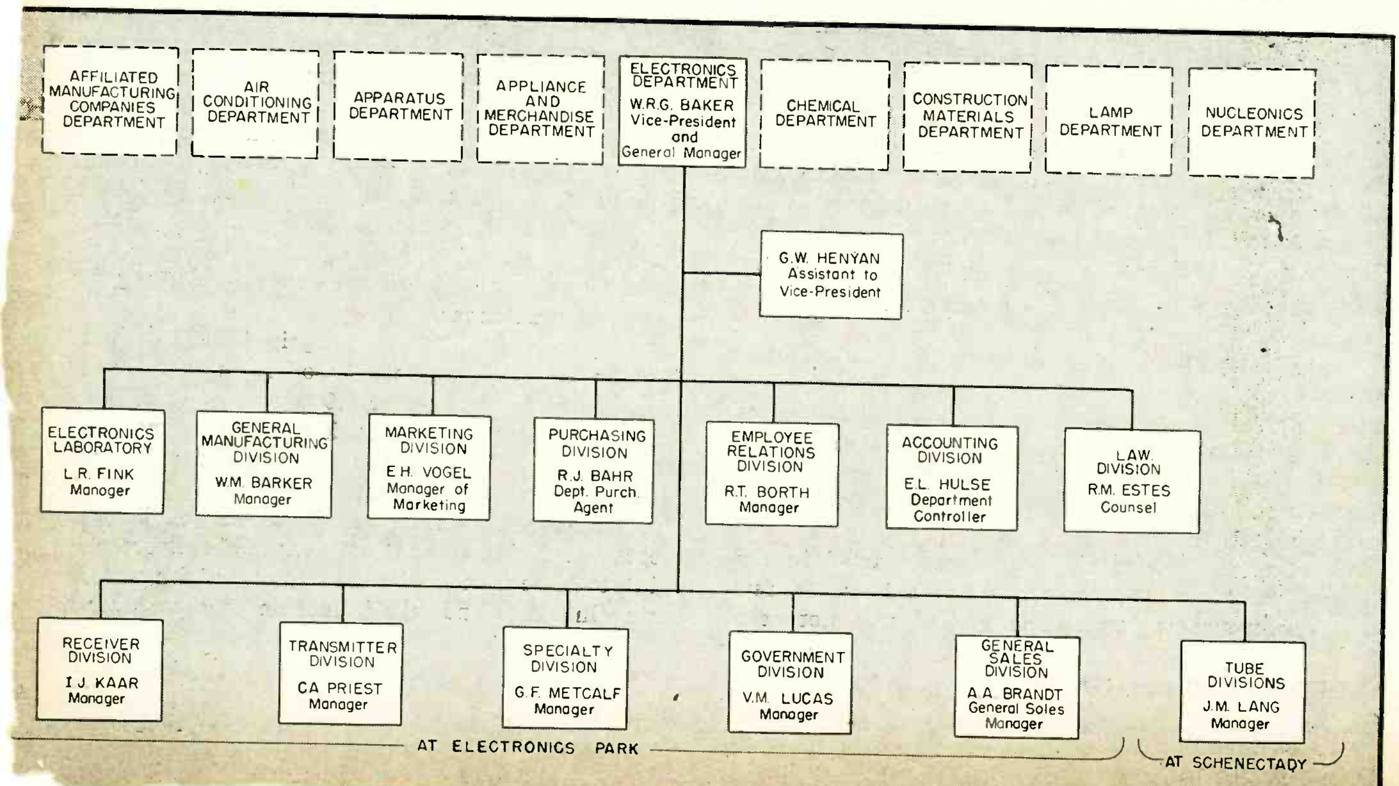
The Management Team

By mid-1948 the Park was erected, staffed and operating. The plant is there, a large investment that has to be managed along creative, productive and profitable lines of action. The Park, in Dr. Baker's opinion, is only incidentally buildings, equipment and machinery. Primarily the Park is people—the ideas they have, the work they do, the decisions they make.

In an outfit of this size, decisions are always potentially dangerous. For example, it takes over 20,000 radio receivers of any new model merely to sample the Receiver Division's dealers. So the right decisions on chassis design, cabinet styling, quantities the market will absorb, and pricing all are extremely important.

The big decisions are made by the management team shown in the organization chart. The Electronics Department is one of the nine operating departments comprising GE, shown at the top of the diagram. Each

DECENTRALIZED OPERATION—Organization chart showing relationship of Dr. Baker's Electronics Department to the other eight operating departments that constitute General Electric Company, with divisions under his wing shown in the lower rows



THEY RUN THE SHOW—Five engineers and a salesman, heading the world's largest concentration of electronic engineering and manufacturing facilities. Left to right: G. F. Metcalf of Specialty Division; A. A. Brandt, General Sales Manager; V. M. Lucas of Government Division; vice-president W. R. G. Baker; C. A. Priest of Transmitter Division; I. J. Kaar of Receiver Division. Not pictured is J. M. Lang of Tube Divisions, located in Schenectady rather than in the Park

Department is in effect a separate business, independent in its engineering, manufacturing and sales, headed by a general manager who in most instances is a vice-president of GE. The departments are assigned budgets at the beginning of the year by the head office, and are responsible only for returning the budget, with a profit at the end of the year.

The Electronics Department management is divided into two teams, the staff divisions (advisory) and the operating divisions. The staff functions, shown in the third row of the diagram, include services common to all operations, and are largely nontechnical. For example, E. H. Vogel, manager of marketing on the staff, represents the vice-president and advises the operating divisions on such matters as general departmental and divisional sales policies, product planning and pricing, merchandising plans and programs, advertising for all products, and market research.

Similarly, the other staff divisions advise the operating divisions on all important decisions, and are brought into operation as their particular services and experience are needed.

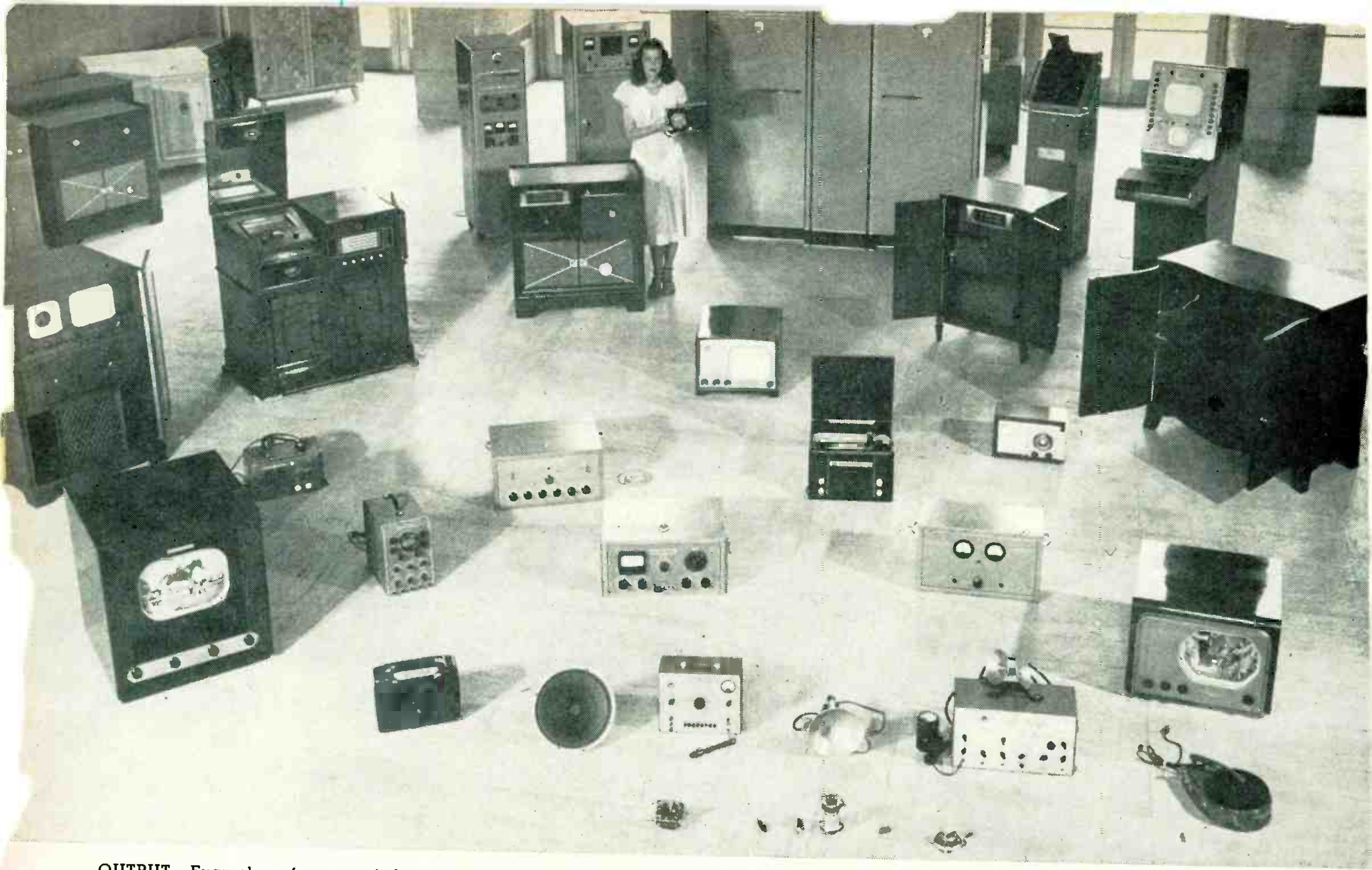
The technical staff unit is the Electronics Laboratory, whose function lies midway between the pure research work carried on in Schenectady and the operating laboratories concerned with development specifically for production. Its job is to develop ideas from the pure research stage to the advanced development stage, and it serves all the operating divisions.

The operating divisions at the bottom of the chart are, like the company's big departments, virtually independent businesses, working from a budget and returning it with a profit. Each division has its corps of engineers and production men, its own engineering labs and manufacturing plants, its own sales people. The heads of the divisions are thus primarily business men with broad management responsibilities. Like Dr. Baker, most of these men came up through the technical ranks of the company.

Operating Divisions

Largest of all the operating divisions is the Receiver Division, with close to 5,000 employees and about 1.5 million square feet of space. About half of these employees and 400,000 square feet of this floor space are in the Receiver Building in the Park, and the remainder is in satellite plants outside the park. This Division makes all kinds of radios and television sets en masse as its principal function and also supplies components, like loudspeakers, to other manufacturers.

Whereas many of its competitors procure the bulk of their engineering from the license laboratories to keep this expense at a minimum, the Receiver Division has preferred to stay in the engineering business and work to achieve the higher volume level required for the break-even point in order to absorb engineering costs. Since seasoned engineering organizations can-



OUTPUT—Examples of many of the products made in the Park. In quantities ranging from one of a kind to hundreds of thousands, they fill freight cars and trailer trucks that leave the Park destined for distributors and customers throughout the nation. Products like large international broadcast transmitters and shortwave receivers are delivered to International G.E. Co. for export

not be created overnight, the existence of a receiver engineering organization is important insurance for the future. Furthermore, GE derives a great deal of prestige, as well as some material gain, through introduction of engineering advances even though these are available immediately to competitors through cross-license agreements.

The receiver engineer must often work toward two entirely opposite goals at the same time. On the one hand, he tries to design a set so there are one or more subassemblies that can be put together separately out in the open, where the work is much easier than deep inside a crowded chassis. On the other hand, a subassembly involves extra expense for producing the separate chassis and for combining it with the main chassis, hence the ultimate goal is to get rid of separate units. The head end of a television receiver is an excellent example of a legitimate and economical subassembly because it involves assembling a dozen sets of tuned circuits positioned around a selector switch, followed by alignment of each tuned circuit.

The Transmitter Division, whose chief function is to build big electronisms, comes next with about 2,500 employees, 90,000 square feet of floor space for offices and development laboratories, and a manufacturing floor equal to 210,000 square feet. The Transmitter Division divides its allegiance approximately equally between government and commercial customers. This was the first of the manufacturing buildings in the Park to go into production.

Although deadlines, economic factors, and the matter of eye appeal plague engineers in the Transmitter Building, commercialism is not nearly so evident as in receiver engineering. The work of the transmitter engineer is more diversified. There are about 192 graduate engineers in this division, of which 126 are in the engineering groups, 37 in factory inspection and test groups, and 29 in field engineering.

The Specialty Division, with some 500 employees and over 100,000 square feet of space, makes special electronic items. Measurement equipment for the new field of nucleonics is now one of the items receiving high priority. The Specialty Building is in the center of the Park.

Finally there is the Government Division, which utilizes about 50,000 square feet of space throughout the Transmitter and Specialty Buildings, and, in addition, about 200,000 square feet in the Thompson road plant in Syracuse. It has every possibility of expanding as government contracts are received for electronic equipments needed by our armed forces. Most of this business involves radar and other highly complex electronic equipment; in line with tradition, GE accepts many tough engineering jobs from government agencies.

At the beginning of World War I GE was doing government electronic business and has been in it ever since. The Government Division is strictly a quality business in every sense of the word, since the best is none too good for our armed forces. Govern-

THINGS AHEAD

IDEAS, some well along in development, that may become the products of tomorrow:

- Low cost, simplified television receivers
- Color television, electronically on a single picture tube
- Metal television picture tube
- Portable f-m receiver
- Radio remote control unit for appliances and for models
- Printed radio receiver, untouched by human hands
- Simplified superregenerative f-m receiver circuit
- High-frequency heater for thawing frozen foods in homes
- Microwave 60-second electronic range for restaurants and homes
- Electronic equipment for guiding and controlling missiles and rockets
- Pocket-size atomic radiation detectors with alarm
- All-electronic aerial superhighways for air navigation and traffic control
- Magnetic learn-to-read unit that pronounces words printed on keys which move pickup head to different parts of magnetized paper disc
- Advanced radar navigators for airplanes and ships
- Higher-powered television transmitters
- Super-powered broadcast transmitters
- Facsimile equipment for police, industry
- Personalized two-way radio sets

ment equipment is built to customer's specifications; there are no standard lines. The customer here always wants something new—rarely if ever is a product reordered, because by that time either the requirements have changed or there have been improvements in the design.

Government engineering occupies the entire second floor of the Specialty Building, with another wing downstairs for its executives. When a design is finished and ready for production, some of the engineers move over to the Transmitter Building with it to see that production snags get ironed out promptly.

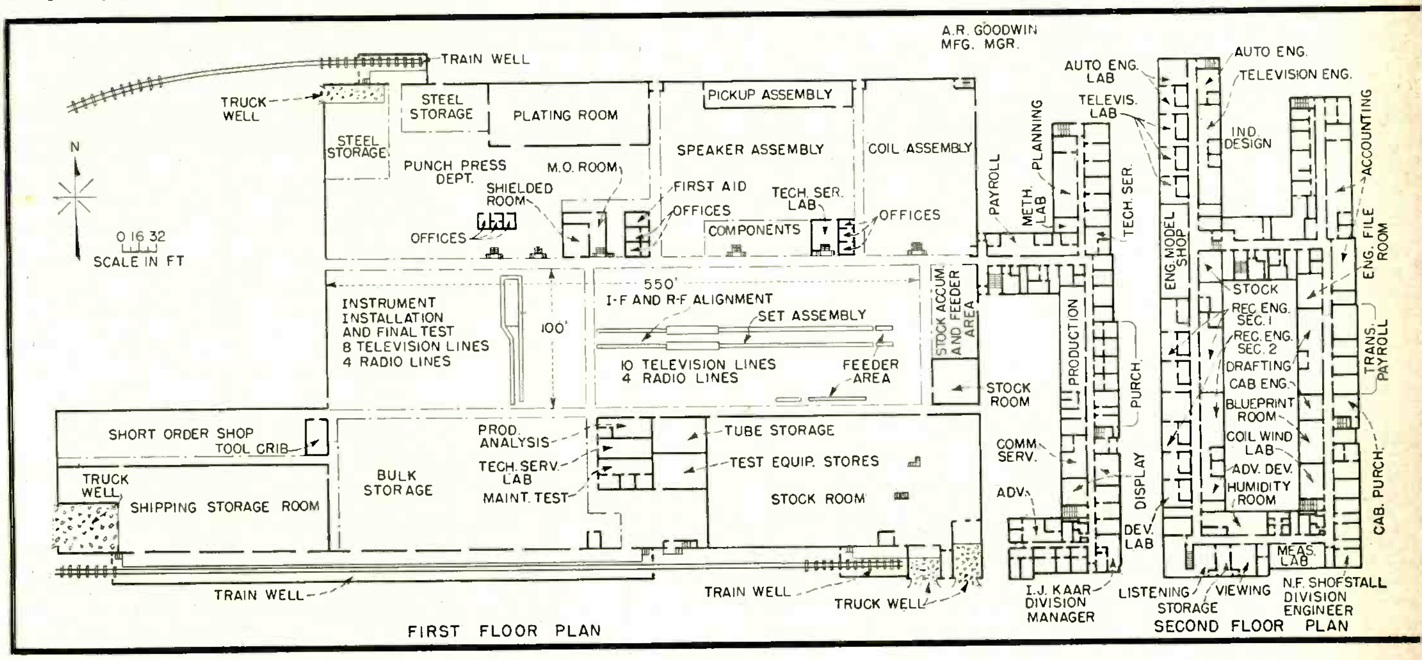
The General Sales Division management headquarters are in the Administration Building at the Park. It is responsible for the sale of the department's commercial products and for operation of the field sales organization in nine districts throughout the country, employing about 110 people. The manager of the division is also responsible for establishing adequate methods and channels of distribution, including distributor appointments and cancellations; for determining and administering commission plans for district managers and representatives; for the preparation of orders received and sales billed quotas for the districts and distributors; and for sales training programs for district representatives. He also shares with the product divisions the responsibility for product planning and pricing; merchandising plans and programs; production releases and scheduling.

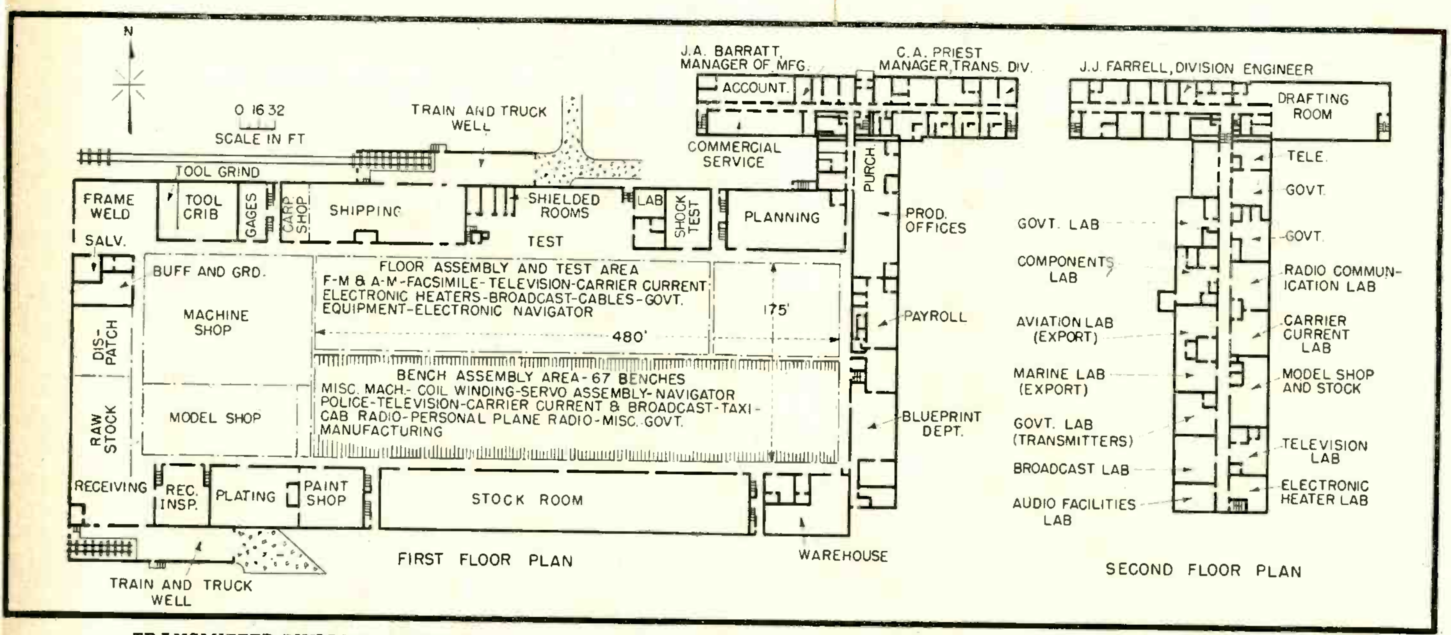
Headquarters for the Tube Divisions of the Electronics Department are in Schenectady where one of the 5 tube factories of the divisions is also located. Original plans called for moving the divisions to the Park, in a separate building. The lack of labor available in Syracuse for all electronics manufacturing, and the cost of the move were heavy factors against it. Another factor was the close relationship between the industrial and power electronics tube work and the company's industrial machinery made or designed at Schenectady and sold through the Apparatus Department. These divisions make a large variety of industrial, transmitting, receiving and cathode-ray tubes in many satellite plants.

Plans for Expansion

The Electronics Department's policy is definitely to limit the Park operations to a payroll of roughly 6,000

RECEIVER BUILDING LAYOUT—Design engineers work upstairs, with production supervisors and the sales staff under them in the front of the building. All moving-conveyor assembly lines for radio and television receivers are in 55,000 sq ft center section





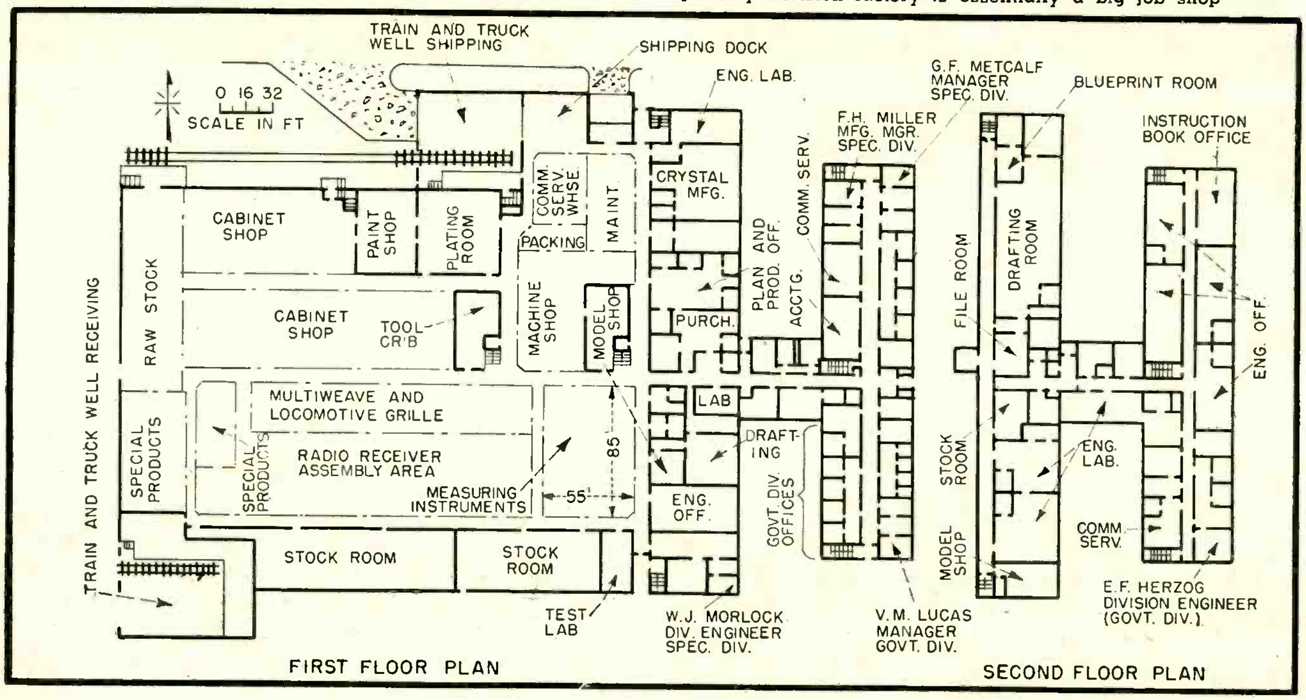
TRANSMITTER BUILDING LAYOUT—Engineers for the Transmitter Division are upstairs here, with supervisory and production planning offices for Transmitter under them in front of building. All assembly work is done either on the 67 benches or on the floor

employees, and to operate satellite plants for production beyond this point. For example, the Department has satellite plants in Buffalo, Clyde, Utica and Schenectady, N. Y., in Wabash, Indiana, in Owensboro, Ky., in Tell City and Huntingburg, Indiana, and in Irvington, N. J. These plants have, in all, 9,000 other employees and produce products like tubes, receivers and cabinets.

Expansion of the department's television receiver business this year has resulted in a plan to make all television receivers at the Park. By the year's end practically all radio receiver manufacture will be out of the Park in satellite plants and the entire Receiver Building manufacturing floor will be devoted to television. Since television receivers still need the attention of development engineers to keep things running, production in the Park will benefit from the close proximity of the television engineering and manufacturing groups.

The overall limitation placed on the Park's size by the availability of labor is an important advantage. The satellite plan of manufacture has an element of flexibility that would be missing in a larger concentration of facilities. Whenever more space is needed now, either temporarily or permanently, additional plants are acquired in cities having the required labor. Lines in heavy production, in which the engineering phases are essentially completed, get moved first to these outside plants.

SPECIALTY BUILDING LAYOUT—Specialty's engineers are downstairs, just off the manufacturing floor, because Government Division offices and labs occupy the entire second floor. The Specialty Division factory is essentially a big job shop



PART II—The Engineering Organization

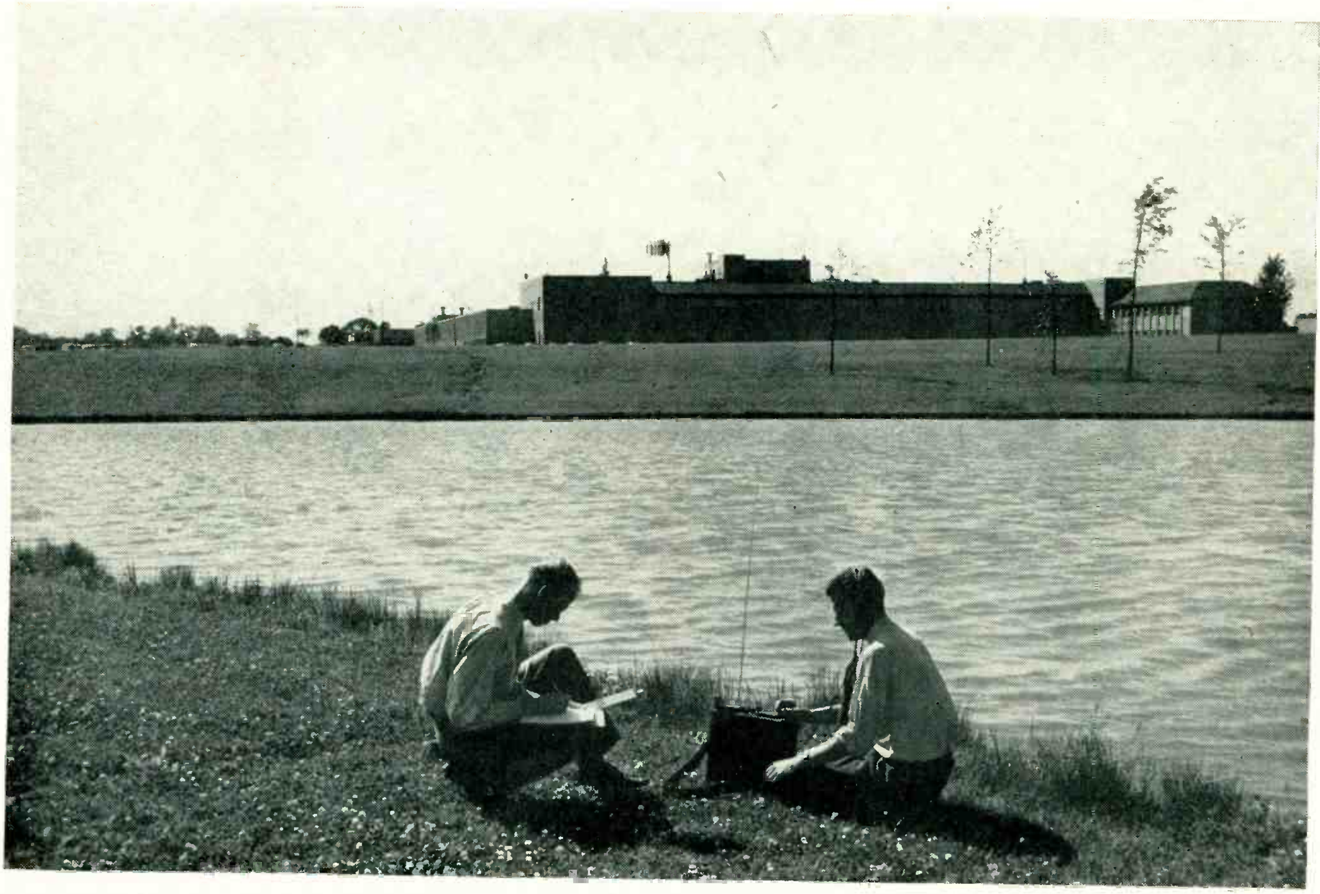
TWO SIDES OF A WALL—When a Receiver Division engineer becomes suspicious of a loudspeaker, he can bring it to this lab and run off a complete response curve in a few minutes. The loudspeaker is mounted in an opening in a wall between the soundproof room and the measurement room, facing the microphone. A motor drive sweeps an audio signal generator gradually from 50 cycles to 20,000 cycles, while an inking pen traces on graph paper the amplified output of the microphone

ENGINEERING is one of the keystones of the structure of Electronics Park. The manpower devoted to engineering is a high proportion of the total working force. The manhours devoted to engineering, in development and production, are proportionately high, and engineering costs follow suit. Add to this the fact that in no other industry is the utility and cost of the end-products more closely tied to the technical skill of the men who design and make them.

It is not strange, therefore, that a major portion of the effort in planning the Park went into providing the best engineering facilities available. But facilities have to be operated, so the story of the engineering organization starts with the men. How are they recruited and trained, how assigned to jobs, inspired to top effort? What are their pet gripes? These questions answered, it is pertinent to inquire what they have to work with, and what problems they wrestle with. In that order, then, let us consider the engineering organization of Electronics Park.

Recruiting and Training Men

Except in unusual cases the newly graduated engineering student has never faced the basic engineering challenge: with data not known to be sufficient, and with a time schedule not known to be adequate, he must design equipment for some new application without losing sight of the basic requirements of cost,



ENGINEERS IN CLOVER—Favorite site for field tests of communication equipment is lawn surrounding the lake in the Park, giving direct line-of-sight path to transmitting antenna atop Transmitter Building in background

efficiency, and dependability. GE has come to regard this aspect of an engineer's training as its own responsibility. Each year it absorbs into its laboratories, offices, and factories hundreds of young graduates from all parts of the country and from all types of colleges.

Channelizing such widely divergent backgrounds into occupations best suited for each calls for a flexible training program at all levels of aptitude and specialization. The best-known aspect of this is the Test Program. With few exceptions, most GE engineers select their specialized field via this medium.

Finding a Niche

For a period of from one to two years each newly-graduated student engineer is assigned to many of the major departments. His responsibility is to test the products manufactured by those departments, and during the course of this work he observes the problems and methods that are peculiar to each activity. The average assignment period is three months. By the end of his test period he can select with some confidence the kind of work that offers greatest interest and opportunity to him. The majority of engineers at the Park are graduates of the Test Program. This system provides the Electronics Department with a continuing influx of young men with new ideas.

Electronics Park is, of course, one of the major steps for Test Program engineers. In addition, the Park has its own Test Program wherein graduates are transferred from building to building within the Park at approximately three-month intervals. This program is for those who have definitely chosen electronics as their life work.

Evening schedules of classes are provided at Syracuse University for engineers desiring to study toward their Master's and Doctor's degrees. These courses have been approved for benefits under the GI Bill. For other engineers, GE pays approximately two-thirds of their tuition if they complete their course satisfactorily. For those who do not, GE pays a third of the tuition. Courses are conducted at Electronics Park as well as in Syracuse University classrooms, and the thesis can be accomplished in any of the labs in the Park. At the present time, over 100 engineers at the Park are studying for advanced engineering degrees.

Another source for Electronics Department engineers is in Schenectady, where some thirty to fifty test engineers are selected throughout the company for an intensive course on engineering analytics. The course is a startling experience for every man who takes it. For four hours he is subject to intensive lectures by specialists called in from design sections or research laboratories. He is busy taking notes, for he knows that most of the material cannot be found in textbooks, and he likewise knows that the material might provide a clue to his weekly problem assignment—a clue which might reduce the 20 to 30 hours normally required for solution to 10 hours.

THEY RUN THE ENGINEERS—Reporting directly to division managers and responsible for the engineering of the Park's present and future products are these four division engineers and the manager of the Laboratory. Seated, left to right: J. J. Farrel of Transmitter; L. R. Fink of Electronics Laboratory; W. J. Morlock of Specialty. Standing: E. F. Herzog of Government; N. F. Shofstall of Receiver. Not shown is O. W. Pike of the Tube Divisions. Section engineers report directly to their division engineers

Only about half of those who complete the first year of this advanced engineering training will continue with it. The elimination is carried out in a spirit of mutual agreement; some have found the going too stiff, while others have taken up permanent jobs in a GE division where additional training of this nature is not essential.

ENGINEERS IN THE PARK

Design and Development Engineers	553
Engineers in Sales, Manufacturing, Etc.	80
Total Engineers	633
Total Employees at Park	6,200

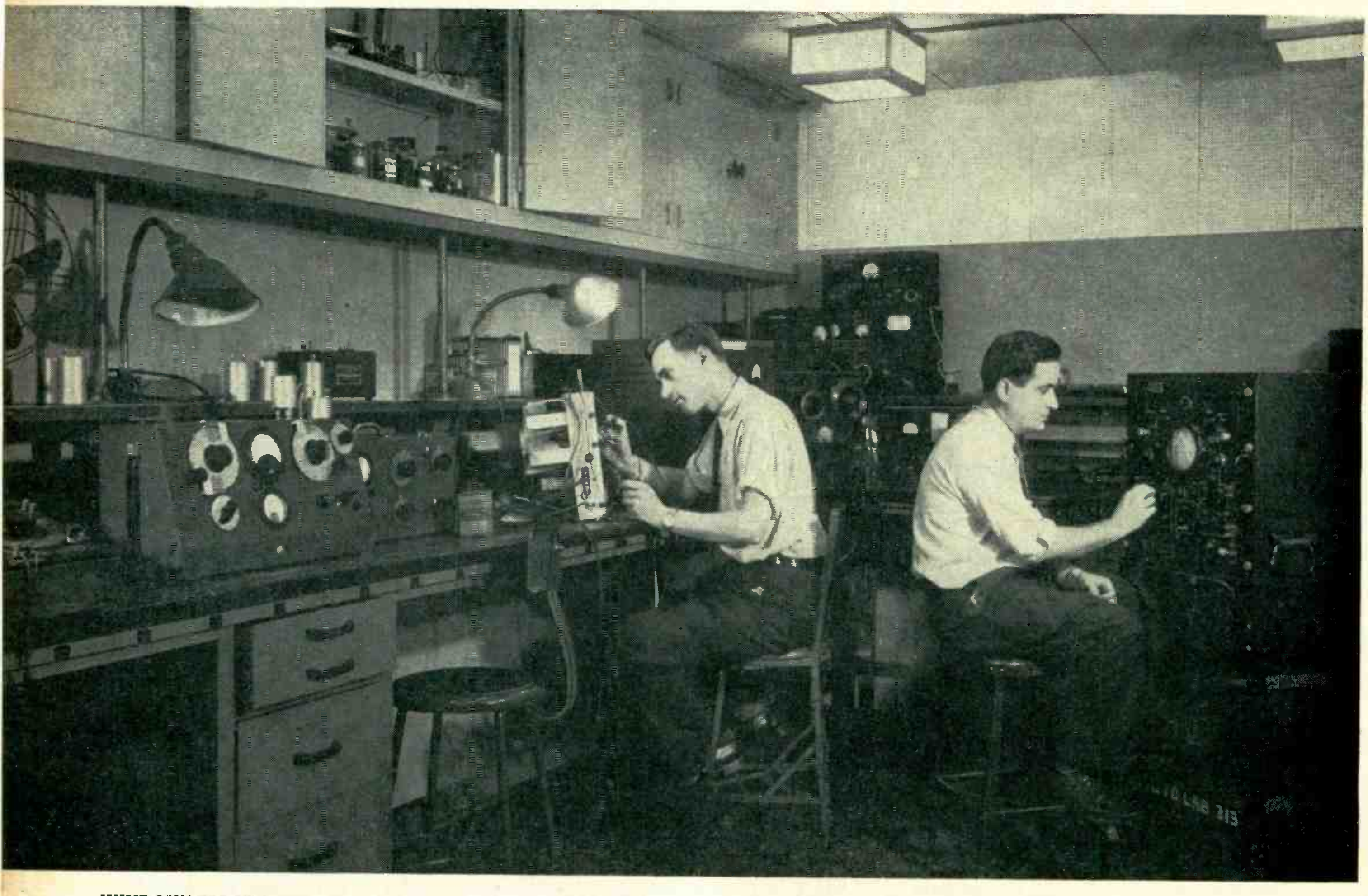
Types of Engineers

There are at least seven distinctly different categories in which the graduate of the Test Program or the engineering newcomer can end up: Research, advanced development, product design, manufacturing supervision, field engineering, sales engineering and commercial engineering. Each calls for its own particular combination of aptitudes, personality traits, and engineering knowledge. Furthermore, the duties of each vary greatly with the divisions—Transmitter, Specialty, Tube, Receiver, Government, Laboratory or Sales.

The chap whose interest is chiefly in the highly theoretical aspects of a problem, almost approaching those of a physicist, invariably ends up as a research engineer in the Laboratory. He has few cost responsibilities, seldom a delivery date to think of and delves only into the laws of nature.

The fellow who likes to work with his hands may end up as a product design engineer. In this category are most of the engineers in the Park. They take an idea and a blank piece of paper and produce working models and blueprints for production. They have to consider costs, eye appeal, delivery dates, and a multitude of related practical factors. A product design engineer, also known as a development engineer, is assigned to develop a particular product for which there is an order or a possible market, and he sticks to that job until a finished working sample is produced—or rather works on it whenever he gets a chance, because there is always a fire to be put out somewhere in connection with production of things he previously designed.

The organizing type of engineer is likely to end up as a manufacturing supervisor or section engineer because he likes to work with people. A factory train-



WINDOWLESS HEAVEN—Shielded room inside one of the Receiver Division laboratories, with desk lamps for delicate tests when overhead fluorescents prove too noisy. All laboratories are air-conditioned, hence lack of windows here is no hardship

ing course is conducted for the express purpose of developing men interested in both engineering and production.

Combine an interest in people with good engineering know-how, plus a love for change and travel, and you have the making of a field engineer. Combine a liking of people with a dislike for the slide-rule engineering of his college days, and you have a sales engineer, simultaneously looked up to and down at by his fellow engineers. He can be as much as 75 percent engineer and still be a topnotch salesman because of the market nature of the product he sells.

Add diplomatic qualities and market analysis to an ability to look ahead and you have the commercial engineer, who provides liaison between engineering, sales and advertising and is broadly responsible for consumer acceptance of a product. He is a main source of ideas for new products because he is continually in touch with customers' needs. Part of his work involves writing the specifications he considers desirable for a new product, and later making sure that the final product is good enough to merit customer acceptance.

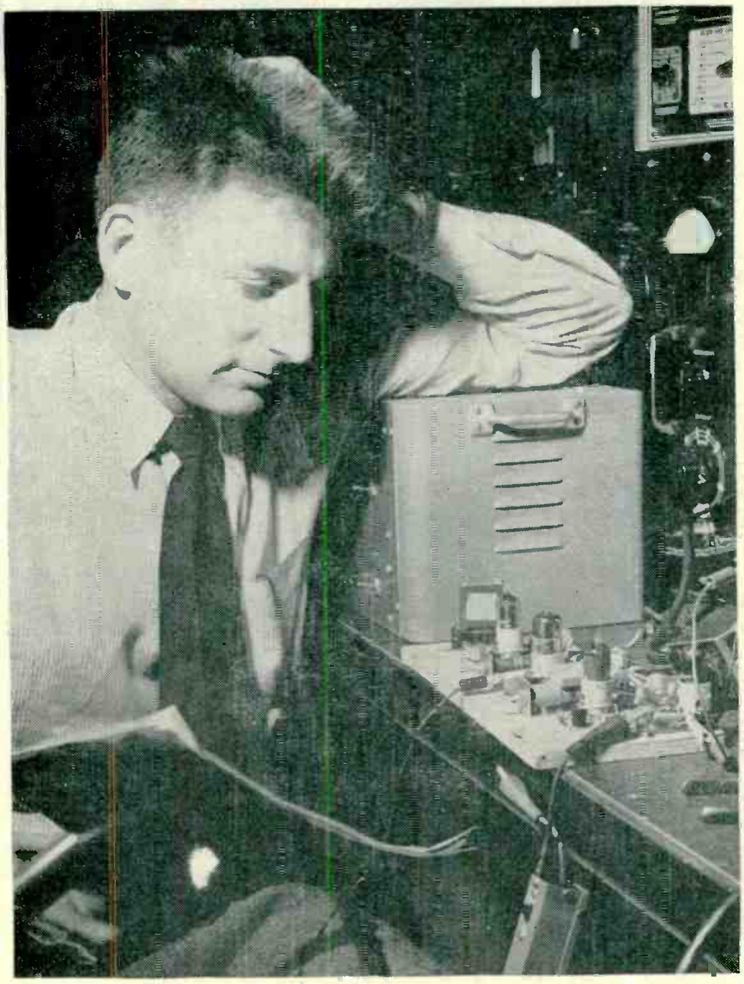
The engineer is encouraged and aided in obtaining professional recognition and prestige by membership and committee participation in engineering organizations, by delivering talks and papers before engineering and other groups, and by writing articles and books.

The secret of getting top-level engineering productivity lies in morale, particularly in the inspiration which can be passed to and from the engineer and his immediate supervisor. Throughout the engineering organization at the Park, there are generally no more than 12 engineers, and often as few as 5, under each supervisor. This makes for rapid two-way communication of ideas, discussion of gripes, and correction of difficulties.

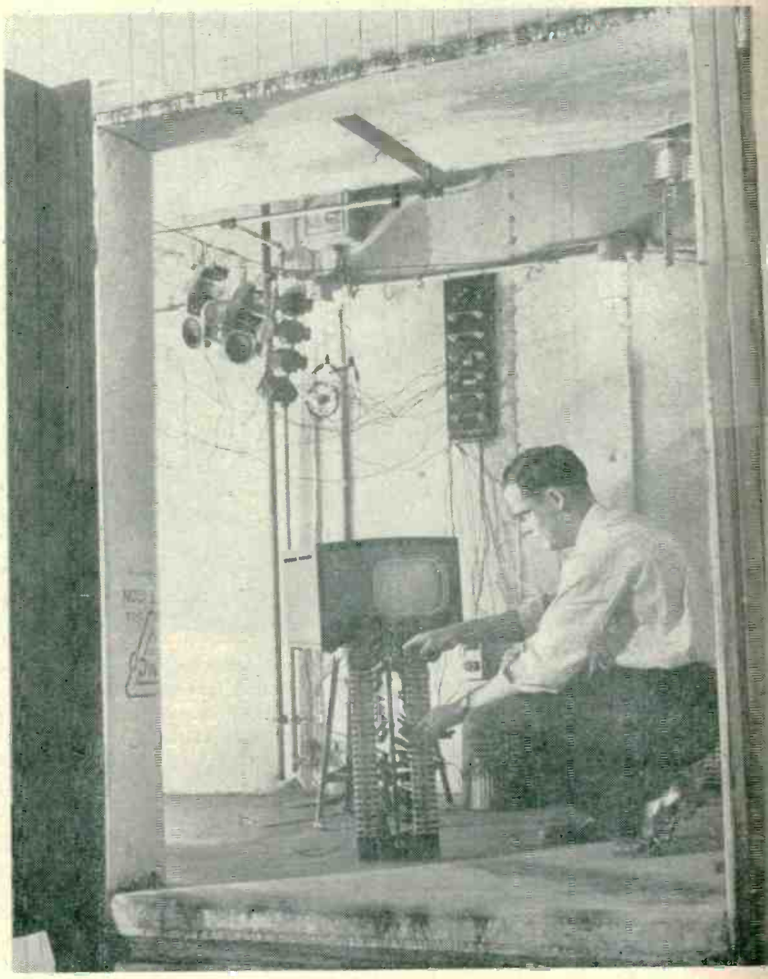
Morale-Building Techniques

Each supervisor is aided in working with his group by reference to a nine-point job program developed from a company-wide survey of employees. If productivity lags, the fault can usually be found in the fact that the company has not considered one or more of the nine elements inherent in a good job: Compensation, working conditions, supervision, job security, respect for basic human dignity, promotion practice, information on management aims, belief in the individual job's importance, and satisfaction in a job well done. Inevitably, GE loses some engineers to other firms. Such moves are seldom discouraged by the management, and as a result GE can claim to have trained the best engineers of many a competitor.

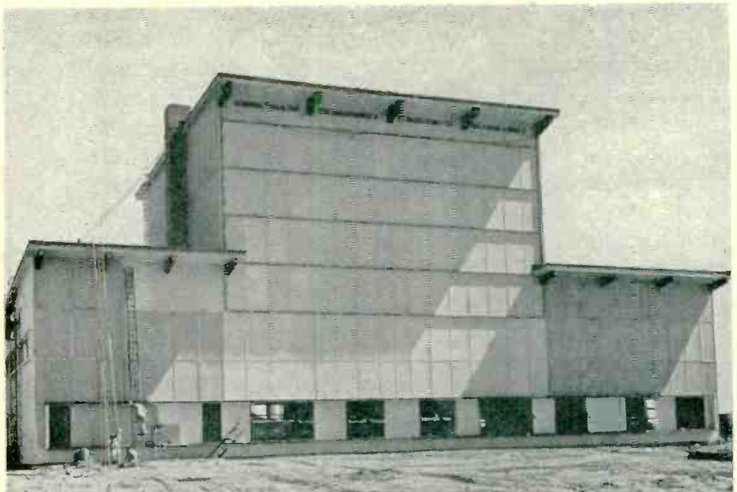
Beyond the salary question, the gripes are scattered



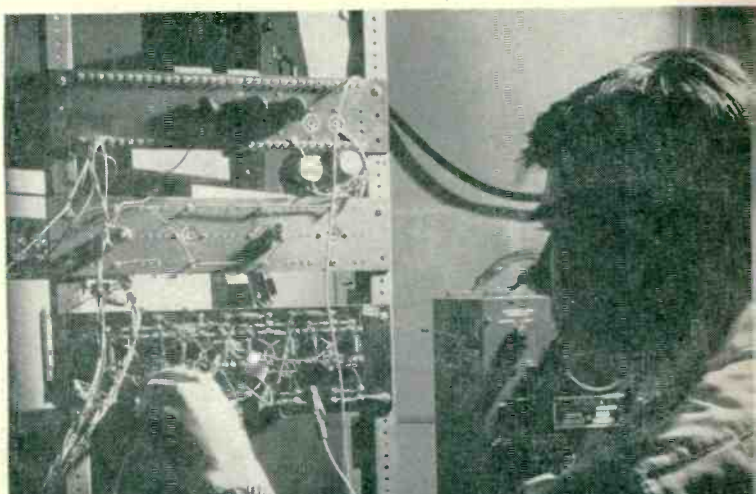
FAMILIAR BREADBOARD—A pause for meditation often pays during the breadboard stage of developing a new electronic product. Here is the true old fashioned breadboard, using woodscrews to hold the parts on the wood base



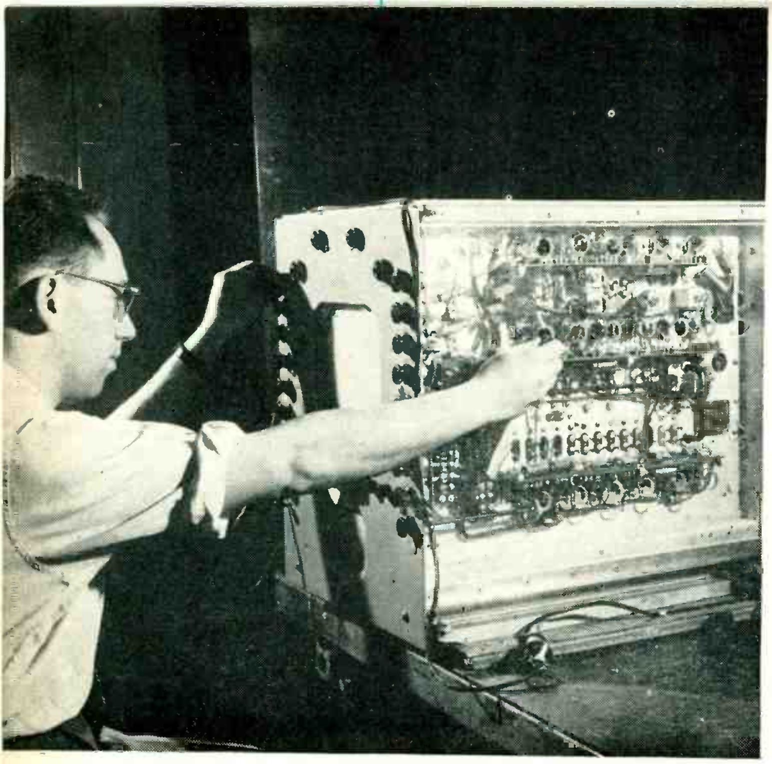
HOT BOX—Here receivers and components can be tested or operated for hours at temperatures up to 150 F and humidities up to 100 percent, to simulate ambient conditions encountered in any part of world where electronic equipment is used



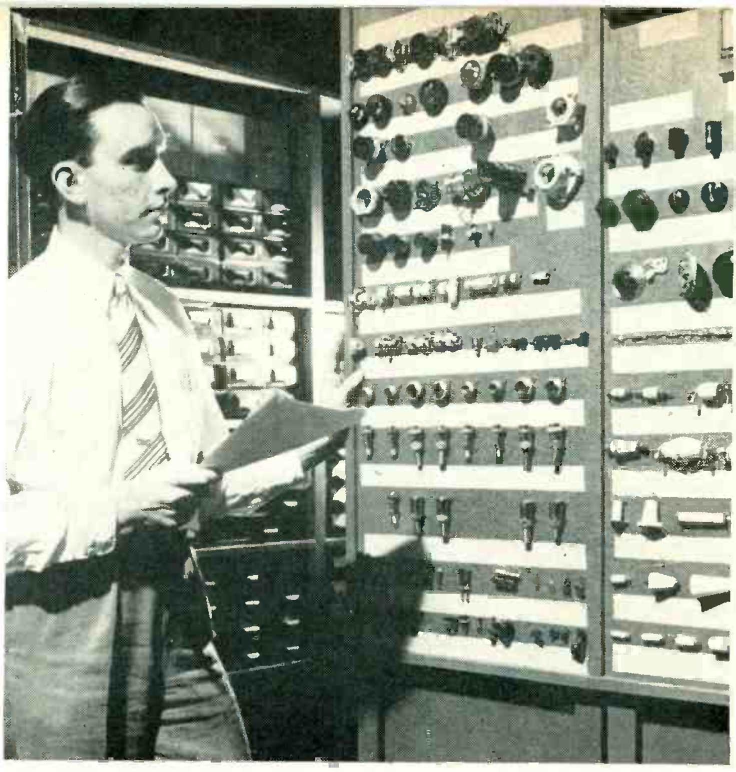
ROOM FOR RADAR—Nonmetallic structure nearing completion at back of Park, for testing huge radar antenna arrays regardless of outdoor weather conditions. Even sprinkler system inside is removable for sensitive tests



REFINED BREADBOARD—A communication engineer in the Electronics Laboratory likes his breadboard circuits to be up in the air, accessible from both sides and supported by a relay rack. Other engineers fasten panels to small wood blocks



MEASURING THROUGH LUCITE—Test program engineer checking television monitor unit by inserting prods through holes over dangerous high-voltage terminals. Transmitter test section has now been in operation over a year without an accident



HELP-YOURSELF STOCKROOM—For engineers who like to pick and choose, this Transmitter lab stockroom ranks tops in popularity. Cabinets have numbered drawers, and samples of parts are mounted on boards having corresponding drawer numbers

and to a large extent self-contradictory. One engineer goes so far as to measure with a recording thermometer the temperature of his air-conditioned office and to complain when it deviates beyond narrow limits, while another engineer objects that he cannot open the windows, sealed for the air-conditioning, to smell the clover on the Park grounds.

Regular meetings of all engineers in each division are held for discussions of any matter concerning the men and their relation to the company. Engineers interviewed say that these meetings are remarkable for their lack of double talk; an unpopular answer to a question is never evaded. Topics of discussion include salaries, employee benefits and services, the budget, profit and loss figures, plans for new products, and the competitive position of the Electronics Department with respect to the entire industry.

Engineering Facilities

The facilities for the engineering staff are of two types: an office and adjoining small laboratory where each engineer spends most of his working time, and specialized laboratories and a library.

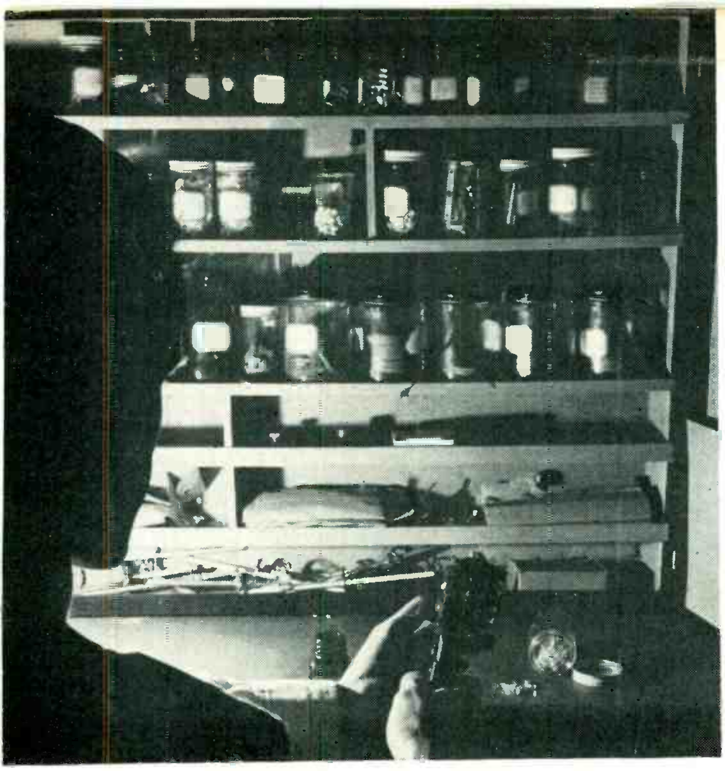
The basic engineering office houses four to six men, and is approximately 12 by 23 feet in size. Adjoining it is a laboratory about 23 feet square, for the personal use of the men inhabiting the office. An elaborate system of conduits permits electric power of various voltages and frequencies to be brought out at each lab, as well as air under pressure, vacuum lines and specialized test signals, including video signals produced by the central video generator in the receiver plant.

The equipment in each lab depends on the particular problem at hand. In receiver development, signal generators, vacuum-tube voltmeters, Q-meters, and oscilloscopes are to be found in nearly every lab, and more specialized equipment is available wherever needed. Each engineer is encouraged to requisition test equipment whenever and wherever it will fill a need.

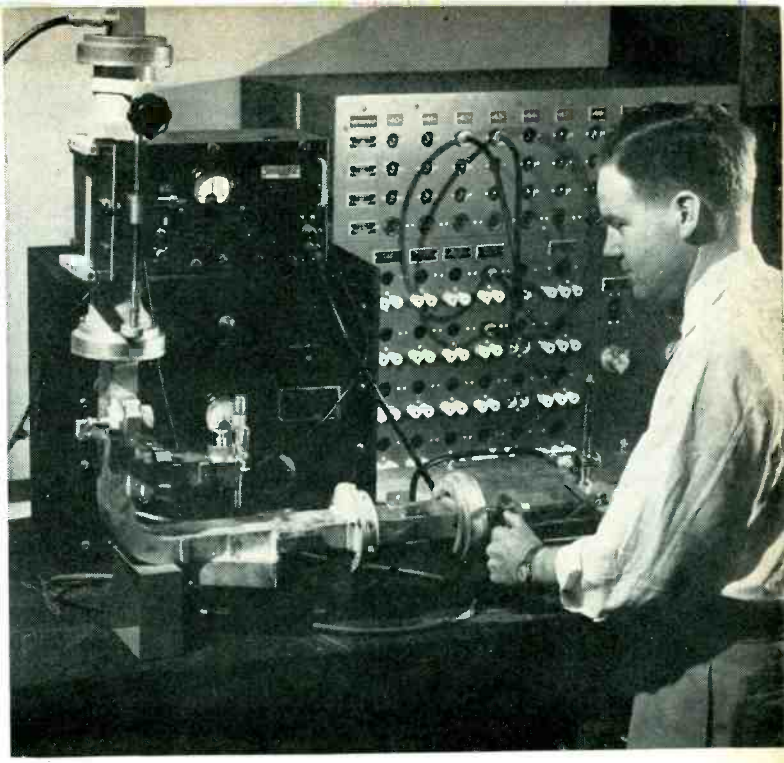
Many of the specialized facilities are located in the Laboratory Building. These include the Park library, a model shop staffed with skilled mechanics and wiremen, a small chemical laboratory for testing materials, a plating laboratory, painting laboratory, welding laboratory, metallurgical laboratory and photographic darkrooms.

Most of the development laboratories, particularly those devoted to receiver development, have individual shielded rooms within which may be found electrical quiet, so elusive near manufacturing plants. Specialized antenna erecting and testing facilities are also available in profusion. On top of the Receiver and Transmitter Buildings' roofs are a number of 30-foot steel poles mounted on gear-and-crank mechanisms which permit a single man to raise or lower them. A special nonmetallic building 60 feet high, for testing radar antennas without interference from metal objects, is located in one corner of the Park. This contains a steel monorail crane support and a sprinkler system, but these may be temporarily removed. Radar and similar line-of-sight transmitters may be tested in the clear at a site on top of a nearby hill.

One objection many engineers have to working in a large organization is the tendency toward excessive standardization of equipment and methods. The Park management has attempted to avoid this pitfall, as witness the case of the lab benches. Five distinctly different styles of lab bench are in use, one for each of the four divisions and one for the laboratory. One design could have been imposed by the management,



SWITCHES TO ORDER—Instead of ordering specially made samples of complicated wafer switches and waiting weeks for shipment, engineers in one Receiver lab assemble their own at this cabinet, which contains all necessary parts



PLAYING WITH PLUMBING—Typical workbench scene in Government Division lab assigned to microwave development problems. Jumpers can be inserted in power panel at rear to feed any desired type of power to any particular bench

but the engineers couldn't get together on one design so Dr. Baker approved them all. Receiver benches are eight feet long, while Specialty benches are five feet long with drawers underneath at the right. The Receiver boys are quick to point out that the Specialty drawers are usually blocked by a soldering iron cord.

Six to twelve engineers share the same stenographer, an arrangement made possible by the fact that few of the engineers dictate correspondence and reports, preferring to write them out longhand for retyping. The stenographer is her own boss, an arrangement that avoids conflicting directions and leads to a display of tact on the part of the engineers.

Getting a Project Started

Ideas for new or improved products come from many sources. Perhaps the most valuable are those relayed from the consumer to the engineering staff via the commercial, field and sales engineering forces. Three noteworthy engineering developments of the Electronics Department, the self-contained antenna in standard radio sets, the variable-reluctance pickup and the high-brightness television picture tube, all started with suggestions from customers. Not infrequently the engineers themselves come up with an idea for a new product, but usually the engineer thinks in terms of improvements rather than innovations.

Whatever the source, the idea for a new or improved product is channelled initially to the commercial engineers and the sales department. This custom is a reflection of Dr. Baker's settled policy of developing only products that can be sold at a profit. The commercial and sales groups, aided by the staff's marketing manager, study the suggestion, calculate its ultimate selling price, then judge whether the market will take it at that price. If the answer is favorable, the idea achieves the status of an engineering project involving analysis, circuit design and breadboard-building to see whether the idea can be reduced to practice.

The projects thus approved go on a waiting list, from which they are removed in a priority rotation established by the division manager and his project committee. One of the divisions keeps track of available project engineers on a wall chart which shows the week-to-week progress of current work and thus gives some advance prediction of availability of engineers.

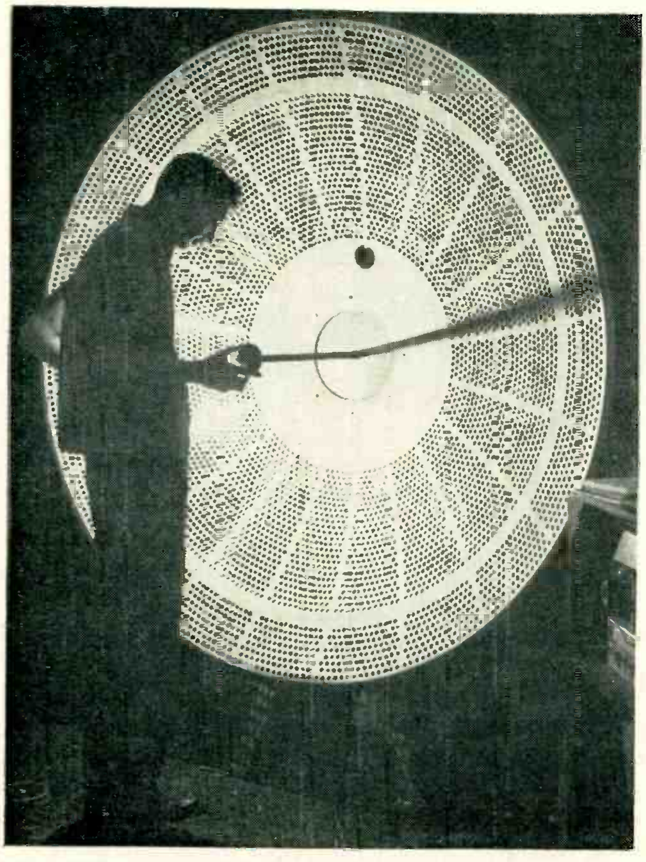
Often the work may be assigned to a project team, since it is not always possible to get the required combination of leadership, cost consciousness, engineering talent and originality in a single individual.

When the project engineer gets the project, with it goes a definite time schedule and cost budget. He is responsible to his supervisor for putting the project through within these established time and money limits, or else he must do a sales job to get more of each. The project engineer then requests other engineers to assist him in the work, and he's off to the races.

The first duty of a project engineer is to query the Laboratory in the Park to see if any new ideas are at hand or in the offing that can be applied to the job at hand. The Research Laboratory at Schenectady is also approached for this purpose, as is everyone else in the Park who may have thoughts or ideas to contribute. All this is routine, made compulsory to insure that the development team starts where others left off, rather than from scratch. Commercial engineers in that particular activity are asked what competitors are doing. Competitive products may even be purchased and dissected as a prelude to creative development work.

With all the facts at hand, actual design starts. Mak-

ROOFTOP PANORAMA—Radio communication test point on Transmitter Building roof, with land-line telephone "just in case"



FOR TELEVISION RELAYING—Parabolic reflector for microwave television relaying, ventilated to catch less wind. Engineer holds waveguide terminus that bounces signals back to reflector

ing it work comes first, and here each engineer has his own preferred type of breadboard. Some like to work on a flat metal panel supported by wood blocks. Some like their panels to be vertical, mounted on relay racks. Some simply let the parts flop around on the workbench for the early hook-ups, so changes can be made more readily. The higher the frequency, however, the more nearly must the breadboard version approach the final precisely machined layout.

Engineers having specialized knowledge and experience with components, cabinet design, mechanical design, theoretical principles and mathematical procedures are always available to help the engineer who is in charge of a project. In the component parts sections of the divisions are other specialists, thoroughly familiar with all parts available from other GE departments and from outside manufacturers.

Technical assistants perform the many routine time-consuming tests associated with development work. These are in no sense flunkies, however; each engineer is expected to clean up his own workbench, put away his own tools and instruments and run his own errands.

Sometimes the engineer builds in finished model-shop form the product that he designed. This is authorized on small rush jobs where there isn't time available to train others, or where the quantity needed is so small that it wouldn't pay to train others.

Transition to Production

As the project proceeds, there comes a time when the development engineer has to quit shelling corn, and pass on whatever he's got to the next team in line. Separating the engineer from his brain child often requires real ingenuity on the part of the supervisor. No one can predict in advance how long it will take a particular engineer to develop an unknown new product to the stage where it is ready for production. Early estimates must be revised frequently as work progresses, and each revision makes the engineer less respectful of deadlines.

An engineer's goal is perfection. Knowing this, and knowing that perfection is never achieved, the wise supervisor works close enough with his men to know when the product is good enough, then takes it away by one means or another. It is rumored that one supervisor actually stole the finished sample while the engineer was out to lunch, and turned it over to production minus last-minute finishing touches.

The philosophy of the supervisor is to encourage his engineers to make and discover enough mistakes fast enough so that they can all be cleared up before production starts. Allowing an engineer to scratch his head carefully for an extra seven months during development is expensive, yet gives no insurance whatsoever against production troubles. Engineers are helped in this activity by an industrial design section which is primarily responsible for final appearance of the product, but also contributes to initial design innovations before the bugs are ironed out. Responsible to the manager of marketing, this section makes plastic pre-production models of portable radios and clay transmitter models, for instance. The hope and dream of the supervisor is that all early design bugs be little ones, such as are caused by tolerance clashes or mechanical misfits.

With electronic manufacturing back to its highly competitive pre-war status, quality of performance is no longer enough to insure sales. Overall appearance and styling must likewise be top-notch in the eyes of the customer, whether the product be a receiver, a transmitter, a tube tester, or even a tube. Today no design is permitted to leave a design section in the Park until it has been made up in model form from wood or plaster.

Even in the professional field of precision instruments, the engineer is faced with the problem of building a unit which will work and at the same time be commercially attractive. In time an engineer acquires this ability—a "must" to satisfy the commercial people and his designer's instinct.

Field Engineering Procedures

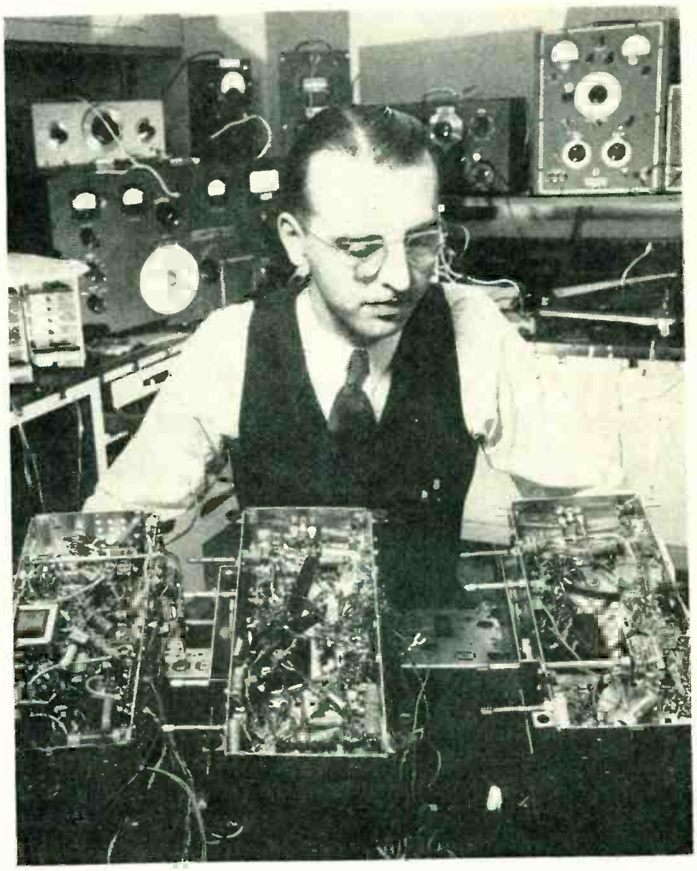
Whereas the Receiver Division sends out service manuals to take care of its troubles in the field, the Transmitter Division sends out a service man instead —an engineer who applies on the job those final touches that design engineers would like to do themselves. Field engineering achieves its greatest importance in the Transmitter Division, where each customer is fol-

EVOLUTION OF A RADIO RECEIVER

The development engineer here was asked to produce a table model set that would outperform competitive models. With a close deadline, the logical approach was to put in extra tubes and parts whenever in doubt. The resulting chassis, at extreme left, worked beautifully and was put into production, but manufacturing costs were out of this world because the chassis was flush level full of parts.

The engineer was kept on the job. One by one he removed bypass capacitors and isolation resistors, measuring effect on performance each time. At regular intervals a cost-reduction committee met to evaluate accumulated savings. By the time the engineer had half-emptied the chassis, the committee authorized launching of a new model (center chassis), and the assembly line was reprocessed for it.

Still costs were too high, so the project was continued. Soon the version at the right, stripped down almost to the bare chassis, will go into production



lowed up and served directly by the factory personnel.

The field engineer by necessity has a degree in electrical engineering, plus at least a year in the test course. His job is to supervise the installation of GE transmitters and other equipment, as well as to take care of troubles that develop in the field. Thus, a high degree of tact and diplomacy is required.

Knowing the field engineer's aversion to red tape, GE requires reports only once a week. Longhand reports in pencil are okay, with no copies. When these reports come in, they are typed up and copies are routed to all interested persons. They may suggest design improvements and point out defects just as would a supercritical customer. The tough job at headquarters is to determine who or what is at fault—engineering, production, the tubes in the product, or the customer.

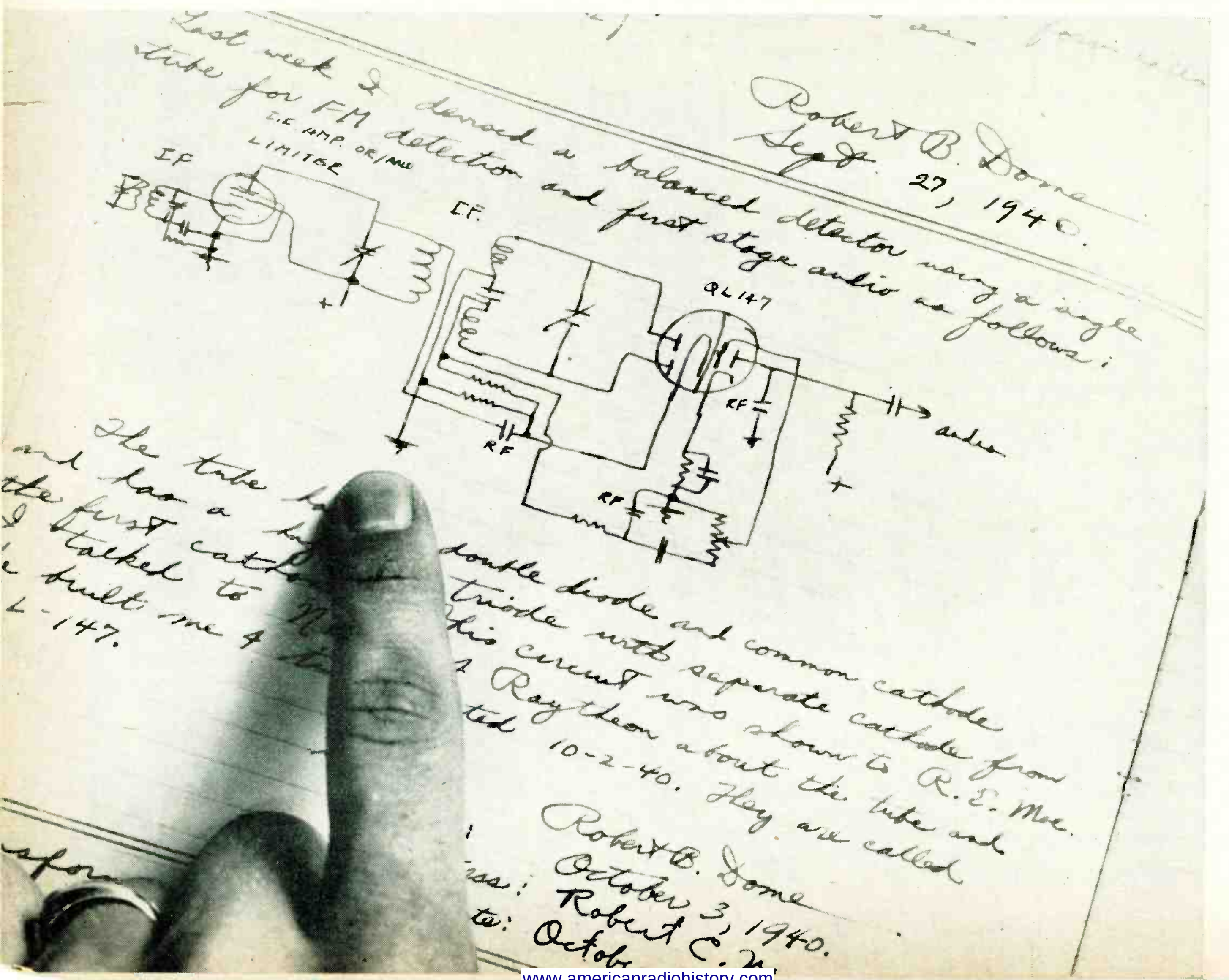
Responsibilities of the Laboratory

Between the fundamental work of the Research Laboratory at Schenectady and the applied development of the Division engineers lies the field of activity of the Electronics Laboratory. Here programs of advanced development or applied research are generated in all lines of the Department's activities, working about three years ahead of production.

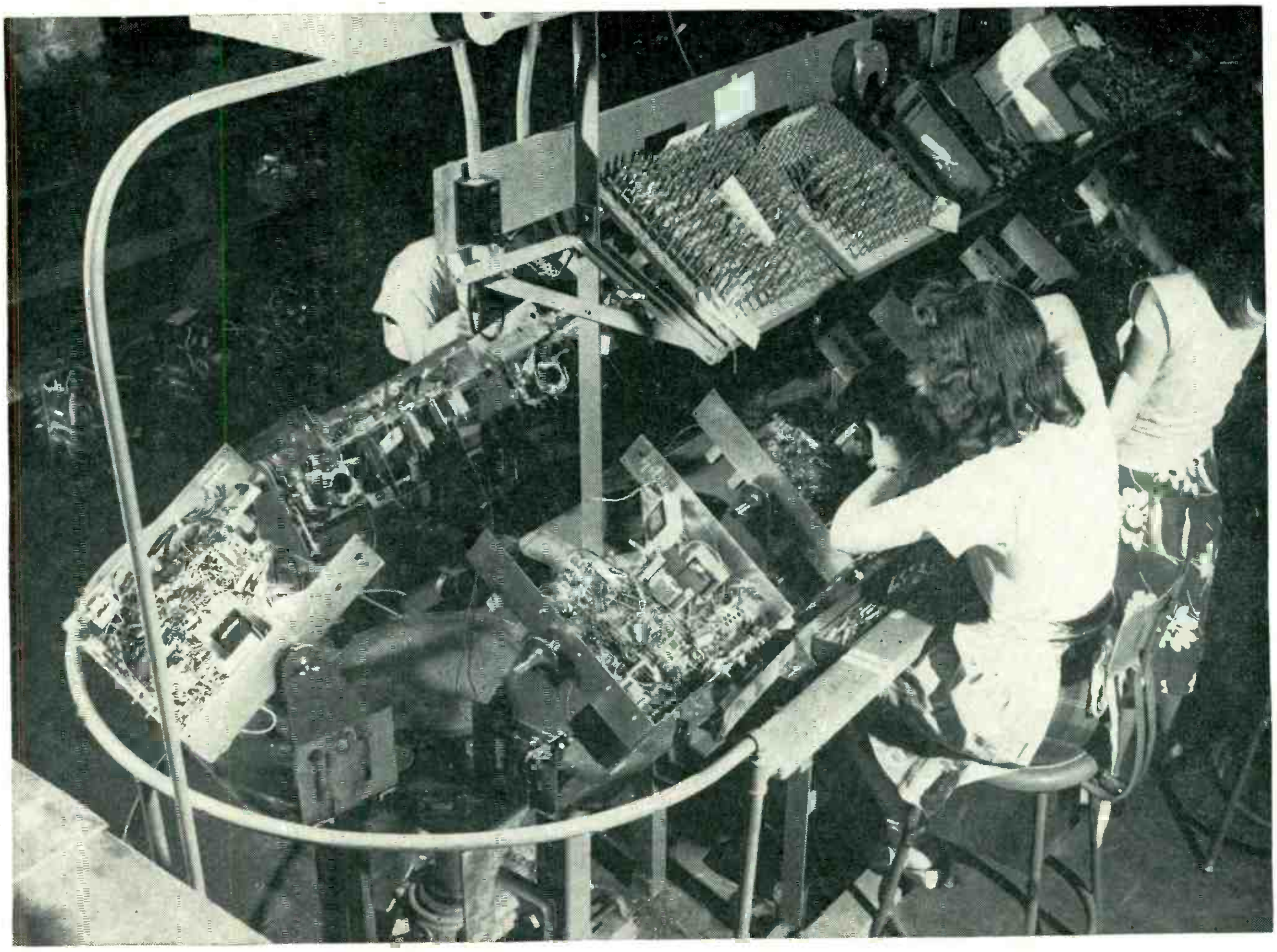
The Laboratory was started during the war years, and much of its effort is still concentrated on development programs for the military. It is growing at a rate determined by its ability to recruit and absorb men with the peculiar qualifications for advanced development. The present staff consists of approximately 80 people, of whom about 40 hold engineering degrees. The remainder are laboratory assistants, model shop mechanics, and the necessary clerical help. In addition, there is continuing rotation of from 6 to 12 assigned people from the company's training programs. While most of them move on to new three-month assignments elsewhere in the Department or in the company, all are candidates for replacement in the Laboratory.

The responsibility of development engineers in the Laboratory Building is to think first of the future and to take calculated risks in reducing research to practice as fast as possible, for the advancement of the electronic art and for the overall profit of the Department's operations. It is not expected that everything tried will work, nor is it expected that everything which works will get into production. All that is expected of the Laboratory is a continued output of ideas, ready for the next stage of development by the operating divisions.

PATENT LOG BOOK—Each engineer has one, in which circuits, ideas for new products, mathematical developments, and inventions are jotted down for possible use by patent department. Each patent application is good for a $25 bonus. Top man patentwise at the Park is Bob Dome, with 52 to his credit. Patent logs are examined regularly by men assigned to patent department liaison



PART III—The Production Technique



TELE COMING 'ROUND THE BEND—Chassis for 10-inch table model is two-thirds completed as it comes around this endless link-chain conveyor. Special jig on conveyor, fitting into holes punched in chassis for the purpose, permits setting chassis at various angles and turning it over whenever necessary as it moves down the line

FINAL production blueprints are converted into finished products in the Receiver, Transmitter and Specialty Buildings. The differences in manufacturing techniques in these three buildings are directly related to the type of product manufactured. A girl on a receiver line may do her assigned work in 30 seconds, whereas a girl at a bench in the Transmitter Building may work for days on the same unit.

In discussing production at the Park, certain definitions are necessary. *Production* means getting ready for manufacturing—doing everything except putting together the product. It is primarily moving of materials so they will be at the right places at the right time. The receiving room and the stock room are in charge of the Production Supervisor. *Manufacturing* is making things. Production starts long before manufacture and goes on concurrently with manufacture. *Inspection* is mechanical, involving checking of such things as dimensions, finishes and tolerances. *Test* is both electrical and mechanical, involving checking of electrical values or electrical performance characteristics of individual components and both physical and electrical specifications of the finished products. All four of these elements, integrated throughout all buildings, are the Park's manufacturing technique.

Broad decisions as to which division will make a particular product or line of products are made generally by the vice-president in consultation with the interested division managers and their staffs. Within each division, committees headed by the manager and containing members of commercial, sales and engineering sections meet weekly to determine the future of a product. One purpose of these meetings is to schedule future production so as to keep labor requirements as nearly uniform as possible and within the allocated labor quota for the division. One rigidly enforced rule is that every promise of delivery of a design or a production quota must be confirmed in writing if initially made verbally. Enough differences of opinion rise in the normal course of events without having arguments over who promised what.

Incentive Pay

In all Divisions, as many assembly workers as possible are employed on a basis whereby they can earn extra pay for extra output. During the period when

MASS PRODUCTION—General view of manufacturing floor of Receiver Building, with television receiver assembly lines in foreground. By Christmas every line here will be making television sets, and ordinary receiver production will be transferred to outlying satellite plants. Fluorescent lamps directly over each line and ceiling fluorescents provide 50 foot-candles at working level

they are training for a particular assembly operation, they receive a guaranteed hourly rate. Their earning climbs gradually as they acquire proficiency in doing their assigned work. On operations involving teamwork of many employees, group incentive pay is used.

CUTTING RECEIVER ASSEMBLY COSTS

Steady introduction of manufacturing shortcuts, like welding of resistor leads and ground straps to chassis, does not offset increased hourly rates for labor.

Automatic receiver-building machines based on printing and spraying techniques are under investigation, but the high initial investment required is a major problem.

Simplifying and cleaning up circuit design is therefore the most fruitful avenue of cost reduction.

Standardization on higher-rating components permits high-volume purchasing savings that often actually reduce cost. Thus, half-watt resistors are the smallest used in receivers, and 600-volt paper capacitors are standard except for cathode and avc circuits

Prices for incentive work are set either by time studies, by tables, or by comparison. All three methods take into consideration the native and acquired skill and knowledge of the employees, the amount of past training and education required, and the effort required in applying the skills on the job. The perfect system for measuring the relative amount of mental and physical effort required on various jobs has not yet been devised; perhaps it will never be, but the manufacturing staff is constantly working toward that end.

There is no attempt to lure labor from other manufacturers in Syracuse by offering higher wages. Records show scores of cases where workers left for higher wages only to come back a few weeks later to the clean working conditions, good lighting, air-conditioned comfort, and straightforward management at the Park.

Inspection of Parts

Inspectors in all divisions are on hourly pay to insure careful work, and many of them are engineering graduates. Inspection is based on modern techniques of statistical quality control sampling. As an example, if an incoming shipment contains 100 units the inspector will test 20 and pass all if there are no rejects. If there is one reject he tests 40 more, and passes the remainder if these 40 are all good. If he finds more than one reject in the first 60, however, he either makes a 100-percent test or rejects the entire lot, depending on how badly the parts are needed.

Vendors who sell parts to the Park are rated every month on the quality of their product. Since the goal in the purchasing department is to have as many reliable vendors as possible on tap, for protection against shutdowns in any one vendor's plant, the purchasing staff will usually send representatives to the vendor's plant for a detailed look into the situation before black-balling.

Receiver Division Problems

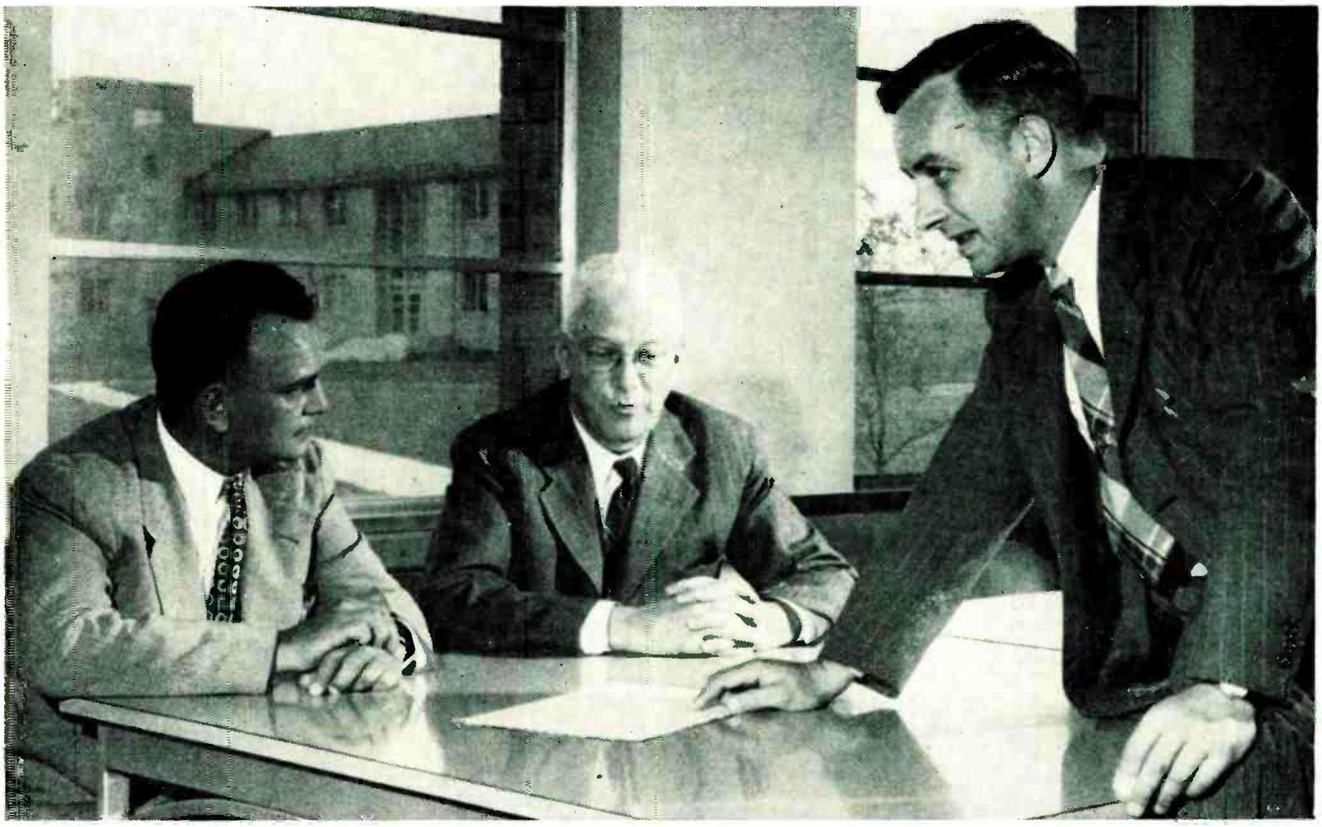
The job of the Receiver Division is to manufacture radio and television receivers of uniformly high quality, according to schedules and at or below standard cost. After a receiver sample is delivered by Engineering, the Planning Section writes a detailed "process" (schedule of operations) and sets up the necessary physical facilities on the floor to care for the production of a given model. This process is based upon standard times and upon time studies made by the Wage Rate group. Concurrently Production takes over the vendors which have been established by the Purchasing group, schedules them and expedites material deliveries to meet the line schedules. As each given model progresses it is the responsibility of the Test and Inspection group to obtain, in conjunction with Planning, the necessary test and inspection facilities to care for the model adequately.

Before all the service divisions have completed their work, pre-production samples are built according to process insofar as possible and delivered to Engineering. Within two or three weeks thereafter a pilot run of 50 receivers is manufactured, using all the production facilities which will finally carry the processes, to check the equipment, allow training time for working leaders, and provide Test and Inspection Section with finished receivers for training purposes. This permits doing on a planned basis what is sometimes done on an unplanned basis at considerable extra cost.

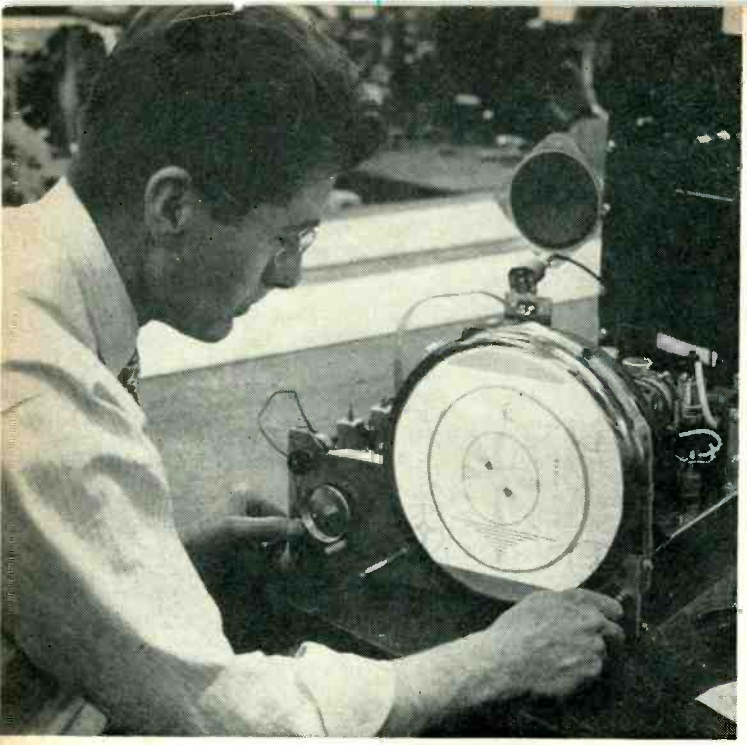
After the pilot run, the line is manned. It becomes the responsibility of the Manufacturing Group to train new operators and to bring the line up to speed. Each line is provided with an organization chart showing the number of operators processed for the line, plus a line buildup schedule showing how many sets should be produced each hour during the period when the line is coming up to schedule. This training schedule is the result of considerable research; it is based on a formula which has been empirically derived to take into account such factors as the time-cycle, skill of workers, and rate of production desired.

Each line is divided into groups of ten to fourteen operators in charge of a working leader. These working leaders do the majority of training on the line. Absenteeism is cared for by training two or more girls to do the same job, enabling breaches in the line to be filled effectively.

Every attempt is made to allow nothing but quality



THEY RUN PRODUCTION—Managers of manufacturing, left to right: Harold Miller of Specialty, A. R. Goodwin of Receiver, and J. A. Barratt of Transmitter. W. B. Gillen, not shown, has corresponding Tube Divisions job at Schenectady. Meeting production schedules, keeping costs down, keeping quality up and keeping workers satisfied are just a few of their responsibilities



IT WORKS—Adjusting horizontal and vertical linearity controls of new table-model television receiver, using video signal and 400-cycle tone obtained from central signal source through coaxial lines. Picture tube is inserted only for alignment and test here, as sets are shipped without the tube

WELDING REPLACES SOLDERING—With electronically controlled resistance welding, this operator is able to weld 15 grounding ribbons and one resistor lead to the chassis of a television set during the two-minute time cycle. A snap-action switch built into the welding electrode applies current automatically

products to leave the assembly line. This is done by check and repair and repeated inspection both in and after the line. Receivers which are in difficulty are analyzed as rapidly as possible and sent to the repair group for modification. The controlling factor in the speed of all lines is quality. A line must stay below 10 percent rejections, and speed is held down until that quality level is realized. It has been found, however, that running a line below half speed does not accomplish a great deal in the way of training; the training is principally for speed, and not simply for memorizing a relatively simple operation.

Inspection cannot in itself insure quality because there is still the possibility of human error in the inspectors and final test men. Therefore, sampling inspection techniques are employed in the shipping room, where sealed cartons are actually opened and sets are tested again. This final inspector has the authority to shut down the entire production line until the trouble has been corrected if he discovers defective sets ready for shipment. Of course, he must be pretty sure of his ground when he shuts down a line because this makes many people above him unhappy.

Getting a television line started, as many manufacturers have learned, is more involved than ordinary radio production. To obtain large-scale manufacture for example, one line at the Park was re-processed four times, resulting in many new work assignments and redistribution of operators' positions. The final setup, however, employing three moving conveyor lines in series was soon producing 400 sets a day.

Transmitter Division Production

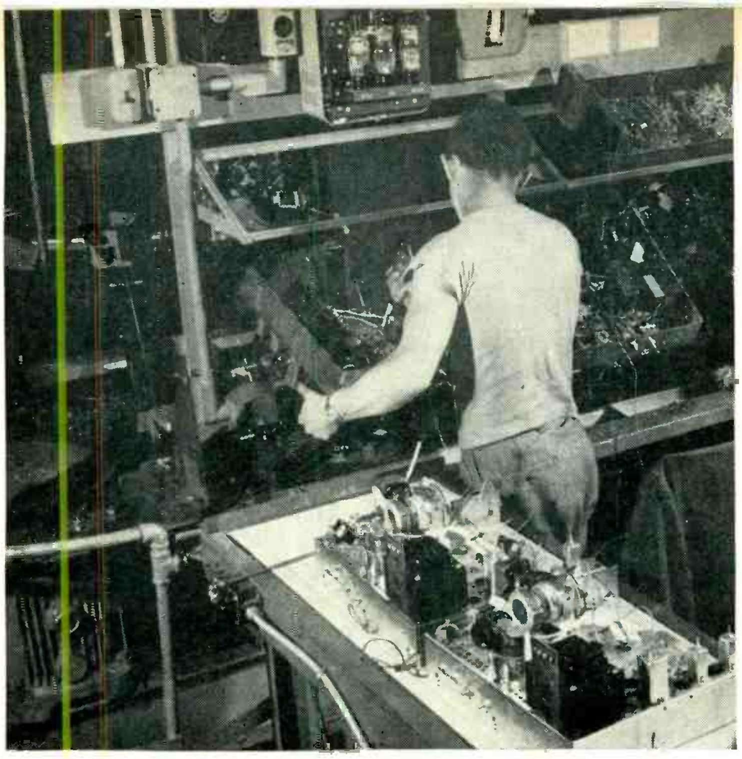
In contrast to the Receiver Division which deals in mass production for orders frequently running to hundreds of thousands of units, the Transmitter Division rarely has an order for over a hundred units. Furthermore, some of these units sell to the customer for well over $500,000 each. The transmitter manufacturing organization employs about 2,000 workers and has approximately 20 workers under each supervisor.

The two main types of products are radar units, communication transmitters and special electronic items for Government use, and a wide variety of products for commercial use, including broadcast equipment (a-m, f-m, television), communication equipment such as taxicab, police, aircraft and marine sets, carrier current communication and controls, electronic navigators, electronic heaters, and facsimile equipment.

Most of the component items required in the Transmitter Building are specially designed and must be made or procured in small quantities. The production section has the responsibility of procuring all items called for on the material lists furnished by the Engineering Section.

On items to be manufactured in the shop, the Planning Section works out each individual step in producing the item and sets a price for producing the item. From this, the price allowed each employee per piece for each step is set and vouchers are made up for use by the employees as pay vouchers. At the same time, raw materials needed are accumulated in the stock room after careful incoming inspection test.

The foreman in charge of assembly of a unit now has on hand the needed raw material, the components purchased outside, and the pay vouchers covering manufacture of components and assembly work. He starts one or two people on the smallest assembly, gradually building up his group to the required size for the order on hand. Finished subassemblies are



ELECTRONICS DOES IT—Thyratron-tube control for drive motor of endless conveyor on television line (above head of man, with cover removed). Speed control knob is alongside. Crossover conveyor in foreground brings sets from end of first line (off picture at lower right) to start of second line

inspected and tested, and assembly of the complete unit is started. When finished, the Test Section proceeds to operate, adjust and test the unit in accordance with instructions issued by the Engineering Section. Most of the test work is done by Test Course engineers, working closely with supervisors. After satisfactory completion of tests, the manufacturing group gets a last chance for final mechanical inspection and touchup of the finish before the unit is shipped.

The test power house in the Transmitter Building provides a variety of voltages and frequencies, and these can be fed through a well-planned cable system to any test setup on the factory floor. Three temperature chambers are available for operating tests at extremes of cold, heat and humidity, as required for most government equipment and for some commercial equipment. Vibration and tilt tables that can duplicate the roll and pitch of a battleship, the vibration of an airplane engine, or the bouncing of a jeep over rough country are available for testing commercial as well as military equipments under simulated field operations. Shielded rooms permit measuring sensitivity and noise right on the factory floor. Dual lighting systems are provided in these rooms; fluorescent lights are normally used, but for delicate tests incandescent lamps can be turned on.

To insure maximum protection to the operator while conducting tests on live circuits, interlocked test cages, safety shields, a central grounding system, and many other safety devices are used. The success of these safety measures is indicated by the transmitter test section's record for 14 months of work—534,250 man-hours without a single lost-time accident among the employees.

Even the huge broadcast and shortwave transmitters are produced on an individual piecework basis computed according to the number of screws, wire, and parts each man installs. Workers with two distinct kinds of aptitude are used here. The true mechanic, who likes to mount things precisely and make them line up, is called an assembler and is used to do all of the mechanical assembly of a transmitter. The electrician type, on the other hand, likes to hook things up according to circuit diagrams; he is called a wire-

SCOREBOARDS FOR MISTAKES

Before each worker on every moving production line is a score card. Whenever an inspector or supervisor discovers a mistake, she goes right over to the worker responsible for that particular operation, and makes a mark on her score card. The psychology of this silent rebuke has been carefully analyzed; comparative tests made with and without the score cards show the system to be highly effective in keeping down rejects. A master scoreboard is kept for each line, in view of all workers, so they can see their hourly output and total rejections at a glance

man and follows the assembler to complete the job.

The Specialty Division is essentially a big job shop, where the setup of a mechanical machine like a drill press or milling machine is changed as often as 20 times a day. It uses few mass-production techniques; just as soon as a product develops enough sales volume to become interesting to another operating division, it may be snatched away from Specialty. Here the men usually work from samples rather than detailed drawings.

The goal is to get the time cycle for a particular operation down to a minimum. In the Specialty Division this can be anywhere from 3 minutes to 40 hours, in contrast to the Receiver Division's average cycle of less than a minute. The number of workers assigned to a particular order depends on daily production requirements as well as on the size of the order. So flexible is production planning here that a rush job can be got out practically overnight if need be.

Small orders, up to the limit of 25 units, are produced in Specialty's model shop, just off the production floor, where everybody is paid on an hourly basis.

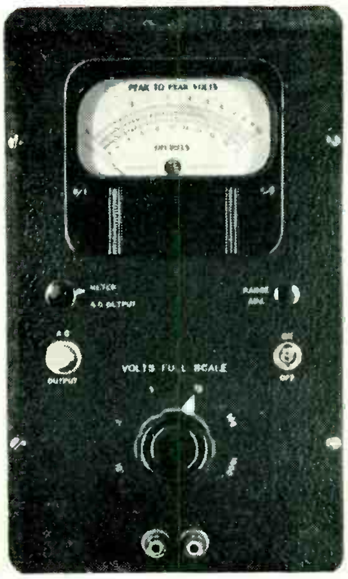
The secret of efficient production in Specialty's model shop is elimination of the paper work associated with planning of production and setting of piecework rates. An engineer develops a new product and turns it over to a wire man. He in turn wires up and builds a production sample, then teaches girls to make the rest of the run. All planning is done in the head of the wireman, with the girls memorizing their duties and using the production sample as their guide. With runs under 25, it costs more to break down the job on paper into individual assignments than the job is worth.

Conclusion

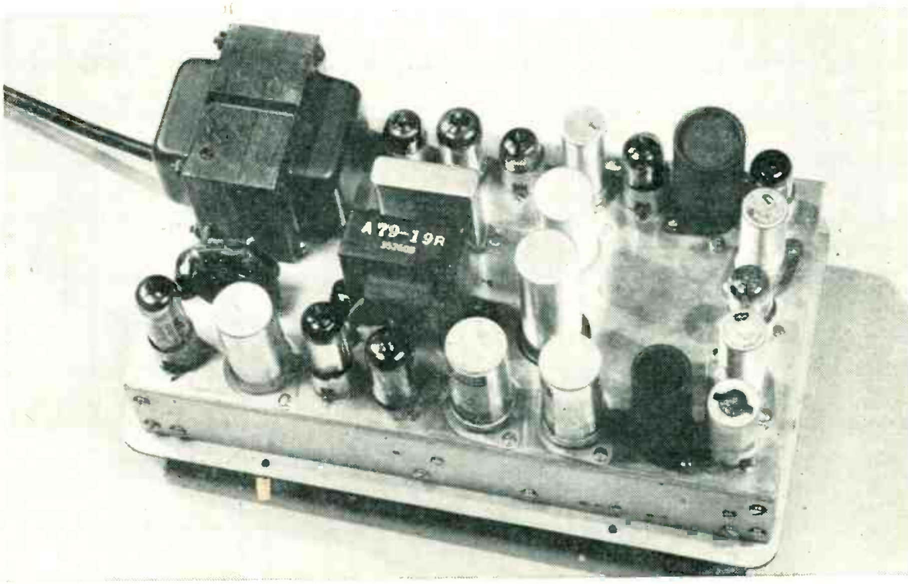
These, then, are the men and the facilities of Electronics Park. On them lies the responsibility and the challenge to substantiate Dr. Baker's theory that one can have the excellent accommodations of the Park and still meet competition. So far, the theory has stood the test of performance.

An article of this detailed nature, covering such intangibles as how engineers think, would have been impossible without the cooperation of a large number of people. A complete list of the names of those who contributed so freely of their time, their ideas and their data would fill this page, hence only a few can be mentioned. Appreciation is expressed to Dr. W. R. G. Baker for making this article possible; to E. L. Robinson for making preliminary arrangements; to Andy Tobin for scheduling the interviews and serving as guide during the entire period; to George Burns of Schenectady for photography; and to practically everyone in the organization chart of the Park for their help.—J. M.

ORGAN-TYPE CONSOLE—For small production runs in Transmitter Building, long time cycles are most economical. Here one operator does practically the entire job of assembling personal aircraft radios, working from a sample and eye-level instruction sheets



Controls and switches on panel



Chassis of electronic portion of the wide-range voltmeter for measuring narrow pulses

Peak-to-Peak Voltmeter

Pulses and transients of short duration are measured by an instrument having extremely high input impedance. Pulse-stretching circuits are used and an amplifier feedback arrangement provides substantially zero-impedance output

By F. H. SHEPARD, JR. *Consulting Engineer, Summit, New Jersey* **and EDMUND OSTERLAND** *Ballantine Laboratories, Inc. Boonton, New Jersey*

IN THE DESIGN of electronic a-c voltmeters and ammeters, a desirable trend has been toward development of average or rms-reading instruments in order that the measurements may more accurately indicate actual power regardless of frequency or waveform.

There is also an increasing demand for instruments yielding peak or peak-to-peak indication of repetitive waveforms. This requirement is a more particular one in the instance where the average value over one cycle is negligibly small, as in the case of television synchronizing pulses, and in a wide variety of timing and controlling operations. Here, the energy level as represented by rms values may be unimportant, and the maximum (or minimum) excursion of the wave is the dimension to be measured together with wave shape and timing information.

In the design of electronic equipment such as high quality amplifiers, modulators, transmitters and recorders, it is the peak values of signal that extend beyond the linear range and cause undesirable transients, distortion and intermodulation. If the transients are of short duration, they are not measured by rms meters.

Measurement of the absolute indication of narrow voltage pulses imposes a rather difficult requirement on available materials and techniques. The voltmeter, to justify the term, must fully respond to the pulse without consuming it. The difficulty becomes immediately apparent when the usual diode peak-reading voltmeter is connected to a source of pulses of 2 microseconds width which are repeated say 10 times per second. Since the storage capacity in the diode circuit must be great enough to keep the output ripple small, the total energy continually dissipated by the diode load resistor must be supplied in less than 2 microseconds.

For example, if the peak 2-microsecond pulse voltage being measured is 10 volts, the energy in a 1-megohm diode load resistor will be 1×10^{-4} watt. This continuous power must be supplied in a small percentage of the time (0.002 percent). To supply this continuous diode load power, the source being measured must supply an instantaneous power of 5 watts. Since this is a rather high power level, neither the source being measured nor the diode of the voltmeter will handle it and the reading will be in error.

As the pulse width or the repetition rate is further diminished, the error is greater still. The effect is also more pronounced when the peak voltage being measured is below about 5 volts since then the curvature of the diode characteristic makes the diode impedance abnormally high and still further limits its peak power-handling capability. The combined effects described limit the best conventional diode peak voltmeter to measurements above a few volts and having a duty cycle not less than 0.1 percent.

The modern cathode-ray oscillograph yields both voltage and wave shape indications and with proper amplification and intensified trace formation, this instrument can identify practically any recurrent wave to the user when suitably calibrated. However, the combination of a stable electronic circuit and a precision meter will afford indications that can be made reliable within one or two percent whereas an accepted reading error of 5 percent accompanies the oscillograph indication. The latter figure may easily rise to 10 percent when the factors of calibration source error and its associated reading error are taken into account.

The basic design of the peak-reading voltmeter under consideration is the amplifier-rectifier type such as has been popular for a-c measurements in the past decade[1]. Each portion of the present instrument, however, demands a new approach to secure the desired response to steep wavefronts and narrow peaks.

Rectifier

The circuit employed to increase the rectified energy available for driving the output meter is illustrated in Fig. 1. The input wave encounters a typical diode rectifier in the first stage. Capacitor C_1 is, however, smaller and higher in impedance than is usual, permitting the grid of triode T_2 to rise to the peak value of a sharp spike without rounding it off. This diode and capacitor combination functions as a pulse stretcher, the output voltage being depicted in Fig. 1, along with the graphical representation of voltages in the other stages. The time scale shown is an approximate one but serves to indicate the effective increase in energy.

Since the impedance of the voltage source at the grid of T_2 is relatively high, T_2 is used as an impedance step-down repeater amplifier to drive a second conventional diode rectifier T_3 with the relatively long-duration (stretched) pulse to charge its output load capacitor C_2. Since the signal pulse has been appreciably lengthened, the duty cycle of diode T_3 has been improved considerably and no difficulty is had charging C_2 to the full peak value of the signal voltage. Triode T_4 repeats this d-c voltage into a low-impedance measuring meter.

Capacitor C_2, together with R_2,

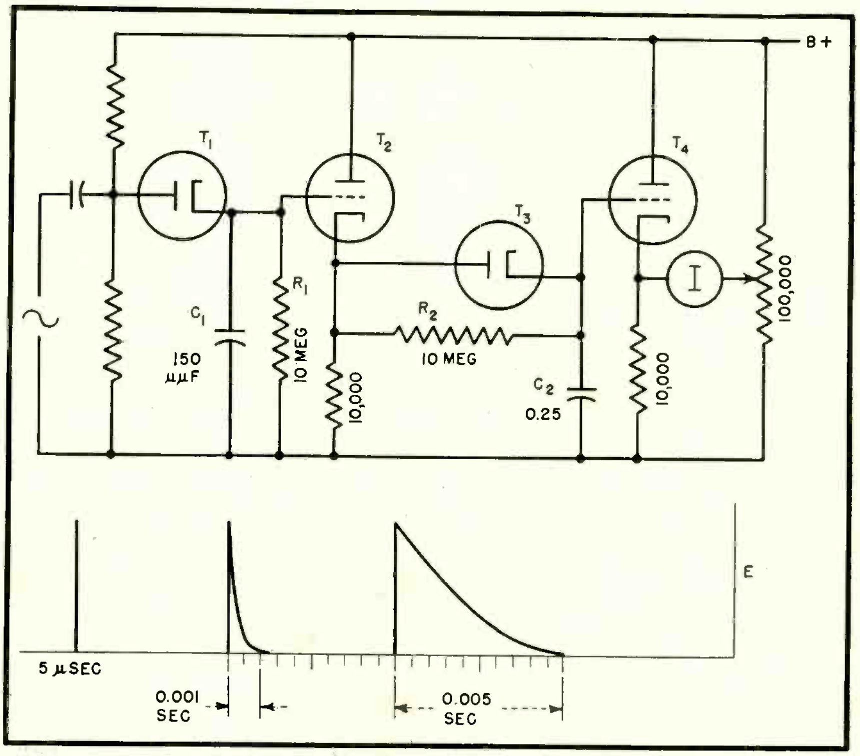


FIG. 1—Circuit and waveforms of pulse stretchers and impedance step-down repeaters

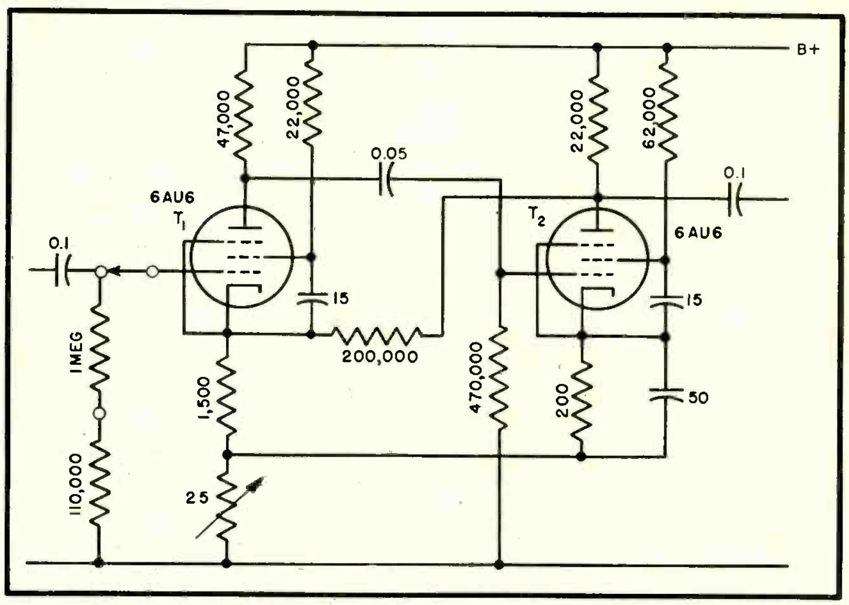


FIG. 2—In the preamplifier circuit, the use of feedback permits the amplifier to have substantially zero output impedance

determines the time constant of the meter circuit and at the same time, the low-frequency limit of operation. With the component values shown, this circuit responds uniformly to pulses of the same peak level when the pulse width varies from a maximum (square wave) to a minimum of less than 2 microseconds at 20 pps.

To adapt this rectifier circuit to the widest variety of applications, an amplifier preceding it is a necessity. The amplifier designed for this purpose provides wide input voltage range coverage with simple switching, uniformly high input impedance and low output impedance, adequate output voltage swing and high stability.

The amplifier is required to produce a linear output versus input relationship over a 10 to 1 amplitude range to satisfy the decade switching feature (the indicating meter is of the logarithmic scale type calibrated from 1 to 10). Furthermore, the low-voltage limit must exceed several volts to avoid encountering the curved portion of the diode characteristic. Finally, the stability must be such as to introduce negligible errors when factors of line voltage variation and tube changes are considered.

The present design yields a peak-to-peak voltage swing of 9 to 90 volts and the sensitivity of the meter circuit is adjusted so that these figures correspond to minimum and maximum scale deflection respectively. The incorporation of about 25 db negative voltage feedback insures amplifier stability equivalent to the attenuator and output indicating meter tolerances (± 1 percent).

Design of Amplifier

Initial experiments with the rectifier section showed that the signal voltage source impedance to the rectifier must be kept low if optimum peak response is to be had.

This factor demands the application of an amplifier ahead of the rectifier section even if only as an impedance transformer. It further requires the amplifier to have an output impedance of about 100 ohms if C_1 is to charge up to the peak value of a 1-μsec pulse in 0.01 μsec (or 1 percent of this pulse interval). The latter figures do not include the forward resistance of the diode or inductance of wiring and circuit elements.

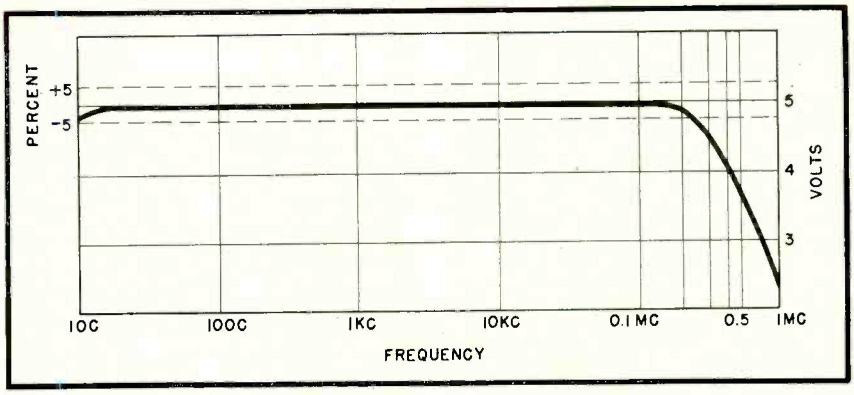


FIG. 3—Wide-band operation is indicated by voltage-versus-frequency characteristic

The requirement of low driving impedance has been met by a method which has received relatively little attention. By its use, the apparent output impedance of the amplifier may be reduced to zero (or may be made negative if desired to compensate for positive resistance in the diode).

Figure 2 shows the basic amplifier circuit. Negative feedback from the plate of output tube T_2 to the cathode of the first amplifier stage T_1 causes output load variations to be reflected through the nominally high impedance of T_2 into the amplifier circuit. In this way, the cathode current at the output stage is effectively modulated by output load variations.

If the output load is low, the output current and cathode current of T_2 will be increased. The increased cathode current of T_2 results in an increased positive feedback voltage from the cathode of T_2 to the cathode of T_1. This acts to effectively increase the output current. The reverse of the above is true when the output load impedance is high. The proper amount of positive feedback as shown enables the amplifier to have substantially zero output impedance within the output current limits of T_2.

The principle employed in reducing the output impedance of the amplifier had been suggested some years ago[2,3] and had also seen practical application in loudspeaker amplifiers where excellent damping of cone resonances was observed[4]. A typical voltage versus frequency characteristic for a sine-wave input is shown in Fig. 3.

Second Amplifier

Additional gain is obtained by a two-stage preamplifier similar to that shown in Fig. 2 but omitting the positive feedback feature. The use of two separate, independent, cascaded amplifiers of two stages each permits use of an attenuator between the units.

The range switch includes a section which is interposed between the units and provides 10:1 step-down from maximum gain. By employing this arrangement as the first step of the attenuator, any slight noise or hum appearing in the input tube is thus reduced 20 db on all ranges but the first. The other ranges are accommodated by attenuation in the input to the amplifier. With the proper choice of compensated resistor elements, this has been found to be a most reliable method of range multiplication.

In the final version of the voltmeter, a full-wave meter rectifier circuit is used so that peak to peak values are indicated by the meter. This is believed to be of greater interest in the majority of cases than half-wave operation where polarity of only one sign would be registered. The instrument shown covers a range of 0.001 volt to 1,000 volts peak to peak or 0.00035 to 355 volts in terms of rms values of a sine wave.

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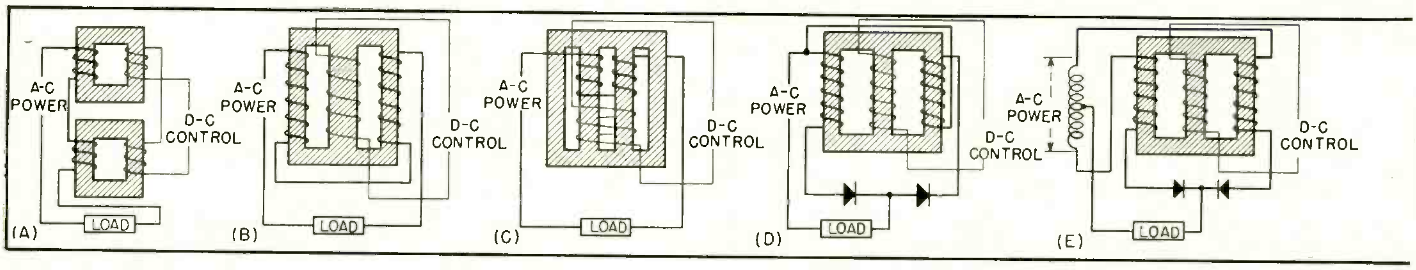

FIG. 1—Presaturated reactors can be variously arranged. The simplest form is two identical units (A), but equivalent results are obtained by winding the coils on one core (B) and (C). This configuration (B) can be combined with rectifiers to produce a doubler

Saturable Reactors

By FRANK G. LOGAN

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BEFORE launching into a discussion of the subject, it is desirable to distinguish between saturable reactors and magnetic amplifiers. Without attempting to formulate definitions of these established terms it is, nevertheless, desirable to review some of the accepted differences recognized by workers in this field. It is impractical, even artificial, to distinguish between these devices on the basis of construction, function, or circuitry. To delineate the areas covered by the two terms on the basis of common usage is futile because they are used interchangeably, the older term, saturable reactor, being the more widely recognized.

A clear means of demarcation seems to be that every magnetic amplifier includes, as an essential component, a ferromagnetic device with adjustable inductance. Commonly, the amplifier is supplied with power from an alternating current source so that this ferromagnetic device can be a saturable reactor, or transductor as it is termed in Europe. From this viewpoint, a saturable reactor is a part of a magnetic amplifier. This viewpoint is not essential, but if followed consistently could avert ambiguity.

Saturable Reactors

Several simple saturable reactor arrangements are shown in Fig. 1. The one in Fig. 1A can be made by connecting a pair of conventional two-winding transformers. The a-c or power windings may be connected in series or in parallel. The d-c or control windings are wound and connected with respect to the a-c windings that no net voltage of the fundamental power frequency appears across the control circuit terminals. The arrangements shown in Fig. 1B and 1C are quite similar in control characteristics to that at Fig. 1A. There are, however, slight differences involving transients and leakage reactances. Many variations of this basic circuit are possible, but all have similar performance characteristics. The manner of operation of the simple saturable reactor has been amply discussed in the literature and need not be reviewed nor enlarged upon here. The self-saturating type of reactor is of greater interest and, although it has been discussed in the literature, a brief explanation of Fig. 2 will show the essential features of its operation.

The circuit of Fig. 2A serves to demonstrate the operation of self saturation. While the circuit itself is of little practical value, it is the simplest self-saturating type of reactor circuit, and its oscillograms showing the effect of control premagnetization apply almost exactly to practical circuits. The circuit consists of a saturable reactor, a rectifier, a load and an a-c source all in series. The reactor has an auxiliary winding which is supplied with control current from a high-impedance source. The oscillograms in Fig. 2B show the load and supply voltages as functions of time and indicate the manner in which the load voltage can be adjusted by means of the control premagnetization. (The resemblance of this type of control to thyratron control is obvious.) Corresponding magnetic conditions in the core are shown in the lower oscillograms (Fig. 2C), which illustrate the effect of the control current on the minimum or initial flux density B_0, and also upon the undirectional pulsating load current. Adjustment over the range of control shown in the diagram (Fig. 2D) is effective in changing the output in a 100-ohm load from 1.5 milliamperes to 150 ma. It should be noted that the maximum flux density at the minimum current or cut-off condition (Fig. 2E) is so adjusted that the hysteresis loop is symmetrical and shows a total excursion of flux density of just less than twice the saturation flux density of the material.

There is a rather sharp increase of the load current as the core flux density reaches saturation. Because of this action the circuit yields to analysis on the basis of sharp firing. Such analyses have been made and give calculated waveforms and transfer curves that are in fair agreement with measurements.

As previously mentioned, the single reactor is of little practical value unless provision is made for minimizing the fundamental component of current induced into the control

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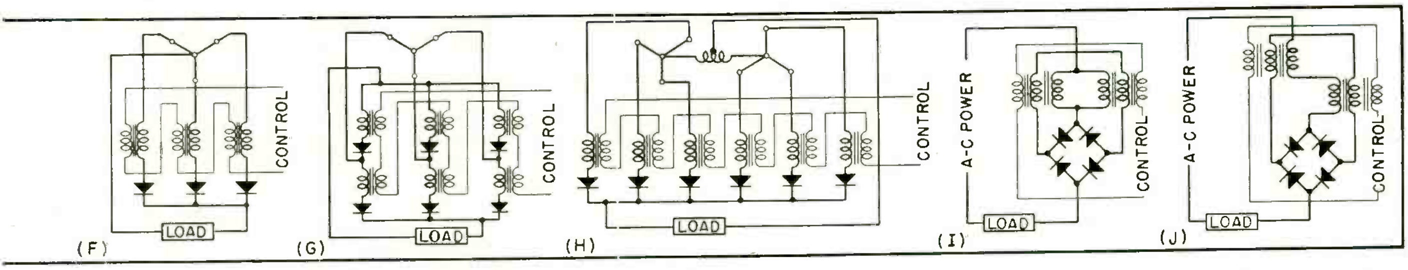


(D) or a full-wave circuit (E). These elements can be grouped (F), (G) and (H) for three-phase operation. Further elaboration of the single-phase circuits to obtain continuous rectified feedback current (I) and (J) results in the self-saturating magnetic amplifier

and Magnetic Amplifiers

Use of saturable reactors as components of magnetic amplifiers is described. The author discusses effects on performance of core material and assembly, and points out importance of reproducibility of core materials and rectifier properties. Applications are described

winding. This may be done by inserting a high impedance in the control circuit or by connecting two reactors or arranging several windings in such a way that the induced current is minimized. The last alternative is illustrated by the circuits of Fig. 1D and 1E. The circuit of Fig. 1D is called a doubler; it gives alternating-voltage output. The circuit of Fig. 1E is called a full-wave circuit; its output is d-c.

Effect of Core Material

The contrast between the sensitivity of the simple saturable reactor circuit and that of the self-saturating type may be seen in Fig. 3A. The transfer curves shown in this diagram were taken for two sets of reactors of approximately the same mean flux path, one constructed with standard E-I silicon steel laminations and the other with gapless medium-nickel iron alloy (Allegheny Ludlum 4750) ring laminations. In each case, data is shown for both the simple reactor circuit and the self-saturating type.

Two important differences are evident: (1) the increased sensitivity of the self-saturating circuit and (2) the improvement of performance obtainable with the better steel. With silicon steel, the self-saturating circuit is five times more sensitive than the simple reactor, while with the 4750 nickel steel gapless core, the self-saturating circuit for which data is shown is about 50 times more sensitive than the simpler circuit using the same core. Furthermore, in this same circuit, the 4750 iron has an advantage of 40 times in sensitivity over silicon iron. This makes evident the superiority of the better steel. Of course, the data are not strictly comparable because of the difference in geometry of the cores, but the curves shown may be taken as representative of conditions obtained in two types of cores which do have approximately the same mean magnetic path length. The peak ampere-turns of the load current is over 1,000 times the control ampere-turns for saturation for the self-saturating circuit with nickel-steel core, while the ratio in the case of the same circuit with the air-gap silicon steel core is approximately five for the particular set of data shown in Fig. 3A.

Similar contrasts of the sensitivity of the self-saturating circuit for other core materials, such as Permalloy, Permenorm 5000-Z and Supermalloy show increases in sensitivity over 4750 of the order of 2.5 times for the Permalloy and about 25 times for Permenorm.

The single-phase doubler and full-wave circuits may be arranged for polyphase operation. Several such circuits are shown in Fig. 1F, 1G, and 1H. The first (Fig. 1F) is a simple 3-phase Y-connection with the control windings arranged so that no voltage component of fundamental frequency appears at the control circuit terminals. Other circuits shown include (Fig. 1G) the 3-phase full-wave circuit and (Fig. 1H) the 6-phase circuit with interphase transformer. The polyphase circuits are commonly used for larger power outputs, particularly where fast response and optimum utilization of reactor structure are important. The latter condition develops in virtue of the fact that the several polyphase circuits have different internal impedances when made with identical reactors, permitting the load impedance, which may be fixed by external consideration, to be matched more closely.

Magnetic Amplifiers

Because the change in load current can be greater than the change in control current that produced it, saturable reactors can be used as amplifiers. To improve their performance, feedback is commonly used, particularly in the simple circuits that do not employ self-saturation. Usually the load current is rectified in a full-wave bridge and introduced in a special feedback winding on the reactor structure in such a manner as to aid the control current ampere-turns. Two single-phase feedback circuits are shown at Fig. 1I and 1J. As in the simple reactor circuits, the main windings may be connected in series or in parallel, and the load may be placed in either the a-c or d-c circuit.

Transfer curves of a reactor with adjustable feedback are shown in Fig. 3B. The effect of increasing the positive feedback factor is shown by the increased slope of the transfer characteristic. Of course, this increase in sensitivity with positive feedback is obtained at the expense of the speed of response of the reactor circuit and the stability of the system in which the reactor is used. Negative feedback results in an extended range of linearity of the transfer curve.

In both cases, window space is occupied by the feedback winding, so that the reactor structure must be derated by an amount which increases with the degree of feedback. As an example, in order to provide 100-percent feedback, (feedback turns equal to main turns), a simple reactor would have to be derated by 50 percent. For simple reactors without self-saturation, the use of feedback permits convenient adjustment of sensitivity in the range between that of the simple reactor and that of the self-saturating type and even beyond. The characteristics of the rectifiers are not critical.

The use of large amounts of positive feedback results in a trigger action that is apparent in the +2 curve of Fig. 3B. This trigger action can be exploited to advantage, as in the use of reactor circuits to give relay action which is quite sensitive and capable of high speed, shock-proof operation.

The performance of a magnetic amplifier system, particularly one of the self-saturating type, depends on the properties of the components which are used. The possibilities of the various circuit arrangements have been explored and the limitations on performance are known. In the self-saturating circuit, performance depends as much on the characteristics of the rectifier as it does on the properties of the magnetic core material. In discussing the performance of magnetic amplifier circuits, I shall mention the effect of both rectifier and core material characteristics and I shall attempt to do so upon two different levels: (1) what is now commercially feasible with normal manufacturing and quality-control techniques and (2) what seems to be the ultimate in performance of the best of present materials on a laboratory basis.

The principal performance characteristics of magnetic amplifiers include power gain, power output, speed of response, and weight per unit output. Other factors which may be of interest are shock resistance, ambient temperature limits, stability and linearity.

For optimum performance, the magnetic core material should have the following characteristics: (1) high saturation induction for low pounds per watt, (2) high differential permeability in the second and third quadrants of the hysteresis loop for maximum sensitivity, (3) high resistivity and ability to be made in thin laminations for low eddy-current shielding to give fast response, and (4) stability of magnetic characteristics under changing temperature and mechanical strain and shock conditions.

To be suitable for use in the commercial manufacture of reactors for magnetic amplifier circuits, the core material should have other characteristics in addition to those required for optimum performance. In the first place, it is of the utmost importance that the magnetic core material have properties which are reproducible between different batches and are the same for all the material in each batch. This is the single most important requirement for high-permeability core material for magnetic amplifiers.

Core Assembly

Considerable handling is involved in stacking laminations and in placing a winding upon the stacked core, therefore, it is desirable that the core materials be reasonably free from adverse effects resulting from moderate mechanical stresses. It does not seem feasible at present to consider the use of toroidally-shaped tape cores for low-level amplifiers (0.1 to 10 watts output) and there is no method presently available, to my knowledge at least, of obtaining satisfactory stacking factors with unit cores that are assembled before annealing and are used just as they come from the oven.

It is also necessary that the laminations have adequate interlamination resistance, which may be developed in stacks made of laminations with commercially available film coatings of the oxide type. Present practice consists of insulating the laminations before assembly with clear lacquer or impregnating the core after assembly with a wax.

The structure of magnetic amplifier cores has been a matter of discussion for some time. Performancewise, there are only minor differences between the core-type reactor arrangement, the three-legged reactor, and the four-legged reactor. For laminated, gapless cores, the simple arrangement using core-type reactors seems most practical. The limits on performance of circuits using reactors of this kind, particularly those made with high permeability core materials, are fairly well known, and the effects of core and copper geometry upon the various performance factors are understood in a general way. While the question of core and copper geometry for optimum performance remains an open one, rather definite conclusions may be eventually

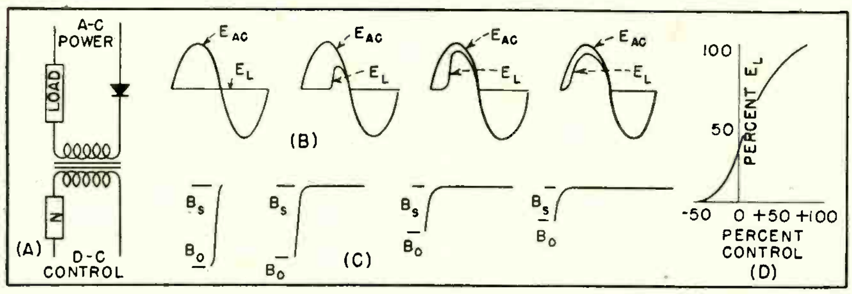


FIG. 2—Action of presaturation can be visualized from a reactor having control and power windings (A). Different values of control current produce different intervals during which voltage appears across load (B) because they shift operating position on the hysteresis curve (C) giving response shown at (D)

reached following a critical study of the problem. Early work along these lines indicates the feasibility of such a study.

Development work has been done on the basis of somewhat more limited objectives. A time constant of 1 cycle on a power supply period basis for the transient response of practical amplifiers is the present limit, while power gain, which is affected by the desired time constant, may be approximately one or two thousand if quick response is not desired. The watts per pound figure may be taken as approximately thirty for low-level 400-cycle reactor circuits. With rectifiers, mounting brackets and resistors included in an amplifier assembly, the watts per pound may become ten or fifteen for low-level, 400-cycle units. If these three factors are the only ones of importance, that is if cost and space are not involved, it seems quite feasible to reach rather definite conclusions concerning optimum core geometry. If, on the other hand, space is also important and high gain may be sacrificed, the rectifiers would be of different design, as would the optimum core shape.

Reproducible Core Material

The importance of the reproducibility of magnetic characteristics of the core material for magnetic amplifiers is shown by Fig. 3C. This graph shows measured magnetization curves of several samples of high permeability core materials, all of approximately eighty-percent nickel. The solid lines represent the catalog information given by the manufacturer as the average and extremes of the normal magnetization curve. The dashed-line curves show several measured curves for cyclic magnetization and indicate that the extremes given by manufacturer are not at all pessimistic. A range of maximum reversible permeability of 85,000 to 25,000 it seen to exist in the measured curves, which were taken for representative samples. A range of maximum normal permeability of 300,000 to 60,000, or 5:1, is shown in the data.

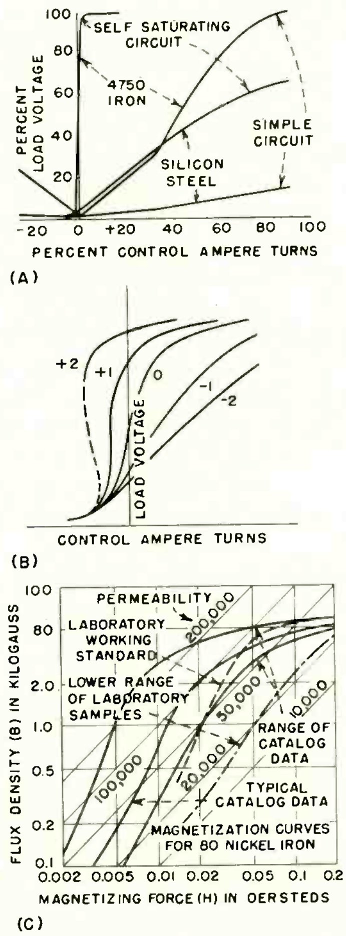
The sensitivity of a magnetic amplifier circuit using reactors made with Hymu 80 or Mumetal, materials similar to that of Fig. 3C, depends on the slope of the upper branch of the hysteresis loop, particularly in the region of zero magnetic flux density and the coercive force value of magnetic intensity. The slope of this portion of the hysteresis loop is dependent to a large extent upon the maximum value of the normal permeability. Changes of normal permeability in the ratio of 5 to 1 result in changes of magnetic amplifier sensitivity of approximately the same ratio. This condition is intolerable from the standpoint of large-scale manufacture of magnetic amplifier systems with fixed or published characteristics. Variations of this kind and magnitude are not amenable of compensation by other than laboratory methods which are often too costly for this type of product.

I think it safe to state that those who are interested in the manufacture of magnetic amplifier components and systems would be gratified if means were found to manufacture a core material with characteristics reproducible to plus or minus ten or even twenty percent, even if this were done at the expense of radically reduced values of maximum permeability and increased cost. As a matter of fact, I feel that this would be a more valuable contribution to the art than the development of core materials of even greater permeability than those presently available.

Characteristics of Rectifiers

The performance of the rectifiers used in saturable reactor systems, particularly those employing the self-saturation feature, affects the characteristics of the circuit. The question of rectifier performance is one which parallels in importance that of the magnetic properties of the core materials. Explicit characteristics desired of rectifiers for magnetic amplifier applications are: (1) sturdiness and (2) low forward combined with high back resistance.

Sturdiness, reliability and long life are essential because magnetic amplifier applications often involve conditions of high-intensity shock and require operation without replacement of parts or servicing for 10,000 hours or more. Because none of the components, except possibly the rectifier, are difficult of manufacture to meet these requirements,



STATIC CHARACTERISTICS OF COMMERCIAL SELENIUM AND GERMANIUM RECTIFIER CELLS

TYPE	SELENIUM SINGLE CELL	GERMANIUM CRYSTAL DIODE
RATED FORWARD CURRENT	40 MA	22.5 MA
PEAK INVERSE VOLTAGE	18 VOLTS	50 VOLTS
FORWARD RESISTANCE	20 OHMS AT 40 MA	75 OHMS AT 22.5 MA
INVERSE RESISTANCE	22,500 OHMS AT 18 VOLTS	150,000 OHMS AT 50 VOLTS
RECTIFICATION RATIO	1,125	2,000
RATED FORWARD VS INVERSE CURRENT AT RATED VOLTAGE	50	65

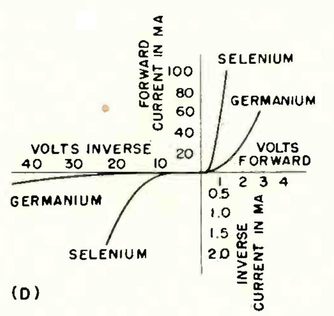


FIG. 3—(A) Core material and circuit determine response of amplifier. (B) Positive feedback gives snap action; negative feedback improves linearity. (C) Properties of cores vary between samples. (D) Rectifiers are also important

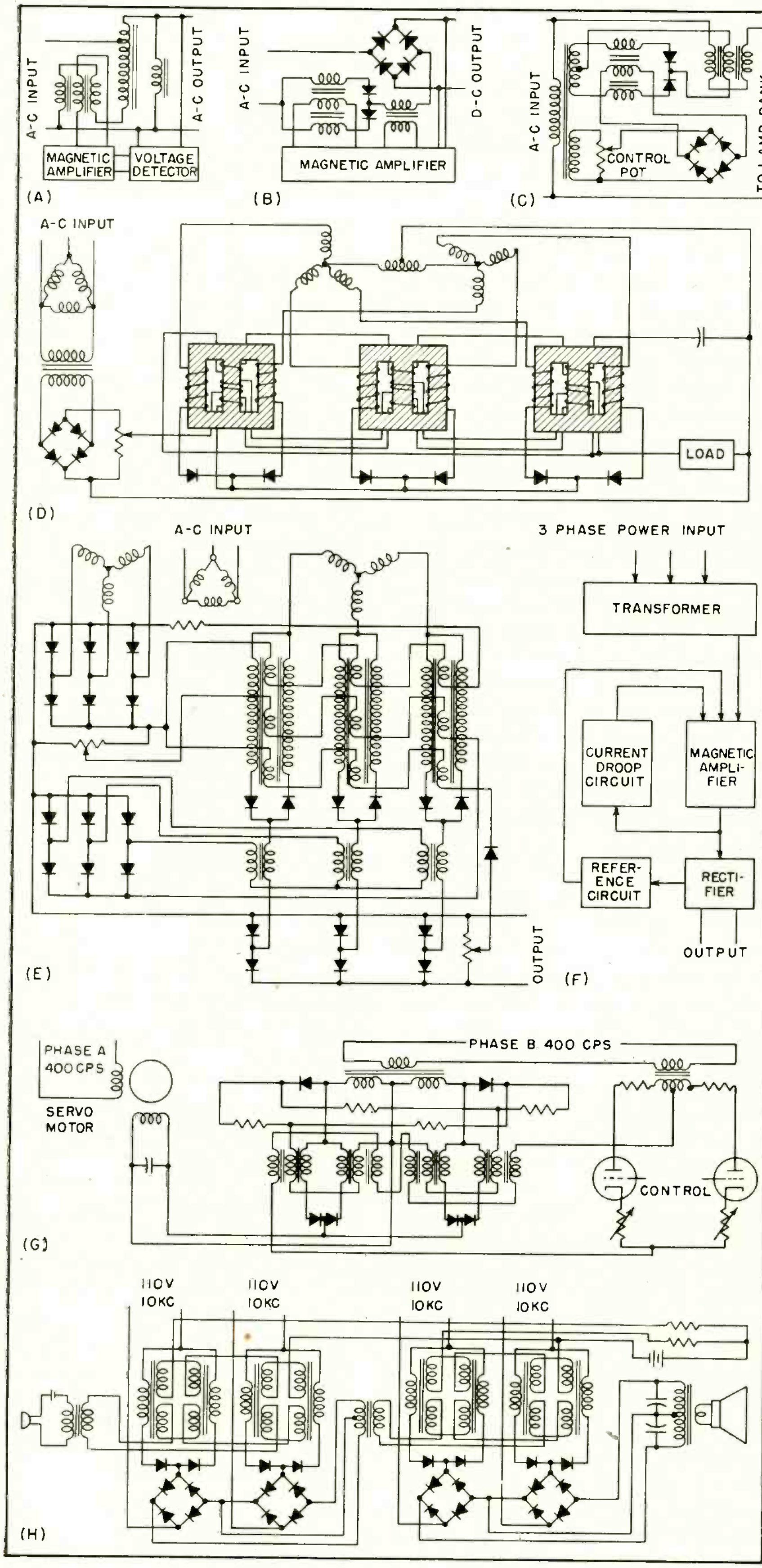


FIG. 4—Presaturated reactors and magnetic amplifiers have been used in various applications, as these simplied diagrams show: (A) line voltage regulator, (B) automatic battery charger, (C) theater lighting control, (D) constant potential rectifier, (E) welding rectifier, also shown in block form (F), (G) servo motor power amplifier, and (H) two-stage audio amplifier

the use of dry-disc rectifiers rather than electronic units is usually indicated. At any rate, they are in common use in magnetic amplifier circuits.

Low forward resistance and high inverse resistance are desirable for obtaining maximum sensitivity consistent with the properties of the magnetic core material. Low forward resistance results in an increase of output for a given control signal. The lower back current resulting from the use of high inverse resistance rectifiers results in less demagnetization output for a given control current.

Figure 3D shows the characteristics of two small, commercial rectifiers. The rectification ratios are seen to lie between 1,000 and 2,000, while the forward-versus back-current ratios are 50 and 65. It is desirable for magnetic amplifier circuits that the current ratio be raised to 500 to 1,000. Such a ratio is not considered unobtainable for special-purpose units by rectifier manufacturers. Commercial requirements in the field of dry-disc rectifier units have been so unlike those for the special units discussed, that there has been little development work aimed at the special characteristics required of rectifiers for reactor circuits. No doubt such improvement in rectifiers can be made without an overly extended development program.

Rather large changes of operating temperature should not be reflected in equivalent changes of electrical characteristics of the rectifiers, particularly the inverse resistance, nor should the rectifier characteristics change radically over the period of their useful life. Rectifiers should have the maximum inverse voltage rating consistent with a high value of forward-versus back-current ratio so that they are light in weight and give optimum amplifier sensitivity. They should not change when unused or should recover rapidly from nonuse such as shelf storage or equipment idleness. Like core materials, rectifiers for magnetic amplifiers should have reproducible characteristics as commercially available units with published resistance characteristics. This requirement is particularly true of the low-level units, especially sensitive types, but is not of great consequence at higher power levels, present published rating data being sufficient.

Applications of Magnetic Amplifiers

Just as the saturable reactor is a basic component of the magnetic amplifier, so the magnetic amplifier can be used as a basic subassembly in various equipments. The characteristics of the amplifier will be determined by the equipment with which it is to be used, and the amplifier will have to be designed accordingly.

One of the commonest applications of saturable reactors is for line voltage regulation in which the self-adjusting property of the reactor is used in place of a manually adjusted tap on a transformer to compensate for input voltage or load current changes. The next step in complexity beyond a single saturable reactor is to substitute a separately controlled reactor (Fig. 4A). Line-to-line voltage regulation is obtained by an autotransformer a portion of which is a presaturated reactor controlled by a magnetic amplifier operating from voltage changes across the output. A bleeder reactor prevents the regulator from losing control at no load.

Automatic battery chargers have long used magnetic amplifiers, especially in Europe. In this application the requirement is to maintain constant charging voltage and to limit the current (at the beginning of the charging cycle) to a safe value. A doubler circuit (Fig. 1D) and a full-wave rectifier can be combined to perform this function (Fig. 4B). Variations in output voltage and input current (coupled to the magnetic amplifier through a transformer) operate the control winding.

Another popular application is in theatre lighting control (Fig. 4C). A low-power control circuit, excited from the power line, produces the direct current to govern a magnetic amplifier of the full-wave type (Fig. 1E), which is also excited from the power line. The output of the amplifier in turn regulates the saturation of the main reactor in series with the lamp bank. Because the primary control circuit and the magnetic amplifier are both excited from the same power line, effects of fluctuations in supply voltage can be counter-acted to some extent. The line voltage has to be about 10 percent higher than the rated operating voltage of the lamp bank to allow for the drop in the main reactor.

The functions of voltage regulation and rectification can be combined in a single unit. A 3-phase unit, suitable for such applications as controlling the speed of a large d-c motor, (Fig. 4D), obtains the fixed reference voltage through a constant voltage transformer across one of the power phases. This voltage is rectified and the current so obtained is used to control three full-wave magnetic amplifier operating from a 3-phase transformer and interphase transformer (compare with the single-phase circuit of Fig. 1E). To increase the sensitivity of the system, positive feedback is used, and to improve transient response, damping windings in series with a capacitance are added. The output voltage (motor speed) can be controlled by the potentiometer in the constant-voltage circuit.

Some applications require that the output be stabilized against several possible variations. The battery charger (Fig. 4B) is one example of this case. The welding rectifier (Fig. 4E) is another example. The output current must be stabilized against changes in output load (current and voltage) and line voltage. The 3-phase doubler circuit has three control windings. One winding is excited by rectified 3-phase voltage from the supply line, the second is excited by current proportional to the load current, and the third by current proportional to the load voltage. All of these control currents pass through a common potentiometer by which the welding current can be set. A potentiometer across the output further provides adjustment of the voltage-proportional control current for no-load reference. Four sets of rectifiers are required: the self-excitation rectifiers of the doublers, the power rectifiers in the output, and the two sets of rectifiers (for input voltage and output current) for the control windings. A single rectifier suffices for the output voltage control circuit because it is already across the power rectifiers (but a rectifier is necessary to provide high impedance to induced reverse currents). A block diagram (Fig. 4F) shows the nature of the feedback paths of this system.

The foregoing systems have operated at 60 cps. Fast response is not required of them and it is most convenient to excite all elements of the system from the same supply. However, if fast response is necessary, a higher operating frequency should be used because then, for the same impedance, the inductances of the windings can be less, which reduces the time constant of the system. In general, equivalent magnetic amplifiers operating at different frequencies can respond in the same number of cycles, thus the higher frequency unit has the faster response.

A fast-acting servo amplifier can be operated from a 400-cps. source (Fig. 4G). A 2-phase system is frequently used with a 2-phase induction motor, although a 3-phase system would be similar. Doublers in push-pull with each other produce a null so that the system has a quiescent point between forward and reverse motor drive. The control windings are excited by electronic tubes; the rheostats in the cathodes permit balancing the amplifier at the required null, or varying the null. Primary control of the amplifier is, as usual, through the grids of the tubes.

An audio amplifier (Fig. 4H) illustrates the use of high-frequency excitation to obtain fast response. Essentially each of the two stages is a carrier-type amplifier. Two pairs of doublers, connected in push-pull to reduce even harmonic distortion as well as to provide symmetrical operation, are excited from a 10,800-cps source (180th harmonic of 60 cps). These two stages are connected by an interstage transformer. Pairs of full-wave rectifiers are used before the interstage and output transformers. A single-button carbon microphone feeds the 5-milliwatt input transformer to develop full power in the 5-ohm 6.5-watt voice coil of the loudspeaker. The operating points of the reactors of each stage are set by a bias battery and biasing resistors.

Television Synchronizing

Horizontal and vertical driving pulses, the composite blanking signal and the composite synchronizing signal, all within FCC and RMA specifications, are produced. Linearity test signals can be mixed with blanking for testing picture monitors and receivers; simultaneous cathode-ray monitoring of all frequencies is provided

THE instrument to be described provides the means for insuring synchronism between the scanning of a picture at the receiver and the scanning of a subject at the transmitter. Features are provided that are not usually found in a synchronizing generator which are specific aids in television station operation and maintenance.

The generator meets the RMA recommendations for the standard signal, that is, the horizontal and vertical driving pulses, the composite blanking signal and the composite synchronizing signal.

Linearity test signals are provided at 900 cycles and at 157.5 kc mixed with blanking by means of a switch for use in testing scanning linearity of picture monitors and television receivers. These produce 15 horizontal bars and 10 vertical bars on a raster permitting a rapid check of sweep linearity. In addition, the 157.5-kc test signal serves as an accurate 10 percent H (6.35 μsec), electronic marker for use with an ordinary oscillograph in the precise setting of pulse widths and front porch.

The leading edges of the equalizing pulses are also the leading edges of horizontal and vertical synchronizing pulses, thus insuring perfect interlacing.

Two 3-inch cathode-ray tubes permit simultaneous monitoring (without switching) of all frequencies in the synchronizing generator. Thus, frequency counts may be checked or adjusted without the use of an external oscilloscope.

A crystal oscillator at 157.5 kc or a highly stable self-excited oscillator at 157.5 kc may be selected by a switch for the master oscillator. The self-excited oscillator is used in synchronizing the generator, by means of the provided lock-in circuit to the 60-cycle power line or to a remotely generated synchronizing signal.

Negative feedback is used in many of the circuits to minimize the effect of changes in tube characteristics and variations between tubes. A double-regulated supply is used having an internal impedance of less than 0.15 ohm.

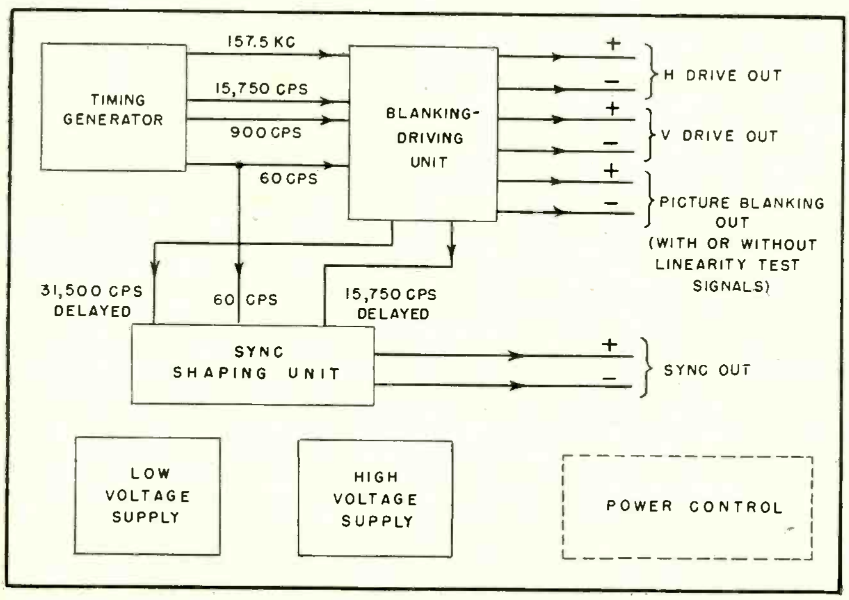


FIG. 1—Interrelation of units forming the sync generator

Circuit Breakdown

The generator consists of the following units:

1. Timing generator
2. Blanking-driving unit
3. Sync shaping unit
4. Regulated low-voltage supply
5. High voltage supply for the cathode-ray monitors
6. Power control panel containing switches and fuses.

Figure 1 is a block diagram showing the interrelation of the units in the development of the standard signals. Accurately timed signals at 157.5 kc, 31,500 cycles, 15,750 cycles, 900 cycles and 60 cycles are developed in the timing generator for use in the other units.

The blanking unit utilizes the 60-cycle signal and the 15,750-cycle signal in the development of verti-

Signal Generator

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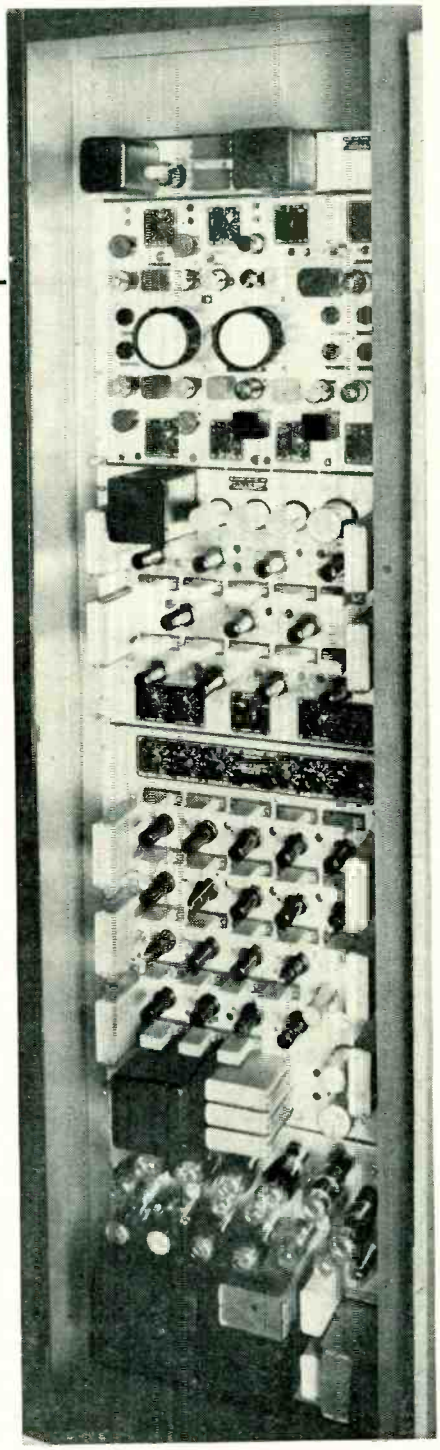

Complete synchronizing signal generator

cal driving and horizontal driving pulses and in the development of the composite blanking signal. It also uses the 157.5-kc signal and the 900-cycle pulses in the development of the composite linearity test signal which becomes available mixed with blanking.

The sync shaping unit utilizes the 31,500-cycle pulses and the 15,750-cycle pulses with suitable delays (for accurate synthesis of the horizontal and vertical sync pulses) in a specially designed delay line contained in the blanking-driving unit for the formation of the high-frequency components of the composite synchronizing signal. The 60-cycle pulse from the timing generator is used undelayed in the development of the low-frequency component of the composite synchronizing signal.

To meet the severe requirements of the RMA-recommended synchronizing signal generator signals, there must be precise time relationship among the pulses developed by the timing generator. This may be obtained by starting at a high frequency and by suitable frequency division deriving the lower frequency pulses. An alternate method is to begin with the lowest frequency and obtain the higher frequency signals by suitable frequency multiplication. In the timing generator shown in Fig. 2, the former method is used because it may be effected by simpler circuits.

In the circuit diagram of Fig. 2, the two basic oscillators are the 6AC7 crystal oscillator and the 7F8 master oscillator, both operating at 157.5 kc. The 6SN7 blocking oscillator frequency dividers are used to derive the lower frequencies required. The first division is by 5 to 31.5 kc, the equalizing pulse frequency. From 31.5 kc there is one division by two to 15,750 cycles, the horizontal rate, and another division by seven to 4,500 cycles. The frequency of 4,500 cycles is divided by five to 900 cycles, one of the linearity test signal frequencies.

Division of 900 cycles is done by five to 180 cycles which is in turn divided by three to 60 cycles, the field repetition rate. Sawtooth wave forms at 60 cycles and at 900 cycles are fed respectively to the deflecting plates of the low-frequency and the high-frequency cathode-ray monitors, to serve as time bases for the presentation of the count-down frequencies on the monitor screens.

Frequency Indicators

Figure 3 shows the presentation on the screens of the cathode-ray tubes. The left-hand screen is that of the high-frequency monitor whose horizontal time base is 900 cycles. The dots represent the master oscillator or crystal oscillator frequency 157.5 kc. There are five dots along each line or step in the vertical "ladder" indicating a division from 157.5 kc to 31,500 cycles.

The bright dots on the high-frequency monitor correspond to the 15,750-cycle horizontal repetition rate. There are seven steps in each of the ladders, indicating a frequency division from 31,500 cycles to 4,500 cycles; in other words each ladder represents 4,500 cycles. The presence of five ladders for each cycle of the time base points to a frequency division from 4,500 cycles to the time base frequency of 900 cycles.

On the right-hand or low-frequency monitor, the ladder steps represent 900 cycles. Since there are five of them to each ladder, the indication is frequency division

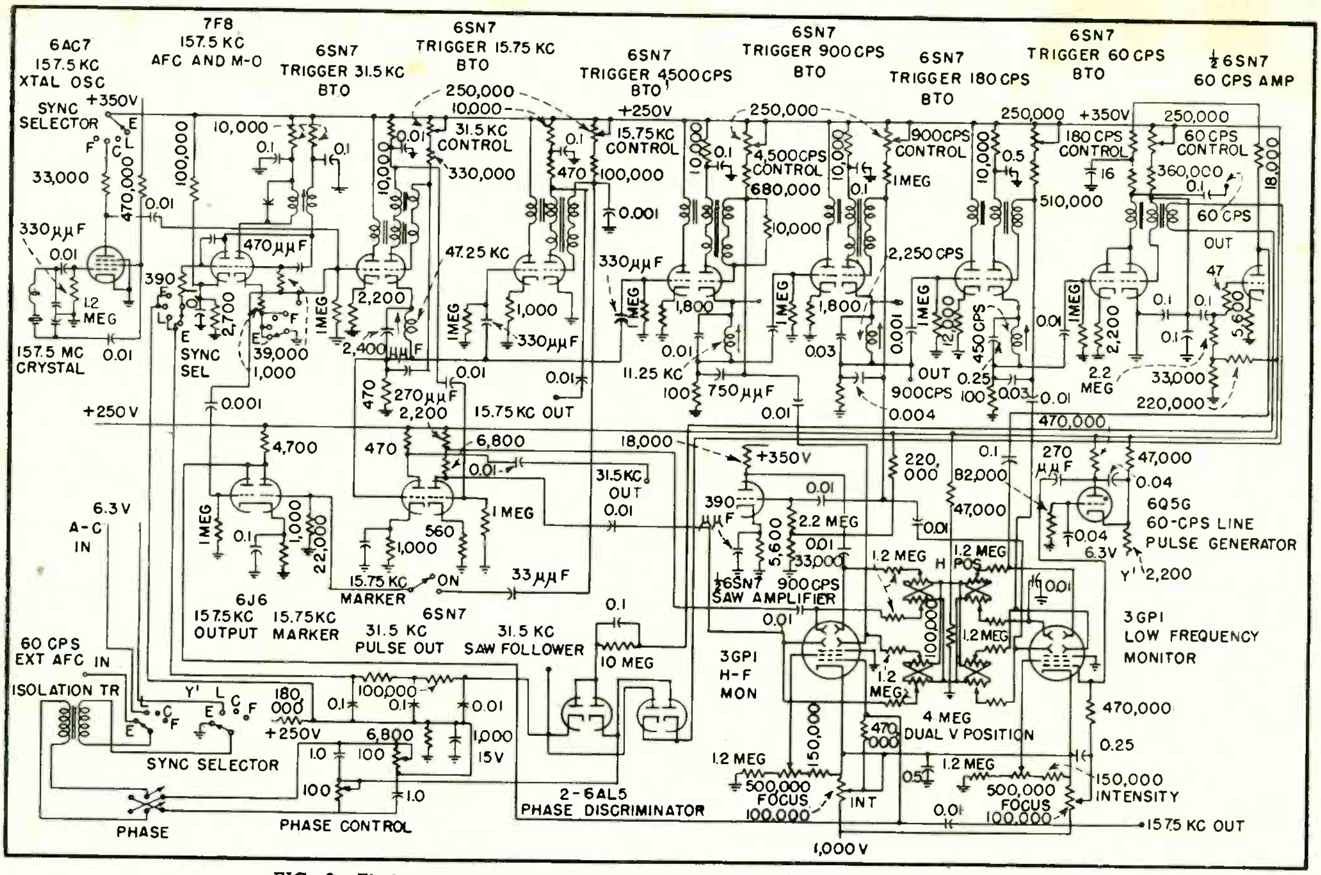

FIG. 2—Timing generator circuits of the Du Mont TA107 A/B sync generator

from 900 cycles to 180 cycles. The three ladders per cycle of the time base indicate a frequency division from 180 cycles to 60 cycles.

The blanked out section in the middle of the low-frequency scan being derived from the power line further confirms the time base of 60 cycles and indicates synchronism with the line. When the generator is not locked to the 60-cycle power line, the blanked out section moves across the time base. This presentation has been found highly useful in the analysis at a glance of synchronizing generator failures due to improper timing.

The type of blocking oscillator frequency divider circuit used is the cathode - tuned - circuit - stabilized type, Fig. 4. Firing of the blocking oscillator results in a surge of current through the cathode circuit which is normally tuned to a frequency half that of the trigger repetition rate. This results in a ringing of the tuned circuit due to its Q. The cathode voltage wave form is that of a damped sine wave lasting for 2½ cycles (for a 5 to 1 count down) before the blocking oscillator fires again. The grid to ground and the grid to cathode voltage waveforms are shown in the diagram of Fig. 4. As indicated, discrimination is very good against all trigger pulses other than the one producing proper count down.

In the design of the timing circuits, extreme care was taken to minimize any possibility of frequency modulation of the timing pulses. Considerable attention was paid to the chassis layout especially with respect to keeping high level pulse points away from the afc circuit. The blocking oscillator grids are returned to +250 volts giving a steep capacitor voltage discharge waveform and consequently improving freedom from jitter.

The source of B voltage is a double-regulated power supply with an output impedance of less than 0.15 ohm. This eliminates the possibility of extraneous signals modu-

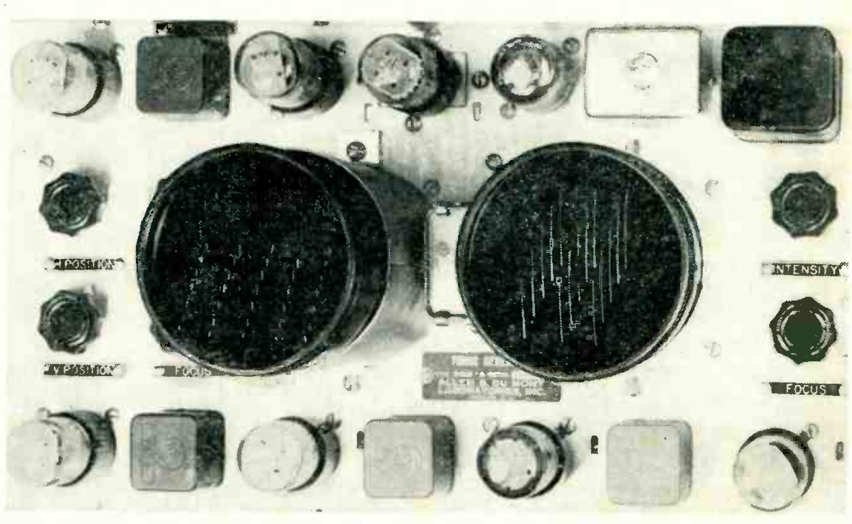

FIG. 3—Presentation of count-down frequencies on cathode-ray monitors

lating the blocking oscillator grid base, a common source of frequency modulation.

The 157.5-kc and 900-cycle outputs of the timing generator are fed directly to the blanking unit for use in the production of a linearity test signal mixed with blanking. The 60-cycle pulse output of the timing generator is routed to the blanking-driving unit and the sync shaping unit for use in the generation of RMA driving pulses, and the low-frequency components of RMA blanking and sync pulses.

To conform to the strict requirements of the RMA recommended synchronizing signal, it is good design practice to use the same signal for the formation of the leading edges of all of the pulses which make up the synchronizing signal. In the synchronizing signal generator under discussion, the leading edges of the equalizing pulses are used to form the leading edges of the horizontal and the vertical synchronizing pulses. This is done by adding a horizontal component and a vertical component, both of which have been delayed a precise time by a lumped LC delay line in the blanking unit, to the equalizing pulses and clipping the result as indicated in Fig. 5.

Two separate delay lines are used, one for the 31,500-cycle signal and the other for the 15,750-cycle signal. Each line consists of 70 π sections with a total delay of 10 percent of the horizontal period or approximately 6.3 microseconds. Provisions are made for tapping connections in any one of the sections in both lines. This permits very accurate shaping of the sync pulses as well as very precise setting of the front porch. Multivibrator stability is in part a function of the trigger pulse rise time. To maintain as short a rise time as practical in the delayed 15,750 and 31,500-cycle trigger pulses, the delay line is designed for a frequency band of over three megacycles. Figure 6 shows the schematic of a single section of the delay line.

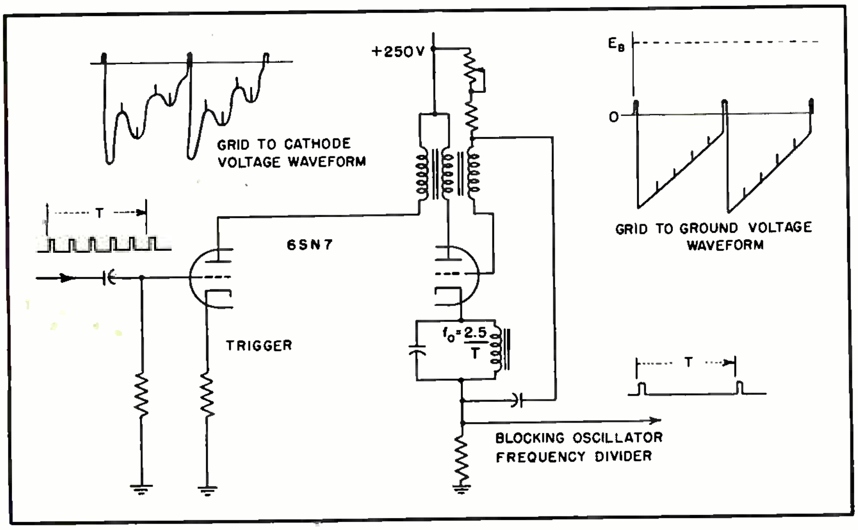

FIG. 4—Cathode-stabilized blocking oscillator frequency divider

Equalizing Pulses

The equalizing pulses shown as *G* in Fig. 5 are generated directly by multivibrator V_{17} in the sync shaping unit, block diagram of Fig. 5. They are amplified and limited by V_{18} and mixed with the

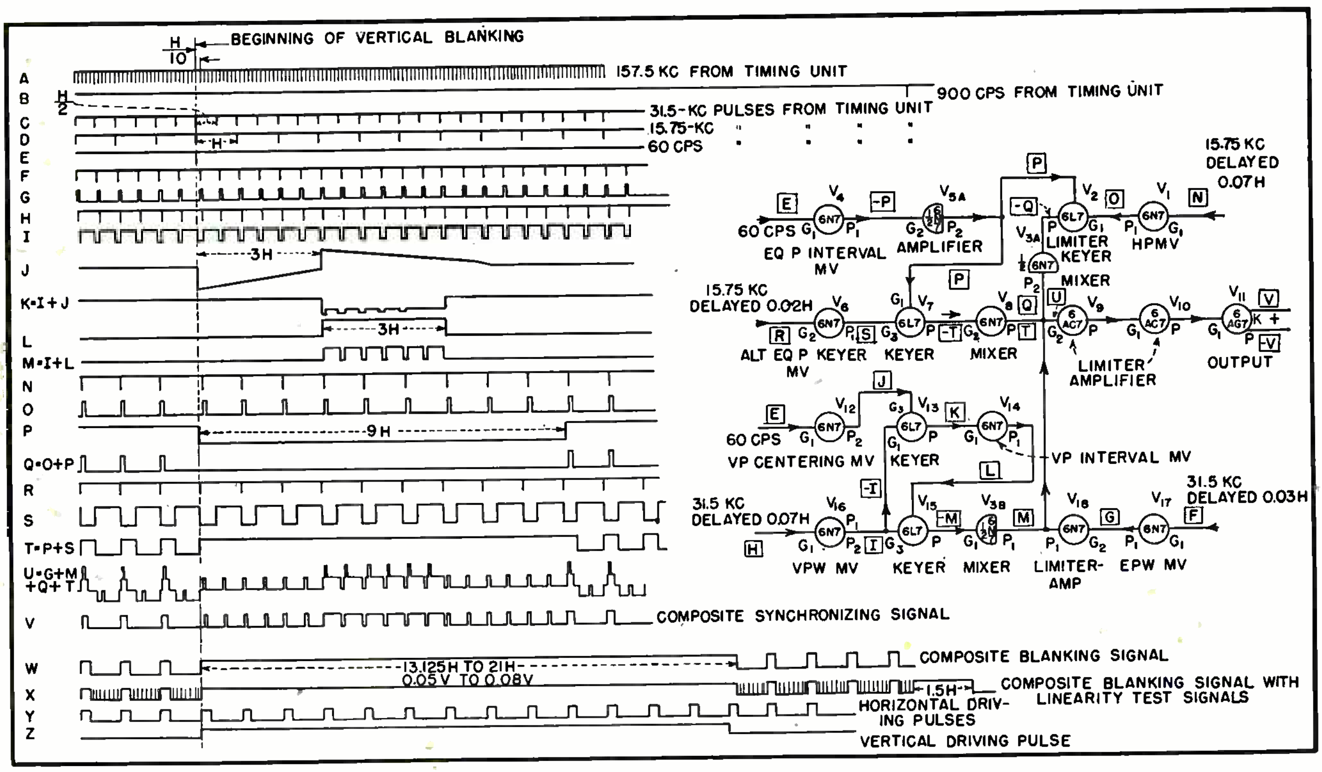

FIG. 5—Timing diagram shows the formation of the composite synchronizing signal and block diagram of sync shaping unit

other synchronizing signal components in the plate circuits of V_{18} V_8 and V_3.

Horizontol Pulses

Figure 5 is a timing diagram indicating the synthesis of the composite synchronizing signal from its various components. The horizontal pulses are formed by adding delayed 15.750-cycle pulses to the equalizing pulses, amplifying, limiting and keying-out undesired 31,-500-cycle pulses. The result before final clipping is shown at U of Fig. 5.

Tube V_1 in Fig. 5 is the horizontal pulse multivibrator whose output (O in Fig. 5) is permitted to clear through V_2 only during the horizontal pulse interval.

The 15,750 cycle pulses (Q in Fig. 5) are then amplified and limited in V_3 and mixed in the common plate circuit of V_{18} and V_8 with the vertical and equalizing pulse components of the composite synchronizing signal.

The first and last sections of U in Fig. 5 show the horizontal component of the mixed signal at V_9. The raised portion of this component indicates the overlap between the equalizing pulse and the delayed horizontal pulse. This is later clipped off in limiters V_9 and V_{10} as shown in the first and last sections of V in Fig. 5.

The keying out of the horizontal pulses during the equalizing pulse interval is accomplished by the gating of keyer tube V_2 by pulse P in Fig. 5 derived from the equalizing pulse interval multivibrator V_4 through amplifier V_5. The elimination of unwanted equalizing pulses is obtained by first pushing them down into a region lower than that of the desired horizontal pulses by means of 15,750-cycle pulses shown as T in Fig. 5 and later removing them by clipping. Waveform T is derived from the alternate equalizing pulse keying multivibrator V_6 through keying tube V_7 and amplifier-limiter V_8. The pushed down equalizing pulse is shown in the first and last sections of U in Fig. 5.

The elimination of alternate equalizing pulses must not take place during the equalizing pulse interval. For this reason keying tube V_7 by means of the equalizing interval pulse P permits the alternate equalizing pulse keying signal S to be applied only during the horizontal pulse interval. The output of V_7 is T in Fig. 5. The duration of the horizontal pulses in the output signal V is 8 percent of H ($+0$ -1 percent).

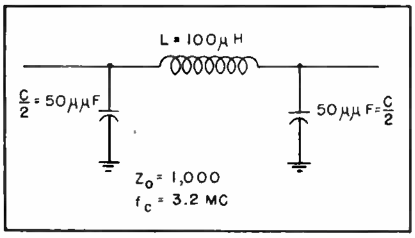

FIG. 6—Single pi section of delay line

Vertical Pulses

The vertical pulses in the composite synchronizing signal consists of a group of six at a 31,500-cycle rate. The group repeats itself once each scanning field, see center section of V in Fig. 5. The duration of each pulse is 43 percent of H where H is the line period and the group must appear during the vertical blanking interval between the first and second group of six equalizing pulses.

The timing of the vertical pulse interval is determined by the trailing edge of a pulse, J in Fig. 5, three lines wide from the 60-cycle vertical pulse centering multivibrator V_{12}. The vertical pulses are generated at a 31,500-cycle rate in the vertical pulse multivibrator V_{16}. These are shown at I in Fig. 5. One of its pulses, upon coincidence with the trailing edge of the vertical centering pulse K, is permitted by keyer tube V_{13} to trigger the vertical pulse interval 60-cycle multivibrator V_{14} whose pulse width is normally set equal to three horizontal lines or the interval required by six vertical pulses at the 31,500-cycle rate.

Waveform L in Fig. 5 is the output of V_{14}. The vertical pulse interval gate, in turn, permits the vertical pulses to be amplified by keyer tube V_{15} only during the vertical pulse interval. The result is M in Fig. 5. In turn, the six vertical pulses during the vertical pulse interval are amplified and limited by tube V_3 and appear in the common plate circuit of V_3, V_8 and V_{18}. Thus, into a common plate load are fed the horizontal pulses during the horizontal pulse interval from tube V_3, the equalizing pulses during the equalizing pulse interval from tube V_{18} and the six vertical pulses during the vertical pulse interval from tube V_8. The mixed signal, U, is amplified and limited by V_9 and V_{10} and appears at the cathode and plate of output tube V_{11} as a positive and negative composite synchronizing signal. Figure 5 shows the final sync output signal at V.

The block diagram of the blanking-driving unit is shown in Fig. 7.

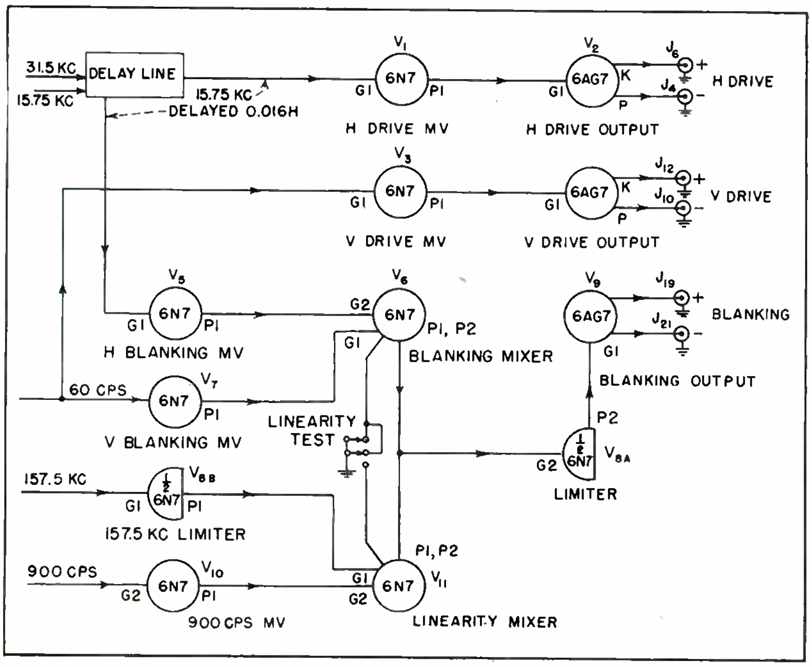

FIG. 7—Functions of stages in the blanking-driving unit

The 15,750-cycle pulses trigger the horizontal blanking multivibrator V_5 whose output is fed into blanking mixer V_6. The 60-cycle pulses trigger the vertical blanking multivibrator V_7 whose output is fed to the grid of the second triode of blanking mixer V_6. In the blanking position of the linearity test switch, the mixed vertical and horizontal blanking signals are limited and amplified in tube V_8 and applied to the grid of blanking output tube V_9. At the cathode and plate of output tube V_9, appear respectively the positive and negative composite blanking signals.

The 157.5-kc signal derived from the timing generator is amplified and shaped in V_8 and mixed in V_{11} with the 900-cycle pulse derived from multivibrator V_{10}. In the *blanking and linearity bars* position of the linearity test switch, these are inserted into the blanking signal in the common plate load of blanking mixer V_6 and linearity mixer V_{11}. The mixed blanking and linearity test pulses are clipped in limiter V_{8A} and applied to the grid of output tube V_9. In this position of the switch the output signals at J_{10} and J_{21} consist of the composite blanking signal mixed with vertical and horizontal linearity signals. In the *linearity bars* position of the selector switch only linearity test signals are permitted to appear at the blanking signal output jacks. Figure 8 shows a test pattern generated by an iconoscope film chain driven by the sync generator. The linearity test switch is in the *blanking and linearity bars* position.

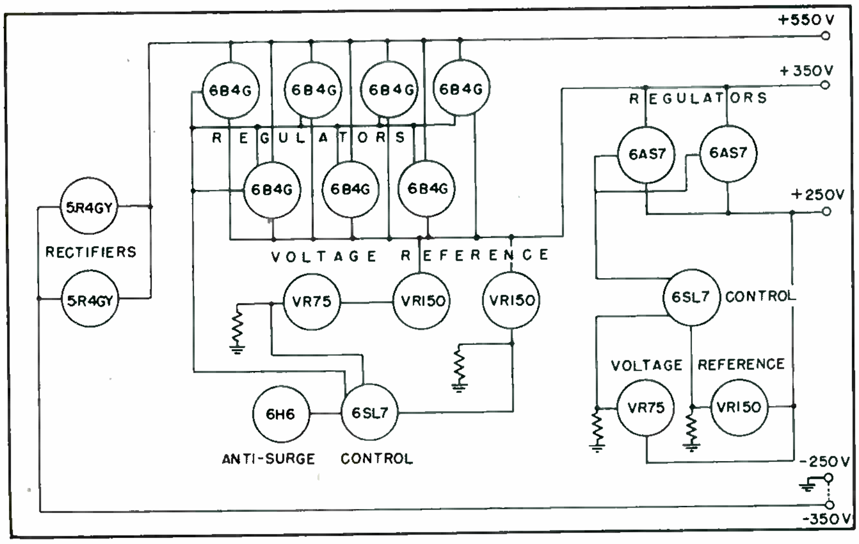

FIG. 9—Block diagram of low-voltage power supply

The horizontal driving pulses originate in the 15,750-cycle multivibrator V_1 and are directly applied to the grid of the horizontal drive output tube V_2. They appear as positive and negative horizontal driving signals respectively at J_6 and J_4. In a similar manner the vertical driving pulses originate in the 60-cycle multivibrator V_3; the output is applied directly to the grid of vertical output tube V_4. Vertical driving pulses appear in positive and negative polarity at jacks J_{12} and J_{10}. At Y and Z of Fig. 5 are shown the waveforms of the horizontal and vertical driving pulses produced by the circuits.

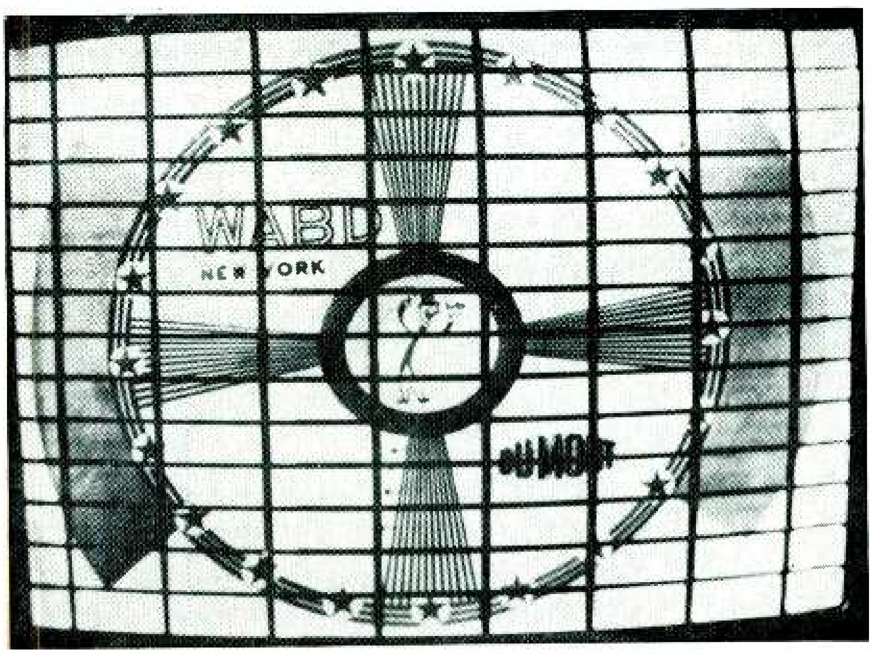

FIG. 8—Camera chain output picture signal with the linearity test switch of sync generator set at blanking and linearity bars for adjustment of monitor sweep linearity

Power Supplies

The high-voltage supply is used to provide the accelerating potential for the cathode-ray tube monitors in the timing generator.

A double-regulated low-voltage supply is used to provide 250 volts and 350 volts for the three signal units. This supply has an output impedance of less than 0.15 ohm at 1,000 cycles. The change from no load to full load at 400 milliamperes results in a change of only 0.1 volt at the output. A block diagram of the low-voltage supply is shown in Fig. 9. Transients from the ordinary power supply filter circuit are eliminated by use of an "electronic choke" in the form of a first regulator for the 350 volts ahead of the final regulator for the 250 volts.

A number of these synchronizing generators have been in operation during the past two years with excellent results.

Acknowledgment

Acknowledgment is made to the following men of the Du Mont Laboratories who took part in the development and product design of the synchronizing generator: H. Beste, L. Durgin, C. Quirk and L. Spooner, and to N. Accardo and M. Demeyer, who aided materially in the test of models.

Single-Sideband CRYSTAL FILTERS

X-cut crystals are used in multiple-section filters for the upper and lower sidebands and the carrier frequency. The carrier filter has a passband 16 cycles wide between 3-db points and the sideband filters are flat within 0.6 db for nearly 6 kilocycles

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ONE PROBLEM involved in the development of an improved type of radio receiver for twin-channel, single-sideband reception was the design and construction of three crystal filters.

These were used to separate the carrier from the sidebands of an amplitude-modulated wave train at an intermediate frequency of 100 kc and to isolate each of the two sidebands.

Specifications called for a carrier filter less than 25 cycles wide at points whose response was 3 db down from maximum, and 175 cycles wide at points 50 db down, with a maximum attenuation of over 70 db available.

Since both speech and musical programs were to be received with high fidelity, each sideband (channel) filter was specified to have a passband 6 kc wide, flat within ±0.5 db except at the edges where a 2-db drop from maximum response could be tolerated. These edges were taken to be 100 cycles and 6 kc respectively from the intermediate carrier frequency of 100 kc.

A maximum relative attenuation of at least 85 db was desired at all frequencies separated by more than 4 kc from the passband midfrequency. This would provide for a 40-db attenuation of adjacent-channel signals of equal strength in addition to a possible unfavorable selective fading differential of 45 db between the two channels.

A piezoelectric crystal such as quartz acts electrically[1] like the LC circuit shown in Fig. 1. For a range near the resonant and antiresonant frequencies of this electrically equivalent circuit, the crystal presents a reactance whose variation is shown by the full-line graph of Fig. 4. Suppose that two crystals are so cut that the resonant frequency of one coincides with the antiresonant frequency of the other. The reactances of both crystals are then as depicted by the full-line and dashed-line graphs of Fig. 4.

Theory

If these crystals be connected in a bridge circuit similar to Fig. 6, or its equivalent lattice, Fig. 2, we have the structure of a simple narrow bandpass filter. The dashed-lines in Fig. 2 indicate lattice arms of the same type as those actually shown. In Fig. 6, the dashed-lines indicate that *XX* are the two halves of a single crystal having divided plating. Likewise for *YY*.

The bridge circuit of Fig. 6 is that of a pure reactance bridge. This will be perfectly balanced when the reactance between points 1 and 2 of the circuit is equal to that between 1 and 4 and of the same sign. The same is true for the reactance between 2 and 3 and that between 3 and 4. There are two frequencies at which this will occur. On Fig. 4, these are designated $f_{\infty 1}$, and $f_{\infty 2}$, for the attenuation (theoretically) reaches an infinite value at these frequencies. Actually, the attenuation will merely rise to a maximum value, called an attenuation peak, at each of the two frequencies of balance as shown in Fig. 5. As the frequency of an input signal is increased from $f_{\infty 1}$, toward f_A, the attenuation will continuously decrease until it (theoretically) reaches zero at f_A, the series-resonant frequency of one of the pairs of crystals.

For frequencies between f_A and f_B the reactances of the two pairs of bridge arms are at each point of opposite sign. Hence, signals whose frequencies lie within this range will pass through the filter (theoretically) with no attenuation. Actually some attenuation is experienced in this range, the amount depending on the Q factor of the crystals and associated circuit elements. For this reason, characteristics of the filters developed in this work are shown as relative attenuation versus frequency rather than actual attenuation. The region between f_A and f_B, as shown in Fig. 5, is the passband of the filter.

In practice, capacitors C_A are placed in parallel with input and output terminals of the filter. Others, C_B, of much smaller capacitance, are connected from input to output as bridging capacitors.

The parallel capacitors adjust the separation between resonant and antiresonant frequencies of the bridge arms and hence control the width of the passband. The bridging capacitors change the shapes of the reactance graphs of the bridge arms somewhat, thereby changing the frequencies at which the two reactance curves cross where of like

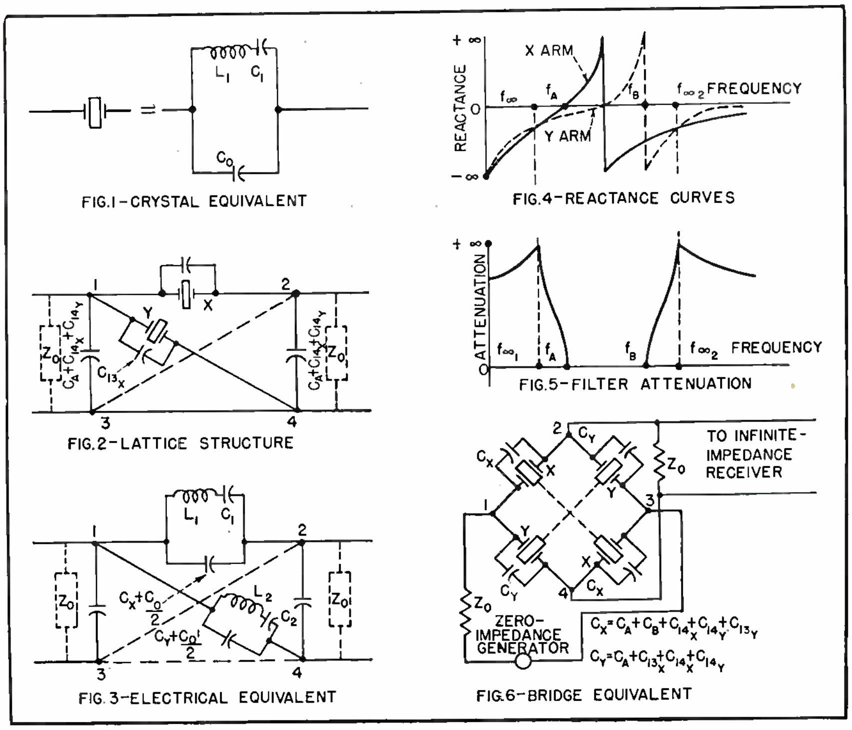


FIG.1-CRYSTAL EQUIVALENT

FIG.2-LATTICE STRUCTURE

FIG.3-ELECTRICAL EQUIVALENT

FIG.4-REACTANCE CURVES

FIG.5-FILTER ATTENUATION

FIG.6-BRIDGE EQUIVALENT

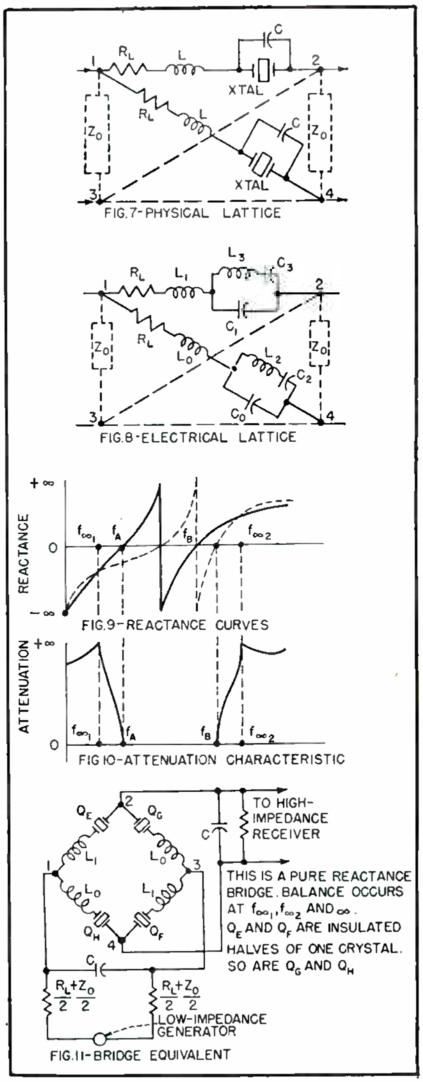


FIG.7-PHYSICAL LATTICE

FIG.8-ELECTRICAL LATTICE

FIG.9-REACTANCE CURVES

FIG.10-ATTENUATION CHARACTERISTIC

FIG.11-BRIDGE EQUIVALENT

Table I—Effect of Temperature on Attenuation Characteristic

db Down	Frequency (kc) of Lower Side		Difference cps	Frequency (kc) of Upper Side		Difference cps
2	93.92	93.93	+10	99.890	99.868	−22
6				100.060	100.035	−25
10	93.58	93.62	+40	100.152	100.127	−25
20	93.41	93.44	+30	100.300	100.278	−22
30	93.29	93.35	+60	100.405	100.360	−45
40	93.16	93.21	+50	100.505	100.480	−25
	Average		+38	Average		−27

sign. Adjustment of the bridging capacitors, therefore, controls the frequencies of the attenuation peaks of Fig. 5.

The resonant and antiresonant frequencies of a quartz crystal are separated by only about 0.4 percent of resonant frequency (for X-cut crystal). Since, as seen in Fig. 4, the passband is only double this amount, some other circuit element must be introduced if wide passbands are desired. Such an element may be an inductance placed in series or in parallel with each crystal of the circuit. These two types of connection result in filters having low image impedance and high image impedance, respectively.

To avoid stray couplings in the channel filters herein described, a reasonably low image impedance was chosen. This choice called for a coil to be connected in series with each crystal of the filter circuit. The widening of the filter passband by the use of coils is due to the fact that their addition produces a large increase in the separation of resonant and antiresonant frequencies of the bridge arms and furthermore extends the upper edge of the passband considerably beyond the higher of the two antiresonant frequencies of the bridge circuit, Fig. 9 and 10.

For the passband region, the image impedance of the filter is a pure resistance whose value changes from near zero at the passband edges to a maximum midway between them. Terminating resistances considerably lower than the midband impedance are used in the filters actually built to secure[2] a better average impedance match over the whole passband.

If all the coils used in the wide-band filter are wound to have equal resistances, or if supplementary resistors are inserted to make all arms of the equivalent bridge circuit have equal resistances, it is possible[1] to consider these resistances as being brought outside the bridge circuit proper and incorporated in the terminating resistors. This leaves the bridge as a pure reactance bridge. Under this condition neither the sharpness of the cutoff at the passband edges, nor the steepness of the attenuation characteristic of the filter is impaired by the resistances of the coils inserted in the filter lattice.

Mason[1] has given mathematical formulas from which the values of the circuit components of a filter section can be computed after certain constants have been chosen. These are (1) the frequencies of the edges of the passband, (2) the frequencies of the peaks of infinite attenuation, and (3) the midband image impedance of the desired filter. The formulas refer to the electrical equivalents of the crystal filter lattice as shown in Fig. 3 and 8.

A sample 6-kc filter calculation using the wideband filter formulas, resulted in the following values. Chosen

$Z_0 = 2{,}000$ ohms
$f_A = 99.50$ kc; $f_B = 106.70$ kc
$f_{\infty 1} = 98.70$ kc; $f_{\infty 2} = 107.50$ kc;
$f_{\infty 3} = \infty$

Having obtained the values of the equivalent electrical components of a crystal filter section, the next step is to transfer the computed series resonant frequencies f_2 and f_3 of the crystals to actual dimensions of the quartz crystals themselves. Equations for accomplishing this depend upon the type of crystal cut decided upon.[1, 3]

Calculated

$L_0 = L_1 = 44.22$ mh
$C_0 = 52.84\ \mu\mu f$; $C_1 = 54.88\ \mu\mu f$
$L_2 = 20.73$ h; $C_2 = 0.1206\ \mu\mu f$; $f_2 = 100.70$ kc
$L_3 = 18.53$ h; $C_3 = 0.1234\ \mu\mu f$; $f_3 = 105.28$ kc

The −18.5-deg X-cut crystal had previously been generally used as a filter crystal due both to its high Q and freedom from the troublesome face shear mode of oscillation. However, this cut has quite a large temperature coefficient of over 20 parts per million per degree centigrade.

The +5-deg X-cut crystal with a width-to-length ratio of 0.35 has a temperature coefficient of only about 4 parts per million per degree centigrade.[4] Moreover, it is easily cut from the mother quartz (involving rotation only about the X or electrical axis). It has the disadvantage of having a relatively large coupling to the face shear mode when wide crystals are used.

Because of the two advantages mentioned, the +5-deg X-cut crystal was chosen for the present filter construction. A single-section channel filter was found to have a spurious resonance due to the coupling to the shear mode. The response occurred at a frequency approximately 116 percent of the passband midfrequency and reduced the attenuation to within 11 db of that of the passband itself.

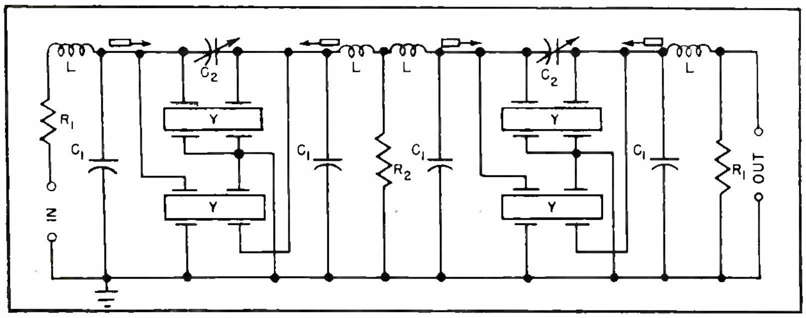
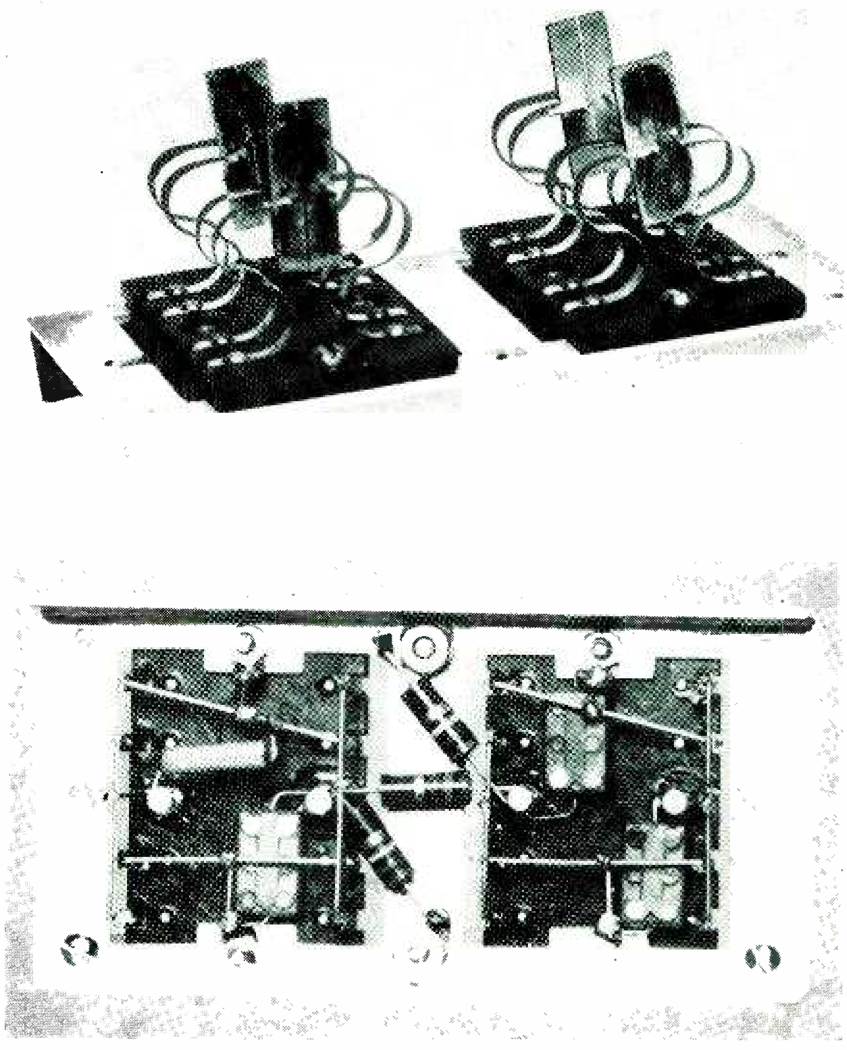


FIG. 12—A double-section 6-kc-channel crystal filter. Capacitors C_1 permit fine adjustment of passband width, C_2 fine adjustment of attenuation peaks, L are passband widening coils, R_1 are terminating resistors, R_2 are interstage impedance-matching resistors and Y are +5-deg X-cut crystals

When a filter of four sections was tested, however, no observable indication of any secondary response at all was present. This is evident in the graphs of Fig. 14 and Fig. 15 where the attenuation is 87 db or greater for all frequencies more than 1.2 kc (1.1 percent) higher than the upper edge of the passband. This desirable result was due to the slight differences in crystal frequencies for the four filter sections resulting from the choice of different peaks of maximum attenuation for each section.

By the use of equations given by



Top and bottom views of two-section 6-kc bandpass crystal filter chassis

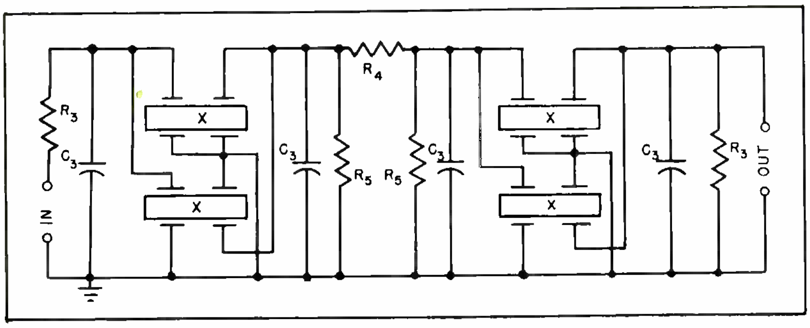


FIG. 13—A double-section 20-cycle crystal filter. Capacitors C_3 control passband width, R_3 are terminating resistors, R_4 and R_5 are interstage impedance-matching resistors and X are +5-deg X-cut crystals. These components are shown in the illustrations on this page

Atwood[3] we find for the +5-deg X-cut crystal that $f = 110.5/y'$ kc.

This equation is strictly accurate for only very narrow crystals, of which y' is the length. The crystals were designed to have a width/length ratio of about 0.35 in order to secure the +5-deg X-cut crystal minimum temperature coefficient of 4 parts per million per degree centigrade previously mentioned. As X-cut crystals of larger and larger widths are used, the crystal frequency constant decreases somewhat from that of a very narrow crystal.[5] For a width/length ratio of 0.35 the decrease is 1.8 percent. Hence the equation is modified for the crystals used in the present project to

$$f = 108.5/y' \text{ kc}$$

A preliminary study of the effect of interelectrode and stray capacitances together with midband frequency and bandwidth requirements for the 6-kc bandpass filters dictated the use of very thin crystals. Having chosen a minimum feasible thickness and a width/length ratio of around 0.35 the equivalent motional capacitance of a sample crystal was found by measurement of its static capacitance together with its resonant and antiresonant frequencies. Substitution of this value for C_2 or C_3 in Mason's equations determined the image impedance Z_0 of the filter. This value of Z_0 was, therefore, used in calculating all the electrical components of the 6-kc bandpass filters.

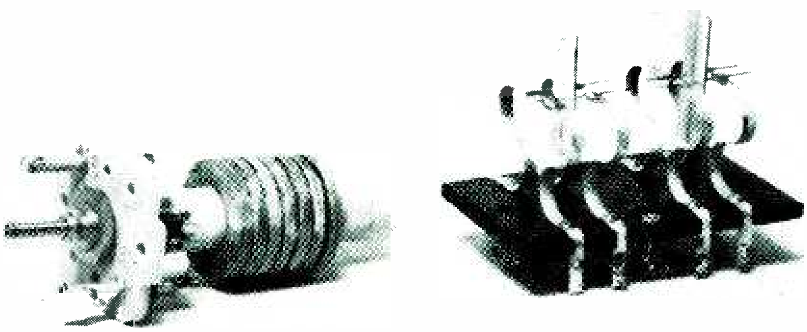
Construction of Channel Filters

To obtain the sharp cutoff and large attenuation required by the specifications, a filter of four sections was built for each of the 6-kc channel filters. Two shielding cans were used as containers for each complete filter, each can containing two filter sections. After the filter was mounted, dry air was passed through the can which was then hermetically sealed.

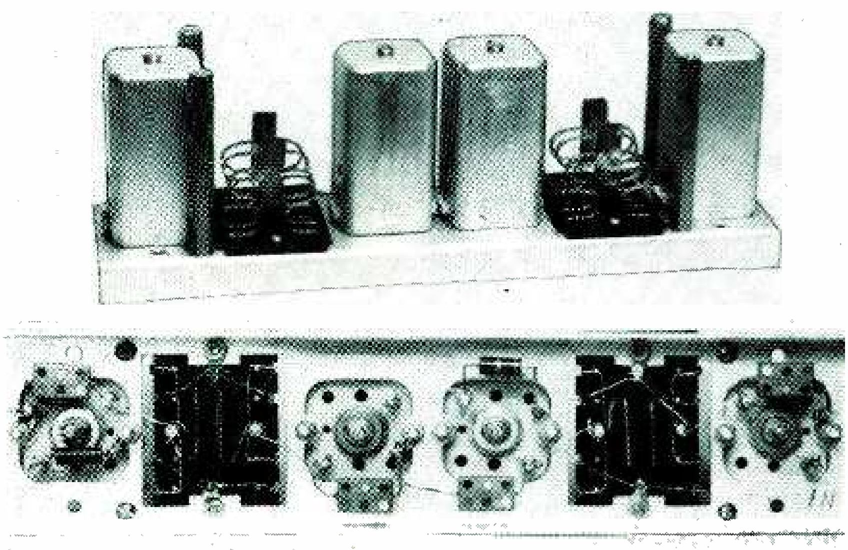
Each single-filter section consists of two crystals with divided plating, two coils in shielding cans, each equipped with adjustable powdered-iron cores, two small, fixed, molded-mica capacitors and a tiny bridging capacitor. The latter is formed by two short lengths of bus bar mounted about ¼-inch apart on the bottom of the Bakelite crystal mounting base.

The circuit of each double-section filter is shown in Fig. 12. Resistor R_2, shunted between the interconnection of each two sections and the chassis, together with the resistances of the input and output coils, provides a T pad to serve for interstage impedance matching. External terminations were used with each double section filter.

Each series coil is a universal-wound coil on a ½-inch-diameter



Crystal mounting and coil details for 6-kc bandpass crystal filter



Top and bottom views of two-section 20-cycle filter chassis for 100-kc carrier

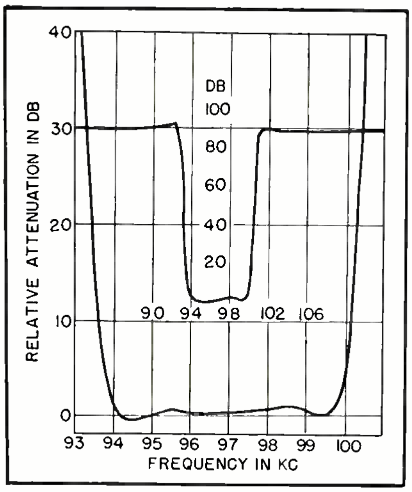


FIG. 14—Attenuation characteristic of a four-section crystal channel filter for 94-99.9 kc

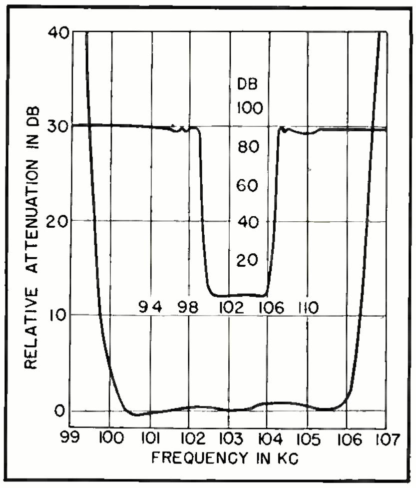


FIG. 15—Attenuation characteristic of a four-section crystal channel filter for 100.1-106 kc

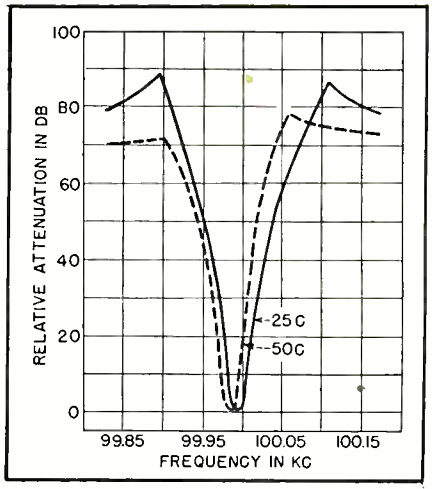


FIG. 16—Attenuation-frequency characteristic and effect of temperature change on the 100-kc 2-section carrier filter

Isolantite form. The coil is equipped with an adjustable powdered-iron core, and in use is mounted in the shielding can.

Construction of Carrier Filter

The narrow-band filter for the 100-kc intermediate-frequency carrier was much simpler in design and construction than the channel filters described above.

Calculated values of the motional capacitance together with the chosen theoretical passband width of 40 cycles, and the chosen frequencies of the attenuation peaks, determined the value of image impedance.

Here, again, as for the 6-kc channel filters, terminating resistors of smaller size than the image impedance were used to give a better impedance match throughout the passband. Figure 13 is a schematic diagram of the wiring of this double-section narrow-band filter.

Each single section consists merely of two divided-plating crystals, two small mica capacitors and the terminating resistors. The three resistors (at the center of the under-chassis view) constitute a pi-type attenuation pad of about 7 db between the two sections. Input and output terminating resistors are mounted externally to the shield can.

Results and Conclusions

Each of the two complete four-section 6-kc channel filters had an insertion loss within the passband itself of about 24 db. To compensate for this loss, the filter was fed from and into vacuum-tube circuits. The tube supplying the signal to the input of the filter was a 6J5 used in a cathode-follower circuit for easy impedance matching. The output of the filter was fed to a 6SK7 pentode amplifer. The result was a gain within the passband of 1.5 db measured from input to cathode follower to output of the pentode amplifier. The same type of tube-circuit arrangement was used with the carrier filter.

The attenuation characteristics of the lower and upper channel four-section crystal filters are shown in Fig. 14 and 15. The average characteristics are as follows:

Width of passband between points 2 db down, 5.94 kc; 2-db point adjacent to carrier, 134 cycles from carrier, passband flat within ±0.6 db over a bandwidth of 5.73 kc; bandwidth at 85 db down, 8.10 kc; attenuation greater than 87 db for all frequencies separated more than 4.17 kc from the passband midfrequency. Tests of the 6-kc channel filters at 25C and 50C respectively show a slight narrowing of the passband with rise in temperature averaging about two-and-one-half cycles per centigrade degree of temperature change. This is shown in Table I.

In Fig. 16 are shown two passband and attenuation characteristics of the double-section carrier filter. These were measured respectively at 25C and 50C. A rise of temperature is observed to cause the characteristic as a whole to shift to slightly lower frequencies. The shift averages only 0.44 cycles per deg. The bandwidth of the filter characteristic measured at room temperature is 16 cycles at a relative attenuation of 3 db, 22 cycles at 6 db, 86 cycles at 50 db and 180 cycles at 78 db. The latter attenuation is maintained for all frequencies outside the 180-cycle band mentioned.

The author desires to express his appreciation for helpful guidance, valuable suggestions, and continued interest to E. D. Blodgett, Thomas Jacobi and L. L. Lakatos of the Engineering Products Department of the RCA Victor Division. He is also thankful to the staff of the RCA Crystal Engineering Department for preparation and mounting of the crystals, and to the RCA-Victor Division of the Radio Corporation of America at Camden, New Jersey, whose facilities made possible the development herein described.

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(1) W. P. Mason, "Electromechanical Transducers and Wave Filters," Chap. VIII, D. Van Nostrand Co., Inc., 1942.
(2) E. A. Guillemin, "Communication Networks," Vol. II, Chap. VIII, Art. 6; Chap. X, Art 2, John Wiley and Sons, 1935.
(3) J. B. Atwood, The Equivalent Electrical Circuit of Quartz Crystals, RCAC Eng. Report F-72-7, 1/19/39, Sheets 6, 12, and 15.
(4) R. A. Heising, "Quartz Crystal Applications," p 538, D. Van Nostrand Co., Inc., 1946.
(5) W. P. Mason, Electrical Wave Filters Employing Quartz Crystals as Elements, *B.S.T.J.* 133, p 410, July 1934.

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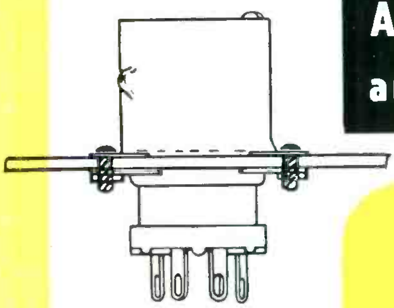

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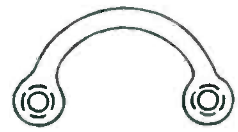

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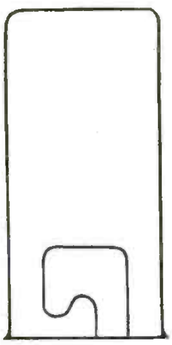

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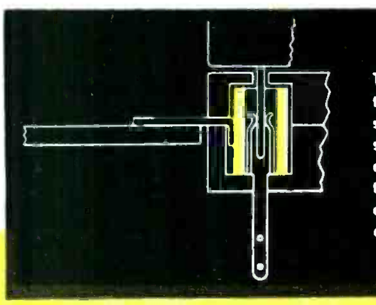

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Tele Service Areas

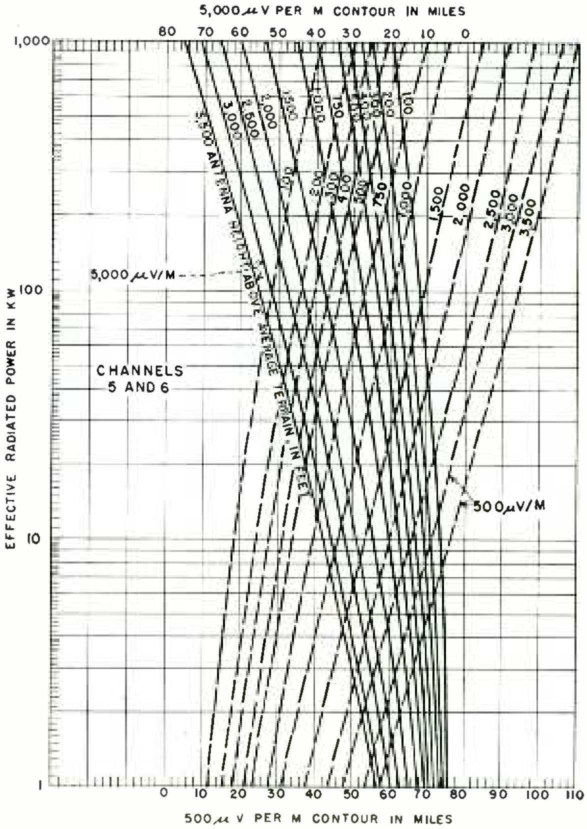
By JOHN H. BATTISON

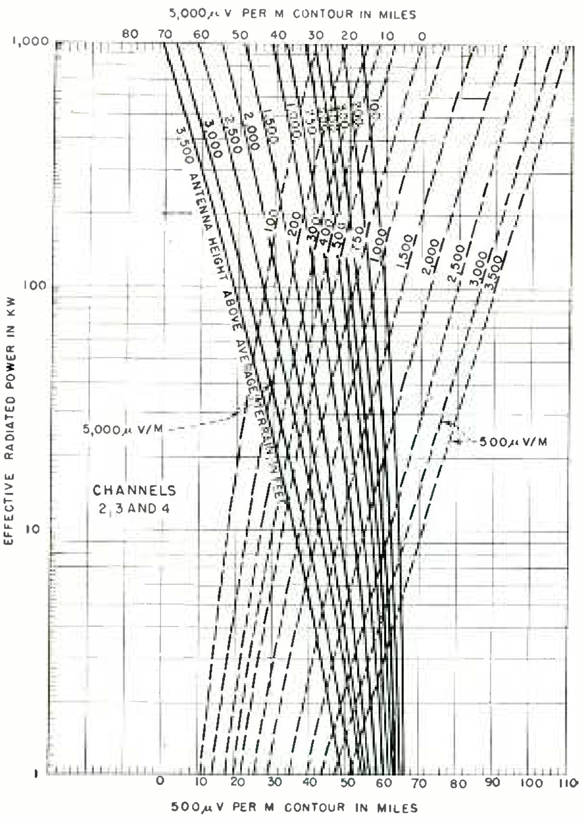
Allocations Engineer
American Broadcasting Co., Inc.
New York, N. Y.

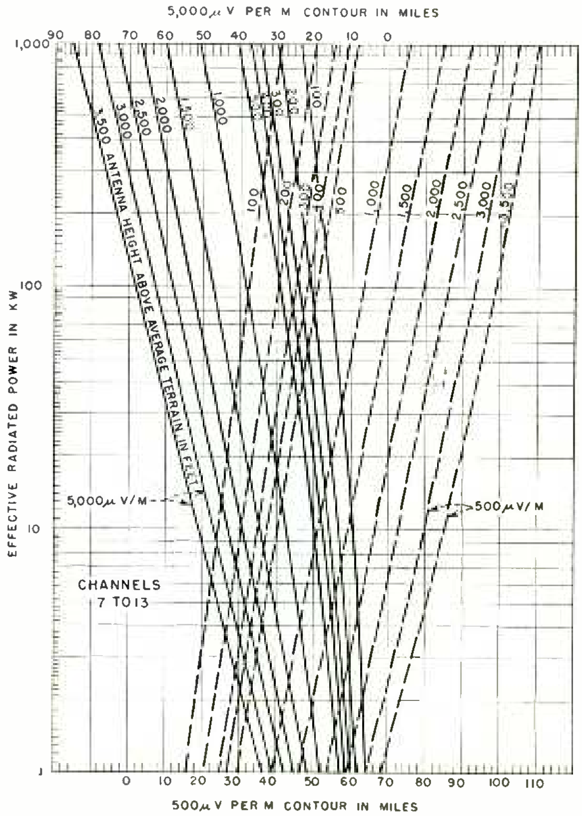
THE accompanying charts, based upon FCC assumptions and data, provide a quick approximation of television service areas for the 5,000 μv per meter (solid line) and 500 μv per meter (dashed line) contours. Receiving antenna height is assumed to be 30 feet above average terrain.

To determine the distance from a channel 2 20-kw transmitter 2,000 feet above average terrain to the 5,000 μv per meter contour, enter the appropriate chart at the left and follow the effective radiated power line across to its junction with the solid curve for 2,000 feet. Then read off the distance in miles (29 miles, in this case) from the scale at the top of the graph. The 500 μv contour from a similar transmitter would be found at 60 miles, using the dashed line for height and the lower scale of miles.

Power and antenna height necessary for desired coverage can also be determined from the charts.







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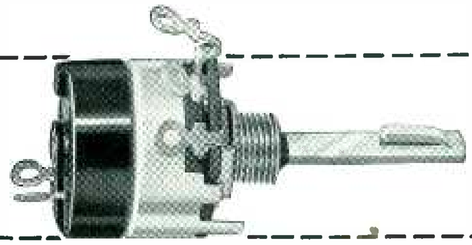

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Airborne Magnetometer

MEASUREMENTS accurate to one part in 50,000 of the earth's magnetic field are made with the airborne magnetometer developed by the Gulf Research and Development Co. engineers and geologists and recently demonstrated at Westchester County airport. The instrument is currently being used in prospecting for oil and mineral deposits. The odds of finding oil have been improved from approximately 16:1 to 5:1 by the use of such reconnaissance tools as airborne magnetometers, gravimeters and seismographs. Novel magnetic and circuit techniques are used in the magnetometer to obtain its high sensitivity.

Operating Principle

Geologists have used the correlation between the magnetic field of the earth at its surface and the underground rock formations for many years. For these measurements on the ground, a delicately balanced instrument was used, but to survey large or rugged areas took a great deal of time and effort.

Several difficulties arise if a conventional magnetometer is used in an aircraft. Accelerations of the instrument must be counteracted. This requirement limits the design to one having no moving parts. Because of the speed of motion, the instrument must be automatically recording; an operator could not take readings fast enough in a plane flying at 120 mph. The magnetic fluctuations to be measured are so slight that they could be masked by unbalanced magnets and currents, so the instrument must be suspended a considerable distance from the mother plane.

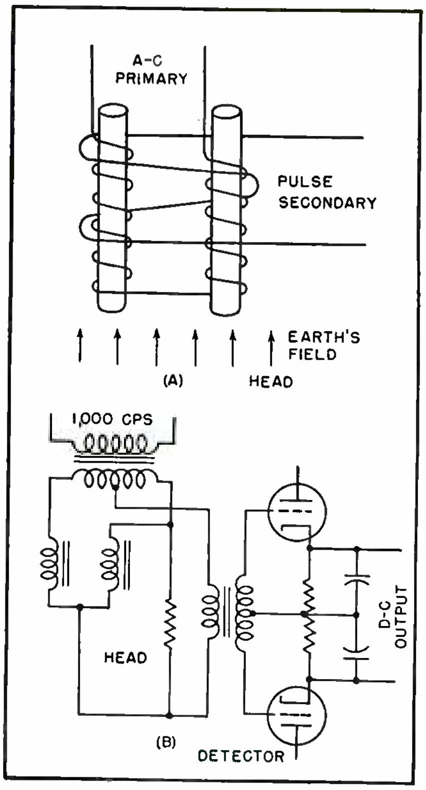
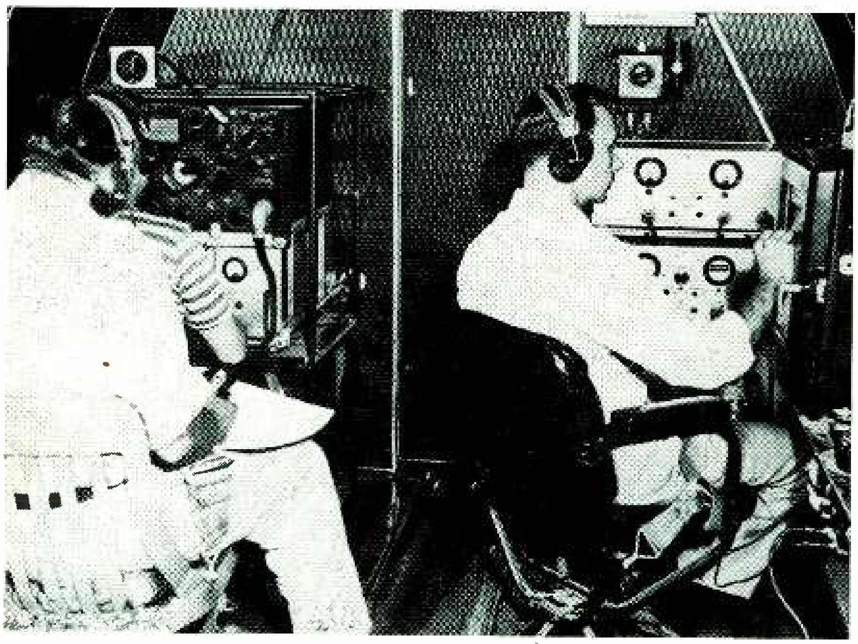


FIG. 1—Magnetometer head depends for its action on the change in inductance as the core becomes saturated *(A)*. The pulses produced by the head are converted to direct current and combined to give a signal proportional to the magetic field

To meet these requirements, a sensing element of the flux-gate type was developed, and by 1941 had been perfected sufficiently for airborne use. During the war the instrument was used for locating submerged submarines, for which application it needed to be sensitive only to short, intense discontinuities in magnetic field. It has been further refined to give an absolute indication and to hold its calibration.

Basically the sensing element consists of two thin cores of highly permeable alloy on which are wound two separate coils as shown in Fig. 1A. The sensitivity of the element is obtained by exciting these identical coils with alternating current (1,000 cps).

As long as the impedances presented by both coils are equal, the voltages across the two primaries will be equal, whether the cores are saturated or not, because both cores will become saturated simultaneously, although with opposite polarities. However, if the element is placed in a fixed magnetic field, the



In flight, the magnetometer operator at the right makes notations on the magnetic record of information provided by the sensing unit. At left, an operator checks the shoran pulses while the flight director corrects the course flown and advises the pilot

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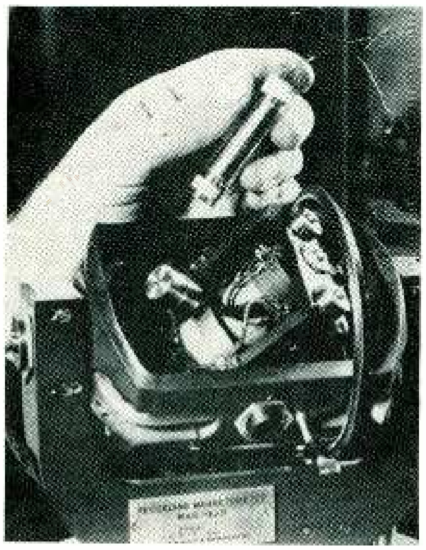

Sensing element of the airborne magnetometer and the gimbal mounting for positioning the unit parallel to the earth's magnetic field

two cores will become magnetically biased so that one will enter saturation in the direction of the external field before the other enters saturation in the opposite direction. Thus there will be a moment when the two coils do not present equal impedances.

A short voltage pulse will occur across a secondary winding (or its electrical equivalent) because of the phase shift of the moment of passing the knees of the magnetization curves of the two cores. For small external fields, the amplitude of this pulse is proportional to the field strength (The Gulf Airborne Magnetometer, R. D. Wyckoff, Geophysics, p 182, April, 1948).

Auxiliary Circuits

To use such an element in an airplane requires several auxiliary circuits. Figure 1B shows the detector circuit with which the pulses are picked off the sensing element by a differential transformer and converted to direct current by cathode followers. By design of the sensing circuit and coupling transformer, sufficient voltage is obtained at the input to the differential cathode-follower circuit so that no subsequent amplification is necessary.

Because of the permeability of the cores of the magnetometer head, the unit is saturated by relatively weak fields. To prevent saturation and also to provide a range

(continued on p 140)

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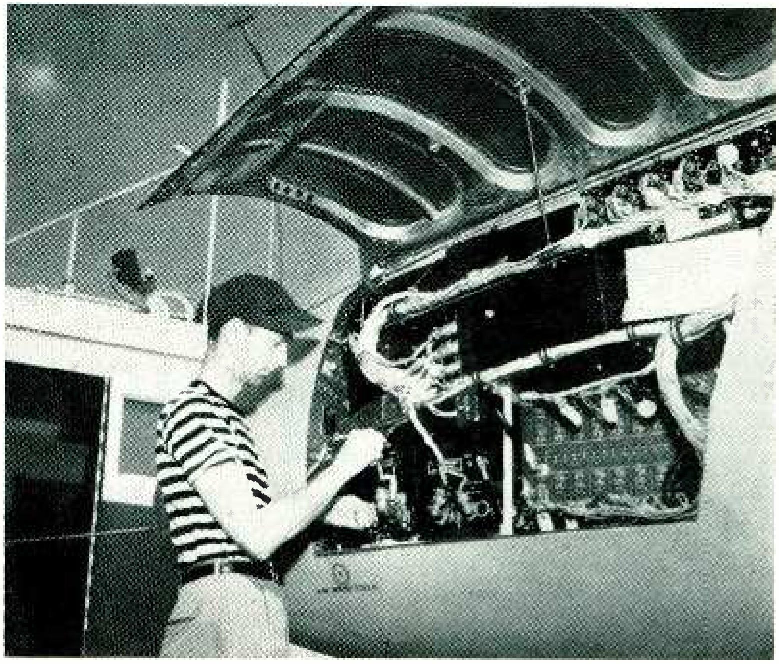
Space normally occupied by the engine in conventional ships contains, in this case, about three times as much equipment as that visible in the accompanying photograph. It includes an f-m transmitter and receiver, telemetering and television equipment.

A television camera monitors an instrument panel set up in the forward portion of the nose. The panel contains the attitude gyro, airspeed indicator, altimeter, tachometer, magnetic compass, accelerometer, elevator trim tab position, correlating counter, dive flap down light and fire warning light.

Four motion picture cameras in the plane are started and stopped by remote control. One is in the cockpit to photograph the regular instrument panel, one alongside the television camera in the nose and two mounted in the fuselage to photograph either wing tip.

The correlating counter on the instrument panel in the nose is used, along with pips entered at intervals directly on movie film in each camera, to correlate all movies with the plane's actions at a given moment and also with a fifth camera photographing the television receiver screen in the truck. By use of television, the plane can be flown by remote control from inside the truck, except for take-off and landing.

Pictured testing the electronic equipment is civilian radio-control engineer Richard W. Hill, of the instrumentation section of the Flight Test Division at Air Materiel Command headquarters, Wright-Patterson Air Force Base, Ohio. U. S. Air Force photo by CWO Stephen P. Mongelluzzo.



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THE ELECTRON ART

Edited by FRANK ROCKETT

Magnetic Field Patterns Shown by Electron Microscope

EXTENSION of the experimental method adapted at the National Bureau of Standards for visually studying magnetic fields provides a powerful means for investigating space-charge fields, fields produced by contact potentials, configurations inside waveguides, and the microstructure of metals. The method, developed by L. L. Marton, is the electronoptical analogy of the Schlieren effect in optics. By it, static magnetic and electric fields can be examined without the disturbing effects of probes; it is being used to measure the magnetization of wire used for sound recording and for storing data to be used by electronic computers.

Dark-Field Image

Figure 1A shows an image produced by the modified electron microscope used in the quantitative study of magnetic fields. The electronoptical arrangement by which this image is produced is shown in Fig. 1B. Electrons from source *A* are normally brought to a focus by lens *C* at point *D*. However, if there is a disturbing field at *B* such as a magnetized wire, it will distort the electron trajectories so that a dark image of the obstruction will be formed on screen *E* placed in the conjugate plane. The lens will also bring to focus on this plane an image of the disturbing field. A stop intercepts the undisturbed electrons focused at *D*. The dark-field image at *E* is made visible by a fluorescent screen or is recorded as a micrograph. Figure 1C is an approximate picturization of the action involved.

Figure 2 shows the image produced when a presaturated thin laminar steel sample with a feather edge is placed in the electron microscope between the source and the lens. The objective lens was slightly misaligned in making this picture to bring one edge of the objective parallel to the observed edge. In this way the direct rays were intercepted by the objective aperture, only the electrons scattered at the edge of the specimen reaching the final image plane to form the image. The faint pattern at right angles to the edge of the bright line, visible wherever the line is interrupted, is assumed to be due to the fringe field of ferromagnetic domains or of grain boundaries. In this way a visual representation of fringe fields from the small domains of spontaneous magnetization in ferromagnetic materials is

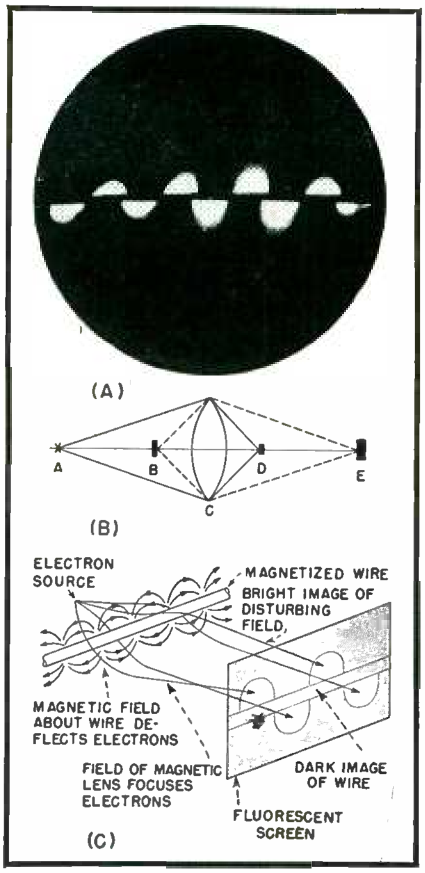

FIG. 1—(A) Opposite polarities of adjacent magnetized regions on both sides of a wire deflect electrons of microscope to produce bright semicircles on a fluorescent viewing screen. The optical system (B) intercepts direct rays unaffected by field of wire as shown by solid lines; dashed lines show how field of wire is focused on screen by same lens. An approximate perspective drawing (C) shows paths of deflected electrons. This electron analogy of the optical Schlieren effect adds another type of object, namely fields, that can be observed in electron microscopes

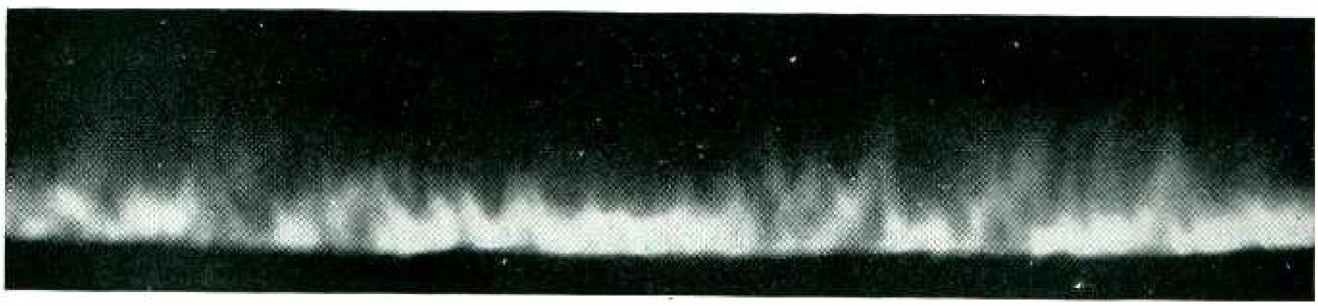

FIG. 2—Micrograph made with modified electron microscope of the fringe field along the edge of a steel sheet indicates that magnetic domains or grain boundaries are a few microns apart (magnification about 50,000 diameters)

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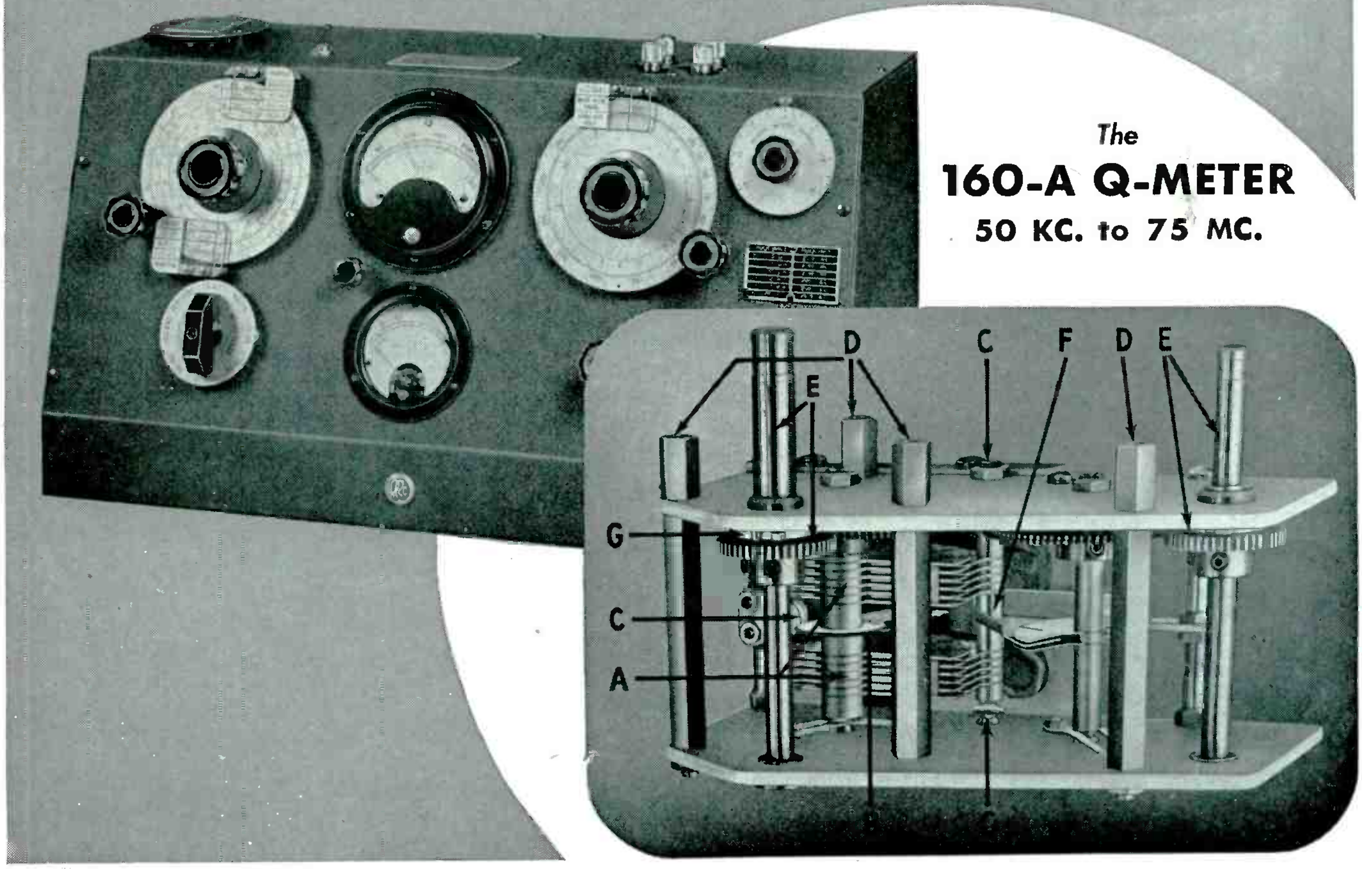
Q, INDUCTANCE and CAPACITANCE

The

160-A Q-METER

50 KC. to 75 MC.



Radio frequency circuit design often requires the accurate measurement of Q, inductance, and capacitance values. For this application, the 160-A Q-Meter has become the universal choice of radio and electronic engineers throughout the country.

Each component part and assembly used in the manufacture of this instrument is designed with the utmost care and exactness. Circuit tolerances are held to values attainable only in custom built instruments.

Consider, for example, the Q tuning capacitor assembly of the 160-A Q-Meter, specially manufactured for maximum range, low loss, and minimum residual inductance. The ultimate design of this unit was reached only after months of intensive engineering research to produce the finest in performance, quality, and workmanship.

This is but one of the many desirable features of the 160-A Q-Meter which contribute to its outstanding accuracy and dependability.

Be sure to include the 160-A Q-Meter in your new equipment plans for 1948.

Write for Catalog "E"

Shown above is the Q tuning capacitor assembly of the 160-A Q-Meter. Note the following design features of this unit—features which insure reliable, trouble-free operation.

A. Parallel connection of dual rotor and stator assemblies minimizes internal inductance and resistance.
B. Spring silver fingers contact both sides of silver disc to provide low series resistance.
C. Three point pyrex ball stator suspension reduces losses and permits accurate stator alignment.
D. Four point panel mounting designed to produce maximum structural rigidity and capacitance stability.
E. Precision-cut brass spur gears and stainless steel shafts, mounted in oversize bearings, assure long, trouble-free service.
F. Common stator mounting for main and vernier stator plates reduces loss and internal series resistance of vernier capacitor section.
G. Positive shaft stop protects main rotor assembly and gears against mechanical overload.

SPECIFICATIONS

Oscillator Frequency Range: 50 kc. to 75 mc. in 8 ranges.
Oscillator Frequency Accuracy: ±1%, 50 kc.—50 mc.
±3%, 50 mc.—75 mc.

Q Measurement Range: Directly calibrated in Q, 20-250. "Multiply—Q—By" Meter calibrated at intervals from x1 to x2, and also at x2.5, extending Q range to 625.

Q Measurement Accuracy: Approximately 5% for direct reading measurement, for frequencies up to 30 mc. Accuracy less at higher frequencies.

Capacitance Calibration Range: Main capacitor section 30-450 mmf, accuracy 1% or 1 mmf whichever is greater. Vernier capacitor section +3 mmf, zero,—3 mmf, calibrated in 0.1 mmf steps. Accuracy ±0.1 mmf.

BOONTON RADIO Corporation
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DESIGNERS AND MANUFACTURERS OF THE Q METER · QX CHECKER
FREQUENCY MODULATED SIGNAL GENERATOR · BEAT FREQUENCY
GENERATOR AND OTHER DIRECT READING INSTRUMENTS

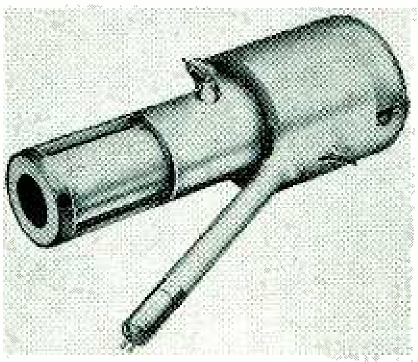
obtained from which the field distribution and domain sizes can be computed.

The Eriscope Camera Tube

By Boyd France
McGraw-Hill World News
Paris, France

High resolution and sensitivity are obtained in the French television camera tube called the eriscope. Like the image orthicon, this tube separates the functions of forming and scanning the image.

Comparative tests of the eriscope and the image orthicon conducted at the Zurich Polytechnical School



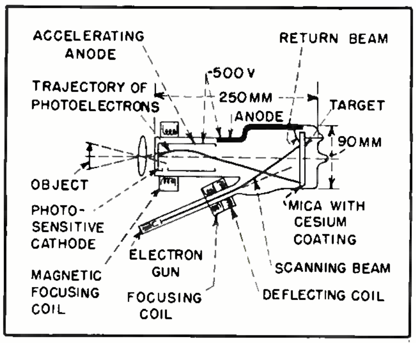
Like image orthicon, formation of electrical image and scanning are separate operation in eriscope; signal is amplified externally

indicated that the eriscope had the greater resolution; it produced sharper images with greater tonal range and haltfone definition and less spotting. All tubes now coming from the production line of the Society Radio Industrie de France have a definition of 800 lines, some are capable of 1,000 lines. All these tubes being made currently are for the state television company. The tests also showed that the image orthicon is the more sensitive. For picking up outdoor scenes with the eriscope, 100 lux is sufficient. Under artifical light it is necessary to increase the illumination to 500 lux because the tube is less sensitive to red than to blue light.

Forming and Scanning the Image

By separating the functions of converting light images into electrical ones and of scanning the electrical images, the elements of the camera tube can be designed independently for maximum efficiency. The transparent photosensitive cathode, whose position is shown in the accompanying diagram, is an alloy of cesium and antimony. The optical image is formed on the interior surface of this cathode thus emitting electrons in proportion to the incident photons. These electrons are accelerated by an anode at 500 volts above the photocathode, the two electrodes forming a divergent lens for the electrons. A magnetic focusing coil gives the electrons a trajectory such as that shown in the diagram.

In this way the optical image has been converted into an electrical image, which in turn has been focused on the scanning target at the far end of the tube. The target is a semiconductor made of a sheet of mica coated thinly with metallic cesium. The electrons from the photocathode form an electrical image on this target corresponding to the optical image. The target is then scanned by a beam of electrons from an electron gun in the arm of the tube. This beam is magnetically focused to a spot whose size determines the resolution of the tube, and is magnetically scanned



Because image target has no mosaic, resolution is only limited theoretically by focus of scanning beam

over the image on the target. With a beam 0.10 millimeter in diameter it is possible to obtain a definition of 400 lines using an 80 square millimeter target. Higher resolutions are obtained by finer focusing.

The beam is charged to the same potential as the target. As it reaches the target, electrons are deflected from it in proportion to the surface charge of the target. These deflected electrons are picked up by an anode on the surface of the tube producing the output signal, which is amplified externally. The undeflected portion of the beam momentarily erases the target image.

The Miller F-M Circuit and Its Use in Railroad Radios

By P. L. Bargellini
Florence, Italy

The increasing development of communication systems using frequency or phase modulation has stimulated the invention of several forms of modulators. In practical use these modulators suffer from poor carrier stability or great complexity in their stabilizing circuits, and limited ranges of linearity. Because of inadequacies in the reactance-tube modulators being used in experiments with railroad radiophones, especially microphonics in the reactance tube, another type of frequency modulation circuit was devised.

Miller-Effect Modulator

Important properties of a frequency modulator are: (1) inertialess linear frequency controlling element, (2) simple production and injection of voltage for stabilizing carrier frequency, and (3) stability in the presence of mechanical vibration. Requirement (1) calls for an electronic modulating element of considerable simplicity. (The reactance tube suffers from the fact that it can never be a pure reactance, always having some residual resistance.) Requirement (2) is more simply satisfied if the frequency modulation is produced directly rather than indirectly as in some systems. A triode more adequately fills requirement (3) than a multigrid tube.

The means taken to meet these requirements is shown in Fig. 1A. By it, a pure reactance can be injected into the oscillatory circuit. The quadrature current is simply obtained from the grid-cathode space current of a triode that is excited by the controlled resonant L-C circuit and that has a purely resistive load. Analysis of the cir-

(continued on p 186)

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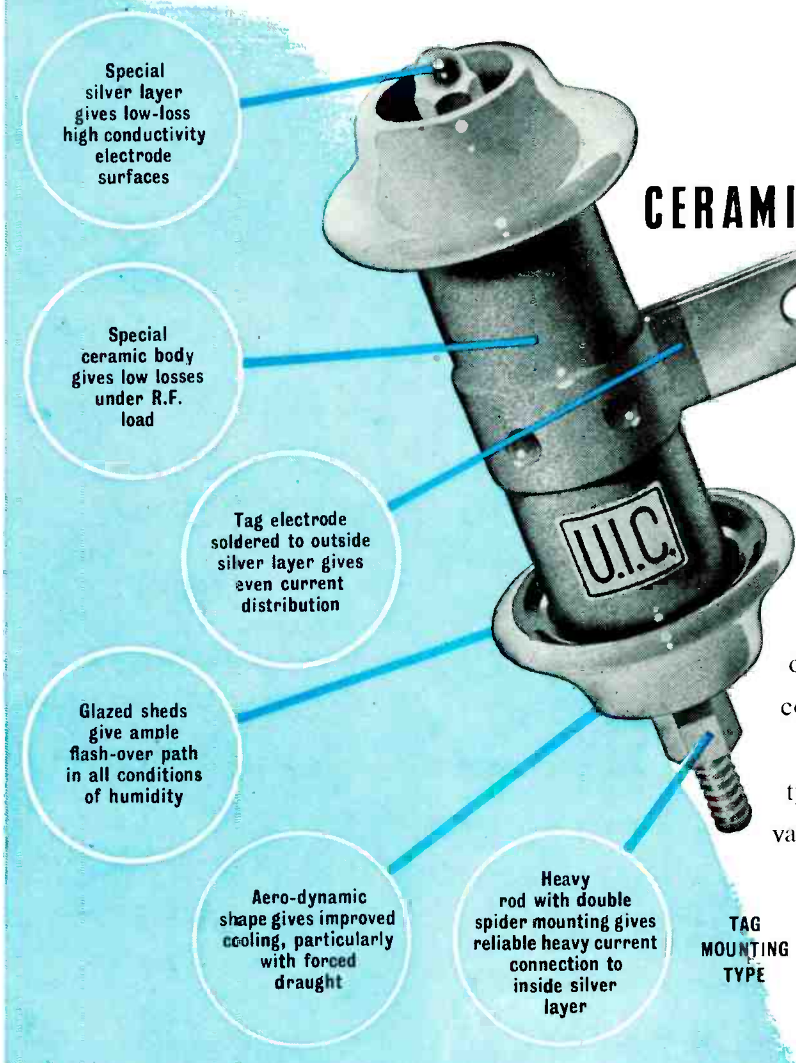


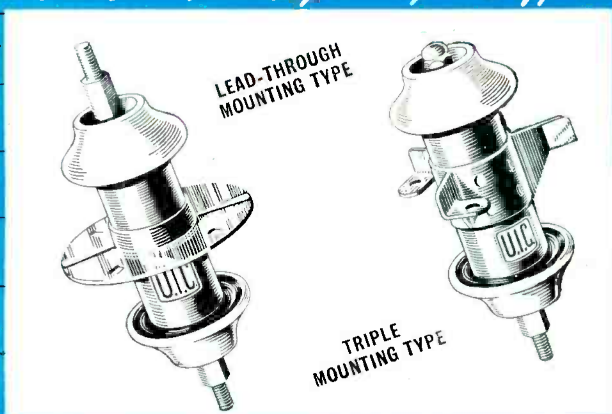
for R.F. Heaters and Transmitters

U.I.C. of England, pioneers in the manufacture of Ceramic Transmitter Capacitors, are foremost in the application of aerodynamic principles to capacitor design. The new aerodynamic shape of U.I.C. "Hi-Load" Capacitors gives optimum cooling in still air. With forced draught their high R.F. ratings can be multiplied. All three types of mounting assist cooling and cater for a variety of applications, such as single stand-off tag fitting, parallel and series banking for very large powers, and lead-through types for anode by-pass.

Examples from a wide range of Types

Type	HLS2031	HLT2021	HLT2021	HLC2011	HLC2014★
Capacitance	125pF	300pF	600pF	800pF	1000pF
Max. R.F. Load	70KVA	50KVA	50KVA	25KVA	40KVA
Peak Voltage	7.5KV	7.5KV	7.5KV	7.5KV	7.5KV
Max. R. F. Current	30 Amps.	30 Amps.	30 Amps.	30 Amps.	30 Amps.
Body Dimensions	1¾″ x 3½″	1¾″ x 3½″	1⅝″ x 3½″	1¾″ x 3½″	1⅝″ x 3½″

★ *Lead-through type, all other examples tag type.*



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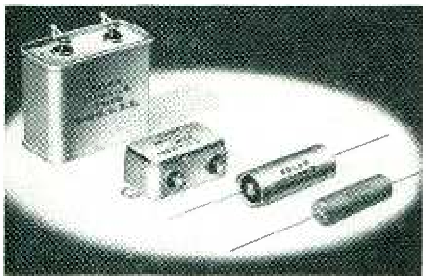
NEW PRODUCTS

Edited by A. A. McKENZIE

New equipment, components, tubes, testing apparatus and products closely allied to the electronics field. A review of catalogs, handbooks, technical bulletins and other manufacturers' literature

Polystyrene Capacitors

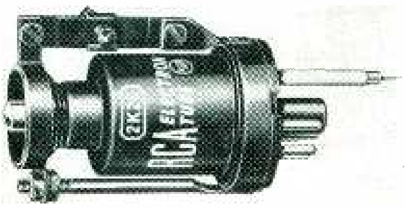
SOLAR MFG. CORP., 1445 Hudson Blvd., North Bergen, N. J., now has available a complete line of polystyrene-film dielectric capacitors. Typical applications include timing and integrating circuit capacitors, r-f padding capacitors



and coupling capacitors in extremely high-gain amplifiers. Complete list of standard ratings is given in catalog bulletin SPD-600.

Klystrons

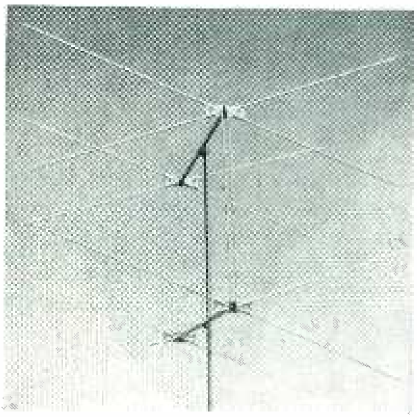
RADIO CORP. OF AMERICA, Harrison, N. J. First of a line of Klystron tubes for use in microwave relay



equipment are types 2K26 and 2K25. These tubes can be used both for transmission and reception, serving as local oscillator in the latter service.

Conical Antenna

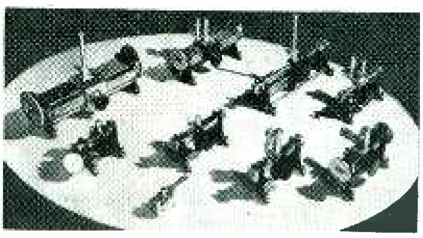
TELREX INC., 26 Neptune Highway, Asbury Park, N. J. Model 4XTV an-



tenna gives conical performance without the bulk of solid spinnings. It features gain, bandwidth and resolution.

Impedance Meters

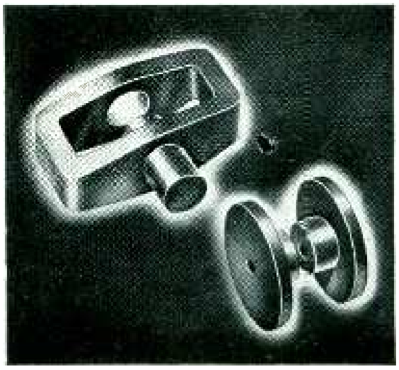
SPERRY GYROSCOPE CO., Great Neck, N. Y., announces a series of nine instruments for determining impedance by measuring standing wave ratios and node positions in microwave transmission lines.



They can also measure relative power, attenuation and wavelength in the line. Accuracy is 2 percent for 650 to 40,000 mc. Catalog sheets are available.

Molded Transformer Cores

STACKPOLE CARBON CO., St. Mary's Pa. Cores are available for horizontal deflection and flyback transformers. Two standard types



are available. Type 10034 is a large rectangular unit with sliding hub designed for universal use with any television tube. A smaller spool type 10748 is recommended for tubes smaller than 10 inches where space is at a premium.

F-M Tape Recorder

AMPEX ELECTRIC CORP., 125 Howard Ave., San Carlos, Calif. De-

signed expressly for f-m broadcast service, the new Ampex tape recorder has a response within plus or minus 1 db between 30 and 15,000 cycles as well as other features designed for broadcast facility. Tape speed is 30 inches per second and the unit has a time capacity of 35 minutes.

Keyboard Oscillator

WEINSCHEL ENGINEERING CO., Dept. E, 123 William St., New York 7, N. Y. This stable oscillator with low distortion is of the resistance-tuned type using negative feedback. Pushbuttons on the panel provide frequency variation. The unit

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Characteristics of Representative RAYTHEON Subminiature Tubes

Type No.	Remarks	Maximum Diameter Inches	Maximum Length Inches	Filament Or Heater Volts	Filament Or Heater Ma.	Mutual Conductance Umhos	Power Output MW	Typical Operating Conditions: Plate Volts	Plate Ma.	Screen Volts	Screen Ma.	Grid Volts
HEATER CATHODE TYPES												
CK5702/CK605CX	Characteristics of 6AK5	0.400	1.5	6.3	200	5000		120	7.5	120	2.5	−2.0
CK5703/CK608CX	Triode UHF Oscillator, ¾ watts at 500 Mc	0.400	1.5	6.3	200	5000		120	9.0			−2.0
CK5704/CK606BX	Diode, equivalent to one-half 6AL5	0.315	1.5	6.3	150			150ac	9.0			
CK5744/CK619CX	Triode High mu.	0.400	1.5	6.3	200	4000		250	4.0			−2.0
CK624CX	Characteristics of 6AS6	0.400	1.5	6.3	200	3200		120	5.2	120	3.5	−2.0
FILAMENT TYPES												
2E31-32	RF Pentode for pocket radio	0.300x0.400	1.56	1.25	50	500		22.5	0.4	22.5	0.3	0
2E35-36	Output Pentode for pocket radio	0.290x0.390	1.56	1.25	30	385	1.2	22.5	0.27	22.5	0.07	0
2E41-42	Diode Pentode for pocket radio	0.290x0.390	1.56	1.25	30	375		22.5	0.35	22.5	0.12	0
2G21-22	Triode Heptode for pocket radio	0.300x0.400	1.56	1.25	50	75 conv. cond.		22.5	0.20	22.5	0.30	
RK61	Gas Triode, Exp. Radio Control	0.550	1.81	1.4	50			45.0	1.5	Special Circuit		
CK502AX	Output Pentode	0.285x0.385	1.5	1.25	30	550	6.0	45.0	0.6	45.0	0.15	−1.25
CK503AX	Output Pentode	0.285x0.385	1.5	1.25	30	550	9.5	45.0	0.8	45.0	0.25	−2.0
CK505AX	Voltage Amp. Pent.	0.285x0.385	1.5	0.625	30	38†		22.5	0.125	22.5	0.04	−0.625
CK506AX	Output Pentode	0.285x0.385	1.5	1.25	50		25.0	45.0	1.25	45.0	0.40	−4.5
CK510AX	Double Space Charge Tetrode Amplifier	0.285x0.410	1.25	0.625	50	150† both units		45.0	0.06			0
CK512AX	Low microphonic voltage amplifier	0.285x0.385	1.25	0.625	20	37†		22.5	0.125	22.5	0.04	−0.625
CK522AX	Output Pentode 20 ma. filament	0.285x0.385	1.5	1.25	20	450	1.2	22.5	0.30	22.5	0.08	0
CK523AX	Output Pentode	0.285x0.385	1.5	1.25	30	360	2.5	22.5	0.30	22.5	0.075	−1.2
CK524AX	Output Pentode	0.285x0.385	1.5	1.25	30	300	2.2	15.0	0.45	15.0	0.125	−1.75
CK525AX	Output Pentode	0.285x0.385	1.5	1.25	20	325	2.2	22.5	0.25	22.5	0.06	−1.2
CK526AX	Output Pentode	0.285x0.385	1.5	1.25	20	400	3.75	22.5	0.45	22.5	0.12	−1.5
CK527AX	Output Pentode 15 ma filament	0.285x0.385	1.5	1.25	15	225	0.75	22.5	0.10	22.5	0.025	0
CK529AX	Shielded Output Pentode	0.290x0.390	1.5	1.25	20	275	1.2	15.0	0.20	15.0	0.05	−1.5
CK551AXA	Diode Pentode	0.300x0.400	1.56	1.25	30	235		22.5	0.17	22.5	0.043	0
CK553AXA	RF Pentode	0.300x0.400	1.56	1.25	50	550		22.5	0.42	22.5	0.13	0
CK5672	Output Pentode	0.285x0.385	1.5	1.25	50	625	60.0	67.5	2.75	67.5	1.0	−6.25
CK5676/CK556AX	Triode, UHF Oscillator for radio use	0.300x0.400	1.5	1.25	120	1600		135.0	4.0			−5.0
CK5677/CK568AX	Triode, UHF Oscillator for radio use	0.300x0.400	1.5	1.25	60	650		135.0	1.9			−6.0
CK5678/CK569AX	RF Pentode	0.300x0.400	1.5	1.25	50	1100		67.5	1.8	67.5	0.48	0
CK5697/CK570AX	Electrometer Triode Max. grid current 5×10^{-13} amps.	0.285x0.410	1.25	0.625	20	1.5†		12	0.22			−3.0
CK571AX	10 ma. filament electrometer tube, $I_g = 2 \times 10^{-13}$ amps.	0.285x0.410	1.5	1.25	10	1.6†		10.5	0.20			−3.0

CK ® RK ®

†Voltage Gain (times)

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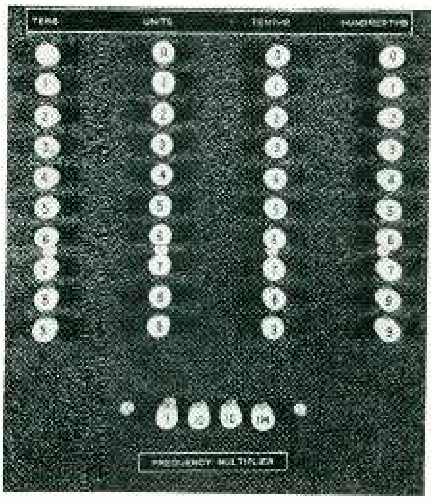
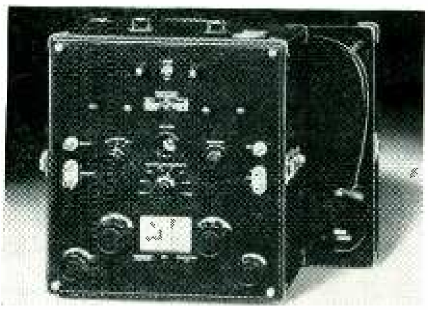


can be used as a signal source for distortion or bridge measurements, and also as an interpolation oscillator. Frequency range is from 1 cycle to 100 kc.

Capacitance Bridge

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1611-A capacitance test bridge measures over the range 1 $\mu\mu$f to 10,000 μf. Accuracy of $\pm$ (1 percent + 1 $\mu\mu$f). Dissipation factor range is 0 to 60 percent. Frequency



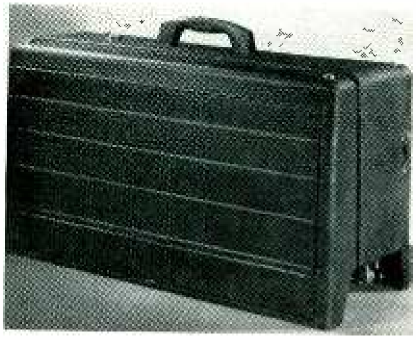
of the test voltage is 60 cycles. A feature of the bridge is the zero-compensating circuit that balances out the initial capacitance and dissipation factor at zero setting of the dials.

Variable Waveform Generator

CENTRO RESEARCH LABORATORIES, Briarcliff, N. Y. The variable waveform generator is an audio generator whose output waveform is built up by addition of a fundamental wave and four sequential harmonics. The harmonics are precisely synchronized and variable over 360 degrees. Level of the fundamental and of each of the harmonics is independently variable.

Rodent Control

LFC CORP., 65 Broad St., Rochester 4, N. Y. The Guard consists of a metal case housing a framework that supports electronic unit, motor for driving the electrocuting arms, mirrors for the light system, and other components. In action, the unit is placed over a rat run and is actuated by breaking of a light beam by a passing animal. It is



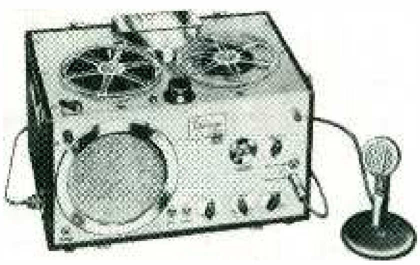
gently squeezed, electrocuted, and ejected to the side. Total death cycle is about 2½ minutes.

Visual Alignment Generator

PHILCO CORP., Philadelphia, Pa., Model 7008 is a new visual alignment generator equipped with crystal-diode high-frequency probe for use in examining the response curve of individual stages and the 4.5 mc video trap. It can also be used to obtain correct termination of r-f transmission lines or measure standing wave ratio.

Portable Tape Recorder

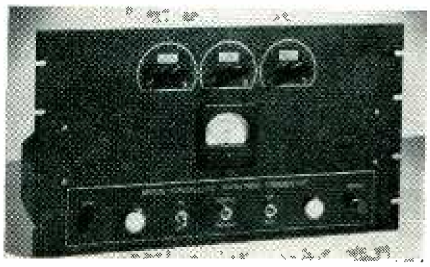
WEBSTER ELECTRIC CO., Racine, Wisconsin. The Ekotape recorder and reproducer uses magnetic tape with a fast forward speed and fast re-



wind. It is equipped with an 8-inch speaker and an oversize motor with high inertia flywheel. Motor drive and capstan operate continuously so that tape starts and stops instantaneously.

Electronic Thermostat

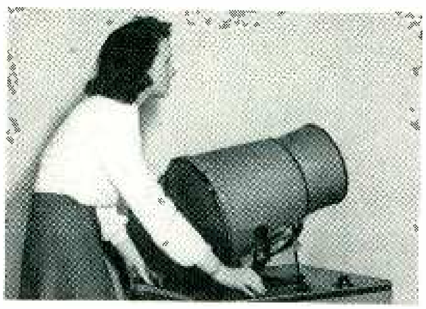
SPENCER-KENNEDY LABS., INC., 10 Follen St., Cambridge, Mass. Model 400A bridge-controlled thyratron thermostat is designed for use with furnaces, molds, chemical baths, ovens, and similar devices. Two types of control are possible, by means of a resistance thermometer,



or by change of resistance of the heater winding itself. Temperatures from 20 to 1,200 C can be maintained to an accuracy of plus or minus 0.1 C when a resistance thermometer is used.

Projection System

RADIO CORP. OF AMERICA, Camden, N. J. Model TLS-86 is a reflective optical projection system employing an all-electronic tuning system.



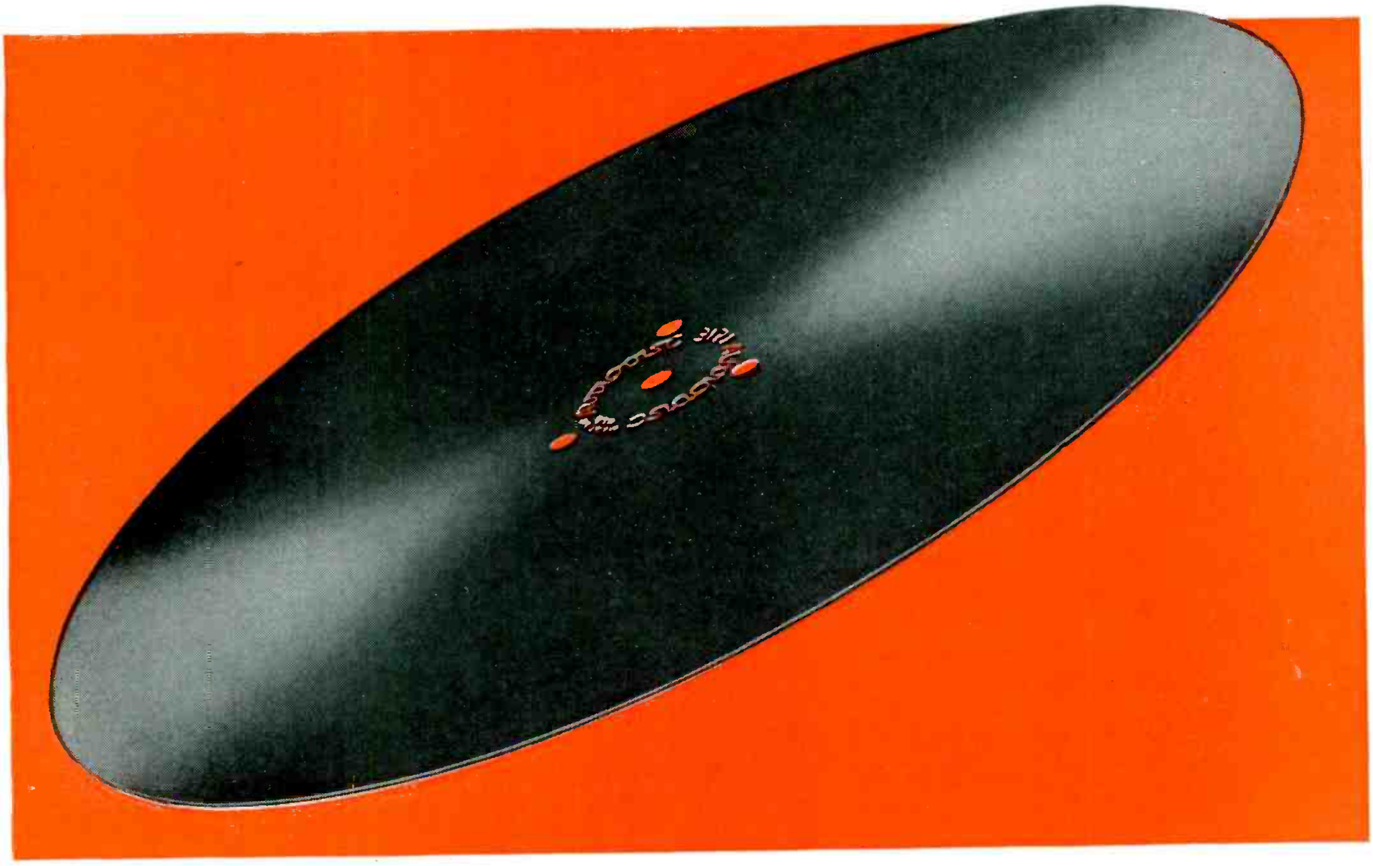
Life-size pictures for large audiences are then projected either on a reflective-surfaced opaque screen or on a translucent screen.

Television Signals

TELEQUIP RADIO CO., 1901 South Washtenaw Ave., Chicago 8, Ill. A combination sync generator, mono-

(Continued on p 206)

PRICES AND AUDIODISCS



A Statement On Our Price Policy

As of September 1st, aluminum prices are again increased. This means higher cost for the principal raw material used in the manufacture of AUDIODISCS. In fact, the cost of the aluminum base has always been the main item in the cost of production. Thus, any increase in aluminum prices is of major importance.

But beyond the cost of raw materials and labor there is a basic factor which determines the cost of manufacturing professional recording discs. This factor is the extent to which the particular process of manufacture enables the producer to turn out a large proportion of first quality discs. There are several methods of production used. None of these will give anything like a 100% yield. It is, however, obvious that as the percentage of yield increases there is a resulting drop in the average cost of aluminum, lacquer and labor.

Fortunately, our patented, precision-machine process—now used for over a decade and continuously improved—gives a more consistent yield of high quality discs than any method of production now used. And we have tested every other process in use.

So our position with respect to the present increase in aluminum prices is this:

1. We are *not* increasing prices of AUDIODISCS as of September 1st.

2. We shall make every effort to absorb this new aluminum price raise and thus continue our prices at the present level. Our calculations indicate that with some improved efficiency, now under way, and continued large volume production, we shall be successful in this hold-the-price effort.

Audiodiscs are manufactured in the U.S.A. under exclusive license from PYRAL, S.A.R.L., Paris.

Audio Devices, Inc., 444 Madison Ave., N.Y.C.

EXPORT DEPT: ROCKE INTERNATIONAL, 13 EAST 40TH STREET, NEW YORK 16, N. Y.

they speak for themselves **audiodiscs**

NEWS OF THE INDUSTRY

Edited by JOHN MARKUS

Australia's rural radiophone; course in automatic control; radio net for India planned; radio license increase

Final details for West Coast IRE Convention are discussed by L. W. Howard (left) president of Triad Transformer and West Coast Electronics Manufacturers president, Robert L. Sink (standing) of Consolidated Engineering, and Convention chairman Loyd Sigmon, chief engineer at KMPC

West Coast IRE Convention

THE PROGRAM of technical sessions of the IRE West Coast Convention to be held September 30 to October 2, 1948, at the Hotel Biltmore, Los Angeles, Calif., has been announced as follows:

Thursday, Sept. 30

1:00 P.M. to 4:45 P.M.—Chairman—Bernard Walley of RCA Victor, Los Angeles:

A Low Cost Program Switching System, by I. Gifford and A. P. Chesney of Langevin.

Antenna Input Systems for Television Receivers, by D. E. Foster of Hazeltine Research, Inc., California.

Operation of AM Broadcast Transmitters into Sharply Tuned Antenna Systems, by W. H. Doherty of Bell Telephone Laboratories, Whippany, N. J.

1:15 P.M. to 4:45 P.M.—Chairman—A. R. Willson of Boeing Aircraft Company, Seattle:

The Outlook for Electronic Computers, by J. L. Barnes of the University of California at Los Angeles.

Input and Output Equipment for Electronic Computers, by C. H. Page of the Bureau of Standards.

Electronic Techniques Applied to Analog Methods of Computation, by D. G. McCann, C. H. Wilts, and B. M. Locanthi.

Design and Use of the Reevac, a General Purpose Electronic Digital Computer; by Dr. Herbert Zagor of Reeves Instrument Corporation, New York City.

8:00 P.M. to 10:30 P.M.—Audio Symposium — Chairman — E. S. Naschke, Chairman Sacramento Section IRE.

Friday, Oct. 1

9:00 A.M. to 11:40 A.M.—Chairman—O. A. Steele, Chairman Portland Section IRE:

A New Type of Direct Reading R. F. Phase Meter for Low Level Signals, by M. K. Goldstein of Naval Research Laboratory.

The Determination of the Shunt Resistance of Cavity Resonators by Means of an Electrical Network Analyzer, by F. W. Schott and K. R. Spangenberg of Stanford University.

A Method of Obtaining the Product of Two Voltages, by M.A.H. El-Said. Paper presented by D. E. Sinclair of General Radio.

Propagation Measurements at High Radio Frequencies over Flat Desert Terrain, by J. P. Day and L. C. Trolese of Naval Electronics Laboratory.

2:30 P.M. to 5:15 P.M.—Chairman—L. E. Reukema of University of California,

RMA Board of Directors for 1948-1949

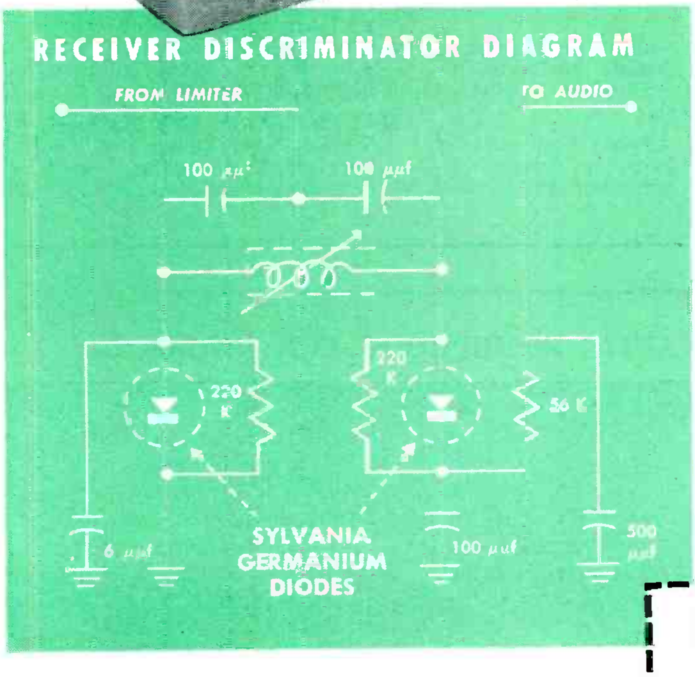
THE Motorola "HANDIE-TALKIE" UNIT IS SMALLER, LIGHTER, BECAUSE . . .

. . . it uses 2 Sylvania Germanium Diodes!

The Motorola "Handie-Talkie" unit has a range in excess of *two miles*. Yet it weighs less than ten pounds; overall dimensions are only 10″ by 12⅝″ by 3⅛″.

An important factor in the smallness and lightness of this efficient unit is the use of two Sylvania Germanium Diodes in the receiver discriminator circuit. These diodes not only eliminate extra tubes, but, by reducing current drain, permit the use of smaller, lighter batteries. Motorola's own estimate of the difference if tubes were used instead: 10% increase in size, 15 to 20% in weight!

Perhaps you too, like Motorola and many others, can simplify the design of your equipment—or improve its performance—through the use of Sylvania Germanium Diodes. Start your planning by getting our literature.



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Gentlemen:

Please send me your literature on Germanium Diodes and Duo-diodes, including the new series of Engineering News Letters showing their applications in television circuits.

I am also interested in receiving literature covering applications of your other products in the field of (check one):

☐ *Communications* ☐ *Radar and Microwaves*
☐ *Radioactivity* ☐ *Industrial Electronics*

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Berkeley, Chairman San Francisco Section IRE:

Signal to Noise Ratios of Linear Detectors, by R. H. DeLano of Hughes Aircraft Co.

A Mass Spectrometer Designed for Industrial Use, by C. E. Berry, R. L. Sink, and Carl Spaulding of Consolidated Engineering Corp.

Problems in the Design of Megawatt Output Klystrons for Pulsed Operation, by Marvin Chodorow and E. L. Ginzton of Stanford University.

Application of Microwave Spectroscopy to Determination of Interatomic Distances in Molecules, by D. K. Coles of Westinghouse Research Laboratory.

Saturday, Oct. 2

9:00 A.M. to 12:00 Noon—Chairman—C. N. Tirrell, Naval Electronics Laboratory, San Diego; Chairman San Diego Section IRE:

Systems Engineering Aspects in Military Communications, by W. S. Marks of U. S. Signal Corps Laboratories, Fort Monmouth.

The V.H.F. Omnidirectional Range, by C.A.A. Radio Development Division representative, R. E. McCormack.

Design of a Radar Set for Commercial Airlines, by F. G. Suffield, consulting engineer.

Design of Antennas for Optimum Directivity, by T. T. Taylor of Hughes Aircraft Co.

Band Width Reduction in Communication Systems, by W. G. Tuller of Melpar, Inc.

Television for Australia

TELEVISION ISN'T QUITE Down Under yet. The Commonwealth Postmaster General has invited bids for two experimental television transmitters, one each for Sydney and Melbourne. These would bring a third of Australia's population within line of sight.

A home television set with a 9-inch screen could be produced by Philips' Australian branch plant in about a year for $325, a spokesman of the company stated. But before the sets can be built, the government must promulgate transmission standards.

There is every indication that both television and f-m are to be a state monopoly; a-m radio is not completely nationalized yet, and a large number of commercial stations remain in operation.

Short-Wave System for East Africa

CONSTRUCTION WORK has begun on the first of 48 Marconi shortwave transmitters to be installed in East Africa to provide ground-to-air

(Continued on p 258)

MEETINGS

SEPT. 27-29: FM Association Second Annual Convention, Sheraton Hotel, Chicago, Ill.

SEPT. 27-OCT. 1: Third National Plastics Exposition, Grand Central Palace, New York.

SEPT. 30-OCT. 2: Pacific Electronic Exhibition and IRE west coast Annual Convention, Biltmore Hotel, Los Angeles, Calif.

OCT. 4-7: 53rd annual meeting of International Municipal Signal Assn., Inc., Hotel Statler, Buffalo, N. Y.

OCT. 5-7: AIEE Middle-Eastern District Meeting, Washington, D. C.

OCT. 7-9: Second joint meeting, URSI and IRE, National Bureau of Standards, Washington, D. C.

OCT. 12-16: Fifth National Chemical Exposition, Coliseum, Chicago, Ill.

OCT. 18-22: AIEE Midwest Fall General Meeting, Hotel Schroeder, Milwaukee, Wisconsin.

OCT. 23-29: Annual convention, American Society for Metals, Benjamin Franklin Hotel, Philadelphia.

OCT. 25-28: Annual Fall meeting of the Institute of Metals, Division American Institute of Mining and Metallurgical Engineers, Hotel Adelphia, Philadelphia.

OCT. 25-29: National Metal Exposition, Commercial Museum and Convention Hall, Phila.

OCT. 25-29: Annual Convention, American Welding Society, Bellevue-Stratford Hotel, Philadelphia.

OCT. 25-29: 64th semiannual convention, Society of Motion Picture Engineers, Hotel Statler, Washington, D. C.

OCT. 27-28: Annual Convention, Society for Non-Destructive Testing, Hotel Adelphia, Philadelphia.

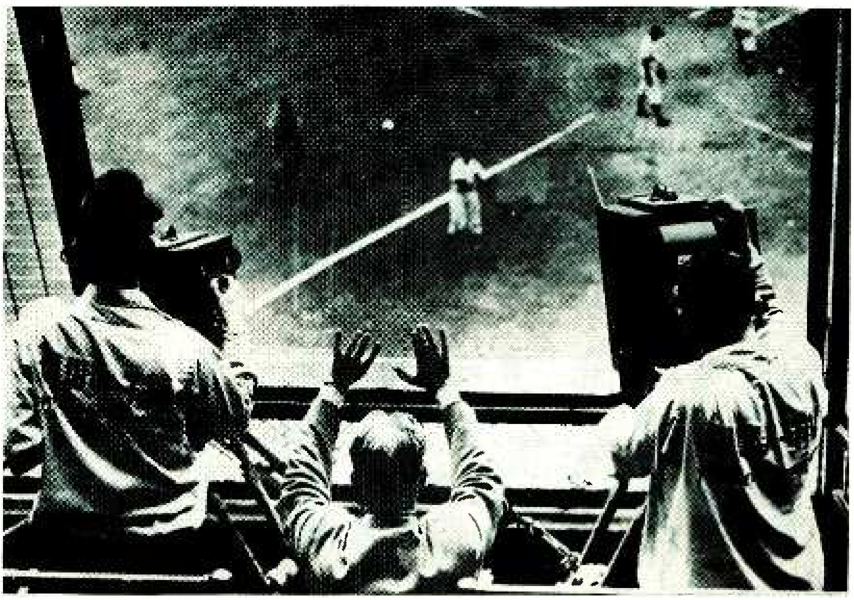
NOV. 4-6: National Electronics Conference, Edgewater Beach Hotel, Chicago.

NOV. 8-10: Twentieth Rochester Fall Meeting of members of IRE and RMA Engineering Dept., Sheraton Hotel, Rochester, N. Y.

NOV. 29-DEC. 1: Conference on electronic instrumentation in nucleonics and medicine, sponsored by IRE and AIEE, Engineering Societies Building, New York City.

NOV. 29-DEC. 4: 18th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.

PLASTIC BOMBPROOF FOR VIDEO



This 7 x 8-ft slab of Plexiglas was recently installed by the Cadillac Plastic Co. of Detroit at Briggs Stadium in that city as a protection for television equipment. The ½-inch sheet will offset the impact of a 9-ounce ball travelling at over 100 miles per hour, according to researchers at Rohm & Haas Co., Philadelphia, makers of Plexiglas

AUDIO TRANSFORMERS *for* UNIFORM RESPONSE / LOW DISTORTION

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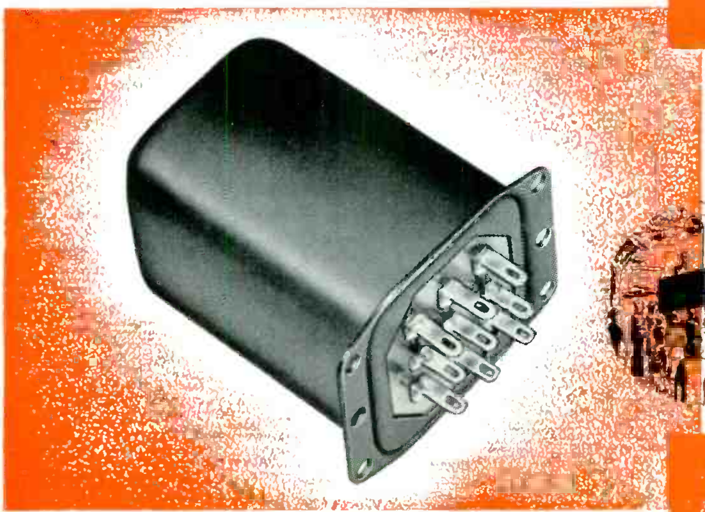
Full Frequency Range

30 to 15,000 Cycles, provides uniform response over this entire band with ± ½ db up to 10 watts of audio power, within ± 1 db over 10 watts. Standard RMA impedances. Hum balancing coil structures and nickel alloy shielding. Included are Input, Output, Driver, and Modulation Transformers; Modulation Reactors. *Sealed in Steel* construction, stud mounting, with pin-type terminals.



Public Address Range

50 to 10,000 Cycles, frequency response within ± ½ db up to 10 watts of power, within ±1db over 10 watts, throughout this range. Secondary impedances match 600 and 150-ohm lines, 16, 8 and 4-ohm reproducing systems. Listed are Driver and Output Transformers. *Sealed in Steel* construction, flange mounting, with solder lugs or wire leads.

Communications Range

200 to 3,500 Cycles, affords response with variations not exceeding ± 1 db over the range of voice frequencies. For use with 600 or 150-ohm lines. Input, Output, Driver and Modulation Transformers offered. *Sealed in Steel* construction, flange mounting, with wire leads or solder lugs.

CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

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(continued from p 126)

control, a direct current is fed to an auxiliary coil on the head to buck out a portion of the earth's field. Thus the magnetometer is

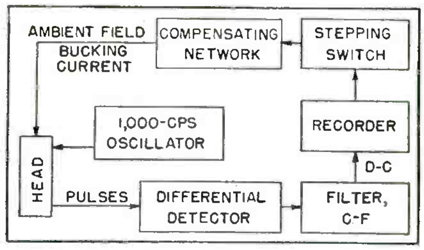


FIG. 2—Block diagram shows how pulses from sensing element are converted into direct current and fed to the recorder, and how a balancing current is obtained to restrict the range over with the head must operate

called upon only to measure the small unbalanced field. This bucking current is obtained automatically by a stepping switch actuated by the recording galvanometer as it reaches the end of its scale, shown in Fig. 2.

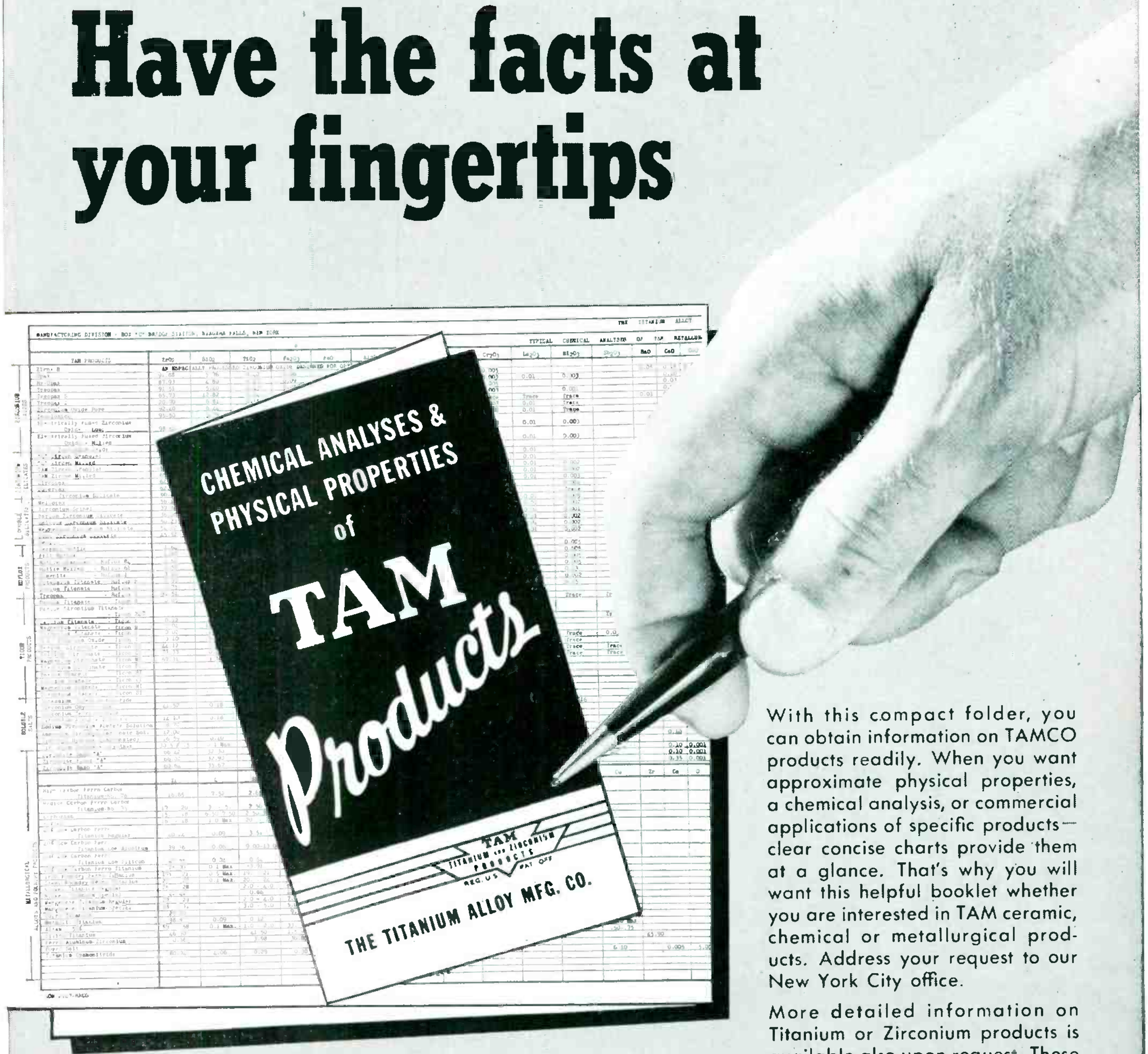
It is necessary that the sensing element be always oriented parallel to the earth's field for the recordings to have significance. This positioning is accomplished by a pair of orienting servos driving gimbals that are at right angles to each other. The sensing element is mounted on these gimbals.

Two auxiliary sensing elements can be used to detect the orientation of the earth's field. If the output from one of these auxiliary units is zero, it must necessarily be perpendicular to the earth's field. Thus these units are mounted mutually perpendicular to the sensing unit. The servo motors drive the auxiliary units to the positions at which their outputs vanish, thus placing the sensing unit parallel to the field. To avoid difficulties from the aircraft's magnetic field, the sensing element and its associated orienting mechanism are housed in a bomb-shaped "bird" that is lowered by its connecting cable to about 65 feet from the plane. The measuring and controlling circuits and recorder are carried in the cabin.

Reconnaissance Technique

Airborne magnetometers are calibrated at the laboratory and sent out to the field to be used in locating areas that can be expected to

Have the facts at your fingertips



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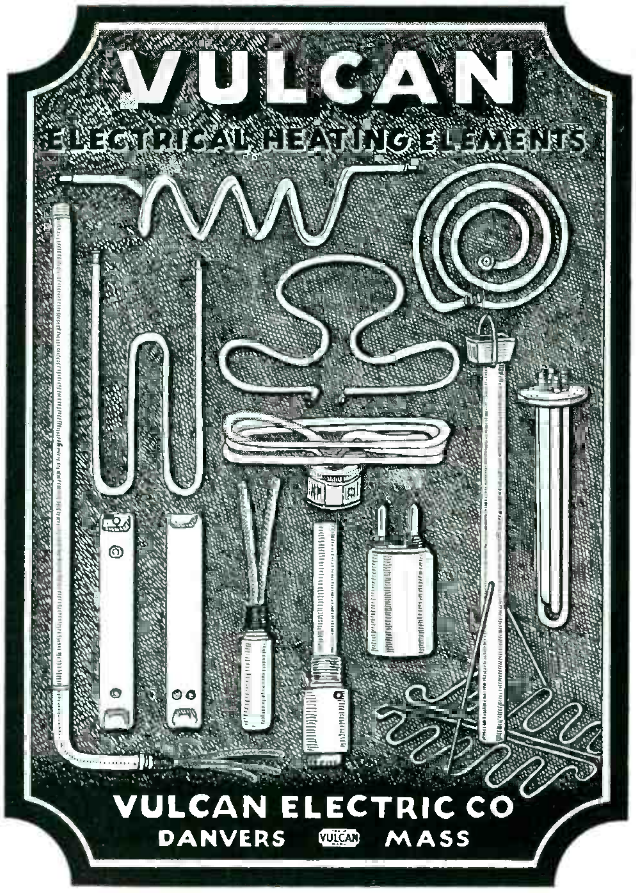
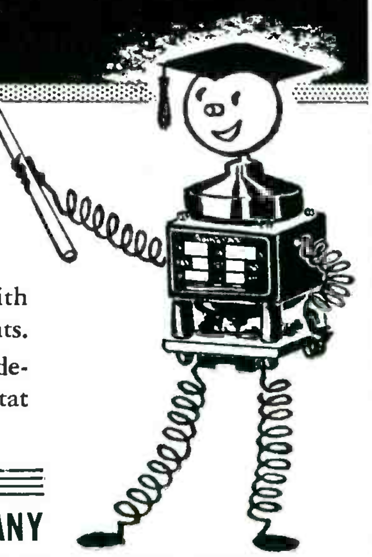


IF YOU NEED

TIME DELAY = AGASTAT

IS WHAT YOU NEED



AGASTAT relay is an important instrument in electronic circuits requiring *time delay* . . . from .1 second to 5 or more minutes.

Instantaneously recycling, reliable and efficient. Available in standard types and with special mounting and terminal arrangements.

Mounting and contact information, type description, etc. on request. Address Agastat Division.

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If you are interested in effecting significant economies in the preparation and printing of your service data manuals, you will want to follow the lead of other major manufacturers. More and more manufacturers of radio receivers, record changers, recorders and similar equipment, are turning to us for the preparation and publication of service manuals and literature. Our laboratories prepare complete, accurate, logical service data, relieving your service and engineering divisions of all burdensome details. Specimens of current work prepared for major manufacturers are available on request. Inquiries invited.

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Address Your Inquiries to

Howard W. Sams & Co., Inc.

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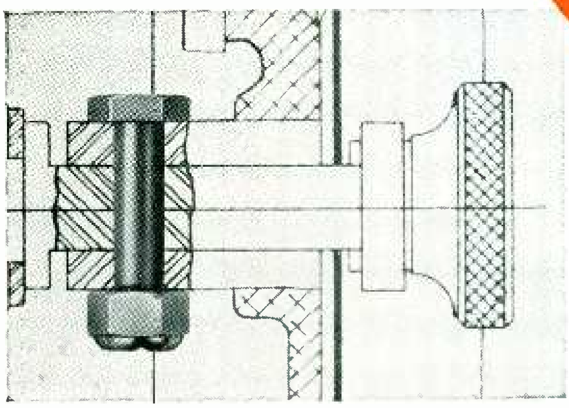
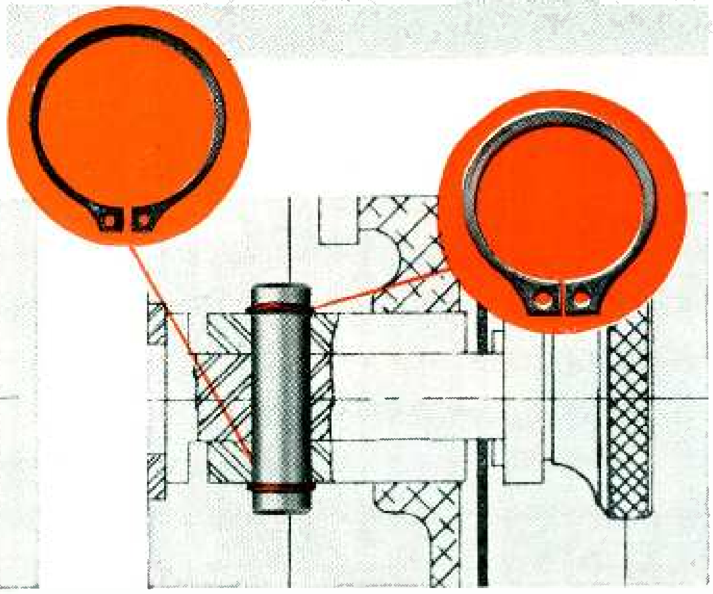
Truarc saves 5 minutes, 9 cents in materials per unit without re-design of electric sanders



OLD WAY

Special ¼" cap screw and ¼-28 fibre-insert nut holds idler arm and pulley assembly on Model A3 "Take-About" Sander, Porter-Cable Machine Company.



NEW WAY

Simple ¼" C.R. shaft, grooved in automatic screw machine, equipped with Waldes Truarc Retaining Rings. Bowed external ring (#5101-25) at top exerts resilient pressure taken up by Standard external ring (#5100-25) at bottom. Assembly is secure against vibration, can be easily taken apart and re-installed many times with same Truarc rings.

Every sander through the production lines costs 9 cents less for materials, requires 5 minutes less labor—with just the simple change from cap screw and nut to Waldes Truarc rings by Porter-Cable Machine Company, Syracuse, New York. The change to Truarc required no new design, no alterations in castings, but just the reappraisal of old methods.

Truarc can help you cut costs and increase production, too. Wherever you use machined shoulders, nuts, bolts, snap rings, cotter pins—there's a Truarc ring that does a better job of holding parts together. All Waldes Truarc Retaining Rings are precision engineered, remain always circular to give a never-failing grip.

Send us your drawings. Waldes Truarc engineers will be glad to show how Truarc can help you.

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TRUARC
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RETAINING RINGS

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

WALDES TRUARC RETAINING RINGS ARE PROTECTED BY U. S. PATS. 2,302,948; 2,026,454; 2,416,852 AND OTHER PATS. PEND.

Waldes Kohinoor, Inc., 47-10 Austel Place E-10
Long Island City 1, N. Y.

Please send 28-page Data Book on Waldes Truarc Retaining Rings.

Name________________

Title________________

Company________________

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City________ Zone____ State________ ★

contain oil-bearing strata. A flight crew surveys a region by flying a grid pattern consisting of flights about 75 miles long and a mile or so apart. The pilot flies the plane back and forth along such a grid, keeping accurately on course by means of two transportable shoran stations. The flight director aboard the craft constantly checks the shoran indications so that later, in plotting the measurements on a map, they can be accurately located. To further correlate the plane's position with ground position, a continuous strip film picture of the terrain is made so that land marks can be readily identified. The shoran indications, strip film and magnetometer recordings are all correlated by recording identical serial numbers at each position at regular intervals.

Later the measurements are transferred to maps thus forming magnetic profiles of the district. On the assumption that the magnetic fluctuations that have been observed are caused by changes in the depth of the igneous bed (or basement) rock, the geologist predicts in what places domed formations likely to contain oil will be found. Of course other magnetic disturbances might have produced the observed contours. The know-how of geologists consists in recognizing the characteristics of the different factors that influence the slight local field contours.

Once a region has been located that appears a likely prospecting area, seismographic parties make detailed examinations to verify the inferences. These two techniques, magnetometer and seismograph surveying, relying heavily on electronics, are proving extremely valuable in the race to find oil as fast as it is being consumed.

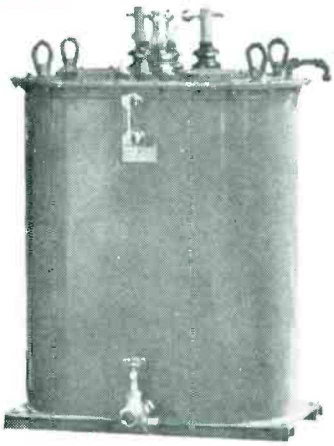
RPM Counter

TURBINE components for new jet engines are whirled at close to 100,000 rpm and in temperature of 1,750 degrees F at Boeing Airplane Co. propulsion laboratory in proving jet engines under development.

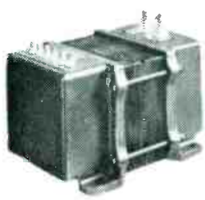
An electronic rpm counter measures the speed of the wheel as it spins. One end of the spinning

Whatever the requirements

— there's an AMERTRAN for every electronic application



Liquid Immersed Plate Transformers—AmerTran oil and Abestol immersed, for indoor and outdoor service—precise overvoltage protection by means of bushing mounted sphere gaps.



"W" Dry-Type Transmitter Components—Economical self-cooled transformers and reactors—for more efficient rectifier operation.

Hermetically Sealed Transformers—Highly resistant to moisture, shock, pressure and temperature variation. Either liquid-immersed or compound filled.

Transtat Type TH for .3 to 20 KVA—Manually operated a.c. voltage regulator providing arcless, stepless control. Brush track on coil periphery where it may be banded to insure trouble-free operation under exacting conditions of service.

PERHAPS your transformer problem calls for design and development. Maybe you require large transformers in small quantities. Or possibly you'd like to obtain the benefits of mass production and need transformers in large quantities.

No matter what your transformer requirements, you will find AmerTran engineers can solve them—efficiently and economically.

In almost half a century of specialization, we have acquired a "know-how" and "can do" which are unsurpassed in the transformer industry. Typical applications of this background are the transformers shown on this page.

Our experience is ready and waiting to go to work on *your* transformer problem. Call in AmerTran today to tell you how we can give you *the* transformers you need . . . *when* you need them . . . at prices made possible only by real manufacturing efficiency

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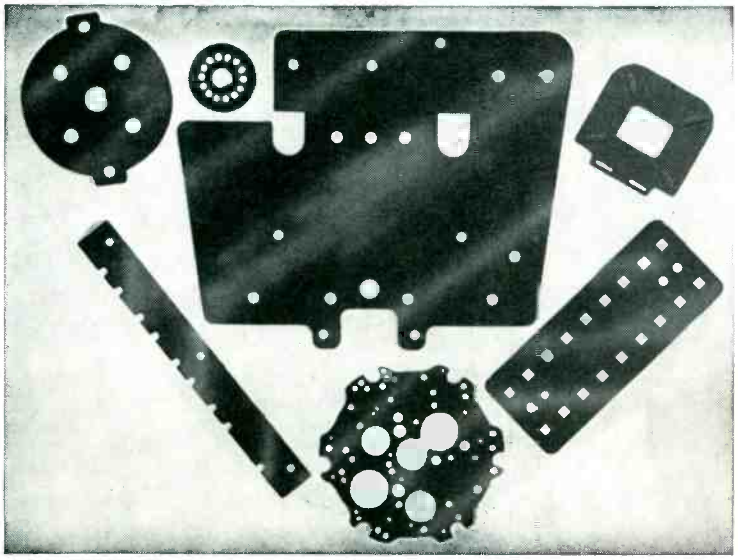

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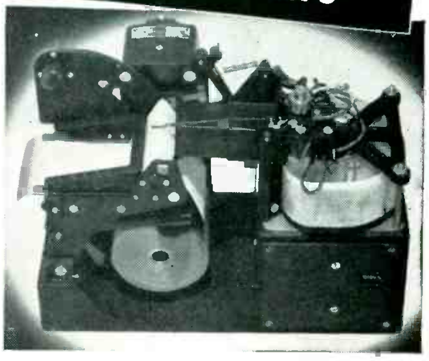
DIRECT WRITING RECORDERS



Galvanometer available separately if desired

PERMANENT Records
•
NO INK
•
RECTILINEAR Writing
•
RUGGED Construction with EXTREMELY HIGH torque movement (200,000 dyne cms for 1 cm deflection)

While designed primarily for use in the Sanborn direct-writing electrocardiograph (the Viso-Cardiette) this assembly (or the galvanometer alone, if desired) has sufficient potential value for varied industrial applications to warrant this announcement of availability for non-medical uses.

The complete unit illustrated comprises the galvanometer and writing arm, with associated paper drive (No. 572M—500). The galvanometer and writing arm are available as a separate unit (No. 572M—300). Recording styli available in two types; fine line writing approximately 1/3 mm; wide line writing approximately 1 mm. Recording paper can be furnished in 200 ft rolls, 6 cm wide (No. 572-737-P3).

TABLE OF CONSTANTS

Sensitivity	10 ma/1 cm.
Coil resistance	3,000 ohms, center tapped for push-pull operation.
Critical damping resistance	500 ohms.
Undamped fundamental frequency	45 cycles/sec.
Stylus heater requires from external source	1.25 volts, 3.5 amps, AC or DC
Maximum undistorted deflection from center	2.5 cm. each way
Marker requires from external source	1.25 volts, at 1.5 amps, AC or DC
Paper speed	25 mm/sec.
Chart ruling	1 mm intervals

In the development stage are other Sanborn "medical recording" instruments which have apparent industrial applications. These include an Electromanometer for direct measurement of "pressures", and several models of multi-channel (2 to 6) recorders, both direct recording and photographic.

For complete information write, giving details of proposed application to

INDUSTRIAL DIVISION
SANBORN COMPANY
39 Osborn St.
Cambridge 39, Massachusetts

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STANDARDIZED READY-TO-USE METAL EQUIPMENT

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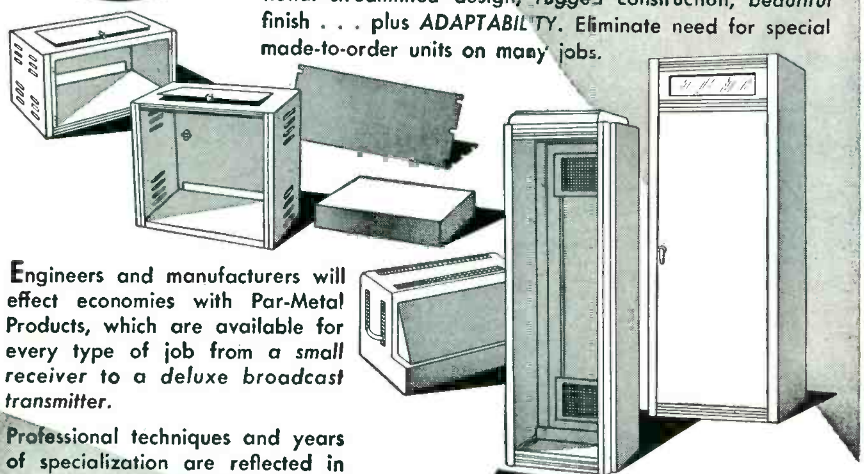
Par-Metal Equipment offers many features, including functional *streamlined* design, *rugged* construction, *beautiful* finish . . . plus *ADAPTABILITY*. Eliminate need for special made-to-order units on many jobs.



Engineers and manufacturers will effect economies with Par-Metal Products, which are available for every type of job from *a small receiver* to *a deluxe broadcast transmitter.*

Professional techniques and years of specialization are reflected in the high quality of Par-Metal. . .

CABINETS • CHASSIS
PANELS • RACKS

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Export Dept., Rocke International Corp.
13 East 40 Street, New York 16

NEW! ...the Roto Ranger

—automatically rotates one of 18 separate scales into position as you select the range.

SIMPSON MODEL 221 ROTO-RANGER
HIGH-SENSITIVITY A.C.-D.C. VOLT-OHM-MILLIAMMETER

Here is the only multiple scale test instrument of its kind in the world. It definitely reduces the possibility of errors by providing a single scale for each range of this finest of volt-ohm-milliammeters. As the selector switch is moved to the range desired, an ingenious gearing mechanism rotates a drum, bringing into place behind the meter window the proper scale for that range. Here is the equivalent of 25 separate instruments combined in one sturdy and compact unit. (18 scales; 7 additional direct reading ranges through use of high voltage and output jacks.) The patented Roto-Ranger principle eliminates the confusion of numerous readings on one scale, and the multiplying factors common to ordinary multi-range testers, by providing a separate scale for each range. There are no cramped calibrations in these full sized Roto-Ranger scales. Each is designed as it would be for a separate instrument.

SIMPSON ELECTRIC COMPANY
5200-5218 W. Kinzie St., Chicago 44, Ill.
In Canada: Bach-Simpson, Ltd., London, Ontario

Simpson
INSTRUMENTS THAT STAY ACCURATE

Ranges

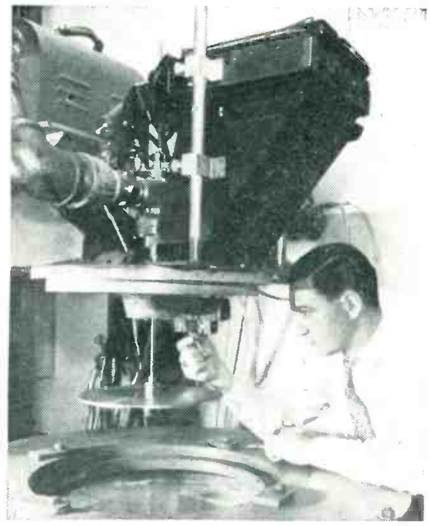
20,000 Ohms per Volt D.C., 1,000 Ohms per Volt A.C.
Volts, A.C.: 2.5, 10, 50, 250, 1000, 5000
Volts, D.C.: 2.5, 10, 50, 300, 1000, 5000
Milliamperes, D.C.: 10, 100, 500
Microamperes, D.C.: 100
Amperes, D.C.: 10
Output: 2.5, 10, 50, 250, 1000
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center).
Size: 12¾" x 10⅛" x 5⅜"
Weight: 8 lbs. 9 oz.
Price, complete with test leads and 28-Page Operator's Manual........ $69.85

High voltage probe (25,000 volts) for TV, radar, x-ray and other high voltage tests, also available.

Ask your Jobber, or write for complete descriptive literature

A separate scale for every range—automatically!

Large 5½" meter, with 18 separate, full length scales!



Spin pit for testing turbine parts. Speed is measured by an electronic rpm counter. The mercury flash lamp held by the Boeing engineer permits photographs at 0.2-microsecond exposure

turbine shaft is divided into two sections, half black, half white. A phototube, focused on the shaft, sends a current impulse to recording instruments each time the black portion passes its scanner. Timed and checked electrically, the speed is controlled within one-half of one percent accuracy.

The spinning is done in pits made up of layers of steel plate, with maple blocks on the inside. The steel shells test turbine components. Power for the tests is derived from compressed air, driving a small turbine which, through a shaft, is attached to the test article. A hoist supports the heavy weight of the cap plate, air turbine and accessories. The entire assembly is lowered into the pit, clamped in place and the air evacuated.

One pit has built-in heating coils of nichrome steel wire imbedded in clay holders to maintain constant temperatures of up to 1,750 deg F. Automatic controls keep temperature to preset levels and also record the whole test. Highspeed rotation and extremely high temperatures combine to prove each new development in turbine parts before incorporation in an actual engine.

High-speed photographs, made with an ordinary 8 x 10 view camera, enable engineers to study test wheels as they break. A small mercury lamp is the light source for the one five-millionths of a second flash. The tripper con-

Another FEDERAL First!

INTELIN K-109

Crimped Type Coax

. . . for permanent automotive lead-ins

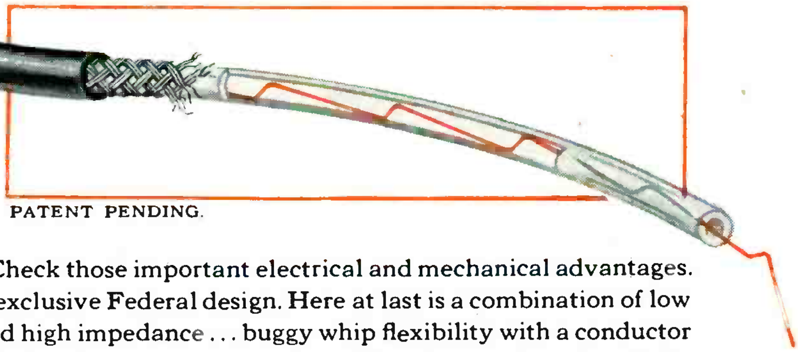
Efficiency — combining low loss and low capacity for high fidelity transmission with minimum attenuation and signal distortion

Flexibility — new ease of handling, installing and maintaining

Shielding — for freedom from interference

Permanent Conductor Set — for electrical and mechanical stability

Spring Action — Eliminates necessity for providing slack in conductor when connecting terminals. Minimizes conductor breakage at the terminals.



PATENT PENDING.

Check those important electrical and mechanical advantages. Check the exclusive Federal design. Here at last is a combination of low capacity and high impedance . . . buggy whip flexibility with a conductor that soaks up vibration and won't break away from terminals.

Federal's new Intelin K-109 Crimped Type Coax has everything for rugged service. It is also recommended for aircraft and marine antenna lead-ins . . . for inter-stage audio connections in general radio and electronic equipment.

Perhaps you see other uses for K-109. For full technical information and prices, write to Department D-613.

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An IT&T Associate

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KEEPING FEDERAL YEARS AHEAD. . . is IT&T's world-wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N. J., is a unit.

SELENIUM and INTELIN DIVISION, 900 Passaic Ave., East Newark, New Jersey

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp. 67 Broad St., N. Y.

sists of double concentric copper screens which line the test pit. At burst, the pieces of the test wheel crash into the screens, pushing them into contact and completing the flash circuit. By this technique, any portion of the wheel which breaks loose under such punishment immediately takes its own picture and establishes the point of failure.

The spin pits test the turbine wheels for the effects of weight and tensile strength of the materials; for rim-loading by their blades; profile, or cross-sectional shape; design of the shaft holes in their hubs.

Metal Picture Tube

A sixteen-inch cathode-ray tube having a metal shell is being made available to receiver manufacturers.

The envelope of the new tube consists of a cone of spun chrome steel alloy. A glass neck houses the electron gun assembly to permit customary mounting and operation of the focusing and deflection coils. The glass neck flares outward to a diameter of about four inches and meets the metal cone in a butt joint. Sealing the metal, which has the same coefficient of expansion as the glass, is accomplished with the aid of induction heating.

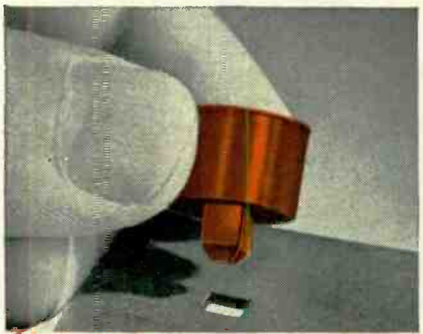
The glass front of the picture tube is drawn glass, polished on both sides, and this too is sealed to the metal cone with induction heating. The curvature of the glass face is such that nearly

New metal-shell picture tube

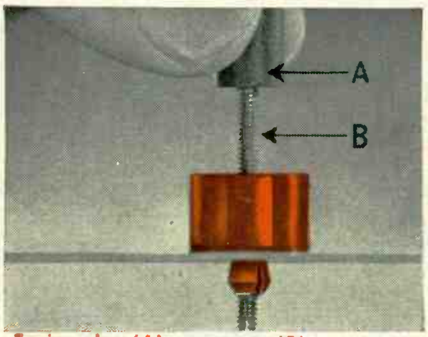
ONE-PIECE NYLON SUPPORT NUT

simplifies coil assembly . . . speeds up production

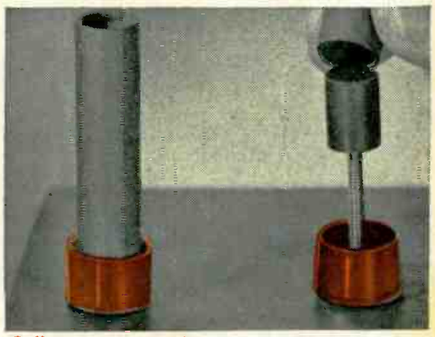
Nylon coil-support nut manufactured by Elastic Stop Nut Corporation of America, Union, New Jersey



Square shank of nylon nut, molded as one unit but consisting of four separate prong-shaped legs, is inserted in square hole of supporting plate. Since nylon itself is an insulator, the nut does not require a grommet. And Du Pont nylon remains stable at temperatures ranging from −60°F. to 200°F.



Tuning slug (A) and screw **(B)** are rotated, impressing thread shape of screw into nylon shank. Prong-shaped legs of shank flare outward, securing nut to plate. Nylon develops torque on screw thread to hold slug in adjusted position, despite vibration and variations in plate thickness and size of hole.



Coil form fits snugly in nylon nut . . . firmly gripped externally by six thin, flexible "fingers" on the inside wall of the support nut. The hollow tube is held securely in place by pressure of the nylon "fingers," although wall thicknesses of the tube may often vary as much as 1/32 of an inch.

CAN NYLON HELP YOU MAKE A BETTER PRODUCT?

Here's a new, all-nylon coil support for radio and television sets. It does the same job that once required a complex assembly of 3 to 5 parts . . . yet it consists of only *one molded nylon nut!* The result—reduced parts inventory, quicker assembly, faster production.

In developing this new product, the manufacturer found all the desired properties in Du Pont nylon. Its light weight, strength in thin sections, resiliency, stability and insulating properties permit a new, multi-purpose design. And nylon's unique workability assures efficient, economical molding of the intricately shaped unit. *It's one more case* where an electrical manufacturer makes a better product with Du Pont nylon.

This Du Pont plastic can be molded or extruded. When designing electrical parts or wires, don't overlook its remarkable properties. Write for free booklet, "65 Success Stories of Product Improvement." Filled with helpful facts. Just address: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Room 1410, Arlington, N. J.

CHECK THESE 7 BASIC FEATURES OF NYLON FOR ELECTRICAL USES

1. Good flexibility
2. High tensile strength
3. Extreme toughness
4. Abrasion resistance
5. Resistance to permanent set
6. Chemical resistance
7. Ability to be molded or extruded

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Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

PRECISION POTENTIOMETERS

Toroidal and Sinusoidal

For use in computing and analyzing devices; generation of low frequency saw tooth and sine waves; controls for radio and radar equipment; position indicators; servo-mechanisms; electro medical instruments, measuring devices—telemetering; gun fire control where 360° rotation, high precision and low noise levels are essential.

The type RL14MS sinusoidal potentiometer is illustrated. It is wound to a total resistance of 35,400 ohms and provides two voltages proportional to the sine and cosine of the shaft angle. It will generate a sine wave true within ±.6%. Overall dimensions are $4\frac{3}{8}$" diameter x 4 11/32 long plus shaft extension $\frac{1}{4}$" diameter x $1\frac{1}{4}$" long.

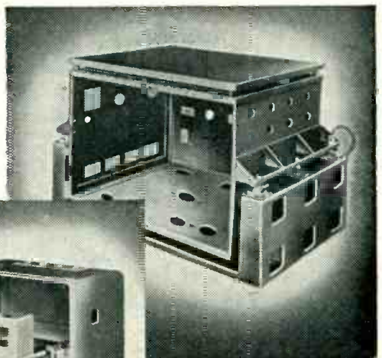
Write for Bulletin F-68

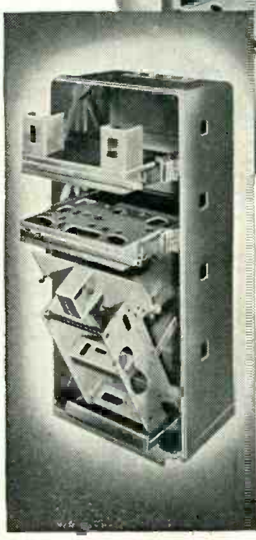
THE GAMEWELL COMPANY

Newton Upper Falls 64, Massachusetts

FABRICATED SHEET METAL PRODUCTS

to your specifications . . .





COMPLETE facilities under one roof for quantity mass production—including welding, baking and finishing. Whistler and Wiedermann equipment for short runs. Tool and die engineering and designing.

Substantial sheet steel inventories permit speed, service and cooperation. Large assortment of stock and special dies for the radio and electronic field. Production and engineering under the personal direction of Mr. E. B. Gunzburg, president—who has had 34 years' experience in sheet metal fabrication.

Quality chassis, metal cabinets, instrument housings, panels, boxes, metal parts and stampings—sample models—in stainless steel or in any metal or any gauge. Close tolerances guaranteed.

Send your blueprints and requests for prompt attention and quotations.

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Telephone: ESplanade 3-2400

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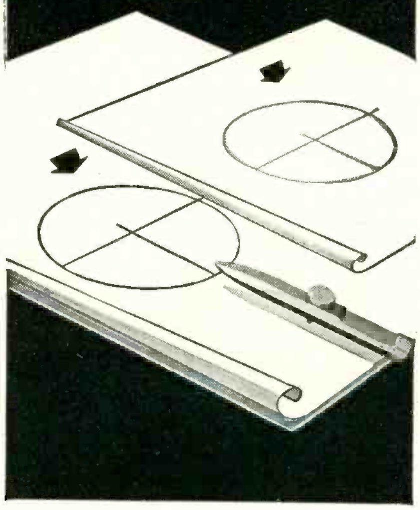

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Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

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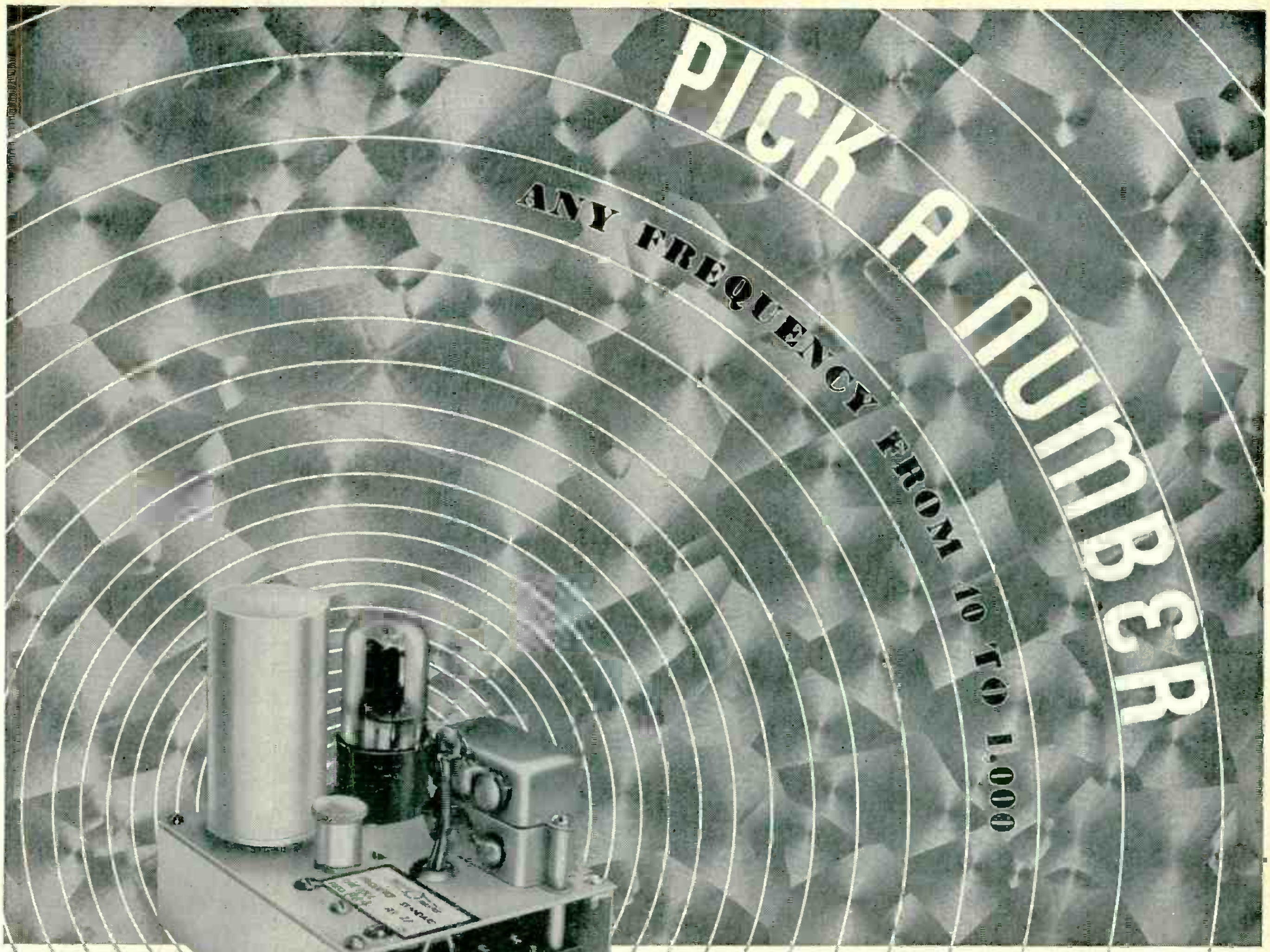
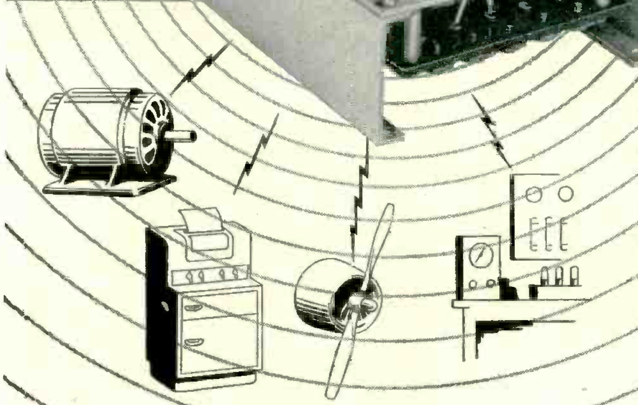




Pictured here is a tuning-fork frequency standard with accuracy guaranteed to one part per million per degree Centigrade. The fork is temperature-compensated and hermetically sealed against variations of barometric pressure. This standard, when combined with basic equipment, facilitates accurate speed and time control by mechanical, electrical, acoustical or optical means.

The unit is available separately or in conjunction with complete timing instruments. Our engineers are ready to cooperate on any problem.

MOTORS · FACSIMILE · AIRCRAFT · LABORATORIES

American Time Products, Inc.

580 Fifth Avenue *New York 19, N. Y.*

OPERATING UNDER PATENTS OF THE WESTERN ELECTRIC COMPANY

150 sq in. image area is provided.

The 16-inch tube has a deflection angle of 53 degrees and, for critical resolution, deflection coils designed for this angle are recommended. However, coils designed for conventional tubes having a deflection angle of 50 degrees have been found to provide good resolution. Operating voltage of the second anode is recommended at about 10 kv although the tube is tested at 15 kv.

The potential of the steel shell is also 10 kv and it is planned to make available an insulating sleeve. A Tenite coating on the sleeve and an Aquadag layer might then be used to form a filter capacitor for the high-voltage power supply as is conventional practice with the 10BP4 and 10FP4. (ELECTRONICS, p 186, April 1948).

The metal tube is manufactured by Tel-O-Tube Corp. of America, at Paterson, N. J. and is used in a table model receiver of Starrett Television Corp. of New York.

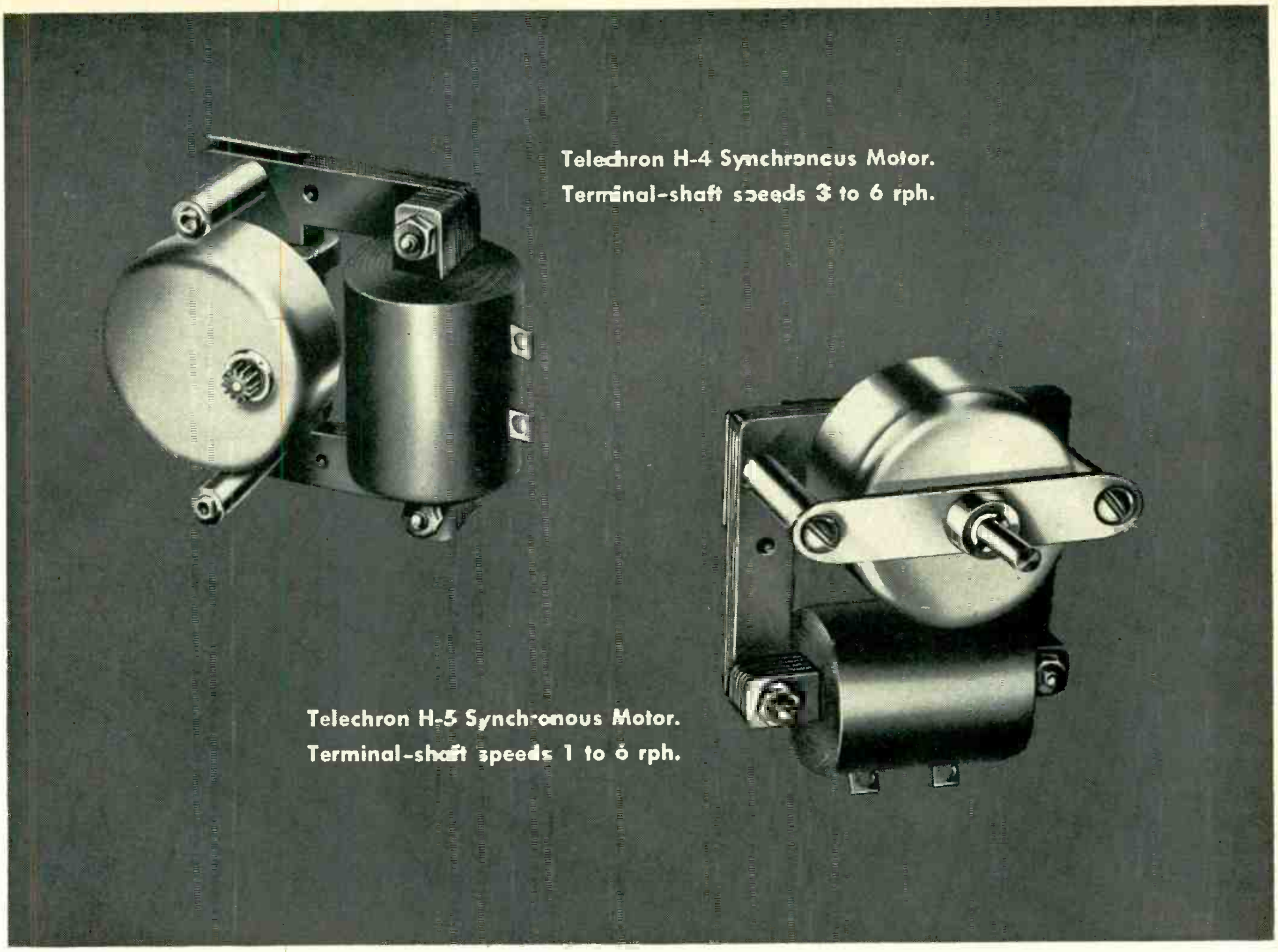
Amplitude Selective Amplifier

By CHARLES E. LOWE
Fenton, Michigan

IN THE development of a servosystem for operation of a drag cup motor in response to the output signal of a magnetic bridge, it was found that the use of an amplitude-selective amplifier overcame many irritating and vexing problems.

Slight modification in normal resistance-coupled amplifier performance enables such amplitude discrimination to be obtained with few additional parts. Although in ordinary amplifier usage such a condition is known as bad transient response, in this application it acted as a cure-all with no ill effects.

The output signal of the magnetic bridge contained much second harmonic of the motor operating frequency throughout the near-balance condition of the bridge and through the null point of the operating signal. This unwanted harmonic content tended to mask the null point as it decreased the sensing efficiency of the overall system at the critical time of balance indication. At the same time, the nonlinear operation of the bridge magnetic elements combined with the



Give your timers **extra life** with Telechron motors

There's longer service in any time switch or timer powered with an H-4 or H-5 Telechron synchronous electric motor. Efficient, dependable lubrication is assured by a special terminal-shaft bearing incorporating an oil gland that extends motor life.

These dependable, self-starting motors are designed for general-purpose time switches, dishwasher timers, stoker and oil-burner controls, appliance timers, defroster timers, fast battery chargers and many other timing and switching devices. They operate in perfect synchronism with any commercial frequency . . . can't run fast or slow.

The H-4 motor is available in terminal-shaft speeds from 3 to 6 rph. The H-5 motor is available in terminal-shaft speeds from 1 to 6 rph. Their conservative torque ratings at 60 cycles range from .20 pound-inch at 6 rph. to .50 pound-inch at 1 rph. Like all Telechron motors, they are precision-built for long, dependable service by the largest producer of synchronous electric timing motors for over 25 years. Every one is Underwriters Laboratories approved. Why not talk over your special needs with Telechron's application engineers? Address Motor Advisory Service, Dept. M, Telechron Inc., Ashland, Massachusetts. A General Electric Affiliate.

see our CATALOG in SWEET'S FILE for PRODUCT DESIGNERS

Telechron
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SYNCHRONOUS MOTORS

THE FIRST AND FAVORITE SYNCHRONOUS ELECTRIC TIMING MOTOR

ANOTHER SPECIAL BY PROGRESSIVE

CATALOG SHOWS DOZENS MORE

Special heads, threads and finishes on any metal or alloy adapted to cold upset. Weekly output: 25,000,000 pieces. Many specials, suggesting production savings for you, illustrated in latest catalog. Includes weights per 1M standard pieces, dec. equivs. of fractions, other purchasing and engineering helps. Write for Catalog 19.

The **PROGRESSIVE MFG. CO.**
50 NORWOOD ST. TORRINGTON, CONN.

AMPERITE

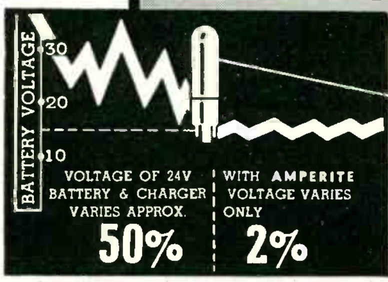
THERMOSTATIC METAL TYPE DELAY RELAYS

PROVIDE DELAYS RANGING FROM 1 TO 120 SECONDS

FEATURES:—Compensated for ambient temperature changes from —40° to 110° F . . Hermetically sealed; not affected by altitude, moisture or other climate changes . . Explosion-proof . . . Octal radio base . . . Compact, light, rugged, inexpensive . Circuits available: SPST Normally Open; SPST Normally Closed.

PROBLEM? *Send for "Special Problem Sheet" and Bulletin.*

AMPERITE REGULATORS

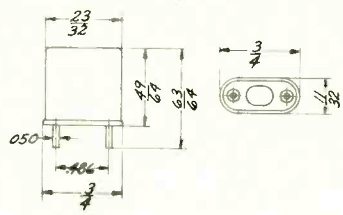


Amperite REGULATORS are the simplest, lightest, cheapest, and most compact method of obtaining current or voltage regulation . . For currents of .060 to 8.0 Amps . . . Hermetically sealed; not affected by altitude, ambient temperature, humidity.

Write for 4-page Illustrated Bulletin.

AMPERITE CO., 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp., Ltd., 560 King St., W. Toronto

WHEN SPACE IS A FACTOR ....



TYPE 20 by STANDARD is the answer. Superior engineering, hermetic sealing and filling with dry nitrogen result in a highly stable plated type, wire mounted crystal unit.

Fundamental frequencies from 1mc. to 20mc. Harmonic mode, 15mc. to 75mc. Tolerances from .02% to ± 0.003% over temperature range —55 to + 90°C.

This unit can also be supplied in CT and DT cut, center mounted, plated crystals in the frequency range from 200kc. to 1000kc.

Let us send you our FREE catalog showing the STANDARD line of frequency control units. For special problems, our engineering department offers consultation service with no obligation.

We manufacture quality Supersonic and Ultra-sonic crystals.

STANDARD PIEZO CO.
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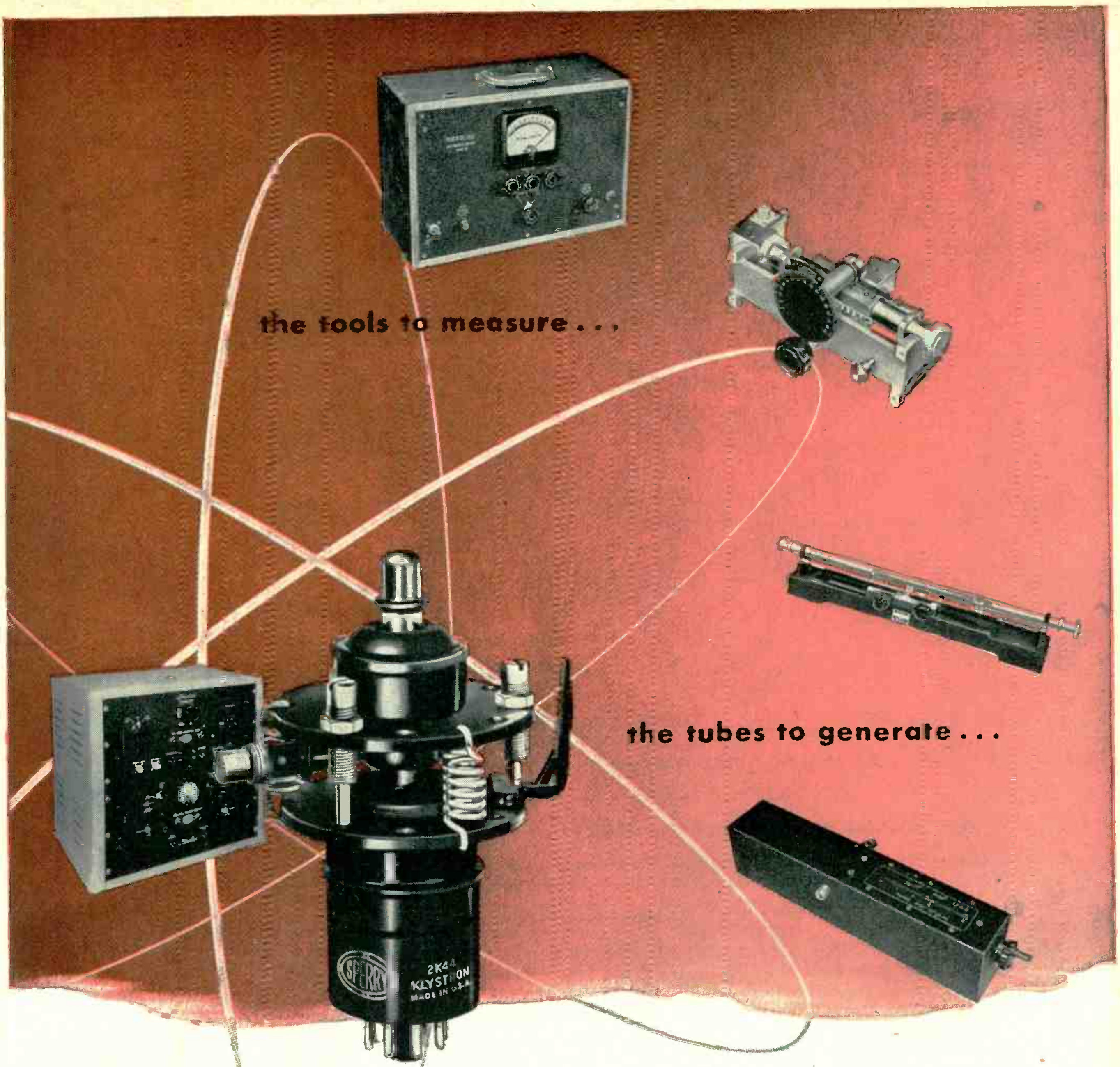


microwave Energy

The Sperry Klystron Tube to generate ultra-high-frequency microwaves . . .

The Sperry Klystron Signal Source to "power" them . . .

The Sperry Microline to test and measure them . . .

These Sperry products equip the research or development engineer with every essential for development or design in the microwave field.

The Sperry Klystron Tube has already opened up new vistas in navigation, aviation, medicine, radio, telephone, telegraph and other major applications. It is ready for many new local oscillator or high power uses.

The Sperry Microline includes practically every type of instrument for quick precision measurements in the microwave frequency bands.

This Sperry service — beginning with a source of microwave energy, the Klystron, and following through with every facility for measuring microwaves — opens up almost unlimited possibilities for industry.

We will be glad to supply complete information.

SPERRY GYROSCOPE COMPANY

DIVISION OF THE SPERRY CORPORATION · GREAT NECK, N. Y.

NEW YORK · LOS ANGELES · SAN FRANCISCO · NEW ORLEANS · CLEVELAND · SEATTLE differentiation through the mutual inductance of the output winding, coupled to the bridge proper, created an output signal inconsistent in waveform. As a result, the speed of the motor did not bear a simple direct relationship to the primary control displacement and the final calibration of the system became partially dependent upon an unreliable and erratic variable.

Presence of the second harmonic of the bridge excitation frequency in the bridge output signal was a necessary evil of the bridge design. Since it was designed to respond to minute direct currents in its input winding and to sense their direction as well as their amplitude, it was necessary to polarize the bridge arms with direct-current magnetization. In this way the aiding or opposing of this steady flux by the flux set up by the small current from the primary conversion element produced effects that indicated the direction of such current by the phase relationship of the output signal to the bridge excitation frequency. This latter frequency was also one of the phases of the motor excitation.

The sensing of reversal of input current direction by the bridge was indicated to the drag cup motor by a 180-degree change in phase of output signal. A balance for the bridge occurred with no incoming current from the conversion element or with the bridge input terminals shorted. At balance, the opposing alternating-current fluxes from the two bridge arms failed to give zero signal balance indication.

Since each half cycle of the opposing fluxes operated in separate directions along the B-H curve of the core from the operating point set up by the d-c polarization, the peak amplitudes of each half cycle of flux were not equal. Because of this difference, cancellation was not complete, and during every half cycle of the excitation frequency such a left-over bundle of flux appeared to cyclically excite the output winding. Thus, a second harmonic signal is generated. This signal reached its maximum value at the time of the null for the motor-operating signal.

In this application, the drag cup

The latest COSSOR CONTRIBUTION to electronic technique!

DIRECT measurement of voltages
DIRECT measurement of time intervals
FLAT FACE TWIN BEAM TUBE

COSSOR* TWIN-BEAM OSCILLOGRAPH MODEL 1035

A. C. Cossor Ltd., pioneers in the fields of advanced electronic equipment, including the development of the cathode ray tube, now, with pardonable pride, offer the COSSOR TWIN-BEAM OSCILLOGRAPH to the electronic industries of North America.

In all fields of modern research and in all industrial laboratories — in fact, anywhere where competent quantitative measurements and immediate waveform analysis are a necessity, the Cossor Twin-Beam Oscillograph, Model 1035, is essential equipment.

The instrument design incorporates a high speed, linear repetitive time base, featuring "Flyback" suppression with further facilities of external triggering from both positive and negative synchronizing voltages. The time scale is liberally spread over 9 convenient ranges, 150 milliseconds to 15 microseconds, and the time base waveform may be fed out for use with other equipment.

Other important factors which make this a really unique oscillograph, are the two independent systems of amplification with similar calibration arrangement. Voltage scale of amplifier Y1 covers 7 ranges, 50 volts to 50 millivolts, having an efficient frequency response of 10 mcs. to 20 cps. Voltage scale of Y2 covers 5 ranges, having a frequency response of 100 kcs. to 20 cps.

Still another major technical advancement lies in the electrically shielded new Cossor type 89 Double-Beam tube, 4 inches in diameter, with a FLAT FACE, eliminating all possibility of distortion created by the conventional curved-faced type, and, in addition, the graticule is engraved on both sides eliminating the common optical aberrations of parallax.

The instrument provides for mounting a camera directly to the face of the Cathode tube thus providing a permanent record of the waveform displayed.

Mains voltages may be adjusted between 105 to 255 volts and frequency between 50-100 cycles; power consumption 170 watts.

$505.00 f.o.b. Montreal (U. S. Funds)

COSSOR OFFERS MUCH MORE — COSTS MUCH LESS.
IMMEDIATE DELIVERY FROM STOCK.
Write us for further details of both the new Cossor Oscillograph Model 1035 and camera attachment.

COSSOR (CANADA) LTD.

621 CRAIG STREET W, Montreal 3, Canada

**The A. C. Cossor organization has won world-wide recognition for its pioneer development of the X-Ray Tube, the Cathode Ray Tube and the Cathode Ray Oscillograph. It also developed the first Radar Receiver and the first commercial Television Receiver.*

motor is subject to a braking action in the presence of such harmonics, distortion, or spurious frequencies, and mainly suffers a loss of efficiency and is not made unusable. Because of the limitations on the amplifier at a time when its sensitivity should be increased and the very irregular action of the servo-system as the control signal waveform varied, steps were taken to eliminate this nuisance.

Application of tuned circuits and of notch filters helped but reliability under varied conditions of operation was not obtained.

Circuit Operation

In the process of amplitude discrimination, the output signal of the bridge is first amplified and then the fundamental frequency is separated from the envelope of the second harmonic. The output of the amplifier goes through essentially the same waveform changes as the input signal with the exception that the output signal change occurs long before the same degree of input signal change. Watching the input and output signal simultaneously on a pair of oscilloscopes, one can observe only a slight change in the waveform of the input signal while the output signal is changing from complete second harmonic to complete fundamental. The change in output signal during the transition is continuous in that one frequency increases in amplitude while the other is decreasing.

At bridge balance, the amplifier still passes second harmonic signal, however, it is now limited to a much narrower range in the bridge calibration. The increased sharpness of bridge balance indication welcomes the damping action induced on the motor armature by the second harmonic drag. Thus the braking action of the second-harmonic signal of the motor operating frequency may be used for slight anti-hunting purposes to inhibit overshooting.

Bridge Signals

Figure 1 shows the changes in the bridge output from a balanced condition to one of complete unbalance. At Fig. 1A, the balanced bridge indication is an approximate sine wave, a second harmonic

AM · FM · TV
RAYTHEON SPEECH EQUIPMENT

For the last word in complete, up-to-the-minute facilities
. . . or simple, low-cost equipment to suit your limited requirements . . .

Look to RAYTHEON for All Your Needs

RC-11 STUDIO CONSOLE

NOW WITH CUE POTS FOR TWO TURNTABLES

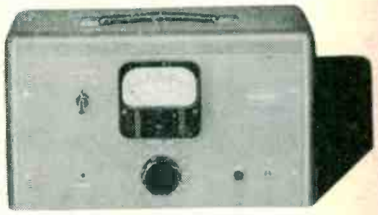
Provides complete high-fidelity speech input facilities with all control, amplifying and monitoring equipment in one cabinet. Seven built-in pre-amplifiers, nine mixer positions, cue attenuators for two turntables. Simple, positive controls reduce operational errors. Frequency response—2 DB from 30 to 15,000 cycles; Distortion—less than 1% from 50 to 10,000 cycles; Noise Level—minus 65 DB's or better. Meets all FCC requirements for FM.

RPC-40 PORTABLE CONSOLETTE

Ideal for remote pickups yet complete enough to serve as a studio console. Four input channels for microphones or turntables, high level mixing, two output lines. Two RPC-40's interconnected provide 8-channel mixing—a feature of special interest to new TV stations planning future expansion.

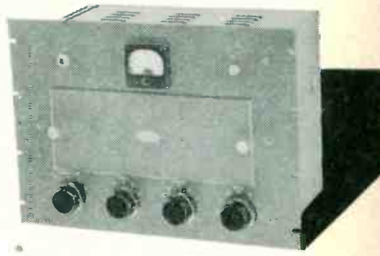
RR-30 REMOTE AMPLIFIER 3 CHANNEL

A lightweight, easy-to-carry combination of amplifier and power supply—simple and quick to set up. Provides three high-fidelity channels, excellent frequency response, high over-all gain.



RR-10 REMOTE AMPLIFIER SINGLE CHANNEL

A complete, self-contained unit with built-in power supply. An excellent low-cost amplifier for remote pickups requiring only one high-fidelity channel.



RL-10 VOLUME LIMITER

Engineered for high-fidelity AM, FM or TV speech input. Increases average percentage modulation without distortion.

RZ-10 PRE-AMPLIFIER

A plug-in type pre-amplifier or booster for microphones or turntables. Handles high input level. Noise level below 85 db from 0 vu output. Low distortion. Plug-in construction permits using one to four units for maximum flexibility.

RP-10 PROGRAM AMPLIFIER

A high-fidelity, single-unit amplifier and power supply. Over-all gain, 65 db; frequency response flat from 30 to 15000 cps; distortion less than 2% at + 30 vu. Designed for rack or cabinet mounting.

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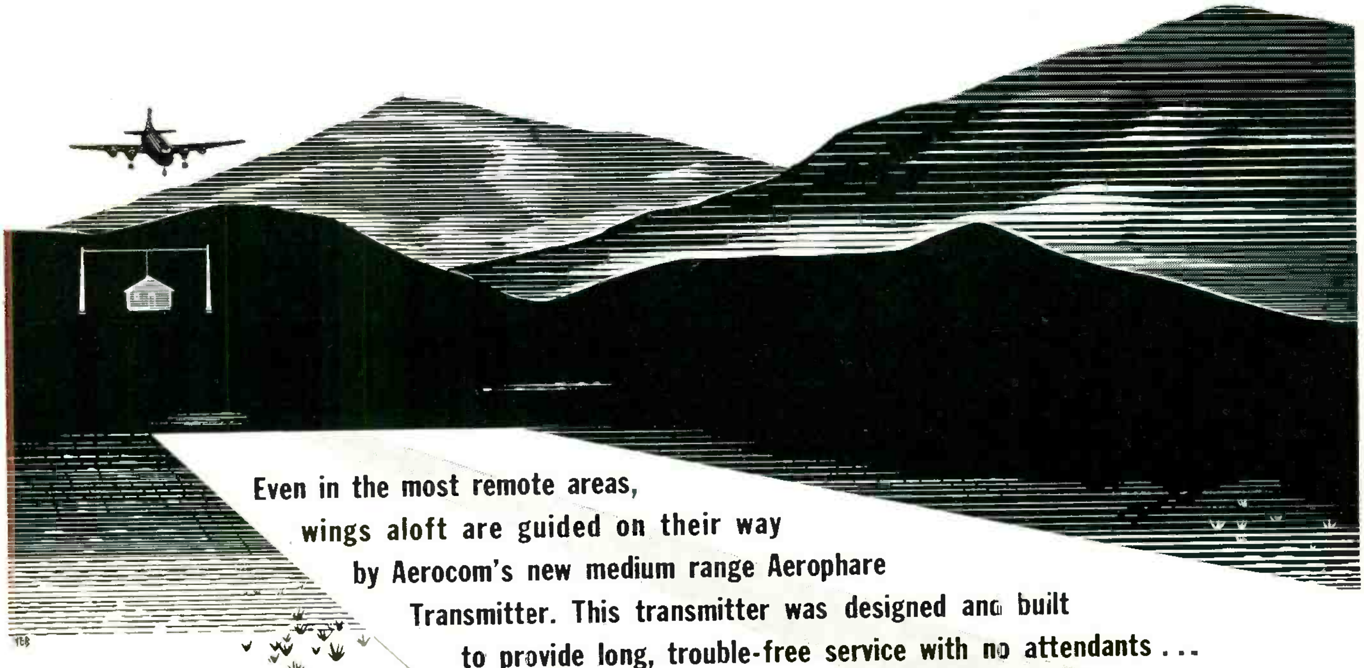

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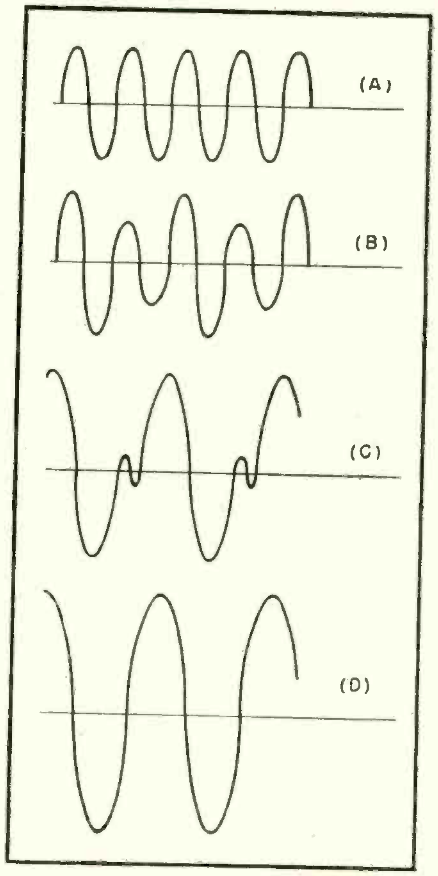
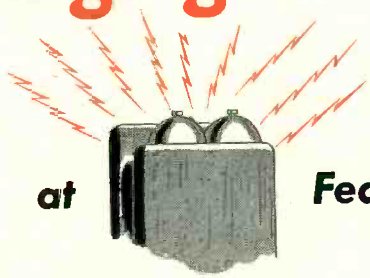


FIG. 1—Bridge output signals showing transition from second harmonic to fundamental to indicate various degrees of unbalance

of the bridge excitation frequency. All of these peaks are of equal height. In Fig. 1B the peaks alternate in height and indicate a slight bridge unbalance for this is a sign of the fundamental making its appearance from the null value. In Fig. 1C, the unbalance has progressed to almost complete disappearance of the second harmonic component. In Fig. 1D, the final output of complete unbalance is an approximate sine wave which has a phase determined directly by which of the alternate set of peaks in Fig. 1B increased in height. If the bridge unbalance had progressed in the opposite direction, the resulting complete unbalance signal would have had a phase difference of 180 degrees from the phase shown.

A slight phase shift in the fundamental frequency occurs as the fundamental takes form. The shift makes this degree of reversal possible from the low and high peaks transition into the final frequency. This shift occurs as the fundamental slides over sidewise on the time

Ringing the Bell



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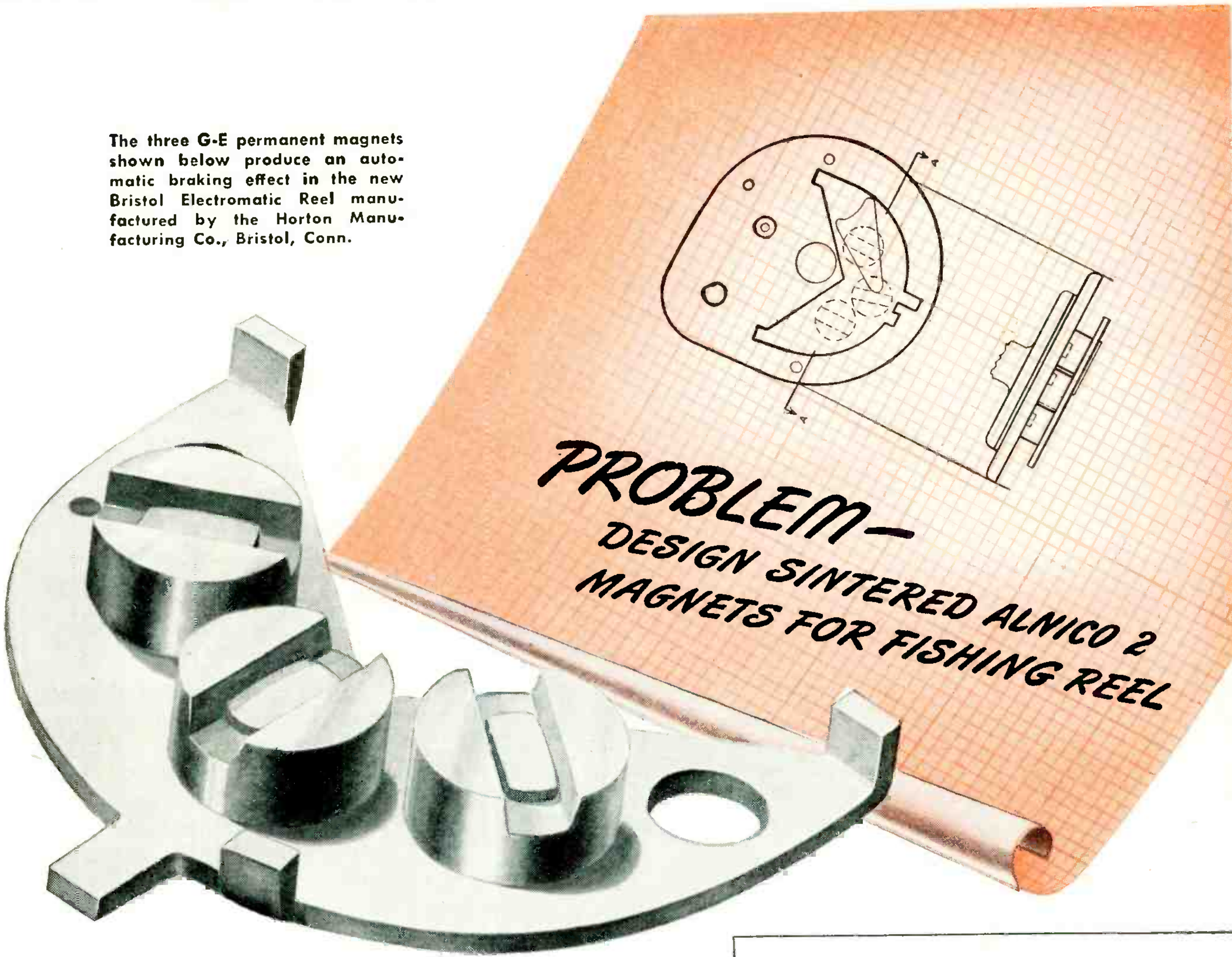

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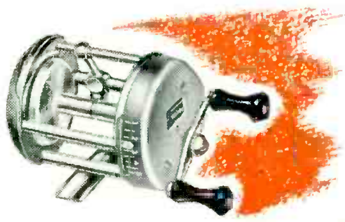

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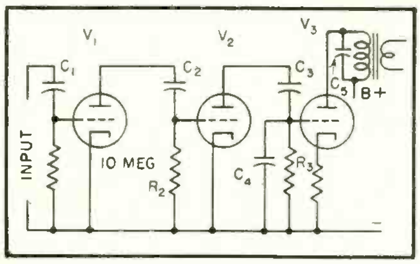

FIG. 2—Essential portions of amplitude discriminator amplifier showing cascaded discriminators and pulse reshaper

axis to help eliminate the second harmonic. This particular servo-system was designed to be a null-seeking self-balancing device and these slight phase errors only slightly affect motor speed and do not affect calibration. Otherwise the application of amplitude discrimination might not be permissible to such a system.

Discriminator Amplifier

In the circuit of Fig. 2, the first stage, tube V_1, can be used for amplification, or it may be identical in action with the following stage, including tube V_2, in which amplitude discrimination takes place. In this manner, both stages together may give a cascaded type of discriminator action to extra large signals. However, it will be shown that amplification ahead of the discriminator is most desirable in that it increases the rapidity with which the circuit indicates unbalance. This is similar to increasing the Q of a tuned circuit. Tube V_3 is a driver for the motor-operating stage. It delivers a sine wave at the output of the driver transformer T_1 for the rectangular input from the effects of amplitude discrimination ahead of it. This motor-operating sine-wave output remains almost constant up to the point of complete bridge balance at which time it rapidly changes to second harmonic of the bridge excitation frequency.

The motor-operating signal had a frequency of 60 cycles to be adaptable to standard power line supply as well as portable power generation. Tubes V_1 and V_2 are normally biased by the contact potentials developed at their grids. However, in operation the positive peaks of the signal may draw grid current and so bias the grids to a value below cut-off in an amount

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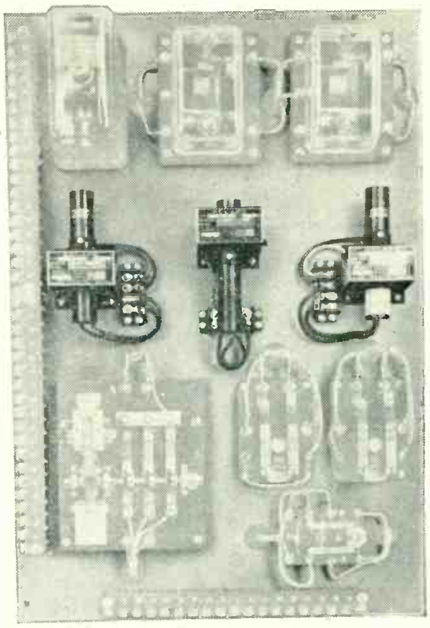

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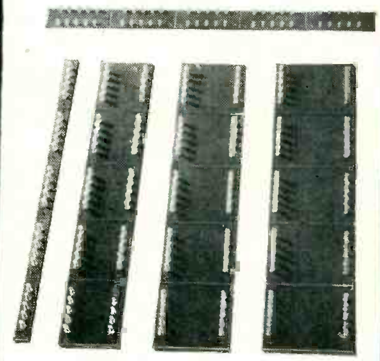

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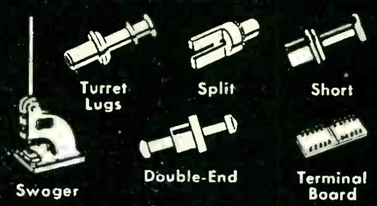

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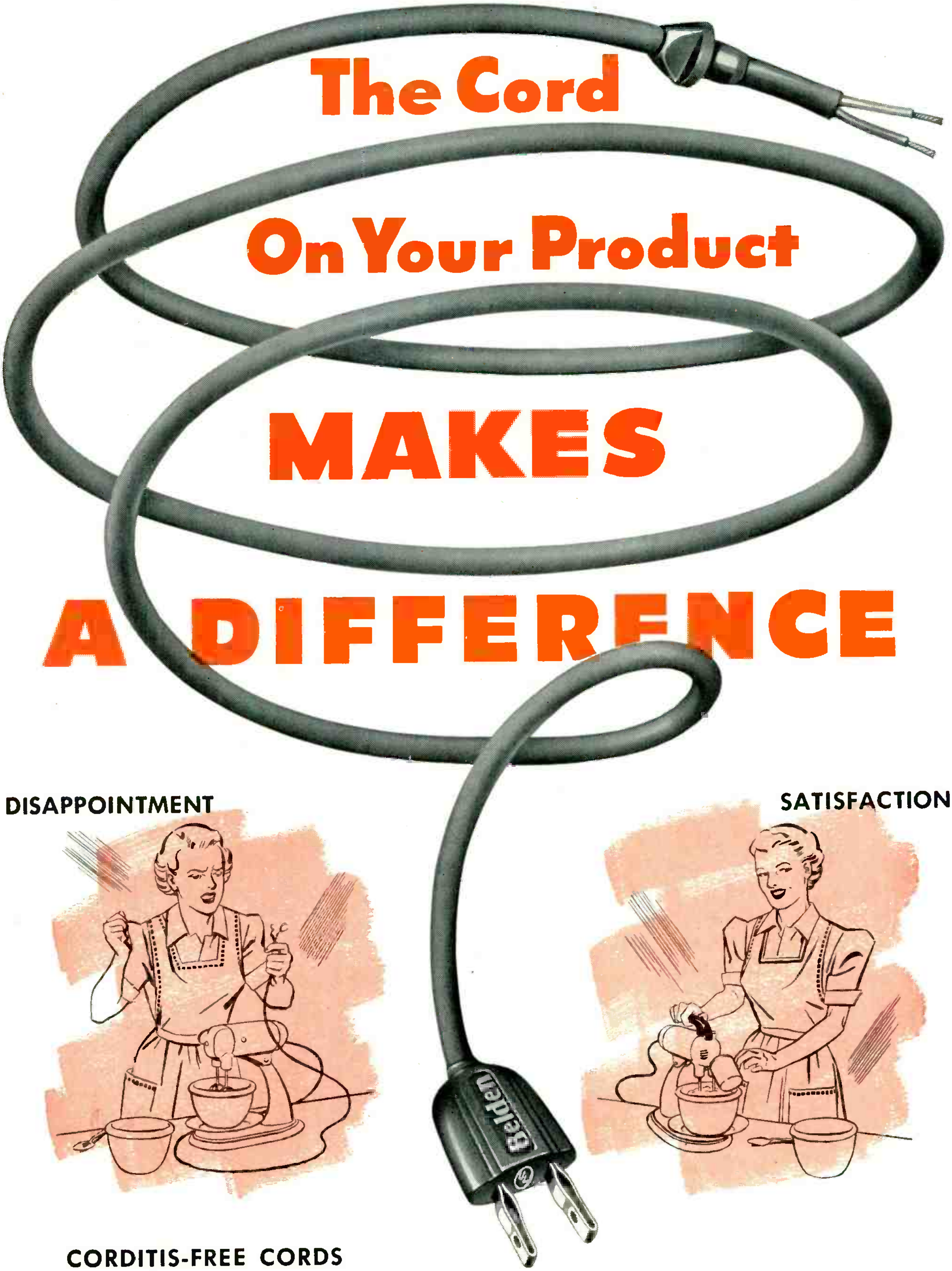

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essentially equal to the signal amplitude. The time constants of R_1C_1 and R_2C_2 should correspond to a frequency much lower than the frequency to be passed by the amplifier. A time constant of 0.1 second was found to be satisfactory in discriminating out a 60-cps signal from the envelope of the second harmonic.

Values of C_3 and C_4 are equal and their time constant individually in connection with resistor R_3 should correspond to a frequency of thirty cycles. The value of C_5 is found by experiment. In combination with the inductance presented by T_1 it reshapes the output signals of the transformer to the closest approximation of a sine wave that conditions permit.

Amplifier Operation

If the output signal of the bridge to the amplifier is as shown in Fig. 3A, then the output of tube V_1 acting as an amplifier is an amplified replica of the signal at the input to the grid of the following tube V_2. This is indicated by Fig. 3B.

The output of V_2 appearing across R_3 in the absence of the integrating capacitor, C_4, is as shown at Fig. 3C. This signal may have almost exactly rectangular waveform as indicated since the tips of the positive peaks are flattened by grid current into the high-resistance grid circuit. Also, the small portion of the waveform between cut-off bias and zero bias intercepted on the transfer characteristic of the tube has its curved sides straightened by the curvature of the characteristic.

The introduction of the integrating capacitor, C_4, changes the vertical edges of the rectangular pulses to exponential type curves. This is shown by the difference between the dashed lines and the solid curved lines in Fig. 3D. The combined effect of C_5 and the inductance of T_1 are shown by the approximate sine waves of Fig. 3E as they finish the reshaping of the pulses into a motor-operating signal of greater efficiency. This signal has its phase directly related to the higher peaks of the second harmonic signal. In this manner the bridge output phase relationship is maintained so as to provide directional response of the

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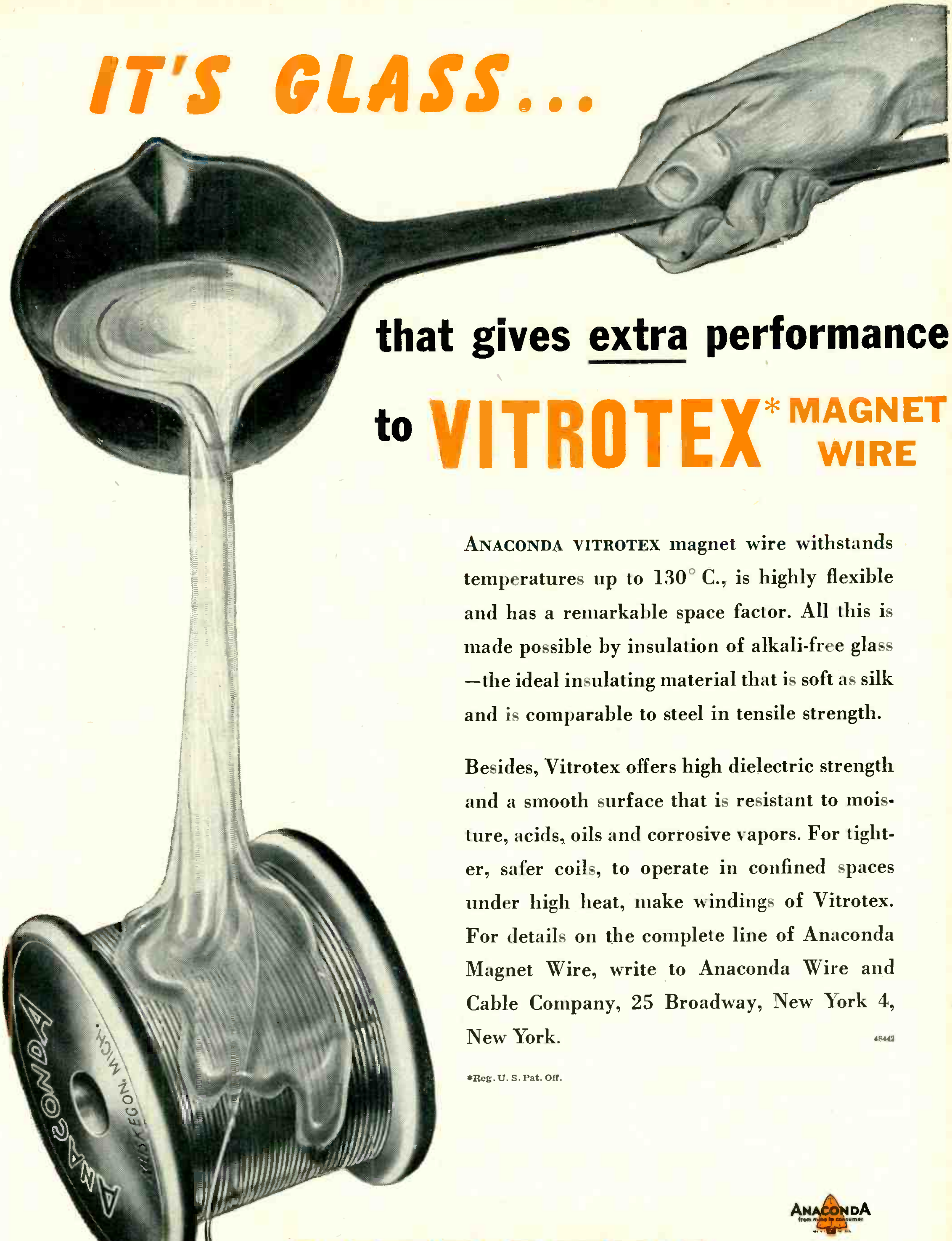

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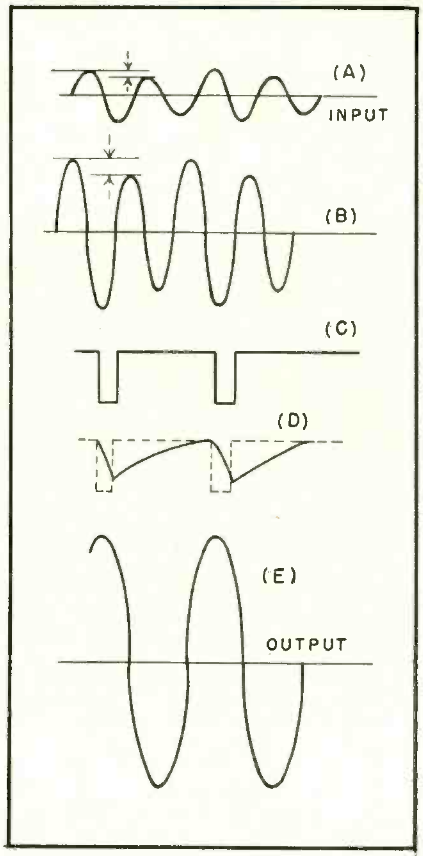

FIG. 3—Bridge signals of slight unbalance indication passing through the discriminator amplifier to be discriminated into a signal of complete unbalance

drag cup motor to the direction of bridge unbalance.

Advantages

From the change in the output to input signal waveform of Fig. 3, it will be noted that only a slight bridge unbalance is needed to give the identical change of signal arrived at through complete bridge unbalance as shown in Fig. 1. Although straight amplification of the null signal along with automatic control of amplifier gain might give almost equivalent results, if the unwanted harmonic signals are first removed, there are other important advantages of this system that make it very desirable.

If a measure of the sensitivity of the bridge circuit is assumed to be in the displacement of the bridge variable necessary to change the output signal from a complete null for the fundamental frequency, while the harmonics are present at a maximum, to the condition where the fundamental is a maximum and no harmonics are present, then, amplification of the bridge output signal is obtained in terms of a small-

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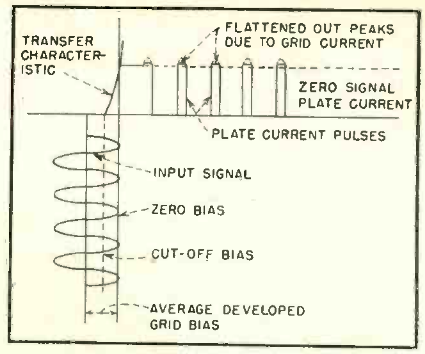

FIG. 4—Discriminator action allowing input frequency to pass through amplifier

er displacement producing a given change of signal. Or in other words, the Q of the bridge is increased.

The circuit automatically introduces gain control in that the grid bias continually adjusts itself to signal levels. Final maximum output is soon reached with a small input signal and overloading of the output does not occur on larger signals. But perhaps the greatest good is achieved because the tips of the peaks of waveforms of radically different shapes can be somewhat depended upon to produce pulses in the discriminator plate circuit of the same phase and shapes. Hence, a certain amount of flexibility is added to the servo-system in allowing the input to the amplifier to operate at different levels of signal distortion.

Discriminator Action

The dynamic transfer characteristic of the discriminator tube is shown in Fig. 4 and 5 to clarify the separation of signals by this action. In Fig. 4, the peaks of the incoming signal are all of equal amplitude. These peaks manage to maintain the grid bias sufficiently low enough to permit the positive tips to just exceed zero bias and

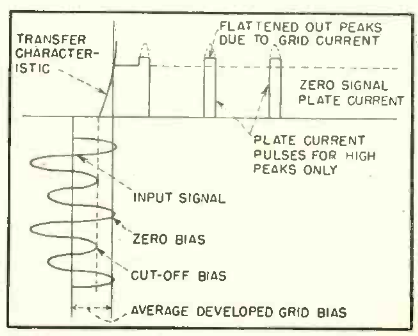

FIG. 5—Discriminator action allowing only input frequency of highest peaks to pass through amplifier

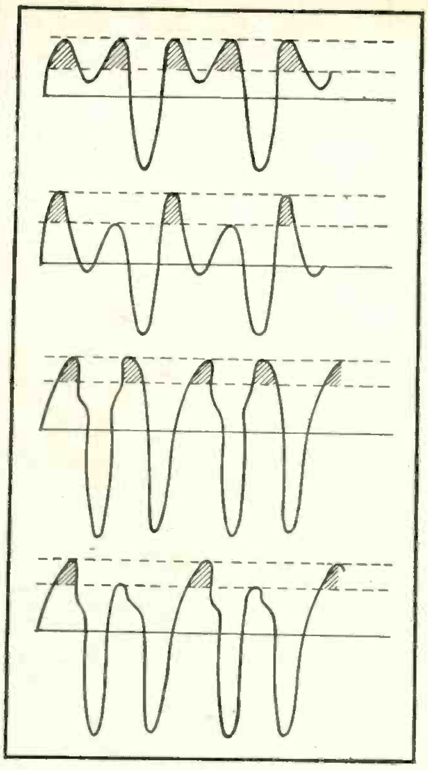

FIG. 6—Different waveforms react the same to discrimination producing almost identical pulses

so draw grid current to recharge the grid circuit negatively. Only that portion of the waveform projecting above the cut-off bias is capable of influencing the plate current of the tube.

In Fig. 5, the positive peaks of the signal alternate in amplitude. If the lower peaks are below cut-off bias they have no effect upon plate current. The higher peaks manage to exceed the zero bias value and draw grid current to maintain an average grid bias proportional to their amplitude. In this case the frequency of the output plate current pulses corresponds to the frequency of the fundamental modulating the envelope of the second harmonic, and no second harmonic is present in the output since there are no plate current pulses to represent it.

The smaller the percentage of the signal amplitude that corresponds to five volts the sooner the early stages of bridge unbalance indication can be completely amplitude discriminated. With the circuit shown it was possible to cause all vestige of second harmonic to disappear and the fundamental to become a maximum with one twentieth of the former required pri-

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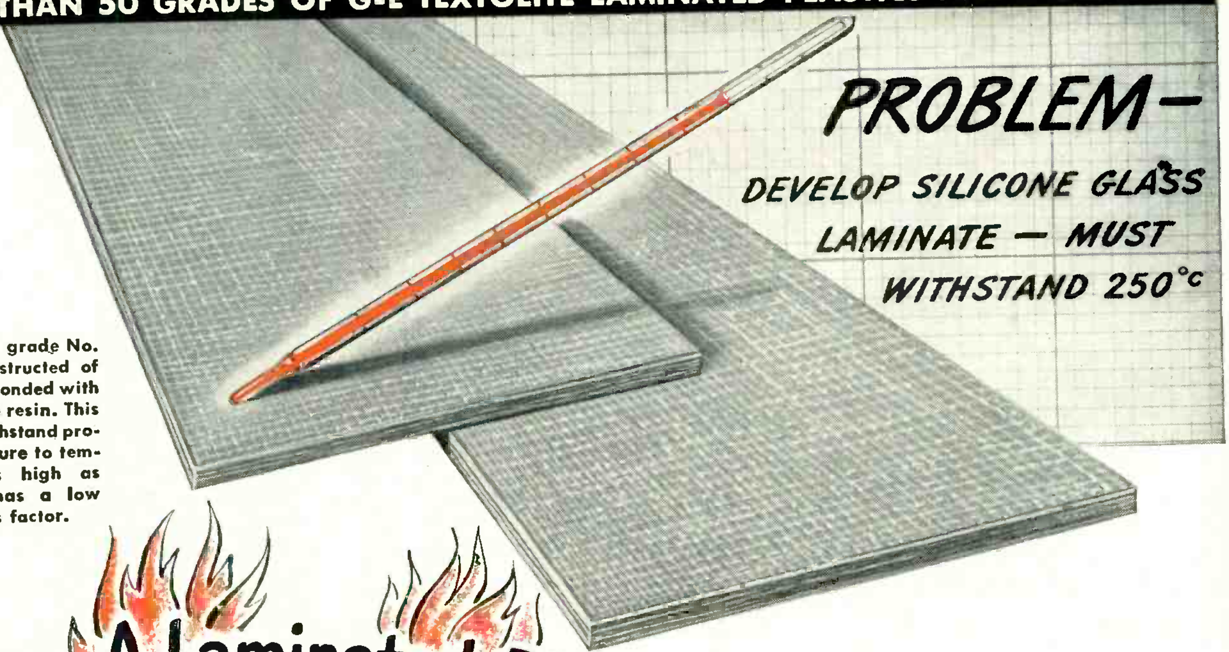

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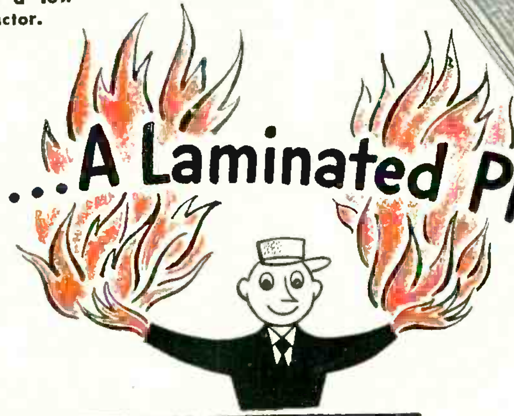

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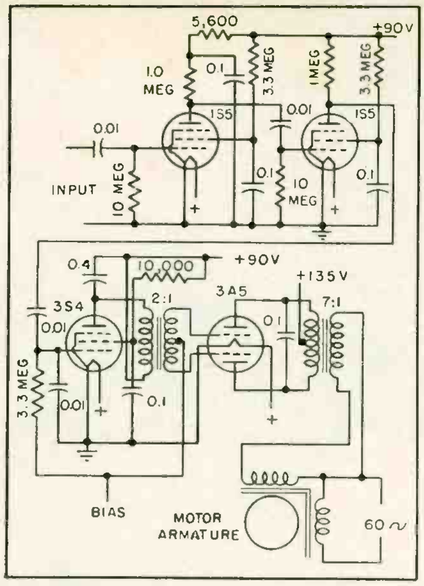


FIG. 7—Experimental circuit of amplifier for portable use

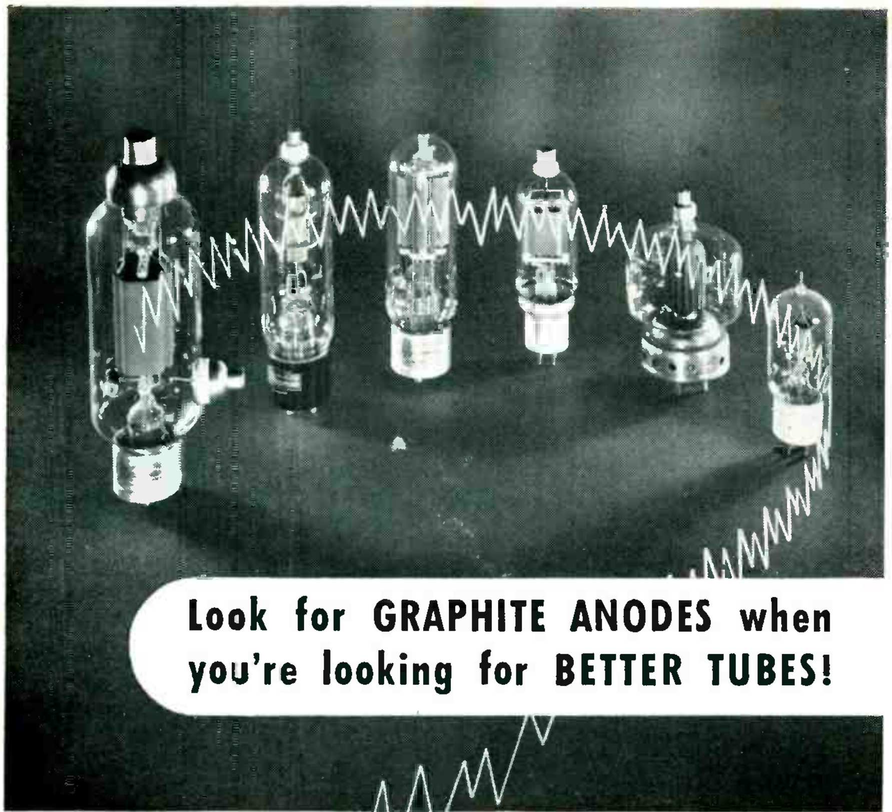
mary control displacement at the bridge input.

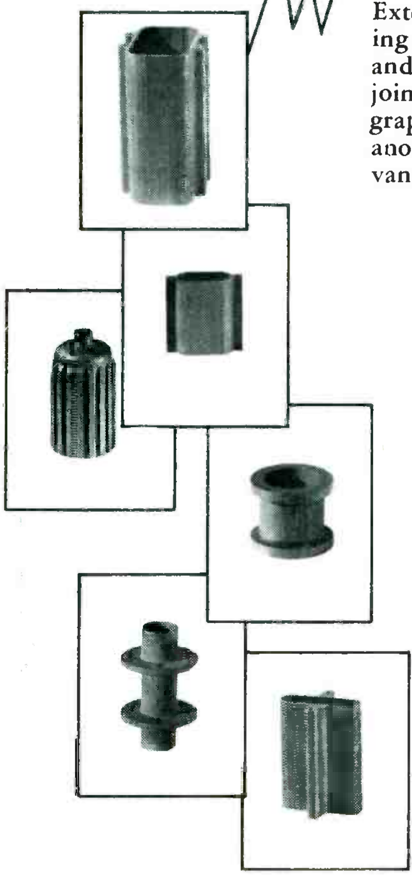
Stray 60-cycle pickup was not the nuisance under this system that it was under ordinary voltage amplification. Such pickup did not modulate the second harmonic nor could it otherwise interfere with the higher level grid signals put into use by this method.

Radically different waveshapes may give fundamentally the same output pulses in the discriminator plate circuit. The curves that are shown in Fig. 6 show how this may be possible. Those parts of the curves between the two lines representing cut-off bias and zero bias determine the frequency of the output pulses. The tips of such wave variations are very similar in shape and become even more so in the plate circuit of the discriminator as they draw grid current and are altered by curvature of the transfer characteristic.

In Fig. 7 an experimental circuit for adaptation to portable use is given with the values for circuit components. Only the amplifier unit alone is shown since the input and output controls are part of other developments.

To one accustomed to thinking of amplification strictly in terms of actual amplitude or power increase, it is surprising to see the output signal anticipate the input signal in changing its waveform while no apparent change occurs in the input.





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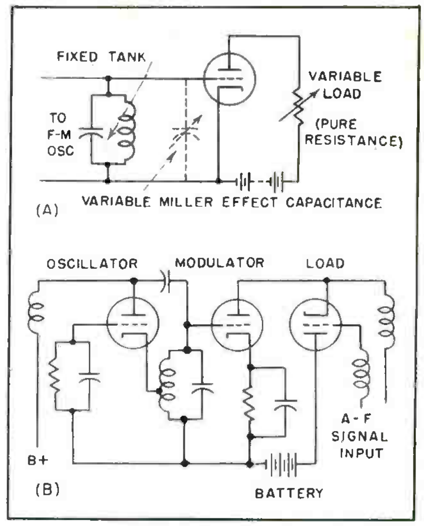

FIG. 1—(A) Basic principle of Miller effect frequency modulator circuit depends on variation of load resistance of tube reflecting a variable capacitance across its input. In practical adaptation of this principle (B) modulator tube is placed across oscillator and has a vacuum tube for load

cuit shows that, in the general case, the input admittance between grid and cathode has both real and imaginary components. But if the load is purely resistive, as in this special case, and the grid-plate and grid-cathode capacitances are of the same order of magnitude and the product of frequency, grid-plate capacitance, plate resistance and load resistance is considerably less than unity, the input becomes purely capacitive. This input capacitance is equal to $C_{GK} + C_{GP} (1 + A)$, and its dependence on the amplification factor of the tube and plate circuit conditions is familarly known as the Miller effect.

Pure negative (capacitive) reactance can thus be injected into the tank circuit without the need for phasing circuits or multigrid tubes; the only requirement is that the plate load be purely resistive. To produce the frequency modulation, the gain A of the tube is varied by the additional elements shown at Fig. 1B. The amplification of the modulator tube is varied by placing in its plate circuit another tube as load which behaves as a variable resistance dependent on the audio-frequency signal voltage. The oscillator tube is connected in a Hartley circuit.

Because both cathode and grid of the load tube operate at r-f potentials, it is necessary to use

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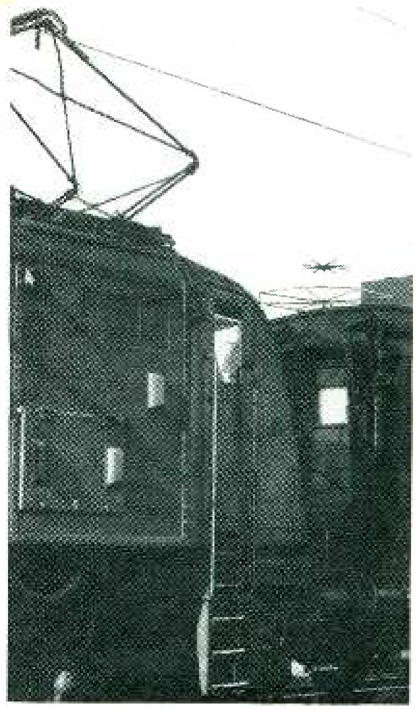

FIG. 2—Frequency modulation radiotelephone train antenna was located near locomotive to create most adverse noise problem for purposes of testing

of the oscillator. Drift of the oscillator's center frequency is easily counteracted by superimposing a compensating voltage obtained by usual automatic frequency control techniques on the battery voltage. Although the frequency stability of this circuit is inherently comparable to that of all direct f-m circuits, the simplicity of this circuit reduces the difficulties of stabilizing frequency. Of course, the frequency of the oscillator can be stabilized by a quartz crystal, in which case the Miller effect modulator can produce phase modulation, which can be used directly or fed to multiplier stages.

Experiments with Radiophone

This new modulator circuit has been used in equipment built for the Italian State Railways to determine the feasibility of very high frequency radiotelephone communications between a moving train and a fixed ground station. Troubles from microphonics en-

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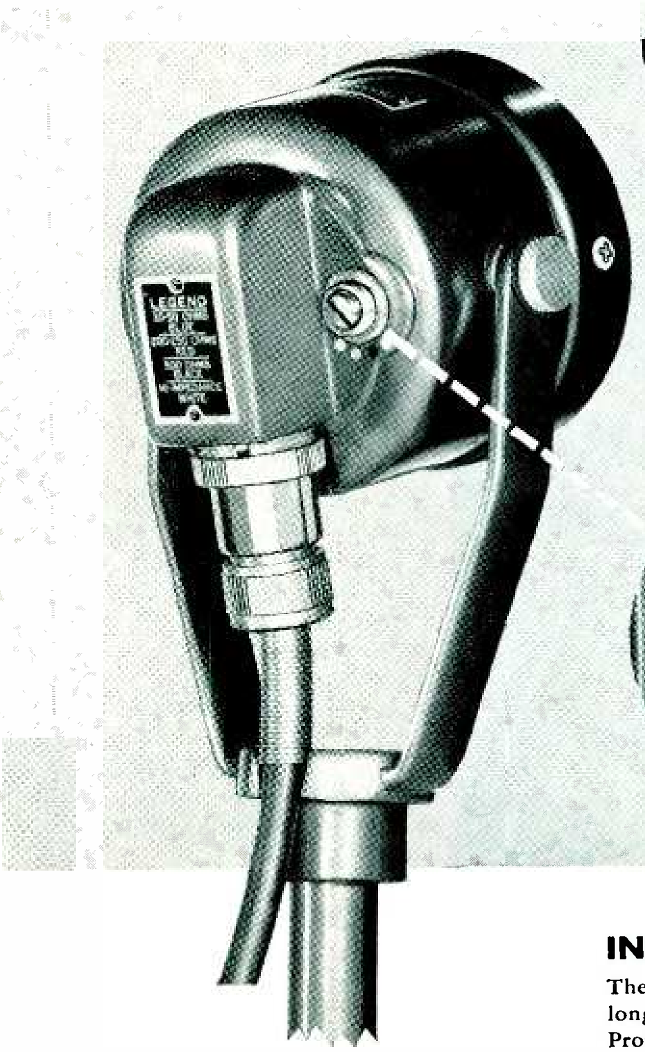

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counted with reactance-tube modulators were eliminated by using the Miller effect modulator and frequency stability was better. These tests were made on carrier frequencies around 110 mc with 40 watts output from the transmitters. For tests the antenna on the train was purposely placed on the coach next to the electric locomotive, as shown in Fig. 2. The electrified sections of the right-of-way use 3,000-volt overhead lines; a train is drawn by a 3,000 hp locomotive.

The transmitter consisted of a Miller effect modulator using a 12J5GT and a 12AH7GT, a 12A6 oscillator multiplier, 12A6 frequency doubler, 832 frequency tripler, and 829B power amplifier. A total frequency multiplication of 18 is obtained to produce a modulation index of 4, which is sufficient to give suitable noise suppression despite the adverse antenna location and the change in signal strength because of the cuts and built-up suburban districts through which the 24 miles of track between Rome and Tivoli pass.

Repeated tests on this line have consistantly indicated the possibility of establishing satisfactory commercial quality radiophone communication between the moving train and a fixed station at Rome with the exception of those places where the line enters tunnels of considerable length near Tivoli.

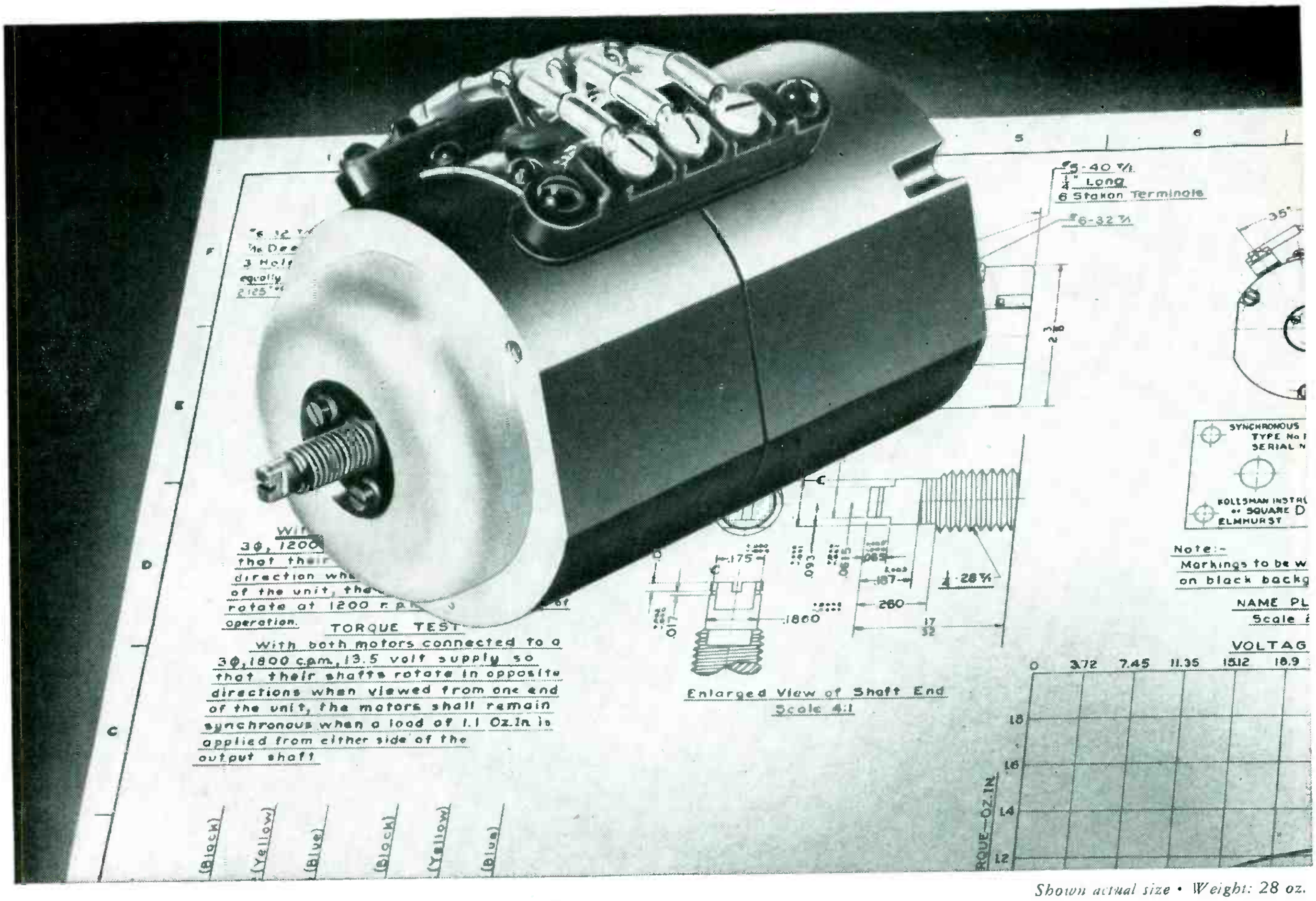
Precision Circuit Printing

By Clifton Tuttle

Vice President, Research & Development
Kenyon Instrument Co., Inc.
Huntington Station, N. Y.

PRINTING ELECTRONIC CIRCUITS has two advantages: it decreases the size and weight of the circuit chassis and components, and it makes production more economical through elimination of wire soldering and lessening of the numbers of units rejected because of errors in manual assembly. Both advantages are either directly or indirectly enhanced by the ability to reproduce conductive patterns with geometrical precision.

The process developed by this company is capable of high resolution of details in the production of



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This unit is composed of two small synchronous motors and a mechanical differential in a completely enclosed frame. The ¼" threaded output shaft turns at a rate equal to ½ the difference of the individual speeds of the two motors. When the input frequencies are equal, the shaft remains stationary.

The efficiency of this unit is greatly increased by the use of hysteresis-type motors. These motors yield the greatest running torque found in self-starting synchronous motors. The units now being produced are designed to operate from a three-phase source over a 15-60 cycle frequency range with an input voltage of .007 times the frequency, in cycles-per-minute. Similar units wound for higher voltages and two- or single-phase operations are also available.

The Synchronous Differential is but one of a complete line of special purpose motors developed by Kollsman for remote indication and control applications. Write for further information to: Kollsman Instrument Division, Square D Company, 80-64 45th Avenue, Elmhurst, N. Y.

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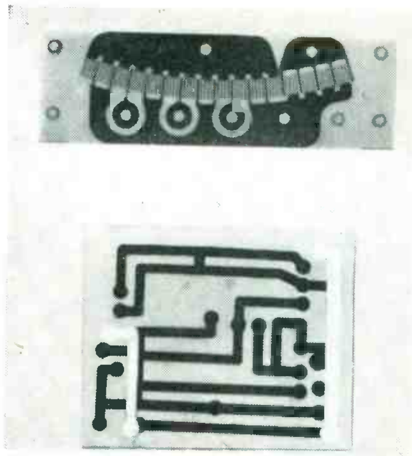


A commutator formed in ceramic and a circuit formed on top and bottom of a thin, transparent plastic sheet

patterns because it is basically a photographic reproduction method. Commercial photographic materials usable in this process are capable of resolving lines less than 0.0005 inch in width which are separated by spaces of the same width. This inherent dimensional accuracy of the photographic material may be realized in accuracy of circuits or other patterns reproduced by the method.

Description of the Process

The first steps in the process are merely the following of the standard procedure of photography: printing opaque and transparent copies either by contact or by optical projection (at any desired reduction ratio) onto a commercial silver halide emulsion. This emulsion may be coated either as a photographic plate or film. Following exposure, the image is developed in the conventional manner, resulting in the reduction of the silver halide to metallic silver particles imbedded in the gelatine. These silver particles, because they are buffered by nonconductive gelatine do not form a conductive layer. In fact, the resistance of the conventional photographic image area is of the same order of magnitude as that of the nonimage area.

The next step in the process is one of physical replacement of the image areas by other materials. Silver, carbon, graphite, or other substances obtainable in finely divided powder form can be used. By this replacement the original base material, glass or film, bears a

faithful and strongly adhering replica of the original image in relief. The definition of detail in this new pattern is influenced only by the photographic image definition and the fineness of the powder used in the replacement step. At this point in the process, the pattern, if it is conductive, can be electroplated to build any desired thickness.

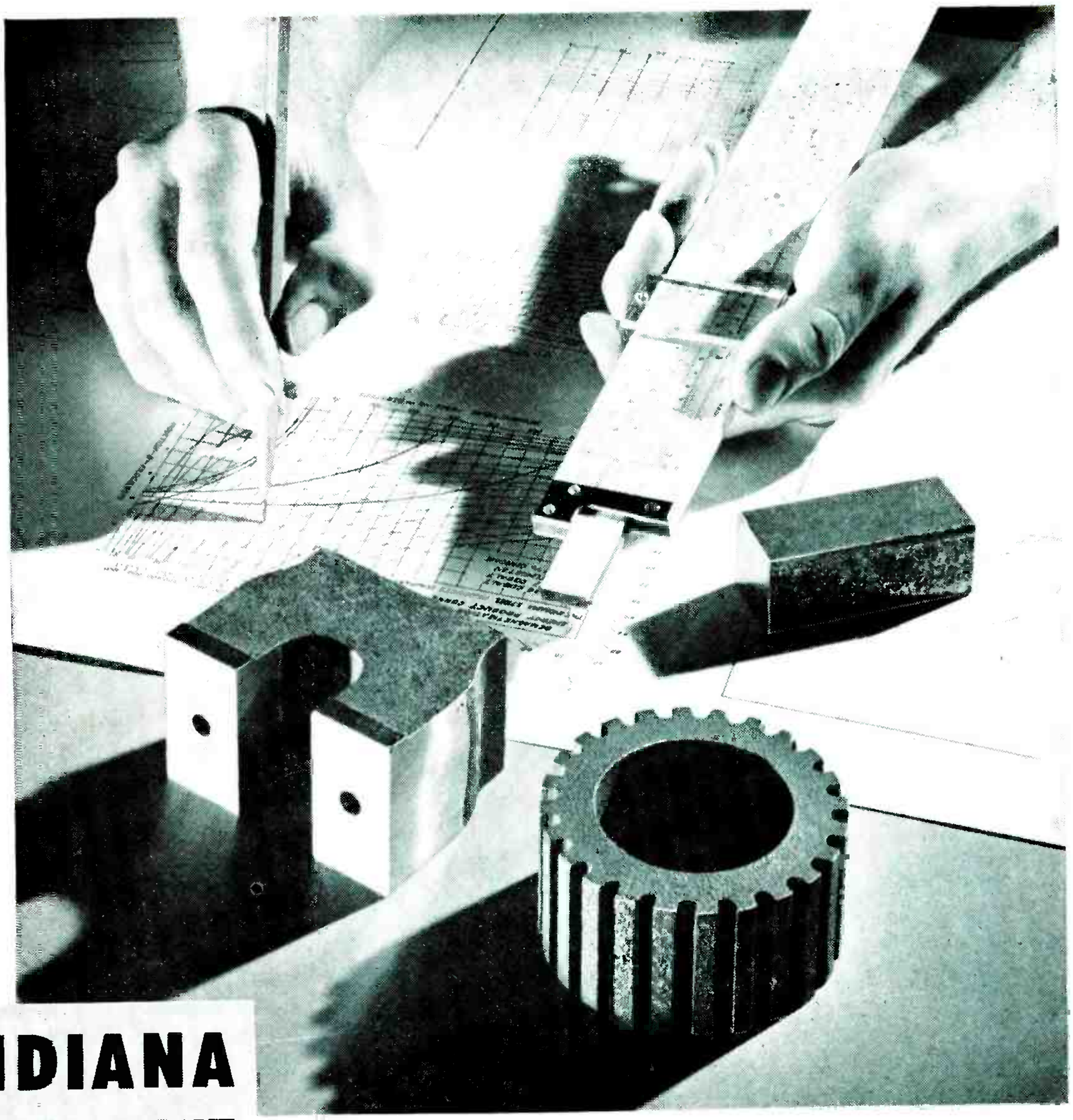
Because the original base, film or plate, is usually mechanically or electrically unsuitable for the ultimate use of the circuit or pattern, a final step is usually required. The entire pattern is transferred to a new base material. Several different types of transfer material are possible. It may be a thermoplastic or thermosetting resin or a ceramic.

Most experience has been with transfer to a thermosetting polyester resin. The resin may be clear or mixed with a filler such as asbestos fiber. To accomplish the transfer step, the image-bearing film is placed face upwards on a flat or curved plate. A hollow rectangle of polyvinyl-alcohol sheeting is placed around the part to serve as a dam for the viscous casting resin, and the polyester co-polymer with a slight amount of added catalyst is poured over the surface. The material, while in its viscous state, fills the interstices between the pattern segments. After the resin sets, the pattern becomes mechanically imbedded and probably chemically bonded to the polyester resin.

As a final step, the casting is lifted from the base plate and the original film base is removed with a differential solvent which leaves the resin base untouched. The pattern surface is then flush with the base surface in which it is imbedded.

Aside from the obvious applications of the described technique to the now conventional printed circuit production, it is possible that other uses may occur to the engineer. There may be, for instance, some applications in the scientific instrument and optical fields.

A few of the applications that have been considered are: (1) formation of complicated conductive patterns to be used as commutators, (2) making tapered re-



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sistors of any complex function for resistance pots in computor systems. (3) making durable and decorative nameplates and dials for instruments, (4) making grid patterns for radioactivity and x-ray screens, using lead, gold or the new Hevimet alloy as the powdered metal, (5) making thermocouple or thermistor-bolometer elementary mosaics, and (6) production of optical grids of greater durability and stability than photographic grids. The first two applications require smoothness durability of the conductive coatings to withstand the action of a moving stylus. Tests have been carried up to several hundred thousand actuations of a rheostat stylus over such surfaces with success.

A dividend of the method, not stressed in the above description, is economy on short runs made possible by lowered (almost negligible) tool costs. Practically the only expense in changing from one part to another or from one circuit configuration to an entirely different one is the draftman's work of drawing new copy.

Photographic illustration of the results of this process are not particularly informative because the finished product looks like the original drawing. The accompanying photograph serves chiefly to indicate the type of circuits than can be rendered in this medium. The author expresses his gratitude for the cooperation and support of the Squier Laboratory of the Signal Corps in the pursuit of this project.

The Synchrostrob Timer

By WALTER R. BERG

Ordnance Research Laboratory
The Pennsylvania State College
State College, Pennsylvania
(Now with Dictograph Products, Inc. Jamaica, N. Y.)

IN VIEWING rotating machines by standard stroboscopic methods constant manipulation of the light source frequency is necessary in order to prevent the stroboscopic image from changing position. Furthermore, it is practically impossible to orient the image to a specified angular position manually. The circuit shown in Fig. 1 automatically holds the stroboscopic image at a

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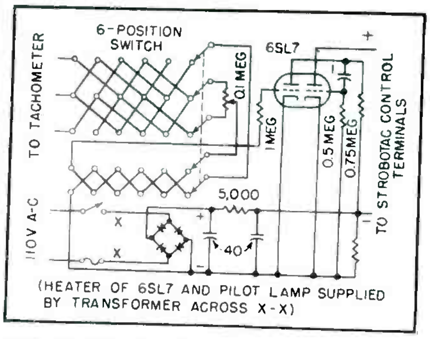

FIG. 1—Circuit diagram of synchronizer that provides phase adjustment throughout 360 degrees

fixed angular position over wide variations in the speed of the rotating member. By means of coarse and fine phase shift controls the stroboscopic image can be held in any position over the entire 360 degrees.

A three-phase generator must be coupled to the shaft of the rotating member. The coarse phase shift, which is a six-position switch, selects each of the generator's three phases at 0 or 180 degrees, which affords a total variation of 360 degrees in six discrete steps of 60 degrees each. The fine phase shift control is a potentiometer which allows complete phase variation over any 60-degree step. By means of a double triode the voltage from the phase shift network is half-wave grid rectified, amplified, and clipped. The resulting wave form has the steep wave front that is necessary to trigger most types of stroboscopic circuits.

FIG. 2—The Synchrostrob is used with a tachometer and a Strobotac to observe rotating machinery

The Synchrostrob was designed to trigger the contactor input of a General Radio Strobotac which, in turn, can be used to trigger a General Radio Strobotron if greater light intensities are desired. Other

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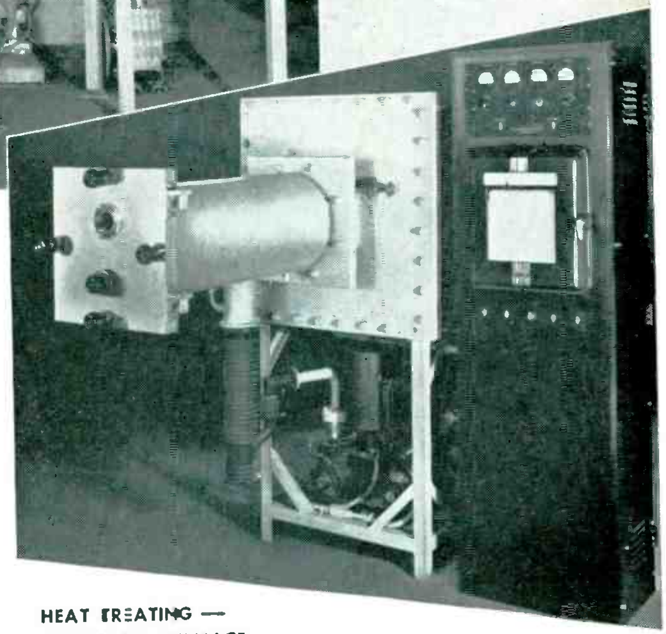

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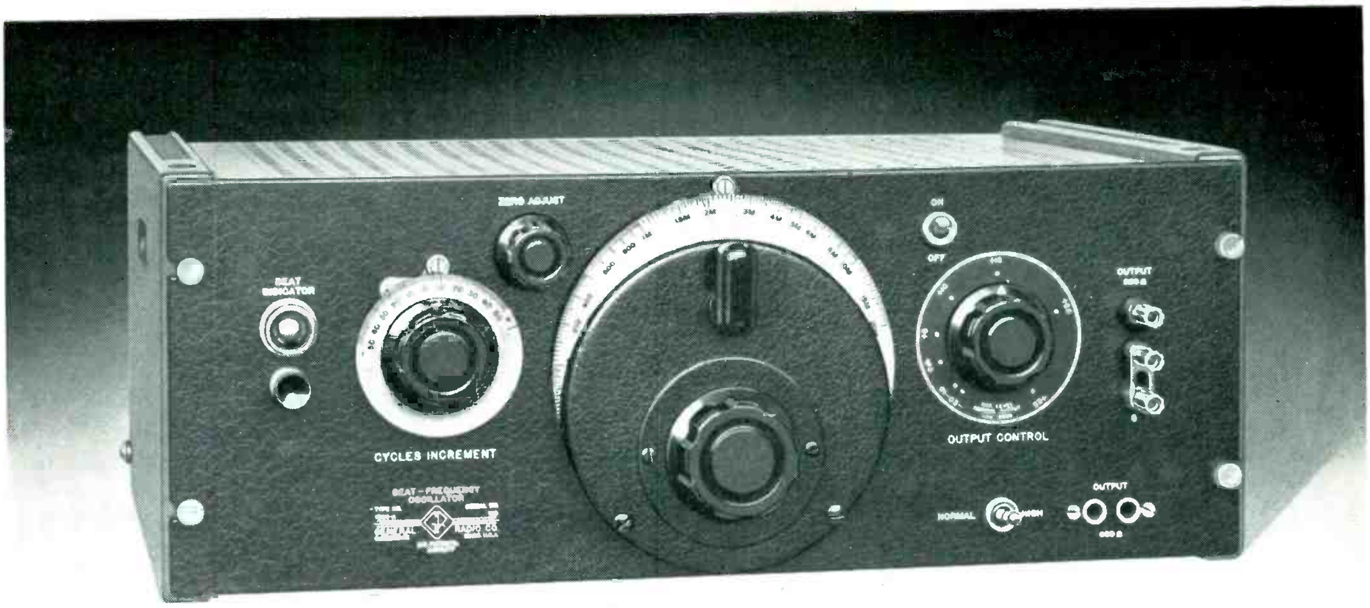
types of stroboscopic light sources can also be triggered with this circuit.

SURVEY OF NEW TECHNIQUES

TRACERS FOR INDUSTRIAL RESEARCH are being used in a large scale experiment conducted in the Cleveland plant of Republic Steel Corp. by Arthur D. Little Inc. Although 75 percent of radioactive tracers are still used in biological work, this industrial study is indicative of the potentiality of tracer technology in other fields. The experiment was conducted to determine methods for keeping undesirable sulfur out of steel. Sulfur enters steel from the coke, with the ore, limestone, scrap, or fuel oil. Some of it leaves the furnace in slag and flue gases. To tell where the sulfur in the finished steel came from, radioactive sulfur was introduced into the coke. The portion of sulfur in the finished steel that was radioactive was then known to have come from the coke. In this manner the contributions made by the various sources can be assessed. The tests indicated that there is no advantage in buying low sulfur coal from which to make the coke. Other applications of radioactive tracers in industry include automatically controlling Bessemer converters by introducing a known percent of radioactive phosphorus and metering the process to determine when the proper grade steel had been obtained. The major advantage of radioactive tracer research in industrial plants is that the experiments are carried out in the plant at operating scale; small scale laboratory experiments do not always correlate with factory results.

SYNTHETIC MICA, known as fluorine-phlogopite mica, has the desirable characteristics of muscovite and phlogopite forms of natural mica and is suitable for use as insulator and dielectric. Inherent in the synthetic process is the possibility that further research may reveal ways of directly fabricating mica components. The research and development program for the production of synthetic mica, jointly sponsored now by the Office of Naval



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√**FREQUENCY CALIBRATION:** can be standardized within 1 cycle at any time by setting instrument to line frequency or zero beat.

√**ZERO BEAT INDICATOR:** neon lamp for zero beat at line frequency or zero scale.

√**FREQUENCY STABILITY:** drift from cold start less than 7 cycles in first hour and completed in 2 hours.

√**OUTPUT INPEDANCE:** 600 ohms, either grounded or balanced-to-ground, and essentially constant at all output voltages.

√**OUTPUT VOLTAGE:** approximately 25 volts open circuit. For matched resistive load voltage varies less than ±0.25 db between 20 and 20,000 cycles.

√**OUTPUT CONTROL:** calibrated from +25 db to —20 db referred to 1 milliwatt into 600 ohms.

THE Type 913-A Beat-Frequency Oscillator, introduced by General Radio in 1942 immediately set a standard of excellence because of its high frequency stability, low distortion and constant output. Since then two improved models have increased its utility and acceptance.

The new Type 1304-A Oscillator is so different from the original that it is essentially a new instrument with many refinements in the circuit, in the oscillator, addition of buffer amplifiers, improved mixer and new amplifier. It is the finest beat-frequency oscillator obtainable.

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- **Cycles Increment Dial.**
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- **Improvement in Distortion Below 100 Cycles** — through new circuits and buffer amplifiers.
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Research, the Navy Bureau of Ships and the Army Signal Corps, was initiated at the Colorado School of Mines; the Owens-Corning-Fiberglas Corp. is retained under a consulting contract, and pilot plant production is being conducted by the Interior Department's Bureau of Mines Electrotechnical Laboratory, Norris, Tenn. Knowledge of the production of silicate mineral crystals large enough to be split into sheets at the Kaiser-Wilhem Institute and the Siemens-Halske Concern in Germany has encouraged this development of synthetic mica.

INFRARED SPECTROSCOPY has been simplified by the development of a method for growing large crystals containing 42 percent thallium bromide and 58 percent thallium iodide by Francis Phelps and of polishing the soft semiplastic crystals by Edgar Robertson, both of the National Bureau of Standards. The prism so made has the large index of refraction of 2.6 in the visible region and 2.2 at 40 microns. The refraction changes greatly with temperature. This new prism extends the observable range to 40 microns (potassium bromide crystals permitted observation only to about 24 microns). Investigations in this unexplored region have already shown polystyrene and polyethylene to be very transparent and that many compounds containing chlorine, bromine, and sulfur have bands in this region.

EXPERIMENTS in pulse code modulation can be readily carried out by a technique developed by D. B. Smith working under Prof. W. H. Radford at MIT. In place of the pulse coding tube developed by Bell Labs. (ELECTRONICS, p 126, Dec., 1947), a conventional cathode-ray tube can be used to code the signal. A coding mask, cut the same as the aperture plate, is placed in front of the cathode-ray tube screen. A phototube receives coded impulses of light as the beam sweeps across the screen at levels determined by the instantaneous sampled amplitude of the signal. With this relatively simple apparatus one can study pulse code modulation systems. At MIT the equipment is being used to investigate the trans-

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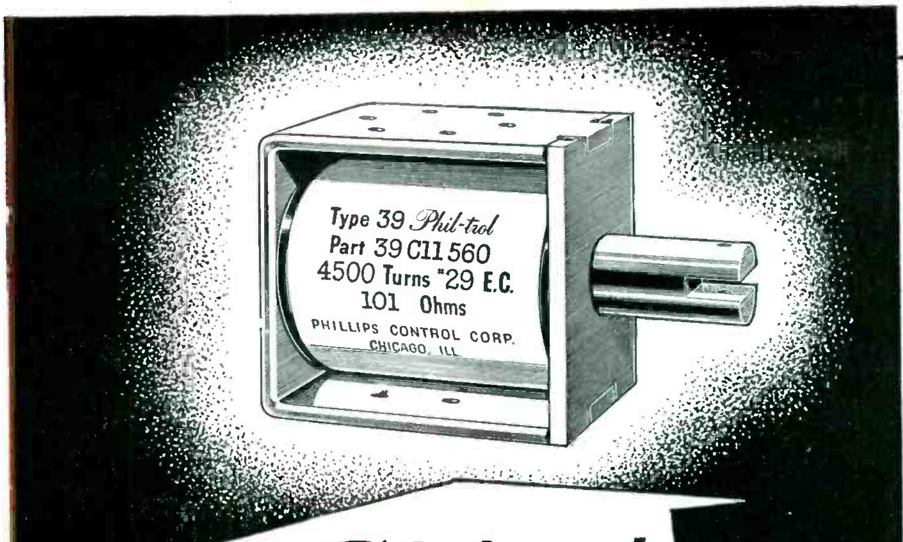
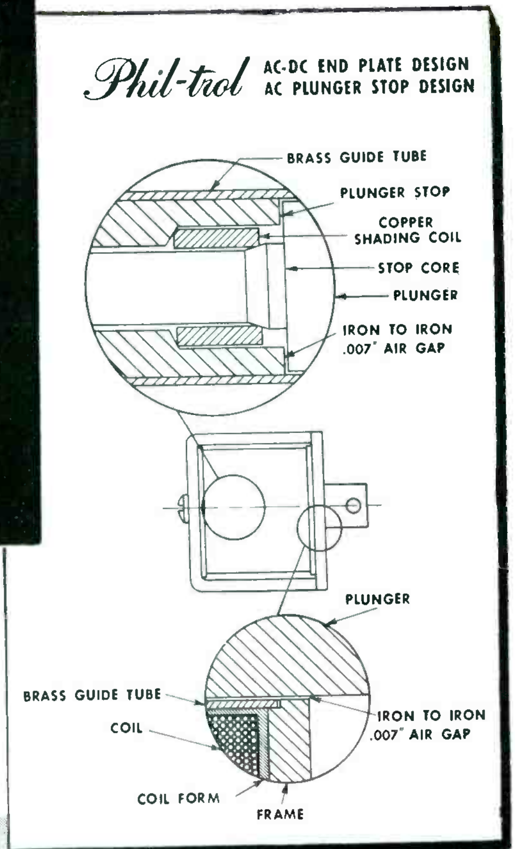
CORONA at high altitude can be suppressed, in the case of ceramic bushings and other insulations upon which are imposed high potential gradients, by application of a semiconducting coating to the entire exposed insulation surfaces. The technique may be applied to such high-voltage equipment as radar and is particularly advantageous when used on airborne electronic equipment where space and weight must be held to a minimum. Coating solder-seal bushings of hermetically sealed components with material having a surface resistivity of about 3,000 megohms per square inch sufficiently distributes voltage stress to increase the high altitude a-c corona starting voltage by 200 percent or more and the average flashover voltage by 120 percent; d-c corona and flashover points are raised 70 percent. Similar improvements are produced on bushings at sea level. The magnitude of the resistivity of the semiconducting coating is such that there would be no serious current drain on actual electronic equipment treated in this manner.

Methods of detecting inception of corona, measurements of improvements obtained, and an analysis of electrostatic field configurations in the vicinity of a typical bushing have been described in High Altitude Flashover and Corona Correction on Small Ceramic Bushings, by W. W. Pendleton, *A.I.E.E. Proc.*, 1947.

HIGHEST POWERED MAGNETRON developed so far for microwaves produces 50 kilowatts at 1,000 megacycles (1 kmc). Unlike most conventional tubes, the cathode is unheated, emission being produced by cathode bombardment with high-speed electrons each one of which releases three or four secondary electrons. The water-cooled tube was developed by the General Electric Research Laboratory under Signal Corps contract. Dr. R. B. Nelson, G. E. scientist, told a group of vacuum tube researchers convened at Ithaca in June that the limit to the power that can be produced at this high frequency is not yet in sight.





Phil-trol ACTUATORS

. . . *Designed for* POWER

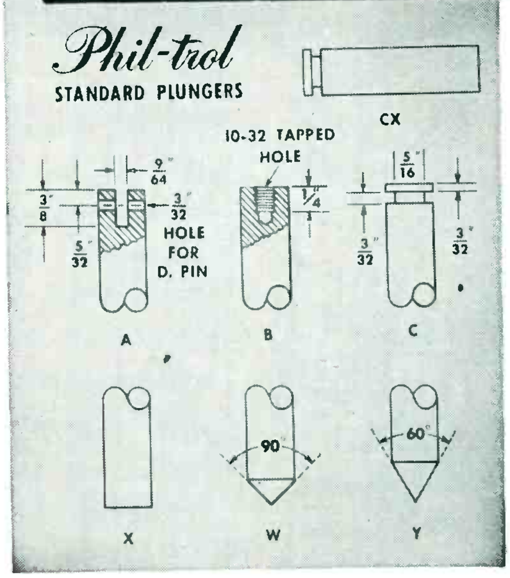
For maximum power, reliable operation and efficient performance, specify Phil-trol Actuators. Exclusive design features incorporated in one-piece solid frame construction make Phil-trol Actuators strong, durable units for a wide range of solenoid uses.

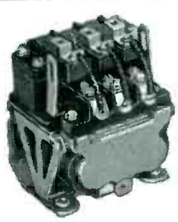
Outstanding construction features include: One-piece 1/8" iron frame, dovetailed and staked into end plate for a secure bond and extra strength; Plunger and plunger stops are made from specially processed steel and are available in three types of end shapes; Standard coils are fiber bobbins wound with enameled copper wire, and impregnated with insulating varnish; Entire frame and plunger stop are cadmium plated and plunger is chrome plated for smooth operation.

Five standard sized Phil-trol Actuators are available in either A. C. or D. C. desired voltage. Designed for "pull" application, they may be converted to "push" with but slight efficiency loss.

Phillips engineers, located in cities listed below, will be glad to assist you in determining solenoid requirements. Special Phil-trol Actuators are designed to specification.

Send for Phil-trol Actuator Bulletin





Type 27

Phil-trol **RELAYS:**

There is a complete line of Phil-trol Relays, all engineered to the highest standards, for electronic and industrial control, signal and traffic control, radio, communication, aircraft and other applications. Send for new Relay Catalog.

Phil-trol PRODUCTS

Relays, Actuators, Solenoids, Contactors, Starting Switches, Focus Coils, Ion Traps and Special Process Control Assemblies.

PHILLIPS CONTROL CORPORATION • 612 N. MICHIGAN AVENUE • CHICAGO 11, ILLINOIS

PLANT: Joliet, Illinois • SALES OFFICES: New York, Boston, Philadelphia, Buffalo, Cleveland, Charlotte, St. Louis, Kansas City, Los Angeles, Toronto

NEW PRODUCTS

(continued from p 134)

scope, picture generator, and distribution panel is available in combination or separately. The equipment produces synchronizing, driving, and blanking signals useful to manufacturers of television receivers. Two monographs giving further details have been published.

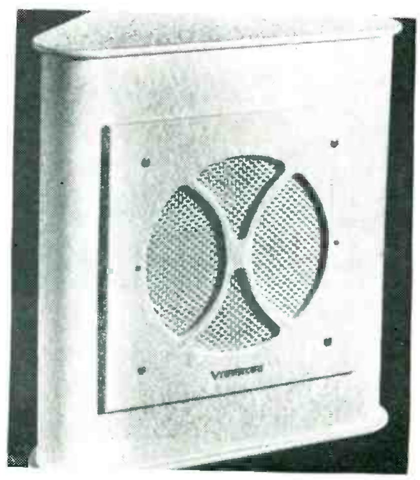
Pilot Light

DIAL LIGHT CO. OF AMERICA, INC., 900 Broadway, New York 3, N. Y. Designed particularly for use with the NE-51 neon lamp, the new Multivue cap refracts light in such a

way as to improve effectiveness of the low-wattage neon lamp in pilot light service.

Loudspeaker Baffle

VIBRALOC MFG. CO., 3597 Mission St., San Francisco, Calif. The new general purpose loudspeaker baffle with Acousticurve design is adaptable to table, wall, or corner mounting. It may be had in a variety of



PLASTICON CAPACITORS

HI VOLT POWER SUPPLIES

Designed to transform 118 VAC to high voltage—low current DC for use in radiation counters, oscilloscopes, dust precipitators, projection television sets, spectographic analysers, photoflash equipment, etc. Hi Volt Power Supplies are self-contained in hermetically sealed steel containers.

HIVOLT

Cat. No.	VDC	Dimensions	Your Cost
PS-1	2400	3 3/16x3 3/4x5 1/2"	$11.14
PS-2	2400	3 3/16x3 3/4x5 1/2"	15.14
PS-5	5000	4 9/16x3 3/4x6 1/8"	38.22
PS-10	10000	4 9/16x3 3/4x8"	58.80
PS-30	30000	7x7x7"	147.00

PHOTOFLASH CAPACITORS

For the best in photoflash capacitors, specify PLASTICONS for faster discharge and more light. Type AOCOE are the lightest photoflash capacitors made, more flexible to use, safer and more economical than single high capacitance large block.

PHOTO FLASH

Cat. No.	Watt Sec.	Pk. Chg V.	Dimensions	Your Cost
AOCOE22C3	7.6	2250	4x2x1 1/4"	$2.92
AOCOE3M2	9	3000	4x2x1 1/4"	3.00
AOCOE4M1.5	12	4000	4x2x1 1/4"	3.20
AOCOE55C1	15.1	5500	4x2x1 1/4"	3.56
AOCE4M12	100	4000	4 1/2x4 9/16x3 3/4	27.17
AOCE4M24	200	4000	8x4 9/16x3 3/4"	38.81

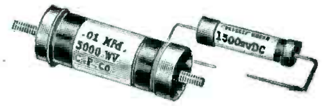
PLASTICONS

By the use of synthetic plastic film dielectrics, PLASTICONS can be made smaller, lighter, more efficient and more economical than older types of capacitors made with paper and mica insulation. Plasticon films are chemically purer and more uniform. Plasticon capacitors have a longer life and can operate under more severe conditions.

SPECIAL PLASTICONS

Taking advantage of the wide variety of plastic film dielectric characteristics, Plasticons are engineered to meet many special applications. We can furnish capacitors for 200°C; for pulse network duty; close tolerances; ultra high resistance. Send us your specifications.

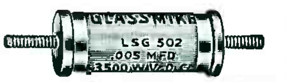
GLASSMIKES ASG



Type ASG are Plasticon A dielectric-silicone fluid impregnated capacitor elements in hermetically sealed glass tubes. Temperature range — 60° C to + 125° C. The smallest and lightest high voltage capacitors made. Type ASG are ideal for DC and low frequency AC applications.

Cat. No.	Cap. Mfd.	Volts D.C.	Dimensions	Your Cost
ASG 1	.01	600	19/32x1 3/16"	$ .88
ASG 2	.02	600	19/32x1 3/16"	.94
ASG 3	.05	600	19/32x1 9/16"	1.03
ASG 4	.1	600	3/4x1 3/4"	1.15
ASG 5	.25	600	29/32x2 1/4"	1.32
ASG 6	.5	600	1 3/8x2 3/4"	1.53
ASG 7	.005	1,000	19/32x1 3/16"	.88
ASG 8	.01	1,000	19/32x1 3/16"	.94
ASG 9	.02	1,000	19/32x1 3/16"	1.00
ASG 10	.05	1,000	3/4x1 3/4"	1.09
ASG 11	.1	1,000	3/4x2 1/4"	1.26
ASG 12	.25	1,000	29/32x2 3/4"	1.47
ASG 13	.002	2,000	19/32x1 3/16"	1.12
ASG 14	.005	2,000	19/32x1 3/16"	1.21
ASG 15	.01	2,000	19/32x1 3/16"	1.32
ASG 16	.02	2,000	19/32x1 9/16"	1.47
ASG 17	.05	2,000	3/4x1 3/4"	1.66
ASG 18	.1	2,000	29/32x2 1/4"	1.88
ASG 19	.25	2,000	1 3/8x2 3/4"	2.18
ASG 20	.001	3,000	19/32x1 3/16"	3.03
ASG 21	.002	3,000	19/32x1 3/16"	3.09
ASG 22	.005	3,000	19/32x1 3/16"	3.18
ASG 23	.01	3,000	19/32x1 9/16"	3.28
ASG 24	.02	3,000	3/4x1 3/4"	3.44
ASG 25	.05	3,000	29/32x2 1/4"	3.62
ASG 26	.1	3,000	1 3/8x2 3/4"	3.82
ASG 27	.001	5,000	19/32x1 3/16"	3.82
ASG 28	.002	5,000	19/32x1 3/16"	3.94
ASG 29	.005	5,000	19/32x1 9/16"	4.09
ASG 30	.01	5,000	3/4x1 3/4"	4.26
ASG 31	.02	5,000	3/4x2 1/4"	4.50
ASG 32	.05	5,000	1 3/8x2 3/4"	4.79
ASG 33	.1	5,000	1 3/8x3 1/2"	5.35
ASG 34	.001	7,500	19/32x1 9/16"	4.12
ASG 35	.002	7,500	19/32x1 9/16"	4.26
ASG 36	.005	7,500	3/4x1 3/4"	4.44
ASG 37	.01	7,500	3/4x2 1/4"	4.79
ASG 38	.02	7,500	29/32x2 3/4"	5.44
ASG 39	.05	7,500	1 3/8x2 3/4"	6.76
ASG 40	.0005	10,000	19/32x1 9/16"	4.29
ASG 41	.001	10,000	19/32x1 9/16"	4.41
ASG 42	.002	10,000	19/32x1 9/16"	4.59
ASG 43	.005	10,000	3/4x1 3/4"	5.29
ASG 44	.01	10,000	29/32x2 1/4"	6.17
ASG 45	.02	10,000	1 3/8x2 3/4"	7.35
ASG 46	.03	10,000	1 3/8x3 1/2"	8.82
ASG 60	.06	10,000	1 3/8x3 1/2"	10.29
ASG 47	.0005	15,000	29/32x2 3/4"	8.53
ASG 48	.001	15,000	29/32x2 3/4"	8.70
ASG 49	.002	15,000	1 3/8x2 3/4"	9.12
ASG 50	.0005	20,000	1 3/8x3 1/2"	11.47
ASG 51	.001	20,000	1 3/8x3 1/2"	12.05
ASG 52	.0005	30,000	1 3/8x3 1/2"	13.24

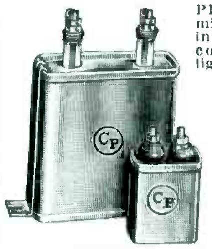
RF GLASSMIKES



Plasticon L film-silicone fluid impregnant in Glassmike style case. Type LSG has Q of 2500 to 5000. Rated at 3500 WV—7500 V Test. Lower losses, more easily mounted, smaller and more economical than mica capacitors.

Cat. No.	Cap. Mfd.	Dimensions OD Length	Your Cost
LSG500	.00005	19/32x1 3/16"	$.88
LSG101	.0001	19/32x1 3/16"	.88
LSG251	.00025	19/32x1 3/16"	.88
LSG501	.0005	19/32x1 3/16"	.88
LSG102	.001	19/32x1 9/16"	1.00
LSG202	.002	3/4x1 9/16"	1.44
LSG502	.005	3/4x1 3/4"	2.06
LSG602	.006	29/32x1 9/16"	2.20
LSG103	.01	29/32x1 3/4"	2.50

INDUSTRIAL and TRANSMITTING



Plasticon A element, mineral oil impregnated in sturdy lead coated steel containers. Smaller, lighter and more economical than paper capacitors. Temperature range — 40°C to + 105°C. Type AOC-rectangular; Type AOCO-flattened oval. Type ASC and ASCO (not listed) have Plasticon A element, silicone impregnated. Same dimensions as corresponding AO types. Temperature range — 60° C to + 125° C; greater capacitance stability. Prices on application.

DC RECTANGULARS

Cat. No.	Cap. Mfd.	Volts DC	Dimensions	Your Cost
AOC6C1	1.0	600	2 1/8 1 3/4 1"	$2.19
AOC6C2	2.0	600	2 3/4 1 3/4 1"	2.65
AOC6C4	4.0	600	3 1/2 2 1/2 1 3/16"	3.30
AOC6C8	8.0	600	4 3 3/4 1 1/4"	4.98
AOC6C10	10.0	600	4 5/8 3 3/4 1 1/4"	5.60
AOC1M1	1.0	1,000	2 3/8 1 3/4 1"	2.37
AOC1M2	2.0	1,000	4 1 3/4 1"	3.17
AOC1M4	4.0	1,000	4 2 1/2 1 3/16"	3.85
AOC1M8	8.0	1,000	4 5/8 3 3/4 1 3/4"	5.43
AOC1M10	10.0	1,000	4 5/8 3 3/4 1 3/4"	6.27
AOC2MO5	0.5	2,000	2 3/8 1 3/4 1"	2.84
AOC2M1	1.0	2,000	3 1/2 1 3/4 1"	3.47
AOC2M2	2.0	2,000	3 1/2 2 1/2 1 3/16"	4.02
AOC2M4	4.0	2,000	3 1/2 3 3/4 1 3/4"	5.43
AOC3M1	1.0	3,000	4 2 1/2 1 3/16"	7.12
AOC3M2	2.0	3,000	4 3 3/4 1 1/4"	9.05
AOC3M4	4.0	3,000	4 5/8 3 3/4 2 1/4"	12.52
AOC4M1	1.0	4,000	4 3 3/4 1 1/4"	16.17
AOC4M2	2.0	4,000	4 3 3/4 1 3/4"	19.40
AOC4M4	4.0	4,000	4 3 3/4 4 9/16"	29.64
AOC5M1	1.0	5,000	4 3 3/4 1 3/4"	19.40
AOC5M2	2.0	5,000	3 1/2 3 3/4 4 9/16"	24.25
AOC75C1	1.0	7,500	3 1/2 3 3/4 4 9/16"	29.11
AOC10M1	1.0	10,000	4 3 3/4 4 9/16"	51.74

DC OVALS

Cat. No.	Cap. Mfd.	Volts D.C.	Dimensions	Your Cost
AOCO6C2	2.0	600	2 3/8 2 1 1/4"	$2.59
AOCO6C4	4.0	600	4 2 1 1/4"	3.11
AOCO1M1	1.0	1,000	2 3/8 2 1 1/4"	2.26
AOCO1M2	2.0	1,000	3 1/2 2 1 1/4"	3.04
AOCO3MO1	0.1	3,000	2 3/8 2 1 1/4"	4.46
AOCO5MO1	0.1	5,000	2 3/4 2 1 1/4"	8.28
AOCO5MO25	0.25	5,000	3 1/2 2 1 1/4"	9.05
AOCO5MO5	0.5	5,000	4 5/8 2 1 1/4"	10.68
AOCO8MOO5	0.05	8,000	2 3/4 2 1 1/4"	8.93
AOCO8MO1	0.1	8,000	3 1/2 2 1 1/4"	9.83
AOCO10MOO5	0.05	10,000	3 1/2 2 1 1/4"	11.32

LABORATORY CAPACITORS

Type LAG (Glassmike style) and Type LAC (Rectangular can) have the lowest dielectric absorption of any capacitor made. Residual charge is .01 — .02%. Dissipation factor at 1 MC is .0002 to .0003. Capacitance and Q is constant from DC to 100 KC. Resistance averages one million megohms per microfarad. Standard capacitance tolerance is ± 5%. Type LA units are used for timing and integrating circuits.

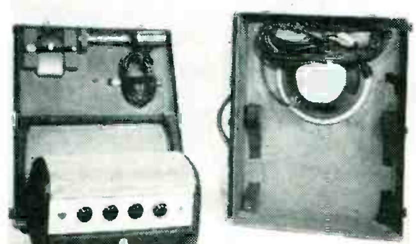
Cat. No.	Cap. Mfd.	Dimensions	Your Cost
LAG101	.0001	19/32x1 3/16"	$1.76
LAG201	.0002	19/32x1 3/16"	1.76
LAG501	.0005	19/32x1 3/16"	1.76
LAG102	.001	19/32x1 3/16"	1.76
LAG202	.002	19/32x1 9/16"	2.06
LAG502	.005	3/4x1 3/4"	2.88
LAG103	.01	3/4x1 3/4"	3.94
LAG203	.02	3/4x2 1/4"	5.12
LAG503	.05	29/32x2 1/4"	6.17
LAC104	.1	2 1/4x1 3/4x1"	9.23
LAC204	.2	2 1/4x2 1/2x1 3/16"	9.82
LAC504	.5	4x2 1/2x1 3/16"	12.35
LAC105	1.	4x3 3/4x1 1/4"	18.87
LAC205	2.	4x3 3/4x2 1/4"	30.16
LAC505	5.	6x3 3/4x4 9/16"	57.98

The above condensed version of the Plasticon Line will appear in the new catalogs of leading electronic distributors. Plasticons are manufactured by Condenser Products Company, Chicago 22, Illinois

sizes and finishes. A catalog sheet is available.

Portable Sound System

RADIO CORP. OF AMERICA, Camden, N. J. Type SP-15A portable sound system consists of an aerodynamic mike, a high-output amplifier and a



heavy-duty alnico permanent magnet speaker. It operates on 100-watt, 50 to 60-cycle power supply. Complete system weighs 45 pounds.

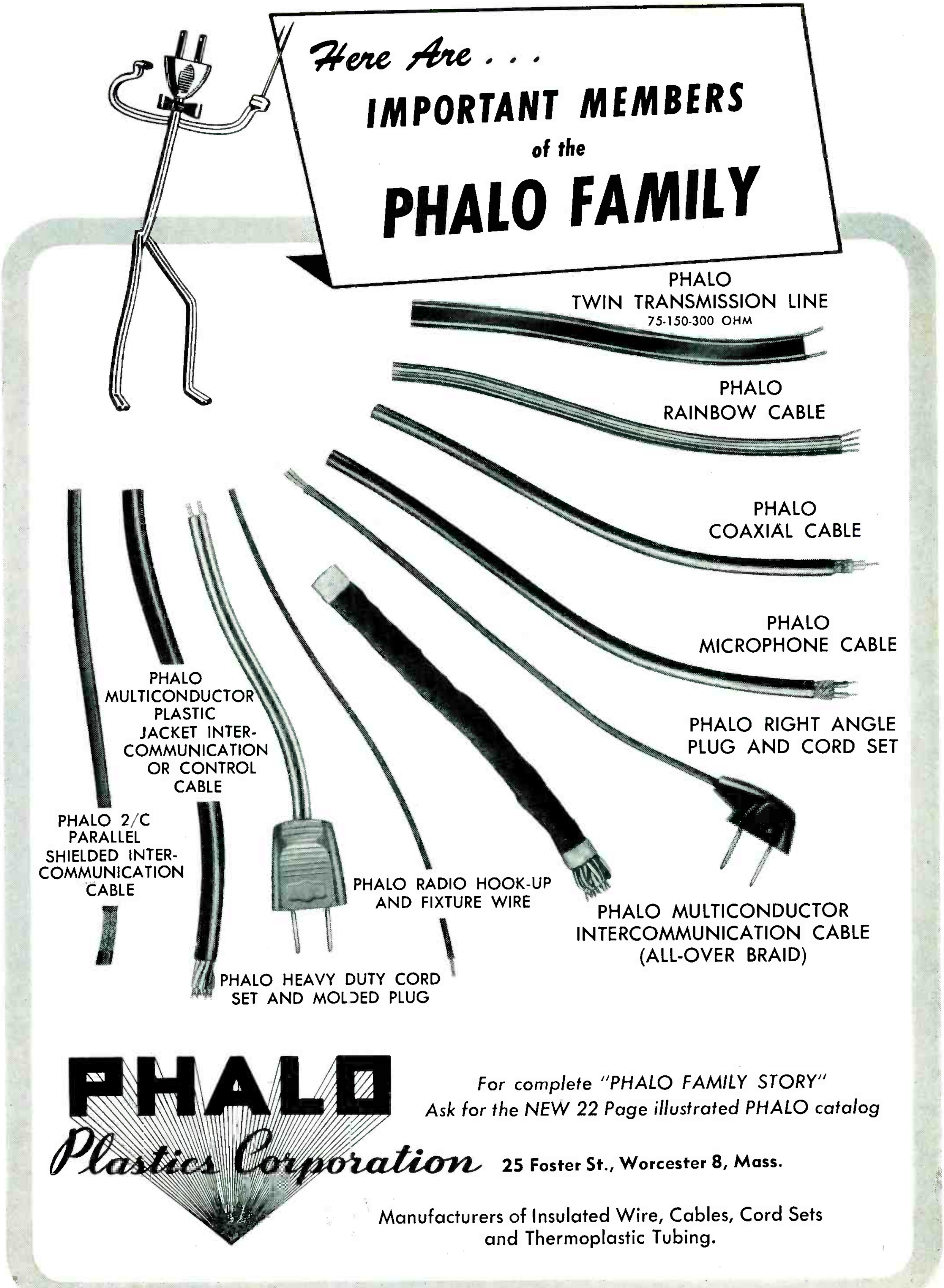
Tube Base Diagrams

RADIO CORP. OF AMERICA, Camden, N. J. The new Triple Pindex is actually three separate booklets in one spiral-bound cover, permitting instant location and simultaneous

study of any three tube base diagrams from over 475 types. Listings are arranged in dictionary fashion. Price is 75c from distributors.

Industrial Rectifier

NATIONAL ELECTRONICS, INC., Batavia Ave., Geneva, Ill. Type NL-649 is a 2-ampere, single-ended industrial rectifier tube. It is mercury vapor filled permitting a peak inverse voltage rating of 900 volts and can be used in 250-volt d-c ap-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PHALO RIGHT ANGLE
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PHALO
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PLASTIC
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OR CONTROL
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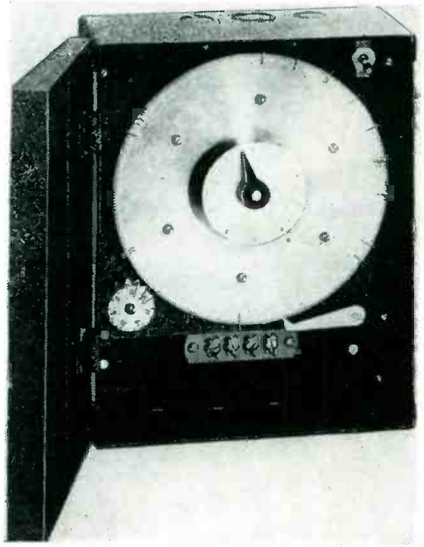
and Thermoplastic Tubing.

plications. Filament voltage is 2.5; filament current, 7 amp; d-c output, 2 amp; peak-current output, 10 amperes.

Industrial Timers

MONTGOMERY MFG. CO., 549 W. Washington Blvd., Chicago 6, Ill., has introduced two synchronous program timers, models TP and TS, designed especially for manufacturing establishments where permanent conduit or BX installations in standard switch box cases are desired. Model TP, for bell ring-



ing, can make a single circuit contact at any 5-minute interval in 24 hours and repeat each day. Model TS incorporates a holding circuit which it closes on the first impulse and opens on the succeeding impulse.

Radio Noise Filters

THE FILTRON CO., 38-25 Bell Blvd., Bayside, L. I., N. Y. Type FA204

WILCOX - *First Choice of* PIONEER *Air Lines*

PIONEER EQUIPS GROUND *STATIONS WITH

Wilcox Type 378A Package Radio

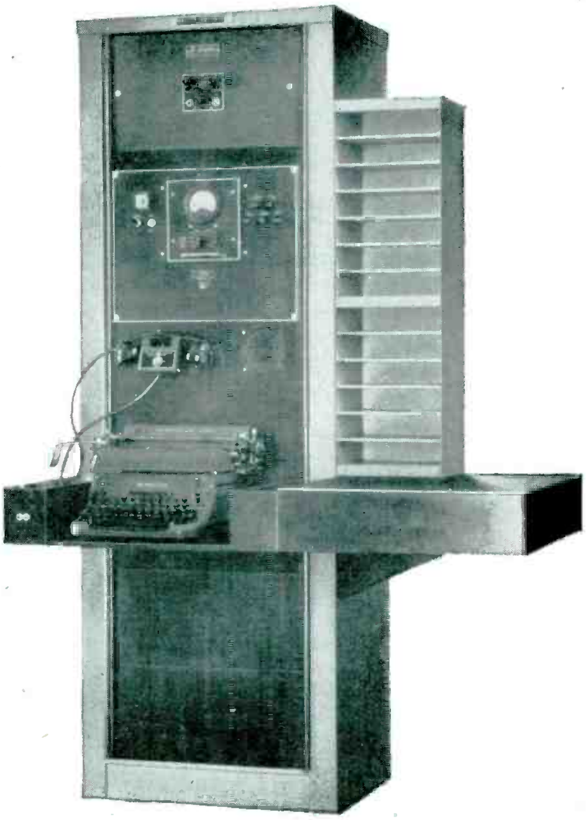
PACKAGE DESIGN SPEEDS YOUR INSTALLATIONS
The Type 378A is *complete* from microphone to antenna, ready for connection to power mains. It is designed for aeronautical VHF ground-air communications at smaller traffic centers.

PROVEN COMPONENTS INSURE QUALITY AND PERFORMANCE—The Type 305A VHF Receiver and Type 364A VHF Transmitter (50 watts) are the principal components of the 378A. Long used separately and field-tested by leading airlines, these units are now available in package form.

NEW AIDS TO CONVENIENT OPERATION
The telephone handset with its convenient push-to-talk button, serves as both headphone and microphone, with an auxiliary loudspeaker for incoming calls. The 378A includes desk front, message rack, and typewriter space—there are no accessories to be added.

LOCAL OR REMOTE CONTROL—If desired, the control panel can be removed and the 378A remotely controlled, either by re-installing the panel at the operating position or by simple adaptation to your existing control equipment.

**Pioneer aircraft are also 100% equipped with the new WILCOX Type 361A Airborne VHF Communication System.*



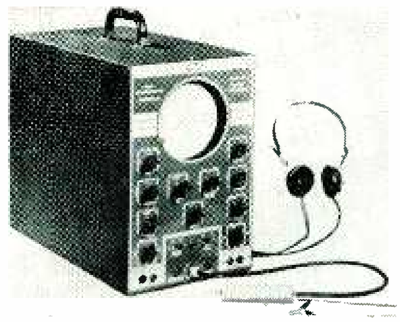
WILCOX ELECTRIC COMPANY
KANSAS CITY 1, MISSOURI
WILCOX Means Dependable Communication

Write today for complete information

radio interference filter is but one of a wide variety of Filtrons for suppression of noise. Featured are high attenuation, small size, light weight, and hermetic sealing. Rating of the unit illustrated is 2.5 amperes, 50 volts d-c.

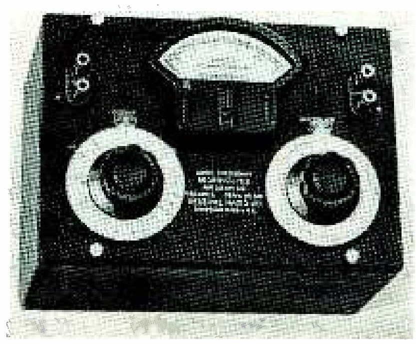
C-R Stethoscope

FEILER ENGINEERING CO., 947 George St., Chicago, Ill. The new five-inch cathode-ray oscilloscope combined with stethoscope is designed for f-m and television servicing. It can also be used for a-m and audio work. Price is $89.95 list.

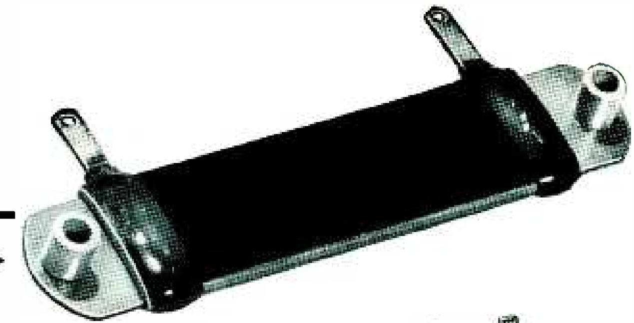


A-F Microvolter

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 546-C Microvolter represents a redesign to standardize its output level at 600 ohms. Sensitivity, frequency response, and distortion



Use one alone—



or stack 'em like hot cakes...

I-T-E OVAL RESISTORS SAVE SPACE!

When space is limited—as in aviation, sound, or electronics applications—I-T-E Oval Resistors and Oval Resistor Assemblies may be the solution you're looking for.

Specially designed to meet the exacting and changing needs of the electronics industry, these modern, wire-wound power resistors are distinguished by their high unit-area wattage ratios, which are due in part to the heat dissipation qualities of the mounting brackets.

An I-T-E Oval Resistor—or an assembly of I-T-E Oval Units—has a much higher wattage rating than that of a conventional round resistor of comparable size. You save space and, at the same time, gain the dependable performance of I-T-E *quality* resistors.

No matter what your resistor problem is—space, exacting service, or dependable performance—be sure to investigate I-T-E Oval Resistors. Complete technical information, as well as valuable application data, are contained in the new I-T-E Resistor catalog. Send for it today.

There's an I-T-E Resistor for Every Purpose→

I-T-E OVAL RESISTORS

Type	Watts	Length	Maximum Recommended Resistance	Mounting Centers
108 Oval	30	1¼"	10000	2"
200 Oval	40	2"	15000	2¾"
316 Oval	55	3½"	25000	4¼"
424 Oval	65	4¾"	35000	5½"
600 Oval	75	6"	50000	6¾"

POWER RESISTORS

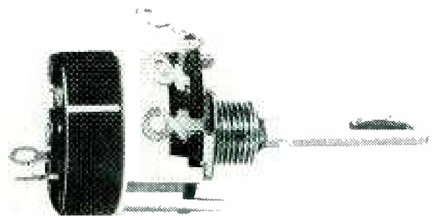
The Leader In Technical Excellence

I-T-E CIRCUIT BREAKER CO., RESISTOR DIVISION, 19TH & HAMILTON STREETS, PHILADELPHIA 30, PA.

SWITCHGEAR • UNIT SUBSTATIONS • AUTOMATIC RECLOSING CIRCUIT BREAKERS • RESISTORS • SPECIAL PRODUCTS characteristics have also been improved. Output voltage range is 0.1 microvolt to 1.0 volt open circuit for an input of 2.2 volts across 600 ohms. Accuracy is ± (3 percent + 0.5 μv) for output levels above 1 microvolt at frequencies below 20,000 cycles. Up to 100,000 cycles the accuracy is ± 5 percent. Distortion introduced by the instrument is about 0.2 percent.

Variable Resistor

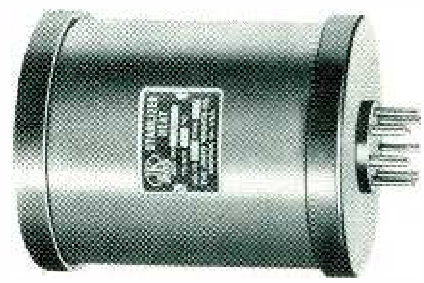
P. R. MALLORY & CO., INC., Indianapolis, Indiana. The new Midgetrol measures 15/16 inch and has a number of other features such as a



flat shaft, or a special phenolic shaft for television applications. Specification sheets and a descriptive folder are available.

Crystal Oven

JAMES KNIGHTS CO., Sandwich, Ill. A new crystal oven recommended for broadcast or standard frequency applications has a large 7-pin base,



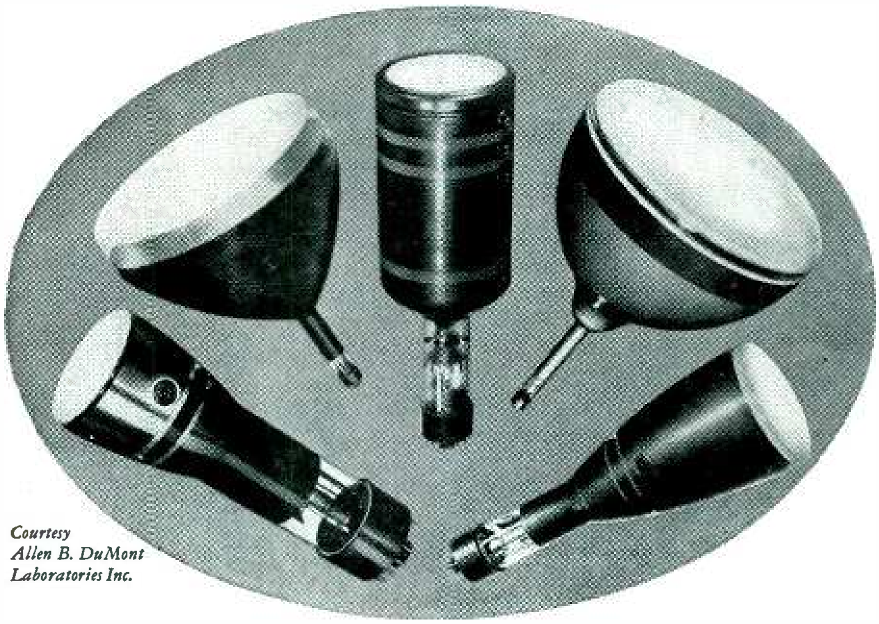
6.3-volt heater, and operating temperature 50± 1 C. The crystals are electrostatically shielded.

Pressure Element

COMMERCIAL RESEARCH LABORATORIES, INC., 20 Bartlett Ave., Detroit 3, Mich. A new Type 5 direct pressure element replaces type 3 pressure element and type 3 gas sampling valve. Owing to the new design, the element is open for less

The *NEW* "dag" CRT Wall Coating . . .

for *all* CRT glass envelopes



Courtesy Allen B. DuMont Laboratories Inc.

Here's an entirely *new* CRT Wall Coating, developed by Acheson Colloids specifically and solely for use on CRT glass envelopes.

"dag" CRT Wall Coating is very easily applied . . . adheres tenaciously to all types of glass . . . does not yield objectionable by-products on heating.

Prominent cathode-ray tube manufacturers have already found this opaque, electrically conductive **"dag"** CRT Wall Coating eminently satisfactory, especially in tubes intended for television reception.

Let Acheson Colloids help you with your CRT wall coating problem. Mail the coupon today for information on this or other electronic applications of **"dag"** colloidal graphite dispersions.

Give me information on "dag" colloidal graphite dispersions for:

- Wall coating of CRT's ☐
- Electrostatic shielding ☐
- Corona prevention ☐
- Dry-film lubrication ☐
- Copper oxide rectifier disc coating ☐
- Electrical resistances ☐
- Filament cement ☐

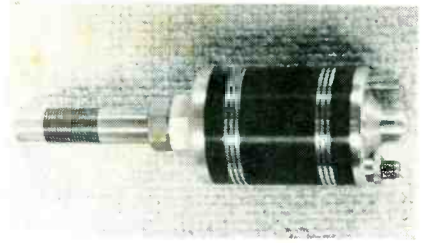
HH5

40th Anniversary Year

Acheson Colloids Corporation

dag
REG. U.S. PAT. OFF.
COLLOIDS

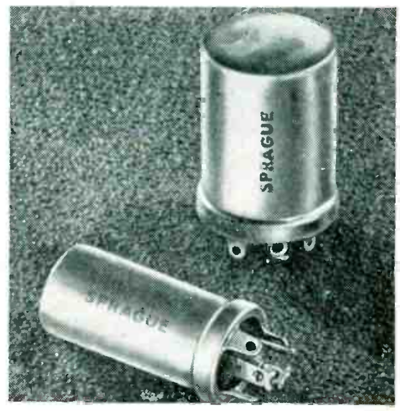
Port Huron Michigan



than 0.001 second permitting its use in tests on high-speed engines over the whole engine cycle.

Television Capacitors

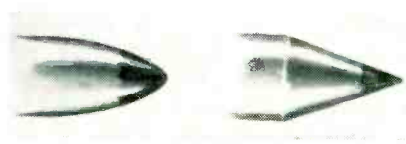
SPRAGUE ELECTRIC CO., North Adams, Mass. A new line of capacitors designed for television serv-



ice is rated at 85 C up to 450 volts. Shelf life of these electrolytic units has been improved.

LP Needles

ELECTROVOX CO., INC., 66 Franklin St., East Orange, N. J. Microgroove needles of sapphire and osmium

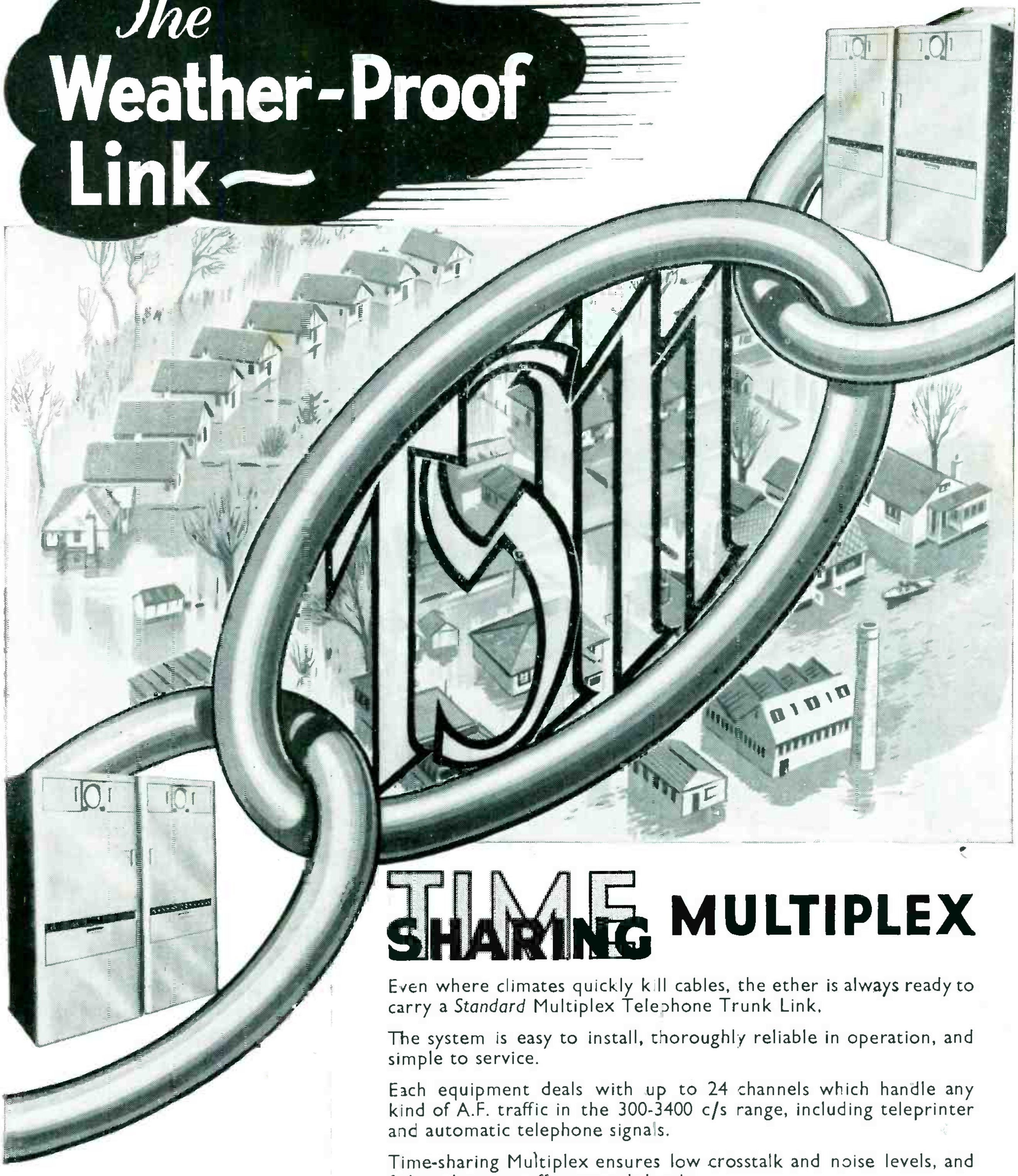


alloy needed for the new long playing records are available in two styles illustrated.

Signal Generator

FERRIS INSTRUMENT CO., Boonton, N. J. Model 24-B a-m and f-m signal generator provides frequencies from 5 to 220 mc with either internal or external modulation. It is designed primarily for production checking f-m and television receivers. Any seven spot frequencies in the range are available with an

The Weather-Proof Link—



TIME SHARING MULTIPLEX

Even where climates quickly kill cables, the ether is always ready to carry a *Standard* Multiplex Telephone Trunk Link.

The system is easy to install, thoroughly reliable in operation, and simple to service.

Each equipment deals with up to 24 channels which handle any kind of A.F. traffic in the 300-3400 c/s range, including teleprinter and automatic telephone signals.

Time-sharing Multiplex ensures low crosstalk and noise levels, and fading does not affect speech levels.
A UHF carrier is used and the normal line-of-sight range may be extended by automatic repeaters.

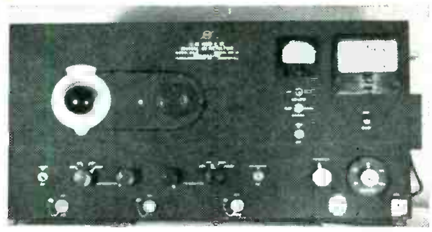
Complete terminal equipment occupies a double cabinet 7′ wide x 2′ 4″ deep x 6′ 6″ high, and aerials may be up to 100′ away from the equipment.

Write for our Bulletin No. 511 which gives further facts and figures.

Standard Telephones and Cables Limited Radio Division

OAKLEIGH ROAD, NEW SOUTHGATE, LONDON, N.11, ENGLAND

R.D.5



additional number by changing coil drums. The instrument has a built-in power supply. Details of the various features are available.

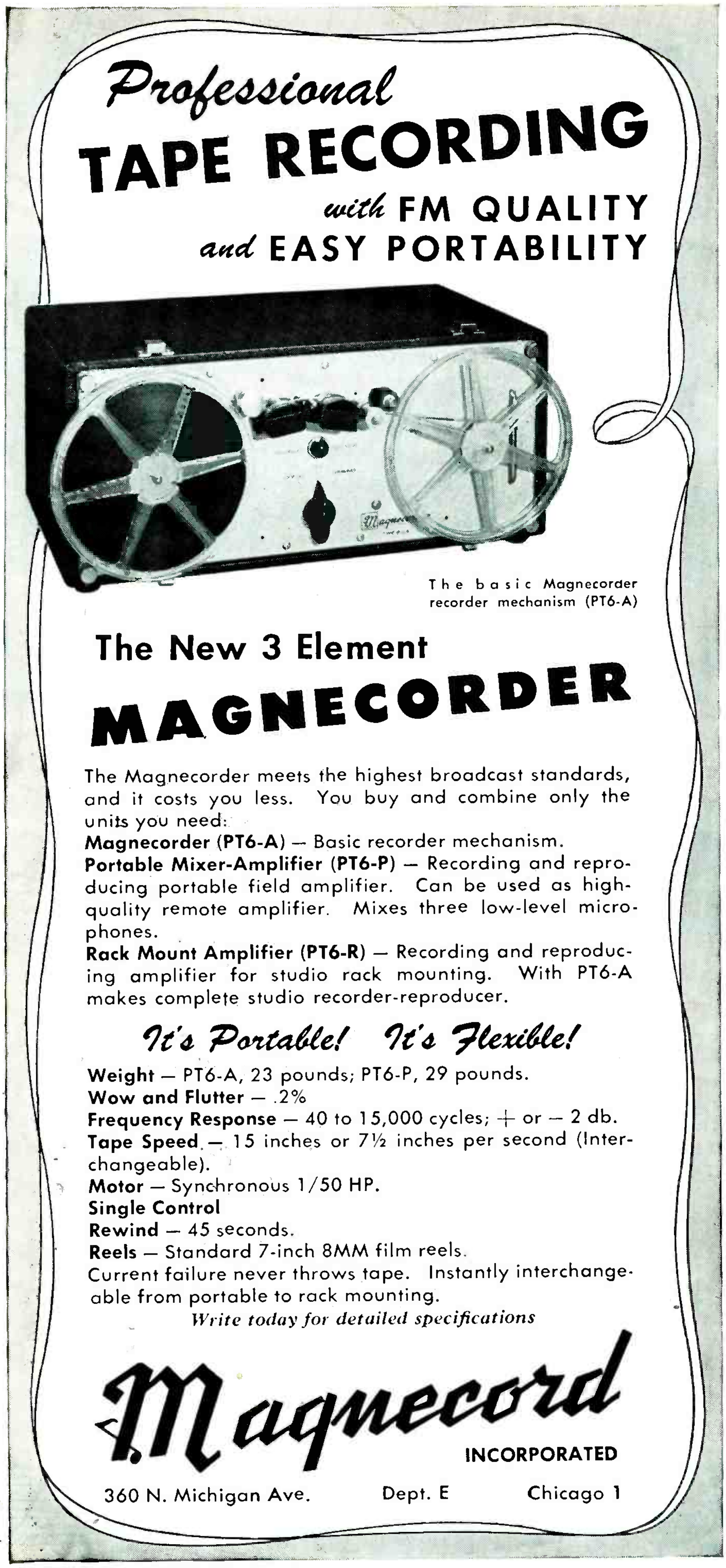
Special Amplifier

BROWNING LABORATORIES, INC., Winchester, Mass. Amplifier TAA-16 is used in the determination of voltage standing wave ratio when used with square law detector probes and slotted waveguides. Two inputs are available. Operations can

be wide band or highly selective as needed. There is an integral power supply, electronically regulated. Full-scale meter readings are obtained with 15 microvolts input under wide band operation.

Isolation Transformer

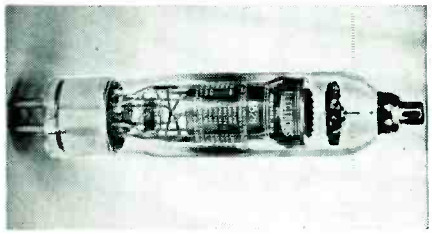
RADIO CORP. OF AMERICA, Camden, N. J. The type WP-24A Isotap variable-voltage isolation transformer has been designed for speedy receiver servicing. Choice of test voltages provided consists of 117-



volt normal supply, 105-volt low supply or 130-volt high supply, under medium-load conditions. The instrument also gives protection against shocks from a-c and d-c chassis to ground and prevents damage to test equipment.

Grid-Controlled Rectifier

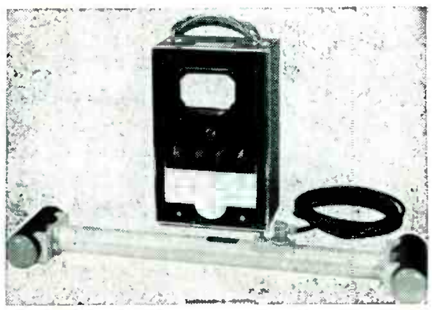
ELECTRONS, INC., 127 Sussex Ave., Newark, N. J. announce development of the type 5528 (C6L) temperature-free grid-controlled rectifier tube designed especially for high power servomotor control or



inverter applications which must operate at up to 800 cycles. It features 60 second heating time, a peak inverse voltage of 500 v, 6.4 amperes steady d-c current, and 77 amperes peak.

Magnetometers

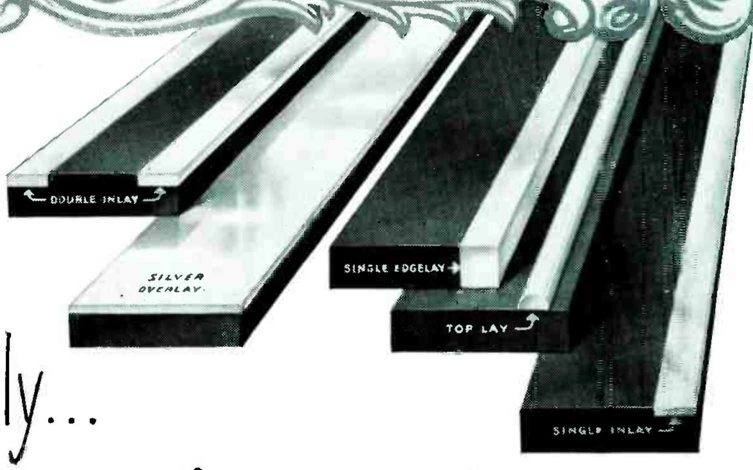
THOMAS E. SMITH, 122 East 42nd St., New York 17, N. Y. Presence and polarity of magnetic fields can be determined using model GW-2



gradientometer that can also be switched for use as a magetometer. The device has been designed for investigating magnetic fields in aircraft frames.

New-Record Pickup

ASTATIC CORP., Conneaut, Ohio. Type FL-33 pickup and LP-33 crystal replacement cartridge have been designed particularly for use with new long-playing records. The



They all belong to the Same Cost-Cutting Family...

GENERAL PLATE *Laminated* STOCK

No one is in a better position to cut your electrical contact and precious metal costs than General Plate . . . pioneers in laminated metals. Through long years of experience in the manufacture of precious to base metal combinations . . . and work with leading manufacturers of electrical and industrial products, General Plate gives you laminated metals that provide economical solutions to your problems.

General Plate Laminated Stock saves money because it eliminates a large waste of expensive silver. By bonding silver or other precious metal to inexpensive base metal you get the high cost metal only where it's needed. The laminated construction not only lowers costs but increases operating life and makes fabrication of parts easier.

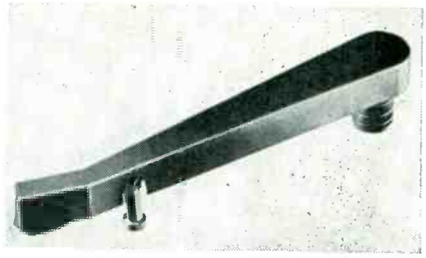
General Plate Laminated Stock is available in sheet, inlaid stripes, elevated stripe, edgelay, as well as tube and wire . . . buttons for spot welding or soldering; rivets— or as completely fabricated parts made to your specifications. Write for information or engineering assistance.

GENERAL PLATE DIVISION

of Metals and Controls Corporation

310 FOREST STREET, ATTLEBORO, MASSACHUSETTS 1-348

50 Church St., New York, N. Y. • 205 W. Wacker Drive, Chicago, Ill. • 757 W. Third St., Mansfield, Ohio • 36 Eastern Ave., Pasadena, Calif.



cartridge can be quickly interchanged with another that is suitable for the more conventional 78-rpm discs. An accessory filter type FL is also available.

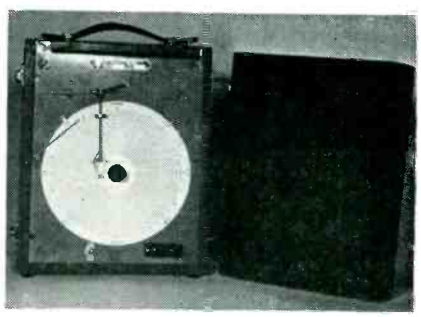
Test Instrument

SIMPSON ELECTRIC CO., 5200 West Kinzie St., Chicago 44, Ill. Model 221 Roto-Ranger is a high-sensitivity a-c and d-c volt-ohm-milliammeter equipped with rotating dials.

Its many applications include measurements of afc diode balancing circuits, grid currents of oscillator tubes and power tubes, avc diode currents and high-mu plate voltage. Direct-current sensitivity is 20,000 ohms per volt.

Microcurrent Measurement

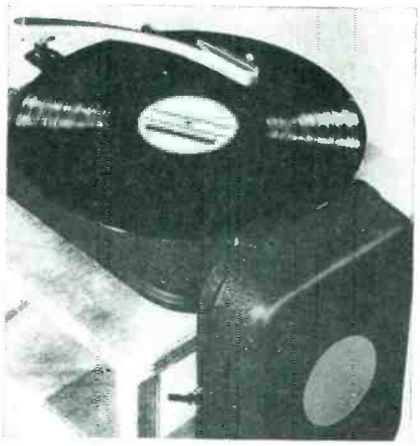
WALLACE & TIERNAN PRODUCTS, INC., Belleville 9, N. J. announce a portable d-c recorder for measuring microcurrents and voltages where exact range may be selected



by the user. The unit is of the moving magnet, interchangeable coil type and is designed for continuous duty. Minimum full scale range is 0 to 0.1 milliampere and maximum is 0 to 12 amperes. Sensitivity is 1 part in 1,000.

Transcription Player

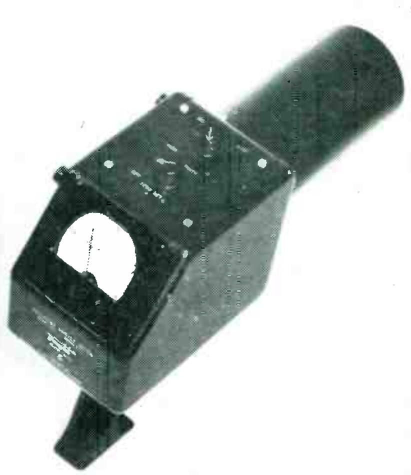
CALIFONE CORP., 1041 N. Sycamore Ave., Hollywood 38, Calif. introduce a new portable transcription player. It reproduces with both 16-in. transcriptions at 33⅓ rpm and regular phonograph records at 78 rpm. It features a wow-free



9-in. turntable, a pickup with replaceable permanent needle, a wide range amplifier and a heavy duty 6-in. speaker.

Small Radiation Meter

TRACERLAB, INC., 55 Oliver St., Boston 10, Mass. The Model SU-1A small portable radiation survey meter facilitates measurement of radiation in places difficult of ac-



KAY ELECTRIC COMPANY

KAY INSTRUMENTS
COVER ALL BANDS
Including the proposed HF-TV Bands (475-890 MC)

The MEGA-MATCH (Standard)

Simultaneous visual display of reflected energy from antennas and terminations when used with standard oscilloscopes. Band width of display 30 mc anywhere between 10 and 250 mc. Completely electronic. Includes no slotted lines, moving parts, bridges or other frequency sensitive devices. Oscilloscope display indicates amount of reflected energy vs frequency. Precision frequency meter indicates frequency anywhere along the oscilloscope display. Reflection coefficients as low as 0.01 can be observed. Internal delay cable allows display of energy from terminations of nominal 53.5 ohm impedance. External delay cable may be used to display reflected energy from terminations of any practical impedance. Reflection coefficients, standing wave ratios, absolute value of terminating impedance can be calculated from display—By use of auxiliary variable frequency signal source, the phase angle of the reflection coefficient and resistive and reactive components of terminating impedance may be calculated.

Price $695 f.o.b. factory

THE MEGA-MATCH (Modified)

The Mega-Match (Modified) meets all of the specifications and includes all the features of the standard model between 10 to 600 mc. With a slight increase in minimum observable reflection coefficient, this model can be used up to 1000 mc. Hence a visual display of reflected energy over band width up to 30 mc can be obtained from 10 to 1000 mc. This performance provides an instrument suitable for use in testing antennas, terminations, and r.f. input circuits in the proposed high frequency television bands and for other high frequency work. A convenient panel connector makes the Mega-Sweep which forms part of both the standard and modified models of the Mega-Match available as a sweeping oscillator.

Price $895 f.o.b. factory

Note: Standard models now in customers' hands modified at factory at price of $200 f.o.b. factory.

MEGA-SWEEP pulse modulated by the MEGA-PULSER

THE MEGA-SWEEP

The Mega-Sweep, a wide range sweeping oscillator has been widely used as a source of frequency modulated test signal. Its features include a wide sweep (up to 30 mc), low amplitude modulation while sweeping (less than 0.1 db. per megacycle), negligible output signal at frequencies other than swept band, low output impedance (50 ohms) and numerous others. It has been advertised as covering the frequency range of 50 kc to 500 mc since this range covered most requirements. By simple internal adjustment which can be made either by the customer or at our factory, its range can be extended to 1000 mc. The Mega-Sweep is therefore applicable to the proposed high frequency television bands and other high frequency work. By simple connections and adjustments the Mega-Sweep can serve as a carrier source when pulse modulated by the Mega-Pulser, providing ultra narrow pulsed r.f. at any frequency to 1000 mc.

Price $395 f.o.b. factory

THE MEGA-PULSER

Provides very narrow pulses (0.025, 0.05, 0.1 and 0.25 microseconds wide), amplitude 100 volts positive or negative across 50 ohms, repetition rate from internal trigger 100, 1000, 2000 pps. Output pulse delayed 0.25 microseconds from trigger pulser available (positive or negative) for starting sweep of auxiliary oscilloscope. Can be externally triggered by either positive or negative pulses. Output pulses .05 microseconds and greater flat-top, rise and fall time all output pulses 0.01 microseconds. Provides a spectrum which more than covers present or proposed television video amplifiers. The Mega-Pulser may be used to pulse modulate the Mega-Sweep with sweep width adjusted to zero. This combination provides a pulse modulated carrier up to 1000 mc for studying transient response of broad band r.f. circuits.

Price $195 f.o.b. factory

INSTRUMENTS

WRITE FOR FULL SPECIFICATIONS

KAY ELECTRIC CO., 25 MAPLE AVE., PINE BROOK, N. J.

Telephone: CAldwell 6-3710

cess. The unit has three full-scale ranges of approximately 25, 250 and 2,500 milliroentgens per hour. It is powered by ten small batteries mounted in a replaceable lucite enclosure within the main instrument case.

Regulated Power Supply

THE HOWARD CO., 934 Argyle Road, Drexel Hill, Pa. The new 300-volt, 200-ma power supply is regulated

within 1 volt from zero to full load with line voltage variation from 105 to 125 volts. Ripple is less than 10 millivolts at full load with 115 volts input.

Microgroove Changer

WEBSTER-CHICAGO CORP., 5622 Bloomingdale Ave., Chicago 39, Ill. Model 133 has been designed to play new long-playing records at

33.3 rpm. The unit will handle up to ten 12-in. or twelve 10-in. records for a total playing time of four hours. Retail price is $38.75.

High-Fidelity Recording

PRECISION AUDIO PRODUCTS, INC., 1133 Broadway, New York 10, N. Y. The Wiremaster, a new wire recorder, has 13 tubes with push-pull 6V6 output and records and reproduces a frequency response of 40 to 10,000 cycles. Its 8-in. extended

AIRCRAFT MANUFACTURERS RELY ON...

FILTRONS

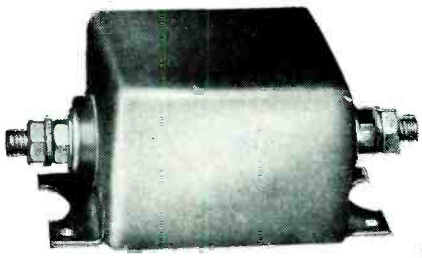
...TO SOLVE THEIR RADIO NOISE PROBLEMS

Shielded Spherical-Seat Terminal Filtron—designed for continuous high attenuation from 150 kc to well above 200 mc

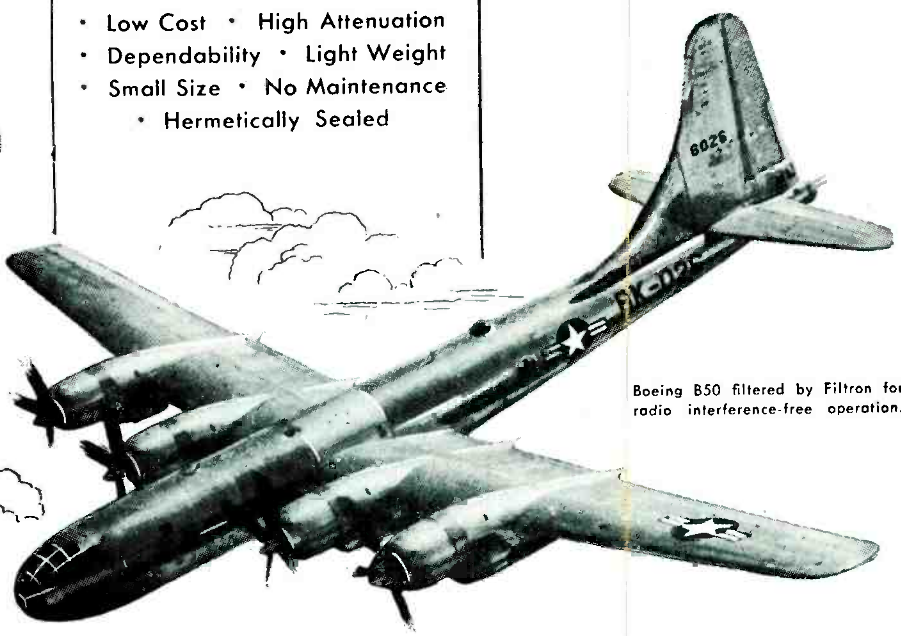
2.5 amp Filtron for 50 V.D.C. operation size $1\frac{3}{4}'' \times 1\frac{1}{4}'' \times \frac{7}{8}''$

FILTRONS OFFER:

- Low Cost • High Attenuation
- Dependability • Light Weight
- Small Size • No Maintenance
- Hermetically Sealed



100 amp & 200 amp 50 Volt Aircraft Filtrons, size $3\frac{1}{2}'' \times 3\frac{1}{2}'' \times 2\frac{1}{2}''$



Boeing B50 filtered by Filtron for radio interference-free operation.

FILTRONS *STOP* CONDUCTED AND RADIATED INTERFERENCE AT THE SOURCE

THOUSANDS OF FILTRONS—radio interference filters—are standard equipment on the majority of current Aircraft production. Thousands of others are in use in vital equipment where radio interference must be suppressed.

Filtron's experienced Engineers, recognized authorities in the noise-suppression field, are available—immediately—to measure the RF interference caused by your product, and to specify a standard Filtron, or design the proper filter to meet Army, Navy, Air Force or FCC interference specifications.

Filtron will design the RIGHT filter for your circuit conditions, with exactly the right attenuation, ampere rating, voltage drop, temperature rise, mechanical arrangement, and space and weight limitations. Filtrons of any current or voltage rating will be designed to meet your application.

Filtron's production capacity and skill will meet your delivery requirements.

All measurements are made in our new modern specially-designed shielded Radio Noise Suppression Laboratory.

"Filtron," the largest exclusive manufacturer of Radio Noise Filters, offers you the PROMPT services of their Engineers and facilities to make your product "Noise Free."

RADIO NOISE FILTERS FOR:

- Electric Motors
- Electric Generators
- Electronic Controls
- Electronic Equipment
- Fluorescent Lights
- Oil Burners
- Signal Systems
- Business Machines
- Electronic Heating Equipment
- Electric Appliances
- Electronic Signs

THE FILTRON CO.
INCORPORATED
38-25 BELL BOULEVARD
BAYSIDE, NEW YORK CITY, N. Y.

SEND FOR CATALOG AND ENGINEERING MANUAL No. FC-20

Write for catalog on your letterhead—it contains complete electrical and mechanical characteristics of standard Filtrons.

LARGEST EXCLUSIVE MANUFACTURER OF RADIO NOISE FILTERS

range speaker is in a separate cabinet to avoid vibration and acoustical feedback. By panel controls the user can record on wire directly from the self-contained radio or phonograph. Spools are available in 15, 30 and 60-minute lengths.

Literature

House Organ. Micro Switch, Freeport, Ill. Micro Tips, vol 1, no. 2 contains a number of suggestions for use of snap action switches including one for pushing the dog out after dinner.

Portable Flaw Tester. Sperry Products Co., Danbury, Conn. The new portable SR05 Supersonic Reflectoscope is pictured in reprint 3013 and further described in bulletin 3001.

Wire Dereelers. Rea Magnet Wire Co., Inc., Fort Wayne, Indiana, has put out a two-color, 4-page brochure on a line of magnet wire dereelers that load quickly and give visibility in the running position.

Special Tools. Palnut Co., 61 Cordier St., Irvington 11, N. J. Special adaptors for many ordinary hand tools to adapt them to speedier assembly with Palnuts only are described in a 4-page brochure.

General Price List. Andrew Corp., 363 E. 75th St., Chicago 19, Ill. Bulletin 10A is a comprehensive tabulation of all transmission

line, antenna, and related equipment, with type numbers, descriptions and prices for over 600 items. A cross index is enclosed with the bulletin.

Fiber. Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N. Y. Various types and grades of fiber rod are summarized and listed in a recently issued brochure.

Fasteners. Shakeproof Inc., 2501 North Keeler Ave., Chicago 39, Ill., has issued a booklet entitled "Fastening Suggestions" that describes a number of special fastener problems and their solution.

Shielded-Section Capacitor. Cornell Dubilier, South Plainfield, N. J. A shielded multiple section capacitor type MC-9A63 has four 0.02-microfarad sections with voltage ratings for 500 v d-c. Details are given in sheet NB-107.

Rectifier. National Electronics, Inc., Geneva, Ill., has recently released full technical information on the new single ended 2-ampere industrial rectifier tube type NL-649.

Brushes. Stackpole Carbon Co., St. Marys, Pa. A 44-page "Fractional Horsepower Equipment User's Guide" just issued contains helpful information on selecting and applying brushes for longer life and better performance.

Battery Terminal. James A. Stanley Co., 277 Broadway, New York 7, N. Y. A brochure can be had describing the new B-319 battery terminal that employs a spring-tension connection to a storage battery terminal post. The new terminal is particularly useful in mobile radio installations.

A-C Motor Control. Louis Allis Co., Milwaukee 7, Wis. Characteristics of the Ajusto-Spede are presented in four pages. The device is characterized as an a-c motor having infinitely adjustable speed.

Photoelectric Counter. Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass. Bulletin PA482

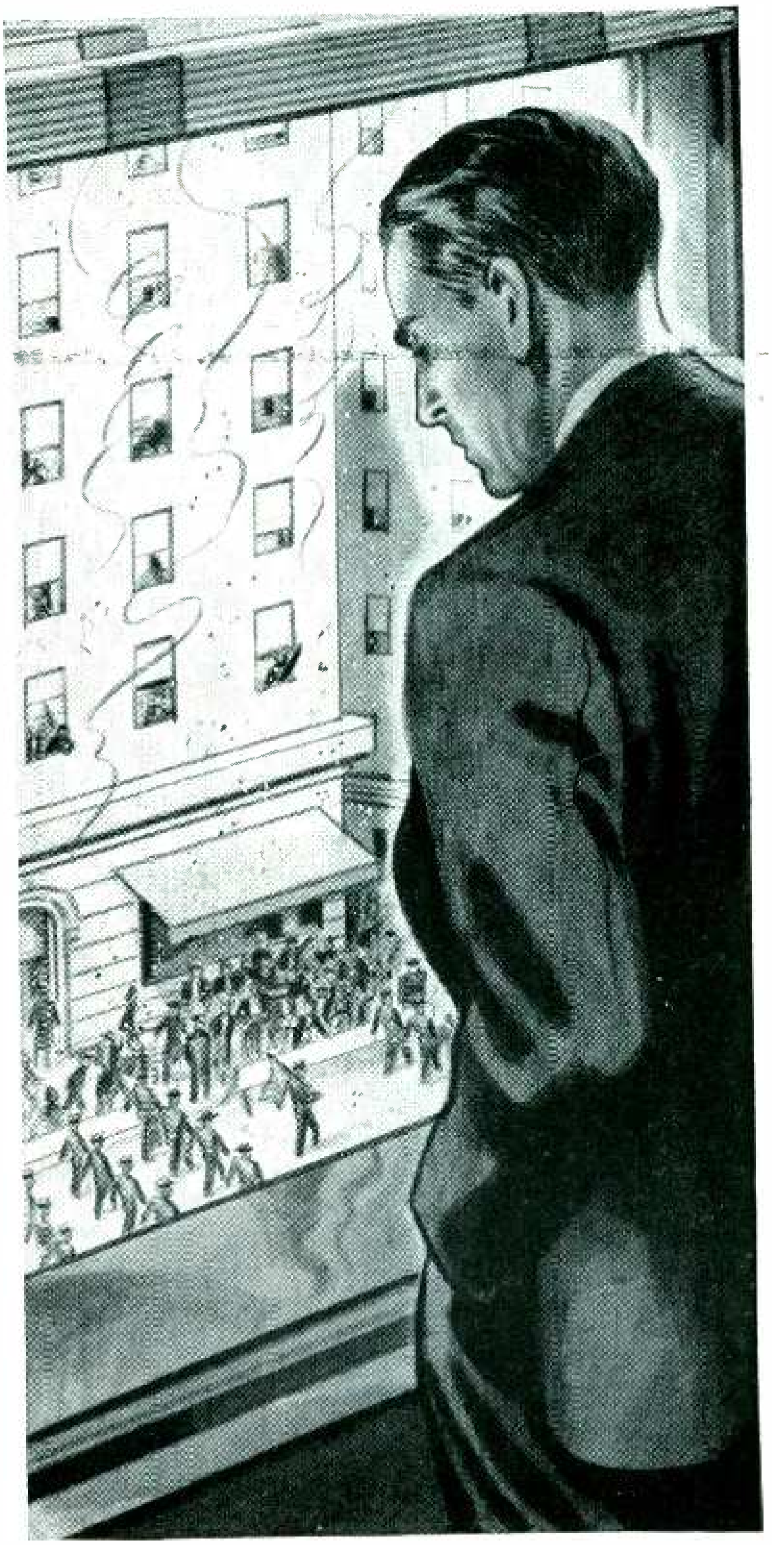
MEMO TO PRESIDENTS WHO WATCHED THE BAND GO BY!

HERE'S ONE parade that isn't "all over but the shouting" after the band has passed. It's the Payroll Savings Plan for the regular purchase of U. S. Security Bonds by employees.

Though the formal spring campaign to sell Bonds is over, any company can still move forward with the parade. Right now thousands of companies are putting *additional push* behind their Payroll Savings Plans. Managements of many companies that have not yet participated are *now installing* the Plan.

It's a "look-ahead" plan, that benefits employee, company, and nation. Every $3 invested in Bonds pay $4 at maturity. Personnel records in the plants with active P.S.P. programs show improved employee attitudes—evidenced by less absenteeism and fewer accidents—as the individual's sense of security grows with Bond purchases. And every Security Bond dollar built up in the Treasury retires a dollar of the national debt that is potentially inflationary. It means less bidding-up of prices. Moreover, Bond buyers are better citizens because they have a tangible stake in the nation's future.

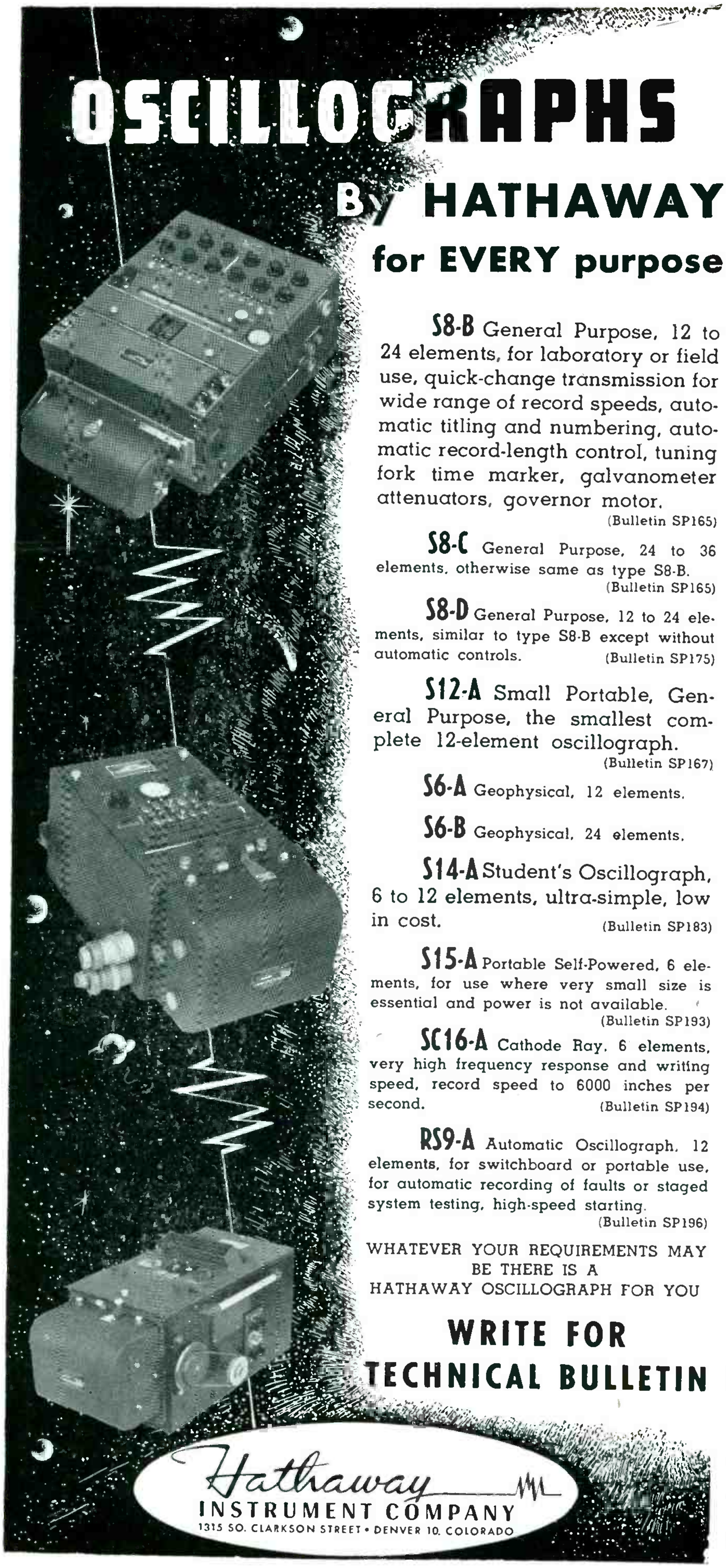
It's just as easy to take action now as when the campaign was at its height. Just call your Treasury Department's State Director, Savings Bonds Division, and ask for the material that helps to get a Payroll Plan started or to keep it rolling.



The Treasury Department acknowledges with appreciation the publication of this message by

ELECTRONICS

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and the Advertising Council.



shows the various uses for type 20 AP5 photoelectric counter designed particularly for case and bottle counting, textile and leather piece goods, as well as freshly painted and hot objects.

Electrosensitive Papers. Alfax Paper and Engineering Co., 40 Riverside Ave., Brockton 27, Mass. Papers for all kinds of recording devices that employ electrolytic papers are described in a minmeographed brochure that gives characteristics and prices.

Hardware and Parts. General Cement Mfg. Co., Rockford, Ill. A new 64-page catalog recently issued lists radio and electronic products, chemicals, hardware, kits, insulation, and other items of interest in the electronics field.

Meters. Millivac Instruments, PO Box 3027, New Haven, Conn. Type MV717A vacuum-tube millivoltmeter and type MV73A multipurpose vacuum tube meter are both pictured in brochures recently made available from the company.

Marking Machines. Adolph Gottscho, Inc., 1 Hudson St., New York 13, N. Y. An 8-page catalog describes 18 different marking and code-dating machines that are useful in packaging all types of electronic equipment.

Molded Cores. Lenkurt Electric Co., 1113 County Road, San Carlos, Calif. "Trancors by Lenkurt" is the title of a new 24-page folder describing a complete line of molded magnetic cores, core assemblies, coil assemblies, and filters.

Speaker Folder. Altec Lansing Corp., 250 West 57th St., New York 19, N. Y. A two color folder announces a new line of general purpose loudspeakers. Frequency response curves and methods of obtaining the curves are presented. Available cabinets are also illustrated.

Contactors. Ward Leonard Co., 31 South St., Mount Vernon, N. Y. For the bigger transmitters and heavy industrial control equipment engineers will want to see

FOR FINER LATERAL REPRODUCTION

(and other benefits explained in Bulletin No. 3)
COLUMBIA BROADCASTING SYSTEM
and
AMERICAN BROADCASTING COMPANY
(as well as hundreds of independent stations)
have placed

GRAY TRANSCRIPTION ARMS and EQUALIZERS

on every transcription table

Ideal for the New Long Playing Micro-Groove Records
The Gray Transcription Arm gives you improved quality of reproduction, greatly extended life of stylus and recordings, economical operation, as well as low first cost. Due to such features as adjustable stylus pressure, frictionless motion, self-leveling base and the accommodation of any standard cartridge, arm obsolescence is precluded.

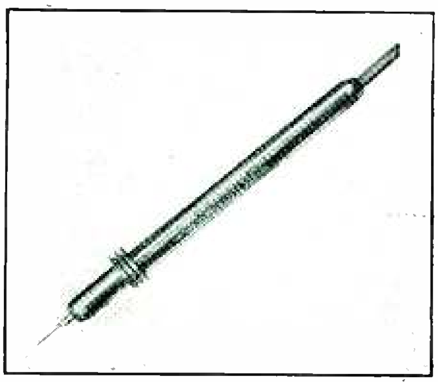
The Gray #601 4-position Equalizer for GE Cartridge, finest performance and workmanship, ideal response curves. Matches pickup to microphone channel.

Write for our Bulletin #5 on Selected GE Reproducers, with Diamond Styli for almost unlimited life.

GRAY RESEARCH & DEVELOPMENT COMPANY, Inc.

16 ARBOR STREET **HARTFORD 1, CONN.**

Keep high voltage off your test instruments!



use **REINER**

HIGH VOLTAGE MULTIPLIER LEADS

accurate within 2%

You can make high voltage and television measurements on a low voltage multimeter with complete safety if you use these Reiner H. V. M. leads. They have special high-voltage type resistors built into the prod handles. The entire voltage drop is virtually complete before the wire lead of the cord is reached, leaving the tip of the lead relatively "cold". Supplied in standard scale ranges from 5,000 to 30,000 volts and in sensitivities of 5,000 to 25,000 ohms per volt. Write for price and application chart—bulletin #111.

REINER H. V. M. LEADS *are available in the necessary ranges for all popular V. T. Voltmeters. Special ranges and sensitivities can be supplied on order.* WRITE FOR BULLETIN #111.

Reiner
ELECTRONICS CO., INC.
152 West 25th St., New York 1, N. Y.

Now . . . the TV high voltage test problem solved with safety and operational confidence.

A super high voltage, custom-molded test probe, "Application Engineered" for the job . . . tested on the job . . . approved for the job.

Designed for SAFETY FIRST.

Rapid removal and interchange of the cartridge multiplier permits the TV probe to be used with more than one multi-range test set, via purchase of appropriate cartridge.*

> Series TV High Voltage Test Probes are now on display at leading radio parts distributors and are available as follows:
>
> **TVP**—High Voltage Test Probe LESS multiplier cartridge. **$12.35 Net**
>
> **TV-1**—Model TVP WITH Cartridge for Precision Series EV-10 VTVM. **$15.45 Net**
>
> **TV-2**—Model TVP WITH Cartridge for Precision (or any) 20,000 ohms per volt test set with built-in 6000 V. D.C. range. **$15.45 Net**
>
> *Stock and special value multiplier cartridges available to match popular high sensitivity test sets.

Series TV High Voltage Test Probes provide direct kilovoltmeter facilities with existing high sensitivity test sets, and VTVM's such as the "Precision" models described below: Write for illustrated 1948 catalog describing complete line of electronic test instruments.

—MODEL 85—
Lab. Type 20,000 ohms per volt AC-DC test set. 34 rotary selective ranges to 6000 V., 60 Megs., 12 Amps., 70 DB, 4½" meter. **$38.75**

—MODEL 858-L—
20,000 ohms per volt Multi-Master, AC-DC V-O-M. 54 push-button operated ranges to 6000 V., 600 Megs., 12 Amps., 70 DB. 4½" meter. **$54.10**

—MODEL EV-10-MCP—
Multi-range, zero-center VTVM plus AC-DC V-O-M facilities to 6000 V., 2000 Megs., 12 Amps., 70 DB. With large 7" meter. **$89.95**

—MODEL 10-54-P—
Electronamic Tube Tester, and 20,000 ohms per volt AC-DC V-O-M. Ranges to 6000 V., 12 Amps., 60 Megs., 70 DB. 4½" meter. **$134.40**

Export Division, 458 Broadway, New York City, U. S. A. Cables, MORHANEX copies of bulletins 4452 and 4453 describing heavy-duty solenoid contactors.

High-Frequency Resistors. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa. Complete specifications and characteristics for type MP high-frequency resistors are given in a 4-page technical data bulletin F-1.

Motor Controls. Square D Co., 4041 N. Richards St., Milwaukee 12, Wis. New products and modified listings for holders of the Electric Motor Control catalog were issued as of July 28, 1948.

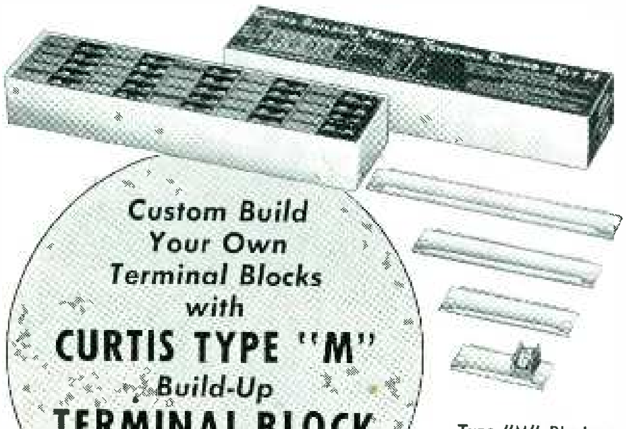
Crystals. Reeves-Hoffman Corp., 321 Cherry St., Carlisle, Pa. A catalog covers the complete line of quartz crystal units for calibration, mobile, aircraft, and commercial crystal applications. Bulletin RHC features a small universal holder for frequency coverage from 50 kc to 100 mc.

A-M Transmitters. Radio Corp. of America, Camden, N. J. A 24-page descriptive brochure provides comprehensive information on 5-kw and 10-kw a-m broadcast transmitters. It is profusely illustrated with schematic diagrams, specifications, layouts, and photographs. Write Department 516.

Capacitor, Tetrode, and Socket. Eitel-McCullough, Inc., San Bruno, Calif. Variable vacuum capacitors that can be mounted singly or in gangs, the type 4-400A r-f amplifier power tetrode, and the special air-system socket are all pictured in brochures available from the company.

Metal Problems. International Nickel Co., Inc., 67 Wall St., New York 5, N. Y. A new booklet entitled "66 Practical Ideas for Metal Problems in Electrical Products" should be interesting reading for the designer of electronic products with problems in choice of proper metal for fabrication.

Assorted Instruments. Kalbfell Laboratories, Inc., 1076 Morena Blvd., San Diego 10, Calif. A heterodyne detector, bridged-T filter, decade amplifier, and the



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CURTIS TYPE "M" Build-Up TERMINAL BLOCK KITS

Type "M" Blocks are designed with ample clearance and creepage distances for use in circuits carrying up to 300 volts, 15 amps.

Curtis Type "M" Terminal Blocks are now available in convenient kits . . . with sufficient components to make up a number of custom or one-time blocks. Easy and quick . . . you can build blocks with an assortment of terminals from 2 to 12. Molded terminals provide ample insulation from metal base. Type "M" kits are the answer for engineering, research, maintenance and repair. Order your supply today!

Write for your copy of Bulletin DS-122

CURTIS DEVELOPMENT & MFG. CO.

Terminal Block Sales
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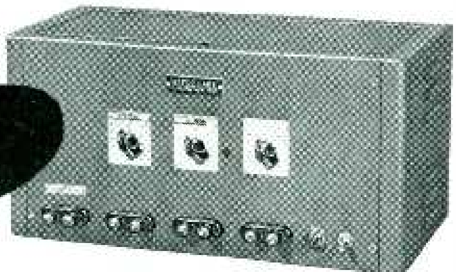
Separate voltage supplies eliminated



Kepco MULTIPLE POWER SUPPLY

Four commonly used voltages from a single compact unit! Separate voltage supplies, ordinarily derived from three or four cumbersome power units, now concentrated in one!. That is what the Kepco Multiple Power Supply brings to busy engineers in the industrial laboratory, for greater convenience and speed in experiments and research work.

Any voltage you need is instantly available through the Kepco Multiple Power Supply—for heater, plate and grids—for studying the characteristics of vacuum and gas filled tubes. Contains:
Two continuously variable B supplies from 0 to 300 volts or currents up to 120 ma.
One continuously variable C supply from minus 50 to plus 50 volts at 5 ma.
One heater supply delivering 6.3 volts at 5 amperes.

The two B supplies originate from a common power transformer; the C supply originates from a separate power transformer and rectifying circuit. B supplies cannot be burned out even if terminals are shorted. Control circuit eliminates the use of heavy duty power potential dividers.

Complete voltage control from front panel, including power switch and pilot light indicating "Off" and "On." All voltages brought out to binding posts along lower edge of front panel.

Strong construction; all component parts of highest quality. Dimensions: Length 16"; height 8"; depth 8 ¾". Weight 28 lbs.

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Complete details on request

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Flushing, N. Y.

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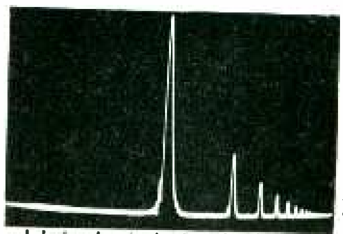
AUDIO ANALYSIS with Model AP-1

PANORAMIC SONIC ANALYZER

Reduce time, complexity and cost of making audio measurements with the unusual advantages offered by the Panoramic Sonic Analyzer. By resolving a complex audio wave into a spectrograph showing the frequency distribution and voltage amplitude of the components, Model AP-1 . . .

• Eliminates slow point-by-point frequency checks • Provides a quick overall view of the audio spectrum • Enables determination of changes in waveform content while parameters are varied • Furnishes simple presentations for production line testing.



Panoramic Sonic Spectrograph of 750 cps square wave.

Use Model AP-1 for analyzing . . .
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Features . . . Continuous scanning from 40-20,000 cps in one second • Wide input voltage range • Linear and log voltage scale • Closely logarithmic frequency scale • Built-in voltage and frequency calibrator • Simple operation.

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micro-miker are briefly listed on a specification sheet.

Components. Aircraft Radio Corp., Boonton, N. J. A series of bulletins made up in catalog form covering a wide variety of test equipment, microwave accessories and electronic component parts. Photographs and mechanical drawings are included.

Wire Catalog. Alpha Wire Corp., New York 13, N. Y. A complete line of wire and wire products for the radio, automotive and electrical industries is covered in the twelve-page catalog no. 48. Specifications for each type are given.

Coil Winding. Universal Winding Co., P.O. Box 1605, Providence 1, R. I. Information covering improvements in coil winding equipment and new ideas in the winding operation may be found in a series of single sheet publications.

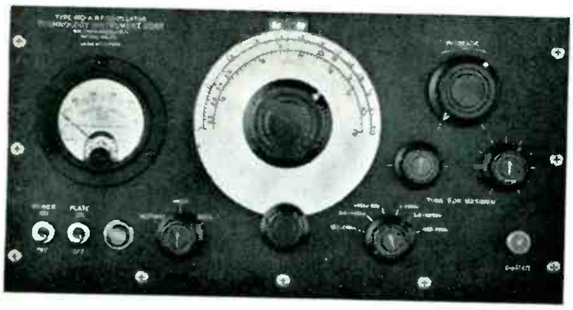
Capacitor Information. Herlec Corporation, 422 North Fifth St., Milwaukee 3, Wisconsin, recently issued two new catalog sheets. One deals with types, physical dimensions and standard values of bypass and audio coupling capacitors together with diagrams of "Bulplates," incorporating several capacitors. The other gives a general description, specifications, and instructions for ordering metal cup capacitors.

Antennas. Tricraft Products Co., 1535 N. Ashland Ave., Chicago 22, Ill., presents in a 16-page booklet the electrical performance data on the models 300 and 400 all-wave television and f-m antennas. Two descriptive catalog leaflets are also included.

Machining Plastics. Monsanto Chemical Co., Springfield, Mass. Bulletin 52 tells how to do it if the cost of a polystyrene plastic article is below that warranting the use of an expensive mold.

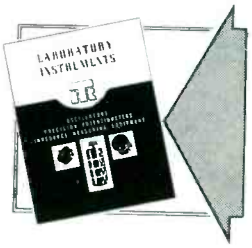
Tube Applications. Radio Corp. of America, Harrison, N. J. Several new tube application notes numbered AN-134 through AN-137 have recently been issued dealing with adjustment of filament voltage

NEW R-F OSCILLATOR



for general laboratory use and as a signal source for R-F bridges

Write today for Bulletin 408 containing complete information and specifications on the Type 410-A R-F Oscillator



NOTE THESE FEATURES

- 100 kc to 10 Mc
- High output—approximately 30 volts
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- Excellent stability
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- Expanded frequency scale.

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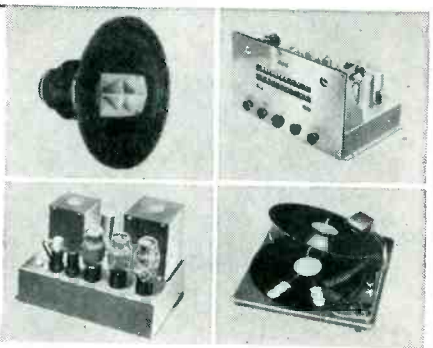
One of many alternative placements of elements. In actual installation, speaker will be concealed by decorative fabric.



The Altec Lansing Custom-in-Built Music System consists of the famous Altec Lansing Duplex speaker, a special Altec Lansing amplifier, a newly designed TRF Altec Lansing AM-FM tuner, and the Webster 70 record changer with GE variable reluctance pick-up. Integrated with the structure of your room, this system transcends completely the inherent acoustical and electronic limitations of conventional radio-phonographs, eliminates radio "furniture," and reproduces the full range of sound (35 to 16,000 cycles). It achieves the highest faithfulness to living sound now known to science. Built-in Altec Lansing Daylight Television can also be included. Complete installation instructions come with each system.

A brochure will be sent on request.

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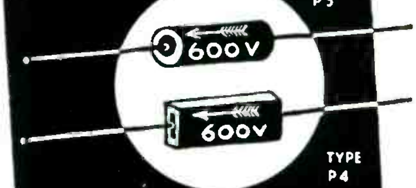
ALTEC LANSING CORPORATION

ALTEC LANSING custom-in-built home music system

Where SPACE and PERFORMANCE are Vital DUMONT OFFERS *The* TINYMITE



SMALLEST PAPER CAPACITOR - - - *yet 100%* **MOISTUREPROOF**

Proof of the pudding is in the eating.

TINYMITES are the largest selling miniature paper capacitors in the world.

- Good for 100°C
- Leads CANNOT pull out
- CAP. from .0001 to 2 MFD from 100 volts to 1000 volts.

Send for List and prices.

DUMONT ELECTRIC CORP.
MFR'S OF CAPACITORS FOR EVERY REQUIREMENT
308 DYCKMAN ST., NEW YORK, N. Y.

of the 1B3 by observation of filament temperature, reduction in peak inverse voltage rating, overload protection for horizontal deflection circuits, and single-section filament operation of 3S4 and 3V4.

Marine Radiophones. Rex Bassett, Inc., Fort Lauderdale, Fla. A folder lists the various two-way marine radiotelephones for tug boats, fishing vessels, tankers and yachts.

Tubes. Radio Corp. of America, Harrison, N. J. Specification sheets on the type 812-A power triode, type 672-A thyratron, and the type 4X500A power tetrode are now in printed form.

High-Power Solenoid. B/W Controller Corp., Birmingham, Mich. Bulletin SOL-2 devotes four pages to an illustrated description of the Hi Power small space, a-c solenoid. Specifications, charts and dimensional drawings are included.

Cast Parts. Austenal Laboratories, Inc., 224 E. 39th St., New York 16, N. Y. A 16-page booklet entitled "New Horizons with Microcastings" contains a number of interesting examples of parts produced by the Microcast process for use in the electronics field.

Synthetic Elastics. E. I. duPont de Nemours and Co., Inc., Fairfield, Conn. Properties and uses of Fairprene, a synthetic elastic composition are described in a 12-page manual. Each of the three groups of Fairprene products is illustrated.

Air-spaced Cables. Transradio Ltd., 138A Cromwell Road, London SW7, England. Publication 27 lists new types of Co-Ax air-spaced articulated r-f cables. They can be used for flexible high-power transmission lines, very low-capacitance cables, and photocell leads.

Transformers. Electro Engineering Works, 6021 College Ave., Oakland 11, Calif. Using modern techniques, this company makes all types of radio, industrial, audio, and other transformers as

PRECISION

COMPACTNESS

Cyclohm 2500 Motors are designed with greater *precision* and *compactness* than any other motors of their type—and the result is *greater output . . . perfect rigidity . . . quieter performance. Synchronous* type for instruments, timing devices and facsimile operations . . . *Non-Synchronous* for general applications . . . *Speed Reducer* for work requiring slow speeds and high torques. Ball bearings or sleeve bearings.

300 IN. OZ. AT 1 RPM

with gear unit

Various speeds, voltages and frequencies available. Write for complete information.

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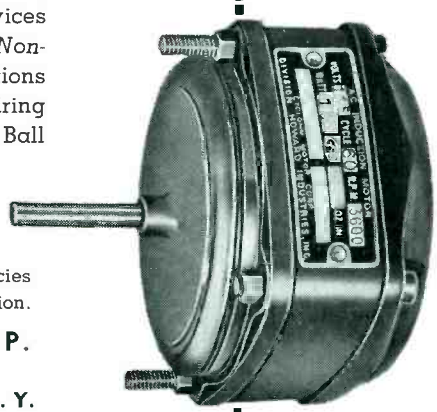

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SYNCHRONOUS • NON-SYNCHRONOUS • SPEED REDUCER

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HEAT RESISTANT WIRES FOR EVERY APPLICATION . . .

TOUGH *and* RUGGED

Do your new circuit designs call for heat resistance wire that's tough and rugged—wire that can take it day after day through countless hours of operation? Then check Lewis Asbestos Covered Wire before you specify. Regardless of what your wire problem is—dropping excessive voltages—filament dropping resistor in the line—high current conductors, it doesn't matter, just . . .

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Let Lewis Build The Wire For You

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.
FOR A TRIAL ORDER OR A CARLOAD *consult*

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Wire Division
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If you need Radio Parts...

in quantities suitable to Volume Production...it may pay you to call upon

the Design Engineers of United-Carr and its subsidiaries. They have helped many manufacturers

★ CUT COSTS

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★ TURN OUT FINER FINISHED PRODUCTS

UNITED-CARR FASTENER Corp.
CAMBRIDGE 42, MASSACHUSETTS

MAKERS OF DOT *FASTENERS*

well as magnets and saturable reactors, according to a catalog sheet just issued.

Industrial Glass. Kopp Glass, Inc., Swissvale, Pa. A new 24-page bulletin just printed in color describes glass products for industry, including some for the electronics field.

Vibration Control. Vibrashock Division of Robinson Aviation, Inc., Malcolm Ave., Teterboro, N. J., announces a new catalog, particularly for product design engineers, showing complete suspensions for the mounting of equipment in standard and special sizes. The many factors entering into vibration control are treated.

Insulation Testing. Associated Research, Inc., 231 S. Green St., Chicago 7, Ill. Bulletin 302 explains the applications and use of the model 404 Hypot, an instrument which independently tests breakdown, leakage, and shorting of insulation with the use of lights to discriminate between them. Range is from 0 to 4,000 volts.

Plastics. General Electric Co., Chemical Dept., Pittsfield, Mass. Bulletin CDP-578 is a 15-page illustrated description of molded and laminated plastics. Also discussed are sealing caps and sleeves, mycalex, silicone rubber, and h-f insulation. Property tables are included for reference.

Permanent Magnets. General Electric Co., Chemical Dept., Pittsfield, Mass. CDM-12 is an eight-page illustrated bulletin describing cast and sintered Alnico, Cunife, Cunico, Vectolite, Silmanal and various permanent magnet holding assemblies. Special alloys are also discussed.

Interlock Switch. Micro Switch, Freeport, Ill. Data sheet no. 45 describes the 1AC1 and 1AC2 interlock door switches designed for use on h-f radio, radar, x-ray and television equipment cabinets, induction heating equipment, and electronic controls of all types.

Electromatic Tester. Tinius Olsen Testing Machine Co., 1022 Easton Rd., Willow Grove, Pa. Bulletin 37

The Advance Hermetically Sealed Relay

Hermetically sealed ADVANCE relays maintain their original efficiency under conditions that soon ruin or dangerously impair other types of relays. Dust, moisture, oil, or fungus cannot reach precisely adjusted parts.

There can be no failure due to arcing, or condensation in the low atmospheric pressure of high altitudes. Important, too, is the fact that these relays are "Tamper-Proof"!

ANY Advance relay can be furnished in hermetically sealed containers on special order.

Built to Army and Navy specifications upon request.
Write today for further details and catalog of complete line.

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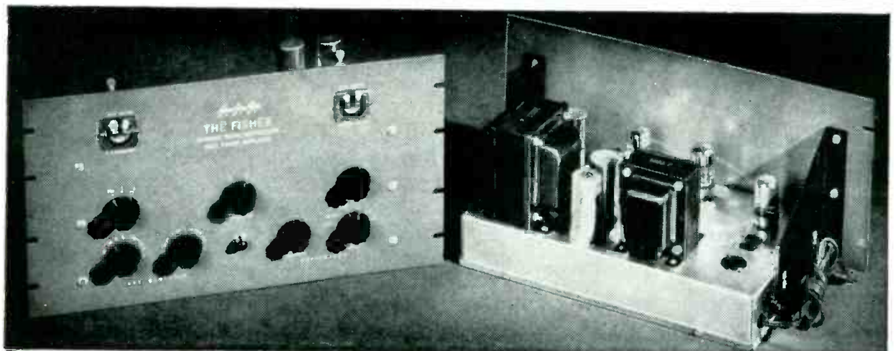
ADVANCE ELECTRIC & RELAY CO.
1260 West 2nd Street, Los Angeles 26, Calif.



By a Wide Margin—the BEST!

The Fisher

NOISE SUPPRESSOR* AND AMPLIFIER

■ For the *ultimate* in record reproduction without scratch, without rumble, coupled with an amplifier of *professional* quality, there can only be one choice—THE FISHER. Less than 1% distortion at 20 watts, 17 tubes, two-chassis construction, two gate indicators, high quality preamplifier for G.E. and similar pickups, three inputs, uniform response 20-20,000 cycles. Available for 10-day trial, if desired.

PRICE $254.50 • IMMEDIATE DELIVERY • WRITE FOR DETAILS

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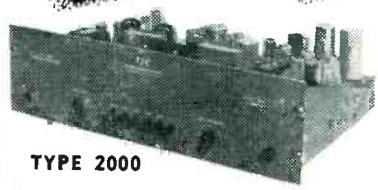
QUICKER!
MORE ACCURATE!

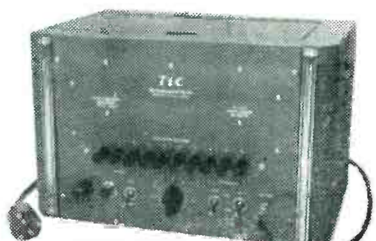
TELEVISION SET
Alignment & Adjustment
TIC PRECISION GENERATORS



TYPE 2000

BAR & DOT GENERATOR

Efficient push-button unit for swift, precise adjustment of horizontal & vertical sweep linearity of television receivers. Used in conjunction with Standard Synchronizing Signal and Monoscope Generator or other pattern or picture signal generator. Requires only 5¼" of standard rack space. Five convenient push-buttons allow instantaneous selection of: • Standard blanking • Vertical bars only • Horizontal bars only • Vertical & horizontal bars • Complete dot pattern. Has phasing control for adjustment of vertical bar position. Power supply is self contained.



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CRYSTAL CONTROLLED MULTI-FREQUENCY GENERATOR

A 10 frequency, 400 cps modulated crystal controlled oscillator, ideal for production line adjustment of stagger tuned I.F. amplifiers in television sets. Available with crystals ranging from 17 to 40 mc. provided to exact frequency and in sequence specified by customer. Each frequency is immediately selectable by means of a push button. Output adjustable. Power supply is self contained.

Write for bulletins 2000 & 1900

TEL Instrument Co. Inc.
50 PATERSON AVE.
East Rutherford, New Jersey
RUtherford 2-9720

is a four-page folder devoted to the Electromatic low-capacity universal testing machine. The unit gives wide spread ranges of 250 to 1, extension ranges of 200 to 1 and straining ranges of 400 to 1. Complete specifications are listed.

Waterproof Connectors. Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif. A new 6-page bulletin W-248 gives dimensional data on the three sizes of type W waterproof connectors, together with photos of underwater geophysical applications. These plugs and receptacles are built to withstand pressures up to 250 pounds or approximately 550 ft underwater for all types of circuits in radio, sound, or power.

Electrical Connectors. Mines Equipment Co., Dept. 12, 4215 Clayton Ave., St. Louis 10, Mo. Bulletin MC108 illustrates and describes in detail a line of molded neopreme rubber electrical connectors and associated equipment. Products are identified by short three-letter symbols. Tabular index is included.

Cylindrical Capacitors. Cornell-Dubilier Electric Corp., South Plainfield, N. J. Descriptive bulletin NB-105 treats of the compact cylindrical-type capacitors, RC-111 and RC-112. Ratings are 0.005 μf at 6,000 volts d-c and 0.05 μf at 6,000 volts d-c, respectively. They are designed for safe operation from -55 to $+100$ C, are hermetically sealed, and Dykanol impregnated and filled.

Technician's Catalog. Walter L. Schott Co., 9306 Santa Monica Blvd., Beverly Hills, Calif. The 1948 catalog lists and describes a complete line of hardware, chemicals, tools, finishing materials, and service items for the electronic technician. Prices are included.

Insulation Tester. Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y. Illustrations, general description, outstanding features and specifications of the Minor Megohmer insulation tester are found in bulletin 450. The portable instrument weighs three pounds. It has a d-c generator with a 500-volt d-c output, and measures up to 50 megohms.

Additions and Corrections

PRODUCT LISTINGS

The following listings are to be used in conjunction with the June 1948-1949 ELECTRONICS BUYERS' GUIDE for information on manufacturers' names, addresses and products omitted or incorrectly listed in that issue.

AMPLIFIERS—*Audio Frequency*

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Planet Radio Mfg. Corp., 6508 Euclid Ave., Cleveland 3, Ohio

AMPLIFIERS—*Audio Input Systems*

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.

AMPLIFIERS—*Decade*

Keithly Instrument Co., 1508 Crawford Road, Cleveland 6, Ohio

AMPLIFIERS—*Facsimile*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

AMPLIFIERS—*Peak Limiting*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

AMPLIFIERS—*Photocell*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

AMPLIFIERS—*Wideband*

Tel-Instrument Company, Inc., 50 Paterson Ave., East Rutherford, N. J.

ANTENNAS—*Television*

Intra-Video Corp. of America 851 Madison Ave., New York 21, N. Y.

ATTENUATORS

Shallcross Mfg. Co., 10 Jackson Ave., Collingdale, Pa.

CAPACITORS—*Oil Impregnated*

Crown Capacitor Corp., Minot & Depot Sts., Wrentham, Mass.

CAPACITORS—*Paper Tubular*

Crown Capacitor Corp., Minot & Depot Sts., Wrentham, Mass.

CAPACITORS—*Wax Impregnated*

Crown Capacitor Corp., Minot & Depot Sts., Wrentham, Mass.

CHOKES—*Filter*

Empire Coil Co., Inc., 238 Huguenot St., New Rochelle, N. Y.

COIL ASSEMBLIES

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Antenna*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Choke*

Empire Coil Co., Inc., 238 Huguenot St., New Rochelle, N. Y.
Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Magnet*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Multiple Wound*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Pickup*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Power & a-f Coils & Windings*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*r-f & i-f Receiving & Transmitting*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Relay & Solenoid*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Television Focusing*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COILS—*Transformer Coils & Windings*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

COMMUNICATION SYSTEMS — *Facsimile*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

CONNECTORS—*Cable Connectors & Couplings*

Electro-Connector Corp., 110 W. Oxford St., Phila. 22, Pa.

CONTROLS—*Alarm System*

Photobell Company, 116 Nassau St., New York 7, N. Y.

CONTROLS—*Counter*

Photobell Company, 116 Nassau St., New York 7, N. Y.

CONTROLS—*Fluid Conductivity*

General Controls Co., Glendale, California

CONTROLS—*Inspection*

Photobell Company, 116 Nassau St., New York 7, N. Y.

CONTROLS—*Photoelectric*

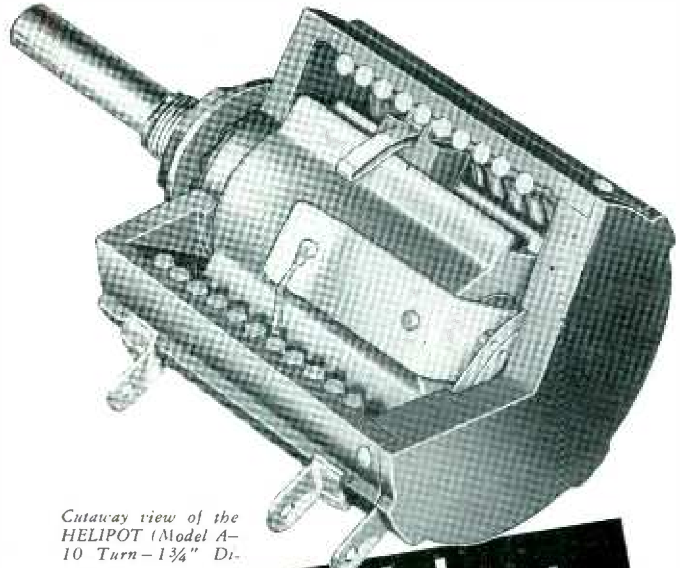
Photobell Company, 116 Nassau St., New York 7, N. Y.

CONTROLS—*Skew*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

(Continued on page 247)

For new simplicity, wide range, and high accuracy in the control of modern electronic circuits...



Cutaway view of the HELIPOT (Model A—10 Turn—1¾" Diameter)

THE BECKMAN Helipot

(Trademark of the HELical POTentiometer)

Provides *many times* greater resistance control in *same* panel space as conventional potentiometers!

If you are designing or manufacturing *any type* of precision electronic equipment be sure to investigate the greater convenience, utility, range and compactness that can be incorporated into your equipment by using the revolutionary HELIPOT for rheostat-potentiometer control applications...and by using the new DUODIAL turns-indicating knob described at right.

Briefly, here is the HELIPOT principle...whereas a conventional potentiometer consists of a *single* coil of resistance winding, the HELIPOT has a resistance element *many times* longer coiled *helically* into a case which requires no more panel space than the conventional unit. A simple, foolproof guide controls the slider contact so that it follows the helical path of the resistance winding from end to end as a single knob is rotated. Result...*with no increase in panel space requirements*, the HELIPOT gives you as much as 12 times* the control surface. You get far greater accuracy, finer settings, increased range—with maximum compactness and operating simplicity!

COMPLETE RANGE OF TYPES AND SIZES

The HELIPOT is available in a complete range of types and sizes to meet a wide variety of control applications . . .

MODEL A: *5 watts, 10 turns, 46" slide wire length, 1¾" case dia., resistances 10 to 50,000 ohms, 3600° rotation.*

MODEL B: *10 watts, 15 turns, 140" slide wire length, 3¼" case dia., resistances 50 to 200,000 ohms, 5400° rotation.*

MODEL C: *3 watts, 3 turns, 13½" slide wire length, 1¾" case dia., resistances 5 to 15,000 ohms, 1080° rotation.*

MODEL D: *15 watts, 25 turns, 234" slide wire length, 3¼" case dia., resistances 100 to 300,000 ohms, 9000° rotation.*

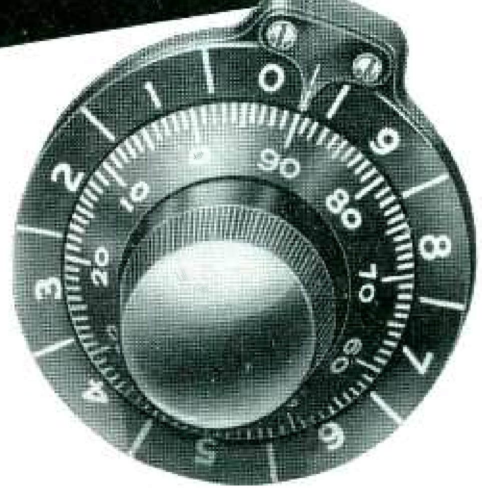
MODEL E: *20 watts, 40 turns, 373" slide wire length, 3¼" case dia., resistances 150 to 500,000 ohms, 14,400° rotation.*

Also, the HELIPOT is available in various special designs . . . with double shaft extensions, in multiple assemblies, integral dual units, etc.

Let us study *your* potentiometer problems and suggest how the HELIPOT can be used—possibly is already being used by others in your industry—to increase the accuracy, convenience and simplicity of modern electronic equipment. No obligation, of course. Write today outlining your problem.

**Data for Model A, 1¾" dia. Helipot. Other models give even greater control range in 3" case diameters.*

THE BECKMAN Duodial



The inner, or Primary dial of the DUODIAL shows exact angular position of shaft during each revolution. The outer, or Secondary dial shows number of complete revolutions made by the Primary dial.

A multi-turn rotational-indicating knob dial for use with the HELIPOT and other multiple turn devices.

The DUODIAL is a unique advancement in knob dial design. It consists essentially of a primary knob dial geared to a concentric turns-indicating secondary dial—and the entire unit is so compact it requires only a 2" diameter panel space!

The DUODIAL is so designed that—as the primary dial rotates through each complete revolution—the secondary dial moves one division on its scale. Thus, the secondary dial counts the number of complete revolutions made by the primary dial. When used with the HELIPOT, the DUODIAL registers *both* the angular position of the slider contact on any given helix as well as the particular helix on which the slider is positioned.

Besides its use on the HELIPOT, the DUODIAL is readily adaptable to other helically wound devices as well as to many conventional gear-driven controls where extra dial length is desired without wasting panel space. It is compact, simple and rugged. It contains only two moving parts, both made entirely of metal. It cannot be damaged through jamming of the driven unit, or by forcing beyond any mechanical stop. It is not subject to error from backlash of internal gears.

TWO SIZES—MANY RATIOS

The DUODIAL is now available in a 2" diameter model and soon will also be available in a new 4¾" diameter model for main control applications. Standard turns-ratios include 10:1, 15:1, 25:1 and 40:1 (ratio between primary and secondary dials). Other ratios can be provided on special order. The 10:1 ratio DUODIAL can be readily employed with devices operating *fewer* than 10 revolutions and is recommended for the 3-turn HELIPOT. In all types, the primary dial and shaft operate with a 1:1 ratio, and all types mount directly on a ¼" round shaft.

Send for this HELIPOT AND DUODIAL CATALOG!

Contains complete data, construction details, etc., on the many sizes and types of HELIPOTS...and on the many unique features of the DUODIAL. Send for your free copy today!

THE Helipot CORPORATION, SOUTH PASADENA 2, CALIFORNIA

Due to circumstances beyond control the above advertisement did not appear in the 1948 Buyers' Guide issue of ELECTRONICS. You may wish to file this data with your Buyers Guide issue

BETA HIGH VOLTAGE POWER SUPPLIES

PROBLEM: A group of physical chemists doing research in semi-conductor properties required *a very low ripple* compact adjustable power supply, capable of providing 0-30 KV DC.

BETA *Built it!*

MAJOR SPECIFICATIONS

Input: 115 volts, 50/60 cycles; 150 volt-amperes
Output Voltage: Low range, 0-3 KV
High range, 3-30 KV
Positive grounded
Output Current: 75 μa available at 30 KV.
Ripple: Less than 0.01% at 50 μa and any voltage.
Size: 21" x 15" x 15".

Power supplies up to 200,000 volts DC, regulated or unregulated, built to specifications. Compactness, low cost and rapid delivery featured.

Submit your high voltage power supply requirements to us for a prompt bid on price anad delivery.

OTHER BETA PRODUCTS INCLUDE:

KILOVOLTMETERS: Up to 50 KV at 50,000 ohms per volt, 20 μa drain.

PORTABLE POWER SUPPLIES: Adjustable from 0 to 30 KV DC. Regulated and unregulated units available.

ELECTRONIC MICROAMMETERS: 0.01 μa full-scale to 100 μa full-scale in 5 decade ranges. Cannot be damaged by overload.

ELECTRONIC RHEOSTATS: Resistance continuously variable from above 100,000 megohms to below 100,000 ohms. Good for voltages up to 15 KV.

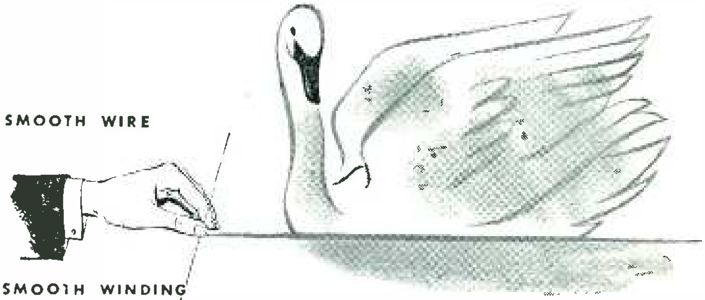
Send for descriptive literature

Sales Engineers throughout the country are at your service to discuss our products more thoroughly with you.

BETA ELECTRONICS CO.
1762 Third Ave., New York 29, N. Y.

Smooth

SMOOTH WIRE



SMOOTH WINDING

SMOOTH OPERATION

From every angle you'll find Essex Extra Test Magnet Wire a smooth product to use in your winding department. In the battle for profitable production it minimizes time lost because of hard and springy wire . . . tacky insulation film . . . poor size uniformity from spool-to-spool . . . and frequent tension adjustments. The chances are, Essex Extra Test Magnet Wire can prove its superiority for you.

ESSEX WIRE CORP.
FORT WAYNE 6, INDIANA

WIRE SX PRODUCTS

Plants: Anaheim, Calif.; Detroit, Mich.; Fort Wayne, Ind. Warehouses* and Sales Offices: *Atlanta, Ga.; *Boston, Mass.; *Chicago, Illinois; Cleveland, Ohio; Dallas, Texas; Dayton, Ohio; *Detroit, Mich.; *Kansas City, Mo.; *Los Angeles, Calif.; Milwaukee, Wis.; *Newark, N.J.; Philadelphia, Pa.; *Portland, Oreg.; *St. Louis, Missouri; *San Diego, Calif.; *San Francisco, California

EXPORT SALES OFFICE—LIONEL-ESSEX INTERNATIONAL CORPORATION, 15 E. 26th ST., NEW YORK 10, N.Y.

BAACH-INTERNATIONAL

Dimensions
24"x24"x72" high

EIGHT HEAD HOT-CUT FLARE MACHINE

Automatic throughout.

Can be synchronized with automatic Stem machine.

Cuts off and flares in one operation.

Production 1250 flares per hour. For miniature flares, fluorescent starters, standard size lamps, fluorescent and radio tubes.

RANGE OF MACHINE

Glass tubing
27 to 45 gauge

Length of flares
5 mm. to 80 mm.

Forms flares up to 47 mm. diam.

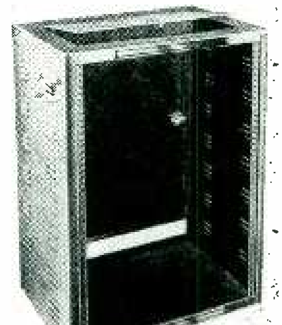
Net weight, 960 lbs.
Gross weight 1450 lbs.

INTERNATIONAL MACHINE WORKS

Manufacturers of High Vacuum Pumps, Automatic Machinery for Incandescent Lamps, Electronic Tubes since 1916.

2027 - 46TH STREET
NORTH BERGEN, N. J., U. S. A.

Tel. UNion 3-7412.
Cable Address "Intermach" North Bergen, N. J.



ECLIPSE

ANNOUNCES

A NEW LINE OF DELUXE DESK PANEL CABINET RACKS

- Available in six sizes from 8¾" panel space to 35". All units 15" deep.
- Black or grey ripple finish, as specified.
- Rigidly constructed of 16 gauge steel.
- Panel mounting holes tapped 10-32 for either Western Electric or Amateur notched panels.
- All doors provided with flush catches.

These cabinet racks are the newest product in a quality line of metal equipment. A partial list of products includes chassis, panels, cases, standard and deluxe cabinets, sloping front cabinets, amplifier foundations and standard and deluxe cabinet racks. Each item is made in a variety of stock sizes, and is adaptable to fit every requirement.

CATALOG SENT ON REQUEST

ECLIPSE MANUFACTURING CO., INC.
CABINETS • PANELS • CHASSIS
294 East 137th Street New York 54, N. Y.

ADDITIONS AND CORRECTIONS (continued)

CONVERTERS—*f-m*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

FILTERS—*Band Elimination*

Filtron Co., The, 38-25 Bell Blvd., Bayside, Long Island, N. Y.

FILTERS—*Band Pass*

Filtron Co., The, 38-25 Bell Blvd., Bayside, Long Island, N. Y.

FILTERS—*Electric Wave Section*

Filtron Co., The, 38-25 Bell Blvd., Bayside, Long Island, N. Y.

FILTERS—*Noise*

Filtron Co., The, 38-25 Bell Blvd., Bayside, Long Island, N. Y.

FILTERS—*uhf & vhf*

Filtron Co., The, 38-25 Bell Blvd., Bayside, Long Island, N. Y.

FORKS—*Electrically Driven Tuning*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

GALVANOMETERS

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

GENERATORS, SIGNALS—*r-f*

Tel-Instrument Company, Inc., 50 Paterson Ave., East Rutherford, N. J.

GENERATORS, SIGNAL—*Sweeping*

Tel-Instrument Company, Inc., 50 Paterson Ave., East Rutherford, N. J.

GENERATORS, SIGNAL — *Television Synchronizing*

Tel-Instrument Company, Inc., 50 Paterson Ave., East Rutherford, N. J.

GENERATORS — *Television Linearity Checking*

Tel-Instrument Company, Inc., 50 Paterson Ave., East Rutherford, N. J.

HEARING AID CHOKES

Microtone Company, The, 4602 Nicollet Ave., Minneapolis 9, Minn.

HEARING AID TRANSFORMERS

Microtone Company, The, 4602 Nicollet Ave., Minneapolis 9, Minn.

HEARING AIDS

Microtone Company, The, 4602 Nicollet Ave., Minneapolis 9, Minn.

LOUDSPEAKERS

Best Manufacturing Co., Inc., 1200 Grove St., Irvington 11, N. J.

LUGS AND TERMINALS

Sheffco Mfg. Co., 116 W. Ruby Ave., Palisades Park, N. J.

METAL PARTS — *Small Metal Stampings*

Sheffco Mfg. Co., 116 W. Ruby Ave., Palisades Park, N. J.

METERS—*Photoelectric Reflection*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

MICROWAVE TRANSMISSION LINKS & MICROWAVE ACCESSORIES

Technicraft Laboratories, Inc., Box 1908, Waterbury, Conn.

ADDITIONS AND CORRECTIONS (continued)

MOTORS—*Servo*

Hansen Mfg. Co., Inc., Princeton, Indiana

MOTORS—*Synchronous*

Hansen Mfg. Co., Inc., Princeton, Indiana

MOTORS—*Timing*

Hansen Mfg. Co., Inc., Princeton, Indiana

MULTIVIBRATORS

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

MUSIC SYSTEMS—*Industrial & Commercial*

Allied Radio Corp., 833 W. Jackson Blvd., Chicago, 7, Ill.

OPTICAL EQUIPMENT AND OPTICAL SPECIALTIES

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

OSCILLATORS—*Audio Fork Controlled*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

OSCILLOGRAPHS—*Recording*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

PHONOGRAPHS—*Electric Phonographs & Record Players*

Shevers Inc., Harold, 33 W. 46th St., New York 19, N. Y.

PICKUPS—*Photoelectric*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

PLUGS AND JACKS

Electro-Connector Corp., 110 W. Oxford St., Phila. 22, Pa.

POTS—*Soldering*

Tech Laboratories, Inc., 337 Central Ave., Jersey City 7, N. J.

POWER PACKS

Electronic Controls Co. of New York, 3124 Avenue I, Brooklyn 10, N. Y.

POWER SUPPLIES

Electronic Controls Co. of New York, 3124 Avenue I, Brooklyn 10, N. Y.
Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

POWER SUPPLIES—*Electronically Regulated*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio
Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

POWER SUPPLIES—*High Voltage*

Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.

POWER SUPPLIES—*Voltage Regulated*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

RECEIVERS—*a-m Fixed Frequency*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS—*a-m/f-m Communication*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS—*f-m*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS—*Fixed Frequency*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS—*Police & Fire*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS—*Television*

Shevers Inc., Harold, 33 W. 46th St., New York 19, N. Y.
Tele King Corp., 601 W. 26th St., New York 1, N. Y.
Telicor Corp., 851 Madison Ave., New York 21, N. Y.

RECEIVERS—*uhf*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS—*vhf*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

RECEIVERS, HOME—*a-m/f-m Combinations*

Shevers Inc., Harold, 33 W. 46th St., New York 19, N. Y.

RECORDERS—*Facsimile*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

RECORDERS—*Film*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

RECTIFIERS—*Dry Disc*

Electronic Controls Co. of New York, 3124 Avenue I, Brooklyn 10, N. Y.

RESISTORS—*Temperature Sensitive*

Carborundum Co., Globar Div., Niagara Falls, N. Y.

RESISTORS—*Voltage Sensitive*

Carborundum Co., Globar Div., Niagara Falls, N. Y.

SCANNERS—*Reflected & Transmitted Light*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

SOCKETS—*Tube*

Electro-Connector Corp., 110 W. Oxford St., Phila. 22 Pa.

SOUND SYSTEMS—*Complete*

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
Planet Radio Mfg. Corp., 6508 Euclid Ave., Cleveland 3, Ohio

STANDARDS—*Frequency*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

STANDARDS—*Laboratory Time*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

ADDITIONS AND CORRECTIONS (continued)

SWITCHES—*Mercury*

General Electric Co., Tube Div., Schenectady 5, N. Y.

SYNCHRONIZERS—*Electronic*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

TELEVISION SYSTEMS—*Industrial*

Tellcor Corp., 851 Madison Ave., New York 21, N. Y.

TESTERS—*Microwave Radar Testing Equipment*

Technicraft Laboratories, Inc., Box 1908, Waterbury, Conn.

TOOLS—*Soldering Guns*

Weller Mfg. Co., 806 Packer St., Easton, Pa.

TRANSFORMERS—*Microwave*

Technicraft Laboratories, Inc., Box 1908, Waterbury, Conn.

TRANSMITTERS—*f-m*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*Facsimile*

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio

TRANSMITTERS—*Fixed Frequency*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*Fixed Station Communication*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*Portable and Mobile Radio-Telephone*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*Pulse Time Modulation*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*Radio Range*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*uhf*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TRANSMITTERS—*vhf*

National Electronics Laboratories, Inc., 200 King St., Alexandria, Va.

TUBE PARTS

Bases

General Electric Co., Tube Div., Schenectady 5, N. Y.

Caps

General Electric Co., Tube Div., Schenectady 5, N. Y.

Cathode Sleeves & Tubes

General Electric Co., Tube Div., Schenectady 5, N. Y.

ADDITIONS AND CORRECTIONS (continued)

Cathode Ray Tube Side Contacts

General Electric Co., Tube Div., Schenectady 5, N. Y.

Grids and Supports

General Electric Co., Tube Div., Schenectady 5, N. Y.

Heat Radiators

General Electric Co., Tube Div., Schenectady 5, N. Y.

Metal Supports

General Electric Co., Tube Div., Schenectady 5, N. Y.

Mica Supports

General Electric Co., Tube Div., Schenectady 5, N. Y.

Water Jackets

General Electric Co., Tube Div., Schenectady 5, N. Y.

Wire Parts

General Electric Co., Tube Div., Schenectady 5, N. Y.

TUBES—*Phototubes and Photocells*

American Scientific Co., P. O. Box 1, High Bridge Station, New York 52, N. Y.

WASHERS—*Metal*

Sheffco Mfg. Co., 116 W. Ruby Ave., Palisades Park, N. J.

WAVEGUIDES—*Flexible*

Technicraft Laboratories, Inc., Box 1908, Waterbury, Conn.
Titeflex, Inc., 410 Frelinghuysen Ave., Newark 5, N. J.

WAVEGUIDES—*Rigid*

Technicraft Laboratories, Inc., Box 1908, Waterbury, Conn.

WIRE—*Fine Wire Specialties*

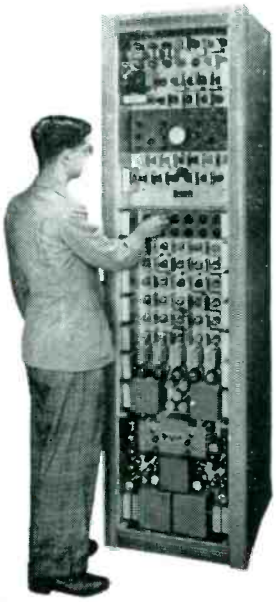
Sheffco Mfg. Co., 116 W. Ruby Ave., Palisades Park, N. J.

NAMES and ADDRESSES ADDITIONS and CORRECTIONS

Acme Telectronix, Div. of NEA Service Inc., West Third and Lakeside, Cleveland 13, Ohio
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.
American Scientific Co., P.O. Box 1, High Bridge Station, New York 52, N. Y.
De Jur-Amsco Corp., Northern Blvd. at 45th St., Long Island City 1, N. Y.
Electro-Connector Corp., 110 W. Oxford St., Phila. 22, Pa.
Electronic Controls Co. of New York, 3124 Avenue I, Brooklyn 10, N. Y.
Electronic Instrument Co., Inc., 377 Blake Ave., Brooklyn, N. Y.
Filtron Co., The, 38-25 Bell Blvd., Bayside, Long Island, N. Y.
Fugle-Miller Laboratories, 398 Main St., Metuchen, N. J.
General Electric Co., Tube Div., Schenectady 5, N. Y.
Hansen Mfg. Co., Inc., Princeton, Indiana
Intra-Video Corp. of America, 851 Madison Ave., New York 21, N. Y.
Kurman Electric Co., Inc., 35-18 37th St., Long Island City 1, N. Y.
Microtone Company, The, 4602 Nicollet Ave., Minneapolis 9, Minn.
Photobell Company, 116 Nassau St., New York 7, N. Y.
Planet Radio Mfg. Corp., 6508 Euclid Ave., Cleveland 3, Ohio
Sheffco Mfg. Co., 116 W. Ruby Ave., Palisades Park, N. J.
Shevers Inc., Harold, 33 W. 46th St., New York 19, N. Y.
Technicraft Laboratories, Inc., Box 1908, Waterbury, Conn.

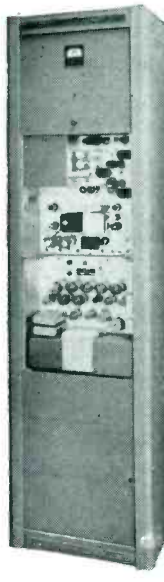
POLARAD
TELEVISION Equipment
for studio • laboratory • manufacturer

SYNCHRONIZING GENERATOR
Model PT 101—Television



FEATURES
- Built-in 3" oscilloscope with synchronized sweeps for viewing Timing and Video Output pulse wave forms.
- Synchronized marker system for checking pulse width and rise time.
- Extreme stability, insured by deriving all pulses from leading edge of master oscillator pulse.
- Means for checking synchronizing pulses in odd and even fields.

SPECIFICATIONS
525 line, interlocad, 60 fields, 30 frames, RMA Synchronizing pulses held to tolerance specified in the NRTPB report of 1945. Output Pulses: Synchronizing, Video Blanking, Camera Blanknig, Horizontal Driving, Vertical Driving Pulses. 5 volts across 100 ohm termination. Dual output jacks. 115 volts 50/60 cps. Complete with tubes.



TELEVISION MONOSCOPE SIGNAL SOURCE
Model PT 102
- Composite Video Signal
- Wide Band Video Amplifier, 6 DB down at 10MC
- Dual outputs for feeding two 75 or 100 lines
- Black positive or Black negative output
- Resolution greater than 600 lines

INPUT: Vertical and Horizontal Driving pulses. Camera and Kinescope Blanking Pulses.

OUTPUT: Composite Video Signal, 3 volts, 100 ohm line 115 volts 50/60 cps. Complete with tubes and including high and low voltage power units.

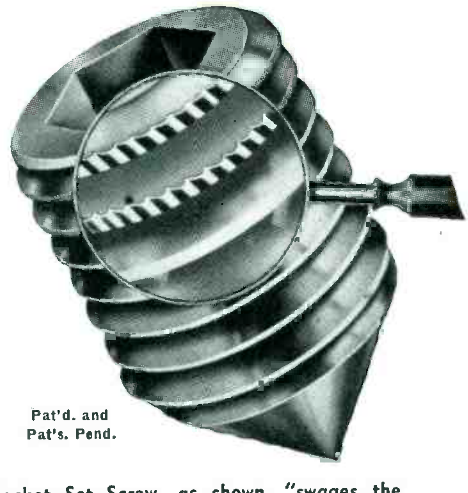
•

9 FERRY STREET
NEW YORK 7, N. Y.

Polarad Electronics Company

Television engineers and consultants to the nation's great television stations.

THIS SELF-LOCKER *won't* SHAKE LOOSE!



Pat'd. and Pat's. Pend.

UNBRAKO
Reg. U.S. Pat. Off.

The Knurling of this "Unbrako" Socket Set Screw, as shown, "*swages* the threads", so that it becomes a most excellent "Self-Locker" . . . for use with the 5 standard points that do not lend themselves to knurling. This "Unbrako" Socket Set Screw positively *will not shake loose*, regardless of the most chattering vibration. Sizes available from #4 to 1½" diameter, and in a full range of lengths. Ask for *your* copy of the "Unbrako" Catalog . . . it is useful and informative.

Our patented "Unbrako" Self-Locking Knurled Socket Set Screws and Stripper Bolts lock in most any industrial screw application. They *won't shake loose*. Millions and millions in use.

Write us for the name and address of your nearest "Unbrako" Industrial Distributor and your copy of the "Unbrako" Catalog.

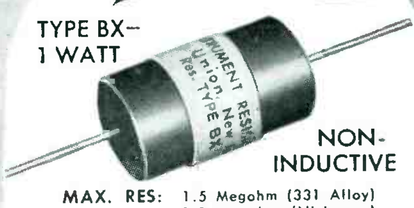
Knurling of Socket Screws originated with "Unbrako" in 1934.

OVER 45 YEARS IN BUSINESS

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 596
CHICAGO • DETROIT • INDIANAPOLIS • ST. LOUIS • SAN FRANCISCO

—high accuracy plus!

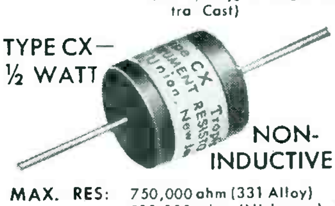
TYPE BX— 1 WATT



NON-INDUCTIVE

MAX. RES: 1.5 Megohm (331 Alloy)
1.0 Megohm (Nichrome)
30,000 Ohms (Manganin)
BODY SIZE: 1" lg. by 9/16" diam.
TOLERANCE: STANDARD 1%
(TO 1/10% at Slight Extra Cost)

TYPE CX— ½ WATT



NON-INDUCTIVE

MAX. RES: 750,000 ohm (331 Alloy)
500,000 ohm (Nichrome)
15,000 ohm (Manganin)
BODY SIZE: 5/8" lg. by 9/16" diam.
TOLERANCE: STANDARD 1%
(TO 1/10% at Slight Extra Cost)

For Instrumentation and other critical applications

IN-RES-CO wire wound resistors are engineered for the manufacturer maintaining a reputation of top quality and performance in his equipment. They cover a full range from 1 watt to 10 watts and .01 ohm to 1.5 megohm. Conservative ratings assure maximum long life; trouble free service. Write for catalog today on company letterhead.

IN-RES-CO
APPLICATION-DESIGNED
RESISTORS
IN-RES-CO

INSTRUMENT RESISTORS CO., 1056 COMMERCE AVE., UNION, N. J.

ADDITIONS AND CORRECTIONS (continued)

Tele King Corp., 601 W. 26th St., New York 1, N. Y.
Telicor Corp., 851 Madison Ave., New York 21, N. Y.
Tel-Instrument Co., Inc., 50 Paterson Ave., East Rutherford, N. J.
Weller Mfg. Co., 806 Packer St., Easton, Pa.

TRADE NAMES ADDITIONS and CORRECTIONS

AMERTRAN
American Transformer Co.

DURATIP
Weller Mfg. Co.

EMPIRE
Empire Coil Company, Inc.

FLEXITIP
Weller Mfg. Co.

INDUSTRIAL TELECEIVERS
Industrial Television, Inc.

KNIGHT
Allied Radio Corp.

MULTIVIDEO
Industrial Television, Inc.

SOLDERLITE
Weller Mfg. Co.

SPEED IRON
Weller Mfg. Co.

SYNCHRON
Hansen Mfg. Co., Inc.

TECH LAB
Tech Laboratories, Inc.

TELEPHOTO
Acme Telectronix, Div. of NEA Service Inc.

Due to an error, the listings of the General Controls Co. of Glendale, California incorrectly referred to an advertisement on page 111 which was an advertisement of the General Control Company, 1204 Soldiers Field Road, Boston 34, Mass. There is no connection between the two companies.

Due to an error, the listings of the Northern Radio Co., 314 Bell St., Seattle 1, Wash. incorrectly referred to an advertisement on pages 190 and 191 which was an advertisement of Northern Radio Co., Inc., 143-145 W. 22nd St., New York 11, N. Y. There is no connection between the two companies.

Electronic Controls Co. of New York advertisement incorrectly listed as Page 224 instead of Page 244.

Manufacturers of glass bonded mica were incorrectly listed, they should have only included the following:

Electronics Mechanics, Inc.,
70 Clifton Blvd.,
Clifton, N. J.

General Electric Co.,
Chemical Dept.,
Pittseld, Mass.

Mycalex Corp. of America,
60 Clifton Blvd.,
Clifton, N. J.

(continued from page 138)

and point-to-point communications for the rapidly expanding civil aviation services and for administrative, public and meteorological traffic. The new system will operate throughout Kenya, Uganda and Tanganyika.

Two of the latest types of Marconi transmitters have been chosen for the service: type TGS. 541—a 200-watt transmitter with a frequency range of 1.5 to 23 mc; and type TGS. 501—a 100-watt set covering the 1.5 to 13-mc range. Special features include crystal control with provision for rapid selection of any one of six working frequencies.

Australia's Rural Radiophone

FIRST INSTALLATIONS are now being made in the Broken Hill district in New South Wales, of a radiophone set which will link Australian ranchers to the telephone network. The equipment was developed by the research laboratories of Electronics Industries Ltd., Melbourne, in cooperation with the Commonwealth Postmaster General's Department.

The subscriber merely lifts a standard telephone handset from the instrument and depresses a key to connect him with the operator. Calls are accepted for any point in Australia and most overseas countries.

The base station transmitter is amplitude-modulated and has an output of 200 watts. It covers subscribers within a range of 200 miles. Subscriber sets are operated from a 12-volt storage battery and transmission is also by a-m.

Automatic Control Course

INSTRUMENTATION FOR the process industries will be the subject matter of a third short course to be conducted by Texas A & M College in cooperation with several industrial concerns at College Station, Texas, October 26-28. Manufacturers of instruments and automatic controls are participating by showing educational exhibits.

The program will be of special value to instrument, process design

and operating engineers. Lectures have been scheduled to cover such subjects as measurement and control of temperance, pressure, liquid level and time.

Registration fee is $5.00. Further information may be obtained by writing Professor P. G. Murdoch, Chemical Engineering Department, Texas A & M College, College Station, Texas.

Plan Radio Net for India

To RELIEVE the overburdened telegraph system in India, a radio communications network covering the ten leading cities is due to be set up shortly. Official estimates are that initial cost will be about $1,300,000 and annual recurring costs about $210,000.

Each of the ten cities will have a 10-kw high-speed short-wave transmitter and a triple diversity receiver. Both will be teleprinter-equipped.

Radio License Increase

MORE THAN 635,000 separate radio authorizations, covering stations and operators, were outstanding with the FCC at the close of the fiscal year. This represents an increase of nearly 90,000 over the previous year. Breakdown is as follows:

STATIONS	As of June 30, 1947	As of June 30, 1948
Broadcast		
A-M	1,795	2,034
F-M	918	1,020
TV	66	109
TV (experimental)	81	124
Educational	38	46
International	37	37
Remote Pickup	583	571
Other	33	26
Totals	3,551	3,967
Nonbroadcast		
Aeronautical	15,843	20,858
Marine	10,755	15,024
Public Safety	4,257	4,903
Land Transportation	1,792	3,122
Industrial	1,571	2,855
Miscellaneous	1,919	1,648
Amateur	*75,000	78,434
Totals	112,137	126,844
OPERATORS		
Amateur	*80,000	77,923
Commercial	*325,000	*347,000
Aircraft	*25,000	79,924
Totals	430,000	504,847

* Estimated.

The station figures do not represent the actual number of transmit-

ters, since a single authorization can cover a number of associated mobile units. Year-end figures for mobile units are not available.

BUSINESS NEWS

BROCINER - MASS INSTRUMENTS, INC., New York City, has been organized for the development and manufacture of photoelectric colorimeters, photometers and related equipment in the electronic instrument and clinical fields.

MAYFLOWER ELECTRONIC DEVICES, INC., West New York, N. J., has formed a client research department to engage in research on dielectric heat and electronic sealing.

ELTRAN CORP., St. Anne, Illinois, has purchased the business of Radell Corp., Indianapolis, Indiana, to complete its line of loudspeakers.

CUTLER-HAMMER, INC., Milwaukee, Wisconsin, manufacturers of electrical apparatus, has acquired the business of the West Electric Products Co., Los Angeles, Calif.

COOK RESEARCH LABORATORIES, Chicago, Ill., has begun construction of a one-story addition to its present facilities. The new building will

Sketch of new Cook Research Lab

approximately double the floor space available for design, development, instrumentation and testing.

INTERNATIONAL TELEVISION CORP. recently purchased the Minerva Radio Corp. plant at 238 William Street, New York City. The additional 50,000 sq ft of space will facilitate full-scale production of a complete line of television receivers.

AMERICAN STANDARDS ASSOCIATION, INC., is the new name of the ASA New York City. The incorporation recognizes the enlarged activities

EISLER

ELECTRICAL & ELECTRONIC

EQUIPMENT

ELECTRONIC TUBE EQUIPMENT

36 HEAD RADIO TUBE EXHAUSTING MACHINE

●

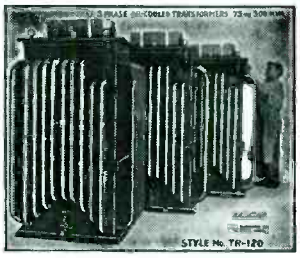
We Make Complete Equipment For The Manufacture Of Incandescent Lamps Radio and Electronic Tubes.

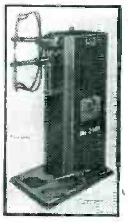
TRANSFORMERS OF ALL TYPES

For LIGHTING POWER FURNACES PHASE CHANGING DISTRIBUTION ETC.

●

Air, Oil, or Water Cooled





SIZES 1/4 to 250 KVA

SPOT WELDERS

OF ALL TYPES
FOR ALL PURPOSES
SIZES 1/4 to 250 KVA
Butt Welders - Gun Welders
Arc Welders
Neon Sign Units
Fluorescent Tube
Manufacturing Equipment

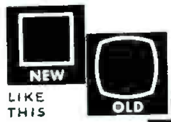
CHAS. EISLER

EISLER ENGINEERING CO., INC.

751 So. 13th St. (Near Avon Ave.), Newark 3, N. J.

PRECISION

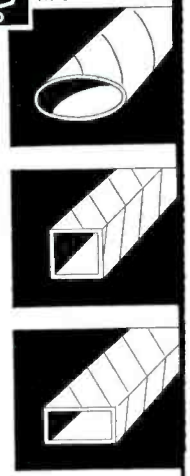
HASN'T "SQUARED THE CIRCLE" BUT HAS "SQUARED THE BOW"



producing

DI-FORMED PAPER TUBES

at no extra cost!



Precision DI-FORMED Paper Tubes have made a most important improvement throughout coil industry. Now ALL coil manufacturers and users can take advantage of the opportunity to obtain Precision DI-FORMED square and rectangular paper tubes for coil bases, *at no extra cost!*

Results: greater strength—automatic stacking—elimination of coil forming after winding—closer engineering of coils, saving wire. Precision characteristics, spiral winding, better insulation, space and weight saving are improved. Tubes also made round, oval, any shape.

Write for samples—also new Mandrel List. Many new sizes.

PRECISION PAPER TUBE CO.

2041 W. Charleston St., Chicago 47, Ill.

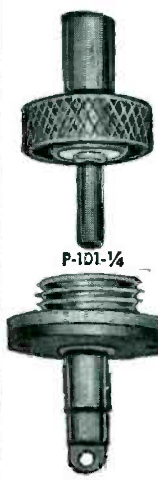
PLANT NO. 2 79 CHAPEL ST., HARTFORD, CONN.

Ideal for
ANTENNA CONNECTIONS
PHOTO-CELL WORK
MICROPHONE CONNECTIONS

JONES

SHIELDED TYPE

PLUGS & SOCKETS



P-101-1/4

S-101

LOW LOSS PLUGS AND SOCKETS FOR HIGH FREQUENCY CONNECTIONS. SUPPLIED IN 1 AND 2 CONTACT TYPES:

101 Series can be furnished with 1/4", .290", 5/16", 3/8" or 1/2" ferrule for cable entrance. Knurled nut securely fastens unit together. Plugs have ceramic insulation and sockets have bakelite. Quality construction. Fine finish. Assembly meets Navy specifications.

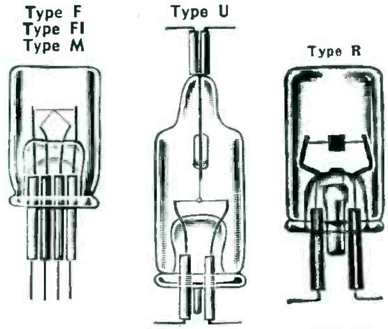
For full details and engineering data ask for Jones Catalog No. 16.

JONES MEANS *Proven* QUALITY

HOWARD B. JONES DIVISION

Cinch Mfg. Corp.

2460 W. GEORGE ST CHICAGO 18, ILL.



FIELD VACUUM THERMOCOUPLES

- TYPE F, contact type, and TYPE FI, with insulated heater, available in ranges of 1.2 milliamperes and over.
- TYPE M, contact type, 25 MV output, constructed in ranges of 100 milliamperes and over.
- TYPE U, with insulated heater, for measurements at ultra-high frequencies, made in ranges of 3 milliamperes and over. Streamlined to make convenient use in coaxial cables or fittings possible.
- TYPE R, for radiant energy measurements.

Write Department VE for latest informative bulletins

FIELD ELECTRICAL INSTRUMENT COMPANY

109 E. 184 ST. • NEW YORK 53, N. Y.

The theory and application of electronics in industry

INDUSTRIAL ELECTRONICS REFERENCE BOOK

By Electronics Engineers of the Westinghouse Electric Corp.

This book was compiled to answer the need for complete and clear information on the application and design of industrial electronic equipment. Written by a group of engineers, each an expert in his particular branch of electronics, the *Industrial Electronics Reference Book* contains the most recent information on the subject. The material is directed at the practicing engineer. Its aim is to give him a better understanding of the scope and limitations of electronic apparatus as it is applied to industrial processes.

1948 680 Double-column Pages $7.50

ON APPROVAL COUPON

JOHN WILEY & SONS, INC.
440 Fourth Ave., New York 16, N. Y.

Please send me, on 10 days' approval, a copy of INDUSTRIAL ELECTRONICS REFERENCE BOOK. If I decide to keep the book, I will remit $7.50 plus postage; otherwise I will return the book postpaid.

Name ....

Address ....

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

Employed by ....

(Offer not valid outside U. S.) E-10-48

and responsibilities of the organization.

PICKARD & BURNS, INC., consulting engineers, recently moved to new quarters at 240 Highland Ave., Needham, Mass.

GENERAL INSTRUMENT CORP., radio and television components manufacturer, is now controlled by a group headed by C. Russell Feldman, founder of Transitone, and Richard E. Laux, formerly vice-president in charge of operations of Colonial Radio Corp., Buffalo, N.Y.

GENERAL ELECTRIC CO., Electronics Park, now has a new division called the Industrial and Transmitting Tube Division. It will consolidate all sales, design engineering and manufacturing activities related to the former Power Electronics Division.

SPERRY PRODUCTS, INC., manufacturers of ultrasonic instruments and hydraulic remote controls, have moved from Hoboken, N. J., to new quarters in Danbury, Conn.

GENERAL ELECTRIC X-RAY CORP., Milwaukee, Wisc., has furnished a two-million-volt x-ray machine for The Babcock & Wilcox Company to examine welds in high-pressure, high-temperature boiler drums 4½ to 6½ inches thick. The machine's exposure time for a 5½-inch plate is 6 minutes when using a film distance of 6 feet. It is the first of its size to be used exclusively for testing welds in pressure vessels. The special new 70 by 30-ft building in which it is housed will accommodate drums up to 13 ft in diameter and 70 ft long.

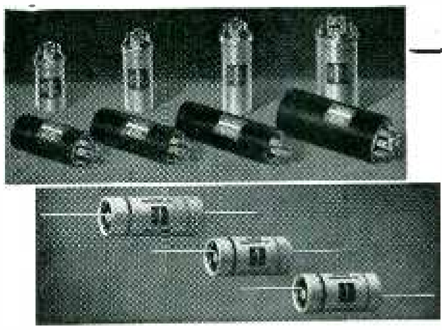
WHEELCO INSTRUMENTS CO. recently opened a new office at 138 East Becher St., Milwaukee 7, Wisconsin.

PERSONNEL

MARTIN KIEBERT, JR. recently joined Raymond Rosen & Co., Philadelphia, to take charge of the engineering, design and sale of all telemetering equipment.

ELTON W. JONES, formerly assistant professor of electrical engineering

ILLINOIS CONDENSERS BELONG IN THE BEST Electronic Sets



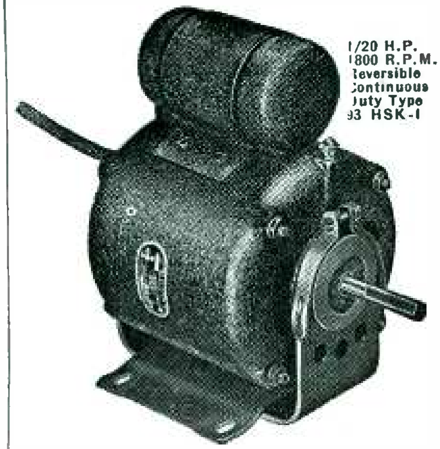
The Trade Mark of "Time Tested Quality"

● Look to Illinois for a complete line of electrolytic capacitors for every electronic application. When you need a capacitor that has superior ability to withstand extreme temperature changes; that's manufactured to exacting specifications; that's time tested through 14 years of high quality production experience—you want an Illinois condenser!

● Write for our latest catalog.

ILLINOIS CONDENSER CO.
1616 NORTH THROOP STREET • CHICAGO 22, ILL.

DUAL SPEED HYSTERESIS
Synchronous Motors



- NO NOISE
- NO VIBRATION
- HUNT and "WOW" ELIMINATED
- INDEPENDENT of LOAD INERTIA

Applications:

Disc, wire and film recorders
Sound cameras and projectors
Facsimile equipment
Television equipment
Timing devices
Stroboscopic work
Teletype equipment

We can furnish on quantity orders COMBINATIONS of any two of the following speeds:

600 R.P.M.
900 R.P.M.
1200 R.P.M.
1800 R.P.M.
3600 R.P.M.

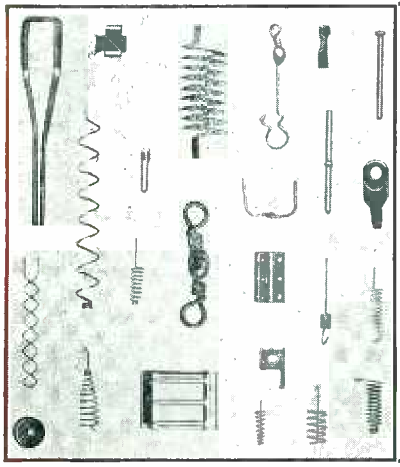
Instantly reversible with D.P D.T. switch! H.P. ratings 1/150 to 1/30 depending on speed combination selected. Round Frame, Resilient Mount, Rigid Base.

The hysteresis design of these new Synchronous Motors lowers noise and vibration level to a fraction of that normally present in conventional salient pole construction. Unaffected by load inertia.

These Hysteresis Motors are now standard equipment on many high quality Recorders.

What are your requirements?

EASTERN AIR DEVICES, INC.
130 FLATBUSH AVENUE
BROOKLYN 17, NEW YORK



SMALL PARTS

Filaments, anodes, supports, springs, etc. for electronic tubes. Small wire and flat metal formed parts to your prints for your assemblies. Double pointed pins. Wire straightened and cut diameter up to 1/8-inch. Any length up to 12 feet.

LUXON fishing tackle accessories.
Inquiries will receive prompt attention.

ART WIRE AND STAMPING CO.

227 High St. Newark 2, N. J.

"Where Professional Radiomen Study"

CAPITOL RADIO ENGINEERING INSTITUTE

An Accredited Technical Institute

16th and Park Rd., N.W. Dept. E-10
Washington 10, D.C.

Advanced Home Study and Residence Courses in Practical Radio-Electronics and Television.

Approved for Veteran Training.

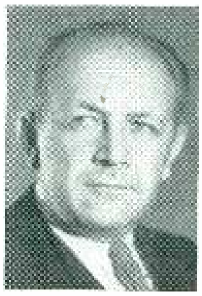
at Pennsylvania State College, was recently named associate professor at Illinois Institute of Technology.

R. JACK WEST, associated with Wired Radio of Canada Ltd. since 1935, was recently appointed vice-president of the company.

CHARLES A. NUEBLING, formerly with Servo Corp. of America and Sperry Gyroscope Co., is now director of electronics for W. L. Maxson Corp., New York City, which recently expanded its engineering activities to include radar and associated high-frequency research and development.

GEORGE M. LEBEDEFF, quality control specialist and formerly chief engineer of Heintz & Kaufman Ltd., has joined Lenkurt Electric Co., San Carlos, Calif., as a carrier engineer.

G. M. Lebedeff



L. Marton

LADISLAUS MARTON, chief of the electron physics section, National Bureau of Standards, has spent the summer in Europe surveying current work in the field of electron microscopy.

LEONARD MILTON, formerly senior engineer at Solar Mfg. Corp., North Bergen, N. J., is now chief engineer at Filtron Co., Inc., Bayside, New York.

HAROLD W. SCHAEFER, until recently in charge of engineering development and research, has been appointed assistant manager of the Westinghouse Home Radio Division, Sunbury, Pa. During the war he was associated with the OSRD in charge of engineering manufacturing of the proximity fuze.

R. W. FERRELL, former counsel for General Electric's Electronics Department at Syracuse, N. Y., has been appointed assistant manager

of the receiver division at Electronics Park.

EDWIN F. STEVENS, formerly chief engineer of International Electronic Laboratories and Lon-Ga-Tone, Inc., is director of sales engineering and research of the newly formed client research department at Mayflower Electronic Devices, Inc., West New York, N. J.

HOBART C. MCDANIEL, formerly commercial engineer with Westinghouse Lamp Division in Bloomfield, N. J., has been appointed manager of the technical press service in the public relations department of Westinghouse Electric Corp., Pittsburgh, Pa.

A. A. EMLEN, formerly vice-president in charge of engineering at American Transformer Co. and then at Newark Transformer Co., has joined the engineering staff of the Peerless Electrical Products Division of Altec Lansing Corp., New York City.

A. A. Emlen

A. E. Cullum, Jr.

A. EARL CULLUM, JR. has been awarded the Presidential Certificate of Merit for meritorious service from August 1942 to February 1946 in his work in radio and radar countermeasures as associate director of the Radio Research Laboratory at Harvard University.

BENJAMIN A. FISHER, formerly professor of electrical engineering at the University of Denver, was recently appointed associate professor at Illinois Institute of Technology.

MAXWELL K. GOLDSTEIN, associated with the Naval Research Laboratory since 1939, has been named to organize and direct the Programs Research Unit of the Research Group of the Office of Naval Research. He holds the Distinguished Civilian

Service award for his work on the radio direction finder and a commendation from the Chief of Naval Research for his contribution to navigation systems in all-weather flying.

CARL D. PIERSON, JR. has been appointed instructor in electrical engineering at Illinois Institute of Technology. From 1941 to 1948 he was senior engineer and division engineer of the Belmont Radio Corp. in research and development.

LEANDER W. MATSCH, former supervisor in electrical engineering research at the Armour Research Foundation, is the recently appointed professor of electrical engineering at Illinois Institute of Technology.

A. M. ZAREM, inventor of the Zarem camera used in the photographic microtime technique developed at the Navy Test Station in Pasadena, Calif., has been appointed chairman of physics research and manager of the new Los Angeles Division of the Stanford Research Institute.

RAY DAVIS KELL, director of television research at the RCA Laboratories, Princeton, N. J. was the 1948 recipient of the Stuart Ballantine Medal of the Franklin Institute for outstanding pioneer work in television and for his efforts in the development of color television.

METEOR HUNTER

Electronic metal-detecting wheelbarrow used by H. O. Stockwell for fragments of a meteor reported to have exploded in mid-air in Norton, Kansas

NEW BOOKS

Alternating-Current Circuit Theory

BY MYRIL B. REED, *Prof. of Elec. Eng., Univ. of Ill. Harper & Brothers, New York*, 1948, 603 *pages*, $5.50.

THIS FIRST VOLUME in Harper's new Electric Power Series is intended as a textbook for the third-year engineering course in a-c theory. Its content was developed over a ten-year period of alternate writing and classroom testing, to provide a basic text that would serve as a background for all the major fields of specialization in electrical engineering.

Topics covered include sine wave and vector representation of a-c, algebra of complex numbers, I, E, P and energy relations in R, C and L, solution of circuits, Fourier series, transients, mesh equations, network theorems, wye and delta connections, measurements, matrices, steady state operation of transmission lines, and electric filters. Many problems are provided, including some that are intentionally made too long or too difficult for the usual homework assignment; these require extra time or extra help from the instructor.—J.M.

Elements of Electrical Engineering

BY WALTER J. CREAMER, *Professor of Communication Engineering and Head of the Department of Electrical Engineering, University of Maine. McGraw-Hill Book Co., Inc., New York*, 344 *pages*, $4.00.

THE transition from abstract science courses to applied engineering courses is made less abrupt by this book. It contains a fusion of basic and applied material, presented to guide students in learning to approach concrete problems from their background of fundamental concepts.

The first two chapters concern electrical quantities and laws, and the second two concern conductors, insulators, and methods of measuring networks. Thus from chapter to chapter there is a progression from the abstract to the applied. Also within chapters the same development has been followed. The chapter on electromechanical action, for example, begins with considerations of ionic formation and concludes with the cause, effect, and cure of electrolytic corrosion of buried pipes; the bulk of the chapter is devoted to batteries.

This book is also indicative of the growing importance of electronics. The title and position of the author in his department are significant; also, in this book the bulk of which is devoted to electric machines the concluding chapter is on electronics for both communication and industrial applications.—F. H. R.

• • •

Books Received for Review

IONOSPHERIC RESEARCH AT WATHEROO OBSERVATORY, WESTERN AUSTRALIA, JUNE 1938-JUNE 1946. By L. V. Berkner and H. W. Wells, Carnegie Institution of Washington Publication 175, Washington, D. C., 1948, 425 pages, paper binding $2; in cloth, $2.50. Devoted mainly to tables of results, this volume includes a summary of results together with brief description of equipment and methods used. A bibliography of publications on ionospheric research by authors in the Department of Terrestrial Magnetism is also furnished.

RADAR. By Orrin E. Dunlap, Jr. Harper & Brothers, New York, 1948 (revised), 268 pages, $3.00. A popular account of all types of radar equipment and the story of its development. The revised edition explores postwar advances and indicates the many peace-time uses of the technique.

TELEVISION . . . HOW IT WORKS. By John F. Rider and others. John F. Rider Publisher, Inc., New York 1948, 203 pages, $2.70. A paper bound volume printed on 8½ x 11 in. stock. Elements of transmitting equipment are described in order to facilitate an explanation of the overall system. The bulk of the material covers different aspects of receiving equipment from the point of view of the service man.

ANTENNA MANUAL. By Woodrow Smith. Editors and Engineers, Ltd., Santa Barbara, Calif., 1948, 306 pages, $3.50. Written for the average radioman rather than the engineer, this book sums up the elements of propagation before launching into a nonmathematical description of many types of antennas and methods of feeding power to them. Waveguides and antennas for microwaves are purposely omitted.

TELEVISION ENCYCLOPEDIA. By Stanley Kempner. Fairchild Pub. Co., N. Y., 1948, 415 pages, $6.50. Chronological history of television from 600 BC to 1947—42 pages; biographical sketches of contributors to development of television—93 pages; definitions of technical and nontechnical terms used—256 pages; Sylvania market survey—7 pages; bibliography—17 pages.

BATTLEFRONTS OF INDUSTRY. By David O. Woodbury. John Wiley & Sons, Inc., New York, N. Y., 1948, 342 pages, $3.50. Role of Westinghouse in World War II, covering design and production of everything from electric torpedoes to the machinery for producing the atomic bomb, with anecdotes of problems encountered and solved in the labs, in the factories, and on the warfronts.

WORTERBUCH DER ELEKTROTECHNIK, ENGLISCH-DEUTSCH. By G. Swoboda and R. Filipowsky. Manzsche Verlagsbuchhandlung, Wien I, Kohlmarkt 16, Austria, 1948, 312 pages, paper cover, $4.30. Pocket-size dictionary listing electronic terms alphabetically in English, each followed by the equivalent German term.

Backtalk

This department is operated as an open forum where our readers may discuss problems of the electronics industry or comment upon articles which ELECTRONICS has published.

Wow

DEAR SIRS:

IN the article "Wow Meter for Turntable Testing" in the March issue, Messrs. Sansbury and Pappenfus discuss the many sources of audible wow in phonograph record reproduction. While the elimination of wow in the mechanism used to drive records is important, it is far more important at this stage of development of the record art to give attention to the wow resulting from eccentricity in the centering of the record spindle hole with respect to the grooves, a fault given only passing mention in the article.

I am not sufficiently familiar with the production techniques of the industry to be able to say just why it is that so many commercial records are so noticeably defective in this respect, but there are few defects more in need of correction. The authors set up a criterion of a permissible frequency variation of three tenths of one percent.

This means that at a radius of five inches on a record, the eccentricity of the spindle hole would have to be kept within about one sixty-fourth of an inch in order that there should be no perceptible wow. At smaller distances from the center the tolerance is proportionally reduced.

When one notes that eccentricities of as much as one thirty-second of an inch are common and even larger amounts not infrequent, it is readily understood that wow should be so often evident. It is my guess that by far the greatest amount of wow found in home reproduction and in broadcast records is due to this eccentricity.

I believe further that a great deal of poor reproduction not ordi-

narily attributed to wow should be so attributed. Wow is most evident when sustained musical notes are being reproduced. For music without sustained notes or for speech, the only audible effect for a nonexpert may be a sense of flatness or general displeasure.

For these reasons, and because it seems to me that there should be no great technical obstacles preventing it, the record manufacturers should make a determined effort to improve hole centering accuracy and should reject as defective any records not passing a reasonable specification for it.

T. H. PROJECTOR
National Bureau of Standards
Washington, D. C.

Citizens Transceivers

DEAR SIRS:

IT HAS been called to my attention, relative to my article on Citizens Band Transceivers in August 1948 ELECTRONICS, that the BC-645, under conditions of extremes of temperature or humidity, variations of plate voltage or filament voltage, or ageing, may shift its transmitted frequency beyond the maximum specified for FCC Class B equipment. This has not been verified by the author, but any prospective users of this equipment should be warned that such shifts may exist. It must be borne in mind, in fact, that the frequency-determining elements of the BC-645 transmitter are solid, tuned lines, not crystals, and that crystal stability cannot be expected of this equipment.

I do not believe that the statements in my article are erroneous, but no attempt was made to subject the equipment to a complete set of tests representative of those required for FCC type approval of commercial equipment.

WILLIAM B. LURIE
Bronxville, N. Y.

THE EDITORS are often called upon to forward mail to authors . . . a recent epistle turned out to be a wedding invitation from a reader, a high government official of a European country, who recognized the byline of his distant relative.

PROFESSIONAL SERVICES

Consulting — Patents — Design — Development — Measurements

in

Radio, Audio, Industrial Electronic Appliances

ENGINEERS
PHYSICISTS

The establishment of a new section in our research laboratory requires the services of Electronic Engineers, Servo Engineers, and Physicists.

POSITIONS AVAILABLE AT ALL LEVELS

An excellent opportunity exists to grow with this expanding group and receive responsibilities commensurate with your ability and experience.

Microwave radar, television, telemetering, ultra-high frequency communication, cryogenic, high altitude physics, auto-pilot, and computor experience is especially valuable.

EMPLOYMENT SECTION

BENDIX AVIATION CORPORATION
Research Laboratories
4855 Fourth Avenue
Detroit, Michigan

Radio and Radar Development and Design Engineers

Openings at

HAZELTINE ELECTRONICS CORPORATION

Please furnish complete resume of experience with salary expected to:
Director of Engineering Personnel
HAZELTINE ELECTRONICS CORPORATION
Little Neck, L.I., N.Y.
(All inquiries treated confidentially)

CHIEF ELECTRICAL ENGR
PROJECT ENGRS
SENIOR ENGRS

Must have extensive experience in home radio receivers and/or television, design & development.

Address Replies To
Vice President in Charge Engineering
AIR KING PRODUCTS CO., INC.
170-53rd St. Brooklyn, N. Y.

TELEVISION ENGINEERS

A well established electronics manufacturer, located in the suburban New York City area, is interested in locating high grade television development engineers. This company is expanding its television activities and seeks capable men with backgrounds sufficiently complete to merit responsible positions.

Please give all details concerning yourself, your background and your previous earning capacity. Address your letter to the "Chief Engineer".

P-6212 Electronics
330 West 42 St., New York 18, N. Y.

WANTED
SENIOR ELECTRICAL ENGINEER
OR
PHYSICIST

M. S. preferred with experience in development of radar, television or digital computer circuits and systems.

Here is an excellent position with future opportunity for the right man in a rapidly expanding aggressive engineering firm. We now have over 150 graduate engineers and scientists engaged in research and development in the field of communications, computing systems, and electro-mechanical devices. Furthermore, it is a thrill to live in Minnesota in the Land of 10,000 Lakes.

Write for application giving a brief outline of scohlastic and employment background.

ENGINEERING RESEARCH ASSOCIATES, INC.
1902 W. Minnehaha Avenue
ST. PAUL 4, MINN.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

TECHNICAL WRITERS, to 30 years. Knowledge of electronics required, also apprentice writers with basic radio experience. Boland & Boyce Publishers, 460 Bloomfield Ave., Montclair, N. J.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (38 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby Inc., 266 Dun Bldg., Buffalo 2, N. Y.

EXECUTIVES $3,000-$25,000. This reliable service, established 1927, 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. E, 241 Orange St., New Haven, Conn.

POSITIONS WANTED

EXECUTIVE ASSISTANT, 33, business administration, education, radio and electronic parts experience. Ex-Army instructor. Knowledge all phases electronics. PW-6306, Electronics.

ELECTRONICS ENGINEER, Spanish speaking, desires position in Latin America, preferably Mexico or Central America. E.E. plus twelve years experience in all phases of radio communications in responsible positions. Now available. PW-6312, Electronics.

(Continued on opposite page)

TELEVISION ENGINEERS

The Crosley division, Avco Manufacturing Corporation is expanding its television receiver activities on a long term basis, creating a few positions for qualified supervisory and senior engineers.

Requirements: College degrees. Three or more years' experience in television and radar design and development of which at least two years have been spent in advanced or product development of television receivers. Specialists in circuit elements will be considered.

Ideal working conditions in well equipped modern laboratories with unlimited opportunities for advancement. Forty hour week, insurance, hospitalization and pension plans. Responsibilities and excellent salaries based on experience and ability.

Replies (which will be kept confidential) stating age, experience, education and salary requirements should be addressed to:

Director of Research and Engineering
CROSLEY DIVISION
AVCO MANUFACTURING CORPORATION
1329 Arlington St. Cincinnati 25, Ohio

PROJECT ENGINEERS

Real opportunities exist for Graduate Engineers with design and development experience in any of the following: Airplane Stability and control, Servomechanisms, radar, microwave techniques, microwave antenna design, communications equipment, electron optics, pulse transformers, fractional h.p. motors.

Send complete resume to employment office.

SPERRY GYROSCOPE CO.
DIVISION OF THE SPERRY CORP.
GREAT NECK, LONG ISLAND

POSITIONS WANTED
(Continued from opposite page)

RESEARCH AND Development Engineer. BSEE 7 yrs director of insulation developments in wire, cable and equipment field. Also 8 yrs. development and manufacturing experience in incandescent and fluorescent lamps. Able administrator. Midwest preferred. PW-6040, Electronics.

ELECTRONIC ENGINEER, experienced in radio, radar and television, desires position combining technical knowledge with background of 10 years manufacturing and top business management. PW-6143, Electronics.

ENGINEER SEEKS position as Assistant to Executive in Los Angeles area or as salaried Field Engineer with manufacturer or representative headquartered in Los Angeles. 17 years application, design, development and supervisory experience in radio, electronic and electrical equipment. 2½ years field engineering. Employed. PW-6251, Electronics.

SELLING OPPORTUNITIES WANTED

SALES REPRESENTATIVE—Excellent contacts with Chicago area radio and electrical manufacturers. Desires to represent established concern either full time or as agent. RA-5624, Electronics.

ENGINEER ACTIVE and experienced in electrical, radio and electronic fields with headquarters in San Francisco or Los Angeles or both is available on Pacific coast to represent eastern or midwestern manufacturer saleswise and intechnical capacity. RA-6088, Electronics.

Chief Engineer

Available

Graduate: Thoroughly experienced in design, development and production of Television, Home Receivers and Electronic Equipment. Cost conscious, sales minded, production-wise. Capable Executive, Engineer and Development Worker. Employed at present by Radio-Television manufacturer in above capacity. Will move to East or West coasts. Finest trade references.

PW-5821, Electronics
330 West 42nd Street, New York 18, N. Y.

Northern Ohio
SALES REPRESENTATIVE

Solicits connection with manufacturers of high quality electronic components and equipment.

Fully experienced

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Cleveland 18, Ohio

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1N23	.59
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2E30	2.25
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2J32	24.95
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2J40	34.95
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3C21	5.95
3C22	39.50
3C23	4.95
3C24	.69
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4A1	1.98
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4J29	34.95
5AP1	4.95
5AP4	5.95
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5CP7	13.95
5D21	29.95
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5GP1	9.95
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5LP1	11.95
5TP4	20.00
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6C21	24.95
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114A	.69
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203B	10.95
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806	17.50
807	1.25
808	2.95
809	2.50
810	7.95
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812	2.95
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813	7.95
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826	.79
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837	2.50
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0A2	1.69
0A3/VR75	.98
0A4G	1.06
0B2	2.05
0B3/VR90	.75
0C3/VR105	.75
0D3/VR150	.75
OY4	.88
0Z4	.88
0Z4G	.88
01A	.50
1A3	.72
1A4	1.28
1A4P	1.28
1A5GT	.88
1A6	1.06
1A7GT	.72
1AB5	1.06
1B3GT	1.56
1B4	1.28
1B5/25S	1.06
1B7GT	1.06
1C5GT	.72
1C6	1.06
1C7G	1.06
1C8	.88
1D5G	1.28
1D5GP	1.28
1D7G	1.06
1D8GT	1.28
1E5GT	1.56
1E7GT	1.56
1F4	.88
1F5G	.88
1F6	1.28
1F7G	1.28
1G4GT	.88
1G6GT	.88
1H4G	.72
1H5GT	.60
1H6G	1.06
1H6GT	1.06
1J6GT	1.06
1L4	.72
1LA4	1.06
1LA6	1.06
1LB4	1.06
1LC5	1.06
1LC6	1.06
1LD5	1.06
1LE3	1.06
1LG5	1.06
1LH4	1.06
1LN5	1.06
1N5GT	.72
1P5GT	.88
1Q5GT	.88
1R4	.88
1R5	.72
1S4	.88
1S5	.66
1T4	.72
1T5GT	.88
1U4	.72
1U5	.66
1V	.72
1V5	.88
1W5	.88
2A3	1.06
2A4G	1.28
2A5	.72
2A6	.88
2A7	2.20
2B7	.88
2E5	.88
2V3G	1.10
2X2A	.69
3A4	.72
3A5	1.29
3A8GT	1.92
3B7	1.06
3C6/XXB	1.28
3D6	.89
3E6	1.06
3LF4	1.06
3Q4	.72
3Q5GT	.88
3S4	.72
3V4	.72
5AZ4	.42
5R4GY	1.03
5T4	1.28
5U4G	.53
5V4G	.88
5W4	.88
5W4GT	.60
5X4G	.60
5Y3G	.50
5Y3GT	.38
5Y4G	.50
5Z3	.60
5Z4	.88
6A3	1.06
6A6	.88
6A7	.72
6A8	.72
6A8G	.72
6A8GT	.72
6AB5/6N5	.88
6AB7/1853	1.06
6AC5GT	1.06
6AC7/1852	1.06
6AD7G	1.06
6AG5	.96
6AG7	1.06
6AH6	1.42
6AJ5	.99
6AK5	.99
6AK6	.88
6AL5	.72
6AL7GT	1.06
6AQ6	.66
6AQ7GT	.88
6AR5	.66
6AT6	.54
6AU6	.72
6AV6	.54
6B4G	1.06
6B5	1.56
6B6G	.72
6B7	1.06
6B8	1.06
6B8G	1.06
6BA6	.66
6BE6	.66
6BG6G	1.92
6BH6	.93
6BJ6	.72
6C4	.60
6C5	.60
6C5GT	.60
6C6	.72
6C8G	1.06
6D6	.60
6D8G	1.06
6E5	.72
6F5	.60
6F5GT	.60
6F6	.72
6F6G	.60
6F6GT	.60
6F7	1.06
6F8G	1.06
6G6G	.88
6H6	.60
6H6GT	.60
6J5	.54
6J5GT	.54
6J6	1.06
6J7	.72
6J7G	.72
6J7GT	.72
6J8G	1.06
6K5GT	.88
6K6GT	.54
6K7	.60
6K7G	.60
6K7GT	.60
6K8	.88
6K8G	1.06
6K8GT	.88
6L5G	.88
6L6	1.28
6L6G	1.06
6L6GA	1.06
6L7	.88
6L7G	1.06
6N6G	1.28
6N7	.88
6N7GT	.88
6P5GT	.88
6Q6G/6T7G	1.06
6Q7	.72
6Q7G	.60
6Q7GT	.60
6R7	.88
6R7GT	.88
6S7	.88
6S7G	.88
6S8GT	.96
6SA7	.60
6SA7GT	.60
6SB7Y	.88
6SC7	.72
6SD7GT	.96
6SF5	.60
6SF5GT	.72
6SF7	.72
6SG7	.72
6SH7	.72
6SJ7	.60
6SJ7GT	.60
6SK7	.60
6SK7GT	.60
6SL7GT	.88
6SN7GT	.80
6SQ7	.54
6SQ7GT	.54
6SR7	.60
6SR7GT	.60
6SS7	.66
6ST7	.88
6SV7	.88
6U5/6G5	.72
6U6GT	.72
6U7G	.60
6V6	1.06
6V6GT	.72
6W7G	.88
6X4	.54
6X5	.88
6X5GT	.54
6Y6G	.88
6Z7G	1.28
6ZY5G	.72
7A4/XXL	.72
7A5	.72
7A6	.72
7A7	.72
7A8	.72
7AD7	1.06
7AF7	.72
7AG7	.88
7AH7	.88
7B4	.72
7B5	.72
7B6	.72
7B7	.72
7B8	.72
7C4/1203A	1.06
7C5	.72
7C6	.72
7C7	.72
7E5/1201	1.06
7E6	.72
7E7	.88
7F7	.88
7F8	1.06
7G7/1232	1.06
7A7	.80
7J7	1.06
7K7	1.06
7L7	.88
7N7	.88
7Q7	.72
7R7	.88
7S7	1.06
7V7	1.06
7W7	1.06
7X7/XXFM	1.06
7Y4	.72
7Z4	.72
10	1.56
12A6	.89
12A6GT	1.06
12A7	1.06
12A8GT	.72
12AH7GT	.88
12AL5	.72
12AT6	.54
12AT7	1.06
12AU6	.72
12AU7	.88
12AW6	.96
12BA6	.66
12BE6	.66
12C8	.89
12F5GT	.60
12H6	.60
12J5GT	.54
12J7G	.72
12J7GT	.72
12K7G	.72
12K7GT	.60
12K8	.88
12K8GT	.88
12Q7GT	.60
12SA7	.60
12SA7GT	.60
12SC7	.72
12SF5	.60
12SF5GT	.60
12SF7	.72
12SF7GT	.88
12SG7	.72
12SH7	.72
12SJ7	.60
12SJ7GT	.60
12SK7	.60
12SK7GT	.60
12SL7GT	.88
12SN7GT	.80
12SQ7	.54
12SQ7GT	.54
12SR7	.72
12SR7GT	.72
12X3	.98
12Z3	.88
14A4	1.06
14A5	1.56
14A7/12B7	.88
14AF7/XXD	.88
14B6	.88
14B7	.88
14B8	.88
14C5	.88
14C7	.88
14E6	.72
14E7	.88
14F7	.88
14F8	1.06
14H7	.88
14J7	1.06
14N7	1.06
14Q7	.88
14R7	.88
14S7	1.06
14W7	1.06
14X7	1.06
14X4	.88
19	1.06
19T8	1.06
20	1.56
22	1.28
24A	.72
25A6	1.06
25A6G	1.06
25AC5GT	1.06
25C6G	1.06
25L6	1.06
25L6GT	.60
25Y5	1.06
25Z5	.54
25Z6	.72
25Z6GT	.54
26	.60
27	.54
28D7	.98
30	.72
31	.88
32	1.06
32L7GT	1.28
33	1.06
34	1.06
35/51	.72
35A5	.72
35B5	.72
35L6GT	.60
35W4	.46
35Y4	.72
35Z3	.72
35Z4GT	.50
35Z5GT	.46
35Z6G	.88
36	.88
37	.60
38	.72
39/44	.59
41	.60
42	.60
43	.60
45	.60
45Z5GT	.60
46	.88
47	.88
49	.88
50	1.56
50A5	.88
50B5	.72
50C6G	1.06
50L6GT	.60
50X6	.88
50Y6GT	.60
53	.88
55	.72
56	.60
57	.72
58	.72
59	1.06
70L7GT	1.42
71A	.72
75	.60
76	.60
77	.60
78	.60
79	.88
80	.42
81	1.28
82	.88
83	.88
83V	1.06
84/6Z4	.60
85	.72
89	.72
99V	1.28
99X	1.28
117L7GT	1.42
117M7GT	1.42
117N7GT	1.42
117P7GT	1.42
117Z3	.54
117Z4GT	1.06
117Z6GT	.88
FM-1000	1.28
1273	.88
9001	.89
9002	.69
9003	.49
9004	.49
9005	.98
9006	.49

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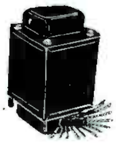
All Prices F.O.B. N. Y. C.

YOUR HEADQUARTERS FOR INDUSTRIAL EQUIPMENT

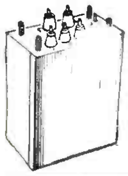
RCA 630 T.S. POWER TRANSFORMER



This transformer designed for heavy duty television service. Primary 115 V. 60 cy.
Sec. #1 325-0-325V. @ 400 ma.
Sec. #2 5 V. 3 amps
Sec. #3 12.6 C. CT. @ 10 amps
Sec. #4 6.3 V @ 7 amps
List price $40.00. Your cost...... **$18.25**

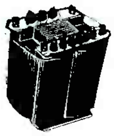
No. T 4106

FILAMENT TRANSFORMER



HERMETICALLY SEALED 115V. 60 CYC.
PRIMARY
Sec. No. 1 6.3 @ 3 Amp.
Sec. No. 2 2.5 volts @ 2 Amps.
Western Electric D Spec 161917 insulated for high voltage inverse peaks—designed to light scope tube and 2x2 tube.
5½" high x 2¾ x 4½" **$3.95**

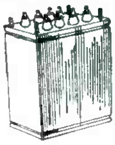
PLATE TRANSFORMER



Primary 220 or 110V., 50/60 Cy Sec. 2050 CT @ 1 amp. Used in a bridge circuit, this transformer will deliver 2000 V. DC @ 487 ma **$17.95**

No. T-4640

TRANSFORMER

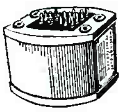


Here is a rugged transformer built to Army specs. Hermetically sealed with Franklyn Terminals for easy soldering. Primary 115 v. 60 cycles.
Sec. No. 1 815 v. vt @ 58 ma.
Sec. No. 2 5.4 v. @ 3 a.
Sec. No. 3 6.3 v. @ 4 a.
Weight 10 lbs.
Your cost **$2.49**

TRANSFORMER

Here is a transformer versatile enough to run almost any piece of Surplus gear—gives you B—, bias and fil. voltages.
Pri. 110/220 V. 60 cy.
Sec. #1—325-0-325 V. @ 250 ma
Sec. #2—0-180 V. @ 40 ma
Sec. #3—5 V. 3 amps
Sec. #4—6.3 @ 3 amps
Sec. #5—12 V @ 10 amps
A real steal **$7.95**

TRANSFORMER

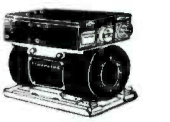


Pri. 110 V. 60 cy—Sec #1 850 V. C. T. @ 142 ma Sec #2 65 V. @ 142 ma; Sec #3 6.3 V. @ 10 amps; Sec #4 6.3 V. @ .6 amps; Sec #5 5V C. T. @ 3 amps—Hermetically sealed—A good buy.
$5.50

INPUT TRANSFORMER

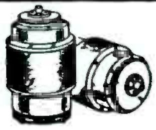
Western Electric Spec. #D168816 600 OHM Line to single grid—3⅜" wide x 4½" high x 1¾" deep.... **$1.85**

DMDFX618



Heavy Duty continuous—28 Volts input @ 18 amps. DC output 1000 Volts @ 150 ma. —also 380 Volts @ 400 ma. Complete with filter—while they last **$19.95**

SELSYN MOTORS

CLOSE  OUT

SPECIAL

Synchronous Type

Pair in Series for 110 v. AC.

Type I—5¼" long, 3" dia.—50 v. AC, 50 cy.—4 lbs................ **$9.95 pr.**

Type II—6¼" long, 4¼" dia.—115 v. AC, 50 cy. 11 oz................. **$12.95**

SYNCHRO—DIFFERENTIAL

Model #1943—C78249-CAL-11280 Bendix Aviation 115 v.—60 cy. 6" length to end of shaft x 4¼" diameter........... **$9.95**

ANTENNA MANUAL

Here is the latest dope on antennas. 350 full pages on beams, stacked arrays, colinear arrays, etc. —how to match them to feed lines—a wonderful manual without mathematics so anybody can understand how and why **$3.50**

DO YOU OWN AN SCR-522?

We have a complete power supply, including a separate voltage regulated bias supply chassis and schematic—all in kit form. This kit will supply all voltage necessary for operation of the set. All parts guaranteed. Complete at the amazingly low price of **$14.95**

IT'S SENSATIONAL

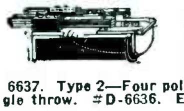
Hottest Item Out! Make your SCR-522 Receiver operate on 144 to 148 MC with ONE DIAL control in less than 1 hour! Parts and instructions..... **$3.00**

Model 200-EA. 5-ELEMENT 2 METER BEAM KIT. Folded di-pole driven element. All aluminum construction. Feed with low impedance coaxial cable. Amateur net price..... **$8.40**

A-BT-Cut Xtal

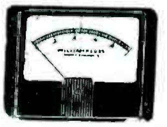
1000 KC mounted in a holder—very few left—practically no drift **$4.95**

RELAY



Telephone Type—dual coil relays, designed for two separate circuits—200 OHMS per coil—Type 1—Double pole, single throw. 1 make, 1 break. #D-6637. Type 2—Four pole, single throw. #D-6636. Each.. **$2.49**

METER



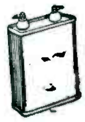
8½" Marion—0 to 1 MA. Model 57S. A beautiful meter for laboratory or shop use, large enough to read from several feet away—a good value @ **$12.00**

Can also be provided in 400 microamps @......... **$13.00**

FIELD STRENGTH METER

Frequency range 3.5 through 148 mc.—panel switched (8 bands) complete with tube and telescopic ant. Will measure standing waves—quite sensitive at upper frequencies....... **$29.95**

CONDENSER

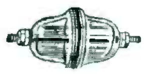


4 Mfd.—1500 Working Volts—DC
3⅞" wide x 4⅝" high x 1¼" deep.
Each ....
$2.95

CONDENSER

Pyranol—Catalog #23F49—G2 1 Mfd. 5000 Volts—DC working—3½" wide x 4¼" high x 4½" deep...............
$5.50

ANTENNA LEAD IN BOWLS



Made of genuine Pyrex—3" in diameter; brass rod 5½ long—complete with hardware and waterproof rubber gaskets.

Special—$1.49

SPEAKER

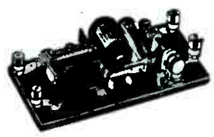
6" Speaker Complete with Output Transformer—1500 OHM Field—Complete with single Output—5000 OMS for 6V6, 43 etc.—a good buy @ each ....
$2.30

POWER TRANSFORMER

700 Volts DC transformer—
Pri. 117.5 Volts—
Sec. #1 6.3 V. @ 1.2 amps
Sec. #2 725-0-725 V. @ 60 ma
Sec. #3 5V., @ 3 amps
$2.95

No. R-3001

OVERCURRENT RELAY



Automatic reset—Overload coil is 3000 ohms—Can be shunted for any current simply—Protect those expensive final amplifier tubes, to reset simply press a button. reset coil is 110 v. 60 cycles **$2.49**

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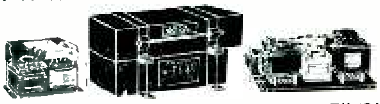
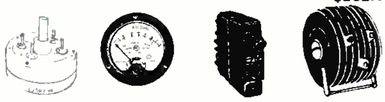
CRB23367 Selector Control Unit op 110V/60cys CRB23368 Selector Control Unit op 24V/DC Designed to generate & transmit over telephone line signals to actuate CRB23368 Selector RCVR permitting actuation of Two Transmitters & Receivers providing Automatic SEND-RECEIVE switching on either of two channels also permits modulation of remote Transmitter selected, also telephone intercommunication with remote station, AUDIO MONITOR & AMPLIFY speech signals received from remote station over telephone line. Cased RACK MTG per Set $39.95



CONSTANT V'REGULATOR NEW RAYTHEON in 95-130V/60 cy; Output 115V/60 Watt Cased $10.95
RAYTHEON in 198 to 242 Vinpt/50-60 cys; Output 220V/500 Watts/0.5% Rgltn Rack mtg. 36.00
SOLA CONSTANT V'REGLTR USN Cased in 95 to 190V/50-60 cys; Outpt 125 to 220V 2KW/17.4 Amps/Constant Duty. LN*..............$130.00
SAME UNIT NEW. USN Cost $369. SPECIAL, $162.00



CONDENSER VARIABLE 360° SINEWAVE 4 taps 90° QUADRANTS for SINEWAVE freqs generator $2.39
Meter GE/DO 58/200 microamp VOM scale /4" sq 6.95
METER 50 microamp/VOM scale /4" sq....$8.95
METER W.E. 0-200 or 0-500V/1000 ohms p/V $4.95
WESTON SQ 3½" B'C/476/15VAC METER..$3.98
WSTGHSE 0-150VAC/.25 to 125 cycles. Meter.$3.95
WSTGHSE RA 35 SQ 3½" B'/476/7.5VAC Meter $4.50
WESTON 2½"/Tuning Meter 5ma movement..$1.98
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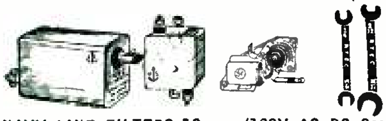
HEINEMAN MAGNETIC BKRS 10 ma, 220 ma 3, 5, 10, 15, 20, 30, 40, 80 & 180 amps New, each 1.95; Asstd. ....10 for $18.00
SQ'D, KLIXON & CH 5, 10, 20, 25, 33, 35 & 60 70 Amps, 98¢ each................10 for $8.00
THERMOSTAT 85°F/20A adjustable........49¢

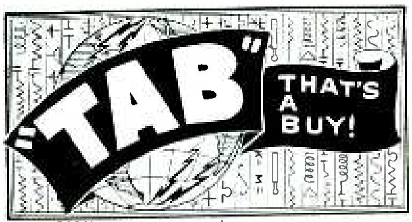
RECTIFIERS BRIDGE

IN	OUT	AMPS	PRICE	IN	OUT	AMPS	PRICE
18	14	1.35	2.49	36	28	1.5	3.95
18	14	3.5	3.49	36	28	3.5	6.75
18	14	5.	4.85	36	28	5.	7.50
36	28	.320	1.49	90	75	150.	1.49
210	190	.04	.79	Write for LIST			

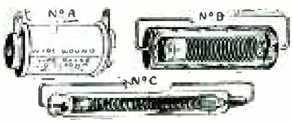
STANDARD ELECTRIC S1 TIMER
ACCY .005 Sec 1/100 Secd & 60 Secd DIAL 24V DC Clutch switch NEW..................$45.00
BAROMETRIC POTENTIOMETER, ALTITUDE CONTROL Sensitive bellows mfgrd COOK R-142/55586/AB Control .175 meg....................$1.98
TRUMPET & DRIVER/35 to 55 Watts W.E. blast & moisture proof head 3½ L/15" D $28.75 @ 2 for $55.
TRUMPET & DRIVERS multicellular 250 Watt 9 Unit W.E. blast & moisture proof $125.00
W.E. Diaphragms for above Trumpets $3.95
MOTOR 1 HP/3 PH/Cont Duty/3450RPM LN*, $29.95



NAVY LINE FILTERS 10 amp/130V AC DC Cased filters 0.1 to 1000 mc's/USN.............$1.29
TOBE 30 amp/250V AC DC filters 0.15 to 1000 mc's USN Cased Cont duty $4.50@; TWO for $8.00
GE 100 amp filter & 2x5 mfd/50V/pyranol Condsrs works 110V AC DC SPECIAL...............$1.98
Hrdnd ELEC WRENCHES 9 & 11/32, ¼ & 15/64 pr. ....25¢



PRECISION RESISTORS "TAB" SPECIALISTS IN PRECISION RESISTORS Write Qty $



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.116	179	680	2600	13500
.42	182	684	2635	14000
.425	199	689	2700	14400
.607	200	697	2850	14440
.7	209.4	700	2860	14460
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1.3	220	750	3000	15000
1.75	220.4	800	3100	15500
3	225	806	3290	16500
3.83	230	854	3384	17000
4	235	900	3500	17500
4.35	240	910	3509	18000
5	245.4	917	3700	18380
5.025	250	946	3730	18500
6	260	978	3760	19000
6.25	271	1000	4000	19500
7	275	1030	4200	20000
7.5	280	1056	4280	20520
7.8	286	1060	4300	21000
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8	299	1110	4440	22000
10	300	1150	4444	22500
10.38	310	1155	4500	22990
10.48	311.5	1162	4720	23000
11.25	320	1175	4750	23150
12	325	1200	4850	23325
13.52	340	1225	4885	23400
14.2	350	1250	4900	24000
14.5	366.6	1260	5000	24600
15	370	1322	5100	25000
16	375	1350	5210	25200
16.37	380	1355	5235	25400
17	390	1400	5200	26600
20	400	1495	5500	27500
21	410	1500	5600	29000
25	414.3	1510	5730	29500
26	418.8	1518	5910	29900
30	425	1600	6000	30000
37	426.9	1640	6140	31000
48	427	1646	6200	33000
50	440	1650	6300	35000
51.78	450	1670	6495	37000
55	452	1680	6500	38140
60	470	1710	6840	38500
63	475	1740	6990	39500
68	478	1770	7000	40000
71.4	480	1800	7500	43000
74	487	1818	7700	47000
75	500	1830	7930	48000
80	520	1865	8000	48660
81.4	525	1900	8250	49000
89.8	540	1910	8500	50000
90	550	1960	8700	52000
95	575	2000	8992	54000
100	580	2045	9000	56000
101	600	2080	9445	60000
105	607	2095	9500	61430
105.7	612	2145	9710	62000
107	625	2160	10000	64000
113.1	633	2195	10430	65000
120	640	2200	10500	68000
121.2	641	2250	10600	70000
125	649	2300	11000	72000
147.5	650	2400	11400	75000
150	657	2450	11500	80000
160	665	2463	11690	84000
165	669	2485	12000	90000
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120000	180600	265000	402000	621000
125000	185000	268000	422000	654000
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1 Meg	2 Meg	3.5 Meg	4.23 Meg	10 Meg
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Vacuum Precision Hivolt Resistors (C)
.12, .25, .6, .75, .83, .99megohms
1, 1.5, 2, 3, 3.75 megohms 0.5% accuracy
SPECIAL $1.00@....................TEN FOR $7.50
SEALED,10 or 12Meg/10KV/9W,$1.35@ 10for $10.00
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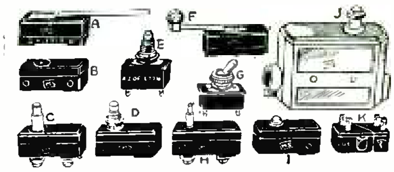
FP Type 30mfd/450V&2x20mfd25V also One10mfd/450V&2x20mfd/25V Both for .59



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(C) GOULD 6V/15AH S'Baty USN NEW....$3.98
(D) BB54/2V 27 amp WILLARD S'Baty....$1.98
(E) WILLARD 4V/40AH/TBY S'Baty.......$5.95
(F) BB206U/2V 11AH WILLARD S'Baty....$1.89

POCKET VOM
1maMTR1000 ohm/pv
OHMETER ZERO
Same Both Ranges
MOLDED CASE
3⅛ x 5⅞ x 2¼"
ETCHED PANEL
WHITE LETTERS
6ACVOLTRANGES
0-15/30/150/300 & 1500 & 3000 VOLTS
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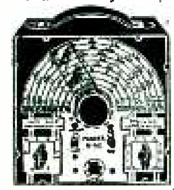
0-7.5/15/75/150 & 750 & 1500 VOLTS
4 DC CURRENT R's
0-1.5/15/150 ma & 0-1.5 Amps
2 OHMETER Rngs
500 ohm & 1 megohm COMPLETE BAT & Test leads..$13.90
Thats A Buy

NEW TUBE TESTER

CHECKS OCTAL, LOKTAL BANTAM, PEANUT, TELEVISION MIN, MAGIC I THYRATRONS & OTHERS CHECKS for SHORTS & leakage up to 5 megs. CHECKS INDIVIDUALLY Diode, Triode, Pentode sections of multiprps TUBES. RMA Switching COMPLETE IN OAK CASE SLIPON HINGED COVER 10¾ x 8¾ x 5¼ Obsolescence Safety factor with new element selector switching keeps tester up to date! SPEEDREAD CHART COMPLETE $29.90



RF SIGNAL GENERATOR FM-TEL-IV-AM 150KC to 50 mc's on fundamentals & 11 to 50 mc's harmonics modulation on & off, positive ATTENTUATOR Stable GndP osc PORTABLE BATTERY operation Complete 1½V & 45V baty&leads $27.75

HIPOWER VARIABLE ANTENNA MATCHING NETWORK 1001A/1KW RF NEW 1.5 to 7 mc's convertible to Hifreqs. PiNetwork adjustable IN & Output CASED 15 x 15 x 23" RACK MTG Ribboncoil & 250mmf/7000V Vcondsr RF mtr, Insltrs Techmanual will match most ANTS. NEW requires recementing coil turns SPECIAL $9.95

BENDIX TA 12/100 Watt XMTR LN* Separate ECO easily converted to 20, 40, 80 mtrs. HAS Micrometer tuning for ea ECO/3000 divs 4 separate output tanks Selector channel switch simultaneously changes ECO, IPA & Output tanks with tubes used LN* "TAB" SPECIAL $36.00

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$3 MIN. ORDER F.O.B. N.Y.C.
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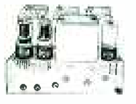
KIT 866A TUBES & TRANSFORMER inpt 115VAC/50-60cys, Outpt 2.5VCT/10A 10KV insltn, Sockets SPECIAL $5.95 KIT 872A TUBES & TRANSFORMER GE 115VAC/50-60cys, Insltd 12.5KV wkg Sockets & TUBES SPECIAL $12.95



COLLINS ART13 AMP. Dynamic or Carbon mike or line inpt, Outpt to PP class "B" Grids. Noise level down-55Db & adj audio osc Amp & Hdphone monitor Jack less tubes & pwr sup wt 5Lbs 7⅞L3½W5 "H" SPECIAL $4.50

CLIPPER KIT&TUBES & information for converting to Clipper Amplifier SPECIAL $8.25

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FOXBORO GRAPHIC TAPE RECORDER 115V/60cy RECORDING & integrating Mechanical Program Cams & counting mechanism Adaptable to Mechanical & Electric Recording New

BC968A Trainer TAB SPECIAL $39.95

XTAL DIODES & THERMISTORS NEW

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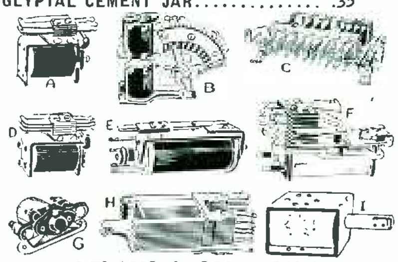
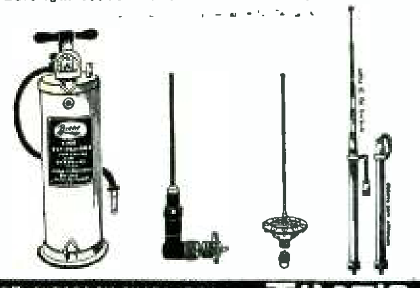
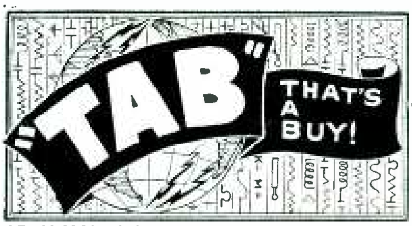
1N21,21A,22,23,23A each $1. 12for$10.00
1N23B,1N26 @ $2. 10for$17.50
D168391 Compensator THERM $2@; 3for$5
D170396 HF pwr meas 90¢@, 3for$2.50
1C Bulb Time Delay ¢90@; 3for$2.50
GLYPTAL CEMENT JAR.............. .35



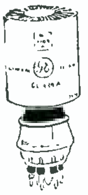
RELAYS & SOLENOIDS

(A) WE D163482/4500ohm/SPDT adj.......$.98
(B) AUTOMATIC RA74 Remote Control Reset Stepping Twin Coil 24to30V/DP 10 Circuit........8.95
(C) W.E.263A Telephone 275ohm dual coil 2 section each 25 pole DTNO palladium cts..........10.95
(D) W.E. Tel D169316 1300ohm/DP1NO&INC. .98
(E) SB Telephone Coil100ohm&100ohm SPNC.. .98
(F) CLARE A12280/115V-60cy/3SPDT & 3SPNC 2.98
(G) CLARE Octal based 115VAC/DPNC & SPNO 3.98
(H) CH/B8/operates7to24VDC/200to1200amps.298
(I) W.E. U682 Telephone coil 500 ohm 12PNO palladium contacts adjustable tension............2.98
(J) PHILTROL SOLENOID 400524/½" CORE 2¼" stroke 24VDC 3.6 ohm Coil....................1.29
FIRE EXTINGUISHER Carbontetrachloride Mfgrd PYRENE one gal Cap—200lb meter selfcharging LN*, shipped dry SPECIAL....................10.98
GALLON of CARBONTETRACHLORIDE.... 2.98
ANTENNA P108/16.5CMlgth*&Coax Cnnctr. 1.98
ANTENNA At1/APN2/30CM 12"lgth*& Coaxial Cnnctn, waterproof gasket&flange mobile mtg SPECIAL $1.49@ with PL259........... 1.75
ANTENNA AN30 Telescopic whip 12"to9ft NEW O'SEAS packgd each $1.49, 2for$2.49
ANTENNA AN130B Spring Swiveled whip End Loaded 33"lgth $1.25 @; 2 for $1.98 Ant MS49-54 whip 18ft lgth 4.50





GE GL434A similar to 7C29 TRIODE useable maxinpt 110 mc's UPto1200 Watts input, UP to 600W output. 3 Terminal Grid & C.T. filament, forced air Cooling 75-200CFM, Ef 10-11V Dsgn for RADAR/BC-677 operated 215 mc's 12KV/310ma inpt "TAB" SPECIAL $7.95



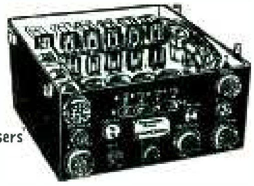
REL36ACORN similar 6J4.......1.98

9LP7 Magnetic DEFL&FOCUS Suitable for TELEVISION 3.98

"TAB" STANDARD & JAN TUBES

OA4G.....	$1.04	6N7.......	.85	866A......	1.35
OZ4......	.85	6S7.......	.87	868.......	1.85
1B3GT....	2.00	6SA7GT...	.54	872A......	2.45
1B21/471..	2.95	6SC7......	.71	884.......	.89
1B24......	2.95	6SF5......	.60	918/CE1C.	1.49
1B27......	3.95	6SG7......	.71	922.......	1.49
1D5GP....	1.25	6SH7......	.70	923.......	.75
1G6GT....	.85	6SJ7......	.72	931A......	3.95
1E7GT....	1.39	6SJ7GT...	.58	954.......	.63
1L4......	.70	6SK7......	.58	955.......	.63
1LC6.....	1.05	6SL7......	.85	956.......	.63
1LH4.....	1.05	6SN7GT..	.75	957.......	.45
1LN5.....	1.05	6SQ7......	.54	958A......	.63
1P5GT....	.85	6SS7......	.98	991.......	.25
1P24......	2.95	6V6GT....	.70	1613/6F6X	.59
1R4/1294..	1.00	6U7G......	.58	1614/6L6X	1.5
2AP1A....	2.85	6X4.......	.53	1616......	1.3
2A3.......	1.04	6X5.......	.85	1619......	.39
2C26......	.59	6Y6G......	.87	1622......	1.69
2C34/RK34	.55	6Z4-84....	.69	1624......	.98
2C40/446A	.81	6Z7GT....	1.23	1625......	.45
2C43......	2.98	7BP7-1813	3.95	1626......	.45
2D21......	1.49	7C29/434..	7.95	1629......	.58
2E22......	1.45	7C4/1203'.	.98	1635......	1.90
2E25/HY65	2.95	9JP1......	3.95	1641......	.75
2J21/725..	12.95	9JP12.....	4.50	2050......	.88
2J26......	12.95	9LP7......	4.35	2051......	.88
2J30......	18.50	10Y.......	.60	7193......	.38
2J31......	16.95	12A6......	.49	8005......	4.70
2J32......	16.95	12AH7GT.	.87	8012......	4.70
2J33......	14.50	12AR7.....	.95	8013A.....	3.95
2J34......	18.95	12DP7....	14.75	8020......	3.49
2J42/700..	29.95	12GP7....	14.75	9001......	.49
2J49......	29.95	12SA7GT..	.58	9002......	.59
2J55......	35.00	12SG7....	.65	9003......	.49
2J61A.....	39.95	12SH7....	.71	9004......	.49
2K25......	9.95	12SK7....	.58	9006......	.45
2K28......	7.00	12SQ7....	.58	C6J.......	4.95
2K29......	6.95	12X3......	.90	CE206....	3.95
2V3G......	1.05	15E.......	1.39	CE215....	5.95
2X2.......	.54	24G/3C24.	.68	CK1005...	.35
3A4.......	.70	25Z5......	.59	F127A....	18.00
3B7/1291..	.95	35L6GT...	.72	FG104....	14.95
3B24......	1.27	35Z5GT...	.54	FG105....	11.95
3BP1......	1.49	REL36/6J4	.198	FG166....	49.00
3BP1A....	2.95	37........	.72	T200......	12.00
3C23......	4.95	41........	.65	VR90/OB3	.74
3D6/1299..	.85	50L6GT...	.70	VR92......	.39
3E29/829B	3.85	HY65/2E25	2.95	VR105....	.74
3FP7......	3.98	80........	.52	VR150....	.90
3JP12.....	2.95	117Z6.....	1.10	WL468....	9.95
3S4.......	.69	205B/VT2.	1.98	WL530....	49.50
4J47......	39.95	211.......	.89	WL531....	9.95
5AP1......	2.75	215A......	2.65	UX6653...	2.95
5BP1/5GP1	1.95	RX215....	7.95	TUNGAR*	
5BP4......	3.95	250TH....	19.49	20X672*...	2.95
5CP1......	3.85	250TL....	19.49	199698*...	2.95
5D21......	19.00	304TH....	5.95	289881*...	2.50
5FP7......	2.95	304TL	1.98	MAZDA PL**	
5HP1......	4.95	307A/RX95	4.25	49**Box 10	.60
5R4G......	1.25	388.......	1.08	64** @....	.07
5T4.......	1.25	393.......	5.95	S6/T4**...	.14
5U4G......	.53	450TH/		100W/	
5V4.......	.87	6C21....	24.90	20V**...	.25
5W4.......	.87	450TL....	29.95	313/28V**	.10
5Y3.......	.38	527/1000S.	11.95	323/3V**..	.10
5Z3.......	.89	631P1/SN4	3.95	Aviation Lgts	
5Z4.......	.88	632A......	8.95	C1249/12V	
6AB7......	.98	701A......	3.95	G4-25for	1.00
6AC7......	.81	702A......	3.49	Sealed Beam	
6AG5......	.89	703A......	4.90	4522/250W	1.49
6AG7......	1.05	704A......	1.75	4560/600W	3.50
6AJ5......	.98	705A......	2.25	NEON BULBS	
6AK5......	.81	707B/2K28	6.95	NE2–	
6AL5......	1.05	710A/8011.	2.75	100Qty..	4.50
6B4G......	1.28	717A......	1.49	NE16/991.	.25
6B8G......	1.05	722/287A..	9.95	NE51/NE20	.08
6C4.......	.49	723AB....	5.50	Qty100–	
6C5.......	.54	726A......	6.95	NE20...	6.00
6C6.......	.71	802.......	2.95	SOCKETS for	
6C8G......	1.05	803.......	7.95	2X2HV...	.30
6D4.......	1.85	804.......	9.75	705/715...	.69
6D6.......	.59	805.......	$4.50	803/304T..	.90
6E5.......	.71	807.......	1.24	807.......	.27
6F6/1613..	.69	808.......	2.25	813.......	.69
6F8.......	1.04	810.......	6.95	829/832...	.25
6G5/6U5..	.85	811.......	2.20	866.......	.24
6G6G......	.86	813.......	6.95	872/211...	.49
6H6GT...	.54	814.......	4.50	ACORN	
6H6.......	.54	815.......	2.49	5 for......	1.00
6J4.......	5.95	816.......	1.15	Dieheptal	.69
6J5.......	.53	826.......	.72	Maginal..	.69
6J6.......	.90	828.......	10.00	Loktal	
6J7.......	.70	829B/3E29	3.95	49SSL...	.24
6K5GT ..	.86	832.......	3.75	Octal 78S8	.06
6K6GT...	.54	836.......	1.12	Octal 49SS8	.15
6K7.......	.70	837.......	2.25	Min 59500.	.12
6K8.......	.86	WL632A..	12.95	Min & SH	.25
6L6.......	1.27	845.......	4.75	TUBES GTD	
6L6G......	1.04	860.......	2.49	except open Fil.	
6L7.......	.85	864.......	.67	& breakage	
		865.......	1.95	Write Qty Pric	

Write for Other Types

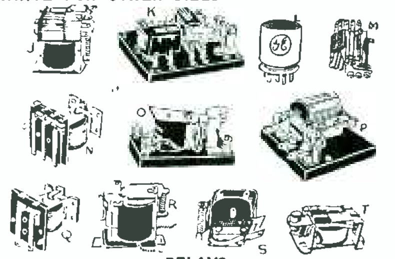


GE RELAY AMPLIFIER NEW Contains 25 RELAYS including DP 10 pos. Reset latching Relay & 4 sensitive relays, parts Jacks, Rstrs, Condensers & Pots & Shock mtg SPECIAL....$18.95

PHOTOFLASH & 2 KRYPTON LAMPS NEW AIRCORPS 1503 SET CONTAINS PWR SUPPLY LAMPS Reflectors, HV rectifier, Condensers 2x25 mfd, HV transformer, Relay, light output 12,000,000 lumens, 15to30000flashes for Color&BWfilm KIT includes INSTRUCTIONS & PARTS to CONVERT 12to 24VDC unit for 115VAC OPERATION "TAB" SPECIAL $59.95
PHOTOFLASH 1503 & RECTIFIED POWER SUPPLY for 115VAC operation READY TO WORK....99.50
PHOTOFLASH KRYTON LAMPS&Reflector 2 for $21

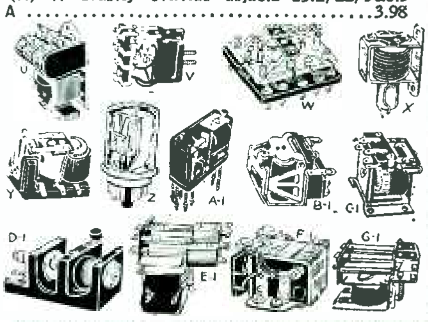
PHOTOFLASH CONDENSERS

8mfdGE/660VAC/3000VDCintermittent 4for 11.95
16mfd/660VAC/3000VDCintermittent 7.95
15mfd/330VAC/2000VDCintermittent 4.50
25mfd/330VAC/2000VDCintermittent 7.95
16mm/PAN/50Film GSAP Camera 54for 8.98
16mm/PANFilm Gun Camera GSAP 10for 1.98
FUSES 3AG-⅛, ¼, ½Amp.06¢@ 20for 1.00
3AG-1,2,3,4,10,15,20Amp. 03¢@ 40for 1.00
3AG-SloBlo 10,20 Amp, .12¢@ 10for 1.00
4AG-SloBlo 3,5,10,15,20Amp. 12¢@, 10for 1.00
7AG-200ma¢10@; 8AG-1/32,1 .09¢..(12 for 1.00
Little Fuse 1000V-⅜-½-1Amp ¢30@ 4for 1.00
BUSS 4000V-½Amp ¢75@ 4for 2.25
WRITE FOR OTHER SIZES



RELAYS

(J) GUARDIAN 500AC/op18-24VAC/4PSTNO/8A $1.25
(K) S'DUNN 32AXX10 Reset&overload 10ma&115 VAC 4.95
(L) GE Sealed plugin 2000ohm/SPDT/5A cts..1.98
(M) ALLIED STK/6to12VDC DPDT&SPNO&NC .98
(M) ALLIED CONTROL STK/7.5to24VDC/SPDT .75
(N) GE CR2791B100J3 3PDT/24V/5A Contacts 1.39
(O) S'DUNN 17AXX109/115VAC/SPNO/6 to 30A cts 1.98
(P) KURMAN 4maSens 650ohm/DP1NO&1NC/5 Amp 2.25
(Q) GE CR2791-B100F3/24V DPDT/5Amp Cts .98
(R) GUARDIAN 125DC/4to12VDC/SPDT/8 Amp Cts .... .98
(S) GUARDIAN 4500ohmCoil/SPST/5 Amp Contacts .... .98
(T) LEACH 115VAC/DPDT/10AmpContacts..1.98
(T) R22 12V/DPDT&SPNO/15AmpContacts...1.69
(U) A Bradley 702/110VAC/3PSTD break 25 Amp 4.49
(V) ALLIED BJ 6V/DPDT/5Amp Contacts...1.89
(V) ALLIED BJ/7.5VAC/DPDT 5AmpContacts.1.98
(V) ALLIED AS 24V/5A/SPDT/5 Amp Contacts .... .98
(W) ADVANCE 4001B Antenna DPDT&SPNO 15 Amp Ceramic HF ins 75to110V$2.75@&Rec 115 VAC 3.25
(X) A Bradley Overload adj18.1 15.2/12/9&6.3 A 3.98

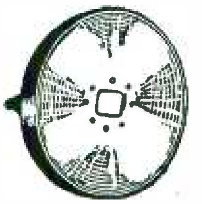


"TAB" MONEY BACK GUARANTEE $3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO.2-7230

THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 10E SIX CHURCH ST. NEW YORK 6, N.Y. U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

"TAB" MONEY BACK GUARANTEE $3 MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES AND 25% DEPOSIT. PHONE WO.2-7230



PARABOLOIDS

Ideal for microwave experimental work.
Spun Magnesium dishes
Reinforced Perimeter
17½" Diameter x 4" Deep
Two sets mounting brackets on rear.
Open center hole 1½" x 1⅝"

Per Pair, Brand New . . $8.75

MERCURY CONTACT RELAY

Western Electric D-168479

For applications in all types of high speed switching devices. Long service life, high operating speeds. Large current and voltage handling capacity, uniform and constant operating characteristics under adverse atmospheric conditions. Hermetically-sealed mercury-wetted contacts in gas-filled glass envelope. Free from moisture, dirt, corrosion and atmospheric pressure. Single pole double throw contacts.

1000 hours life at 60 operations per second. Two coils of 700 ohms, and 3300 ohms. Operating current, coils series aiding—6.6 mils. Release current, coils series aiding—5.2 mils. Four page Technical Data on request.

Brand New in Original Cartons, $4.75

STEPDOWN TRANSFORMERS

Input: 115V.-60 cycles.
Output: 20 V., at 10 amps. Also tapped at 6V., for pilot light. Ideal for Selenium Rectifier Applications, etc.

Brand New $2.45

SELENIUM RECTIFIER

Bridge Type

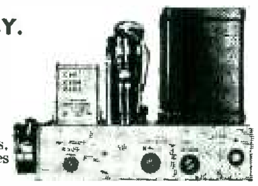
Input: 36 V. AC
Output: 28 V. DC., 1.1 Amps.

Brand New $2.75

PANORAMIC ADAPTER AN/APA-10

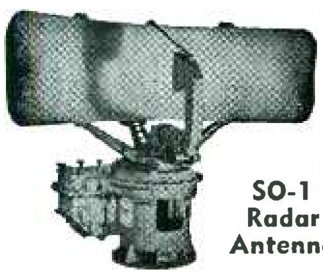
Includes 21 tubes and 3" scope tube. Converted for operation 115 v. 60 cycles. Tested and guaranteed in perfect operating condition....$149.50

400-2600 CY. POWER SUPPLY



Input:
80 or 115 volts, 400 to 2600 cycles

Output:
1200 volts D.C. at 1.5 MA.
400 volts D.C. at 130 MA.
6.4 A.C. volts at 0.8 A (ins. for 1500v. D.C.)
Includes tubes: 1—5R4GY, 1—2x2, 1—6AK5, cathode ray tube socket, resistance capacitance filter, two focus controls, an intensity control and 6AK5 reinserter circuit.
Brand new. Complete $13.75



SO-1 Radar Antenna

RADAR ANTENNAS

Following types available, brand new in original export packing cases:

SO-1 (10 cm.)......................$149.50
SO-3 (3 cm.)......................$139.50
SO-8 (10 cm.)......................$139.50
SO-13 (10 cm.)......................$129.00
TDY (10 cm.)...................... $95.00

ALL BRAND NEW EQUIPMENT

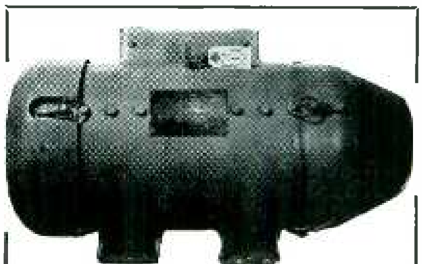
PEAK-TO-PEAK V.T.V.M.

Designed by Radiation Labs. M.I.T. for the U. S. Navy.

Type TS-487U

A portable instrument designed to measure peak-to-peak voltages of recurrent waves, particularly of the type normally found in radar video circuits. It is especially intended for use in setting the levels of video and synchronizing voltages in radar equipment where the relationships between these voltages are important to the operation of associated equipment.

BRAND NEW Price $69.50



MOTOR GENERATORS

Brand New War Surplus Machines Built by Allis Chalmers Co. to U. S. Navy Specifications.
Input: 115V. D.C. at 14 amps., 3600 rpm.
Output: 120V A.C., 60 CY. 1 ph. at 10.4 amps. 1000 Watts continuous duty. Ball bearings.
Splashproof. Fully enclosed. Centrifugal starter.
Frequency adjustable to load.
Length 26"; Width 12⅞"; Height 13".

Price $125.00

Same machine but for 230V. D.C. input.
Price $125.00

Spare parts kit with extra brushes, brush-holders, field coils, bearings, etc., for either machine $29.50

RADAR EQUIPMENT

Radar Repeater Adapters, Antenna Control units with P P I units, Transmitter-Receiver units, etc. for SO Radar.
All Brand New Equipment.
Complete Set SO-3 Tender Spares comprising a complete 3 CM Radar installation and large quantity of spares. Consists of 39 cases of equipment.

Brand New $2,500.00

Spare parts for SG 1 Radar in stock

RADAR TUBES

4C35, 2J62, 3B24, 3C45, 7BP7, 9LP7, etc.

VOLTAGE REGULATOR UNIT

Any unfiltered source of 350-400 volts DC may be connected to this unit to provide filtered and regulated output at 150 and 300 volts. Contains 12 Hy choke: 3-4 mfd. capacitors; bleeder, divider and current limiting resistors, etc. Ideal in the Lab for experimental set-ups. Complete, brand new with 2-VR 150 tubes.

$7.95

G. E. AMPLIDYNES

Type 5AM21JJ7, New................$49.50
Type 5 AM45DB20, NEW............ 89.50

G. E. SERVO AMPLIFIERS

Type 2CVICI, New................$29.50

DYNAMOTORS—500 Watt Navy Type CAJO-211444

Input: 105-130 Volts D.C., 6 amps. Output 13 or 26 Volts D.C. (26 V. at 20 amps. in series of 13 V. at 40 amps. in parallel). Designed for radio use, fully R.F. filtered, complete with separate Square D line switch box.

BRAND NEW $59.50

SYNCHROS

(Selsyns, Autosyns, etc.)

Navy types: 1F, 5B, 5CT, 5DG, 5G, 5F, 5SDG, 5SG, 5SF, 6DG, 7G, etc.
Army types: 2J5FB1, 2J5S1, 2J1F3, CAL 18300, C 78414, C 78863, C 78411, etc.

Also:

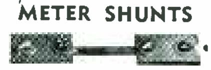
Pioneer Precision Autosyns type AY 101D, brand new available in quantity.

KOLLSMAN COMPASSES

Type B-16 complete with spare pilot lamp

BRAND NEW $9.75

METER SHUNTS



10 Amp. 50 Mv.
BRAND NEW $1.00

Prices FOB, Tuckahoe, N. Y. Subject to Change Without Notice. 20% With Order on C.O.D. Shipments.

ELECTRONICRAFT INC.

All merchandise guaranteed. Immediate delivery, subject to prior sale.

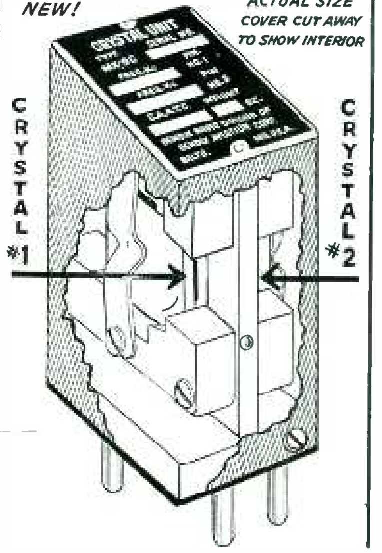
5 WAVERLY PLACE   PHONE—TUCKAHOE 3-0044   TUCKAHOE 7, NEW YORK

"TWO-IN-ONE" CRYSTAL UNITS

TYPE MX-9E

BRAND NEW!

ACTUAL SIZE COVER CUT AWAY TO SHOW INTERIOR



Each unit contains two ¾" sq. crystals differing in frequency by 455 k.c. The following combinations are available:

Kilocycles	Kilocycles
(1183.0 and 1638.0)	(4287.5 and 4742.5)
(2407.0 and 2862.0)	(4310.0 and 4765.0)
(2457.0 and 2912.0)	(4360.0 and 4815.0)
(2481.0 and 2936.0)	(4435.0 and 4890.0)
(2530.0 and 2985.0)	(4702.5 and 5157.5)
(2539.0 and 2994.0)	(4713.0 and 5168.0)
(2560.0 and 3015.0)	(4930.0 and 5385.0)
(2562.5 and 3017.5)	(4935.0 and 5390.0)
(2915.0 and 3370.0)	(4975.0 and 5430.0)
(2945.0 and 3400.0)	(5080.0 and 5535.0)
(3820.0 and 4275.0)	(5217.0 and 5672.0)
(3860.0 and 4315.0)	(5235.0 and 5690.0)
(4002.5 and 4457.5)	(5490.0 and 5945.0)
(4175.0 and 4630.0)	(5835.0 and 6290.0)
(4205.0 and 4660.0)	(6485.0 and 6940.0)
(4242.5 and 4697.5)	(6515.0 and 6970.0)

All above units are brand new, individually packed with frequencies marked on containers and with manufacturer's inspection tags attached.

Priced at a fraction of the cost of the holder alone. Brand new..... $1.95

3 prong Micalex sockets for above crystal units .... 50¢ each

Raytheon RECTICHARGERS

Input: 115 volts AC, 60 cy., 1 Ph. . . . Output: 48 v. DC at 3 amperes regulated and adjustable. Charges 23 to 24 cell battery or may be used direct as battery eliminator.

The Raytheon Rectícharger is designed to supply current at constant voltage to any load within its rating, and in addition to supply current to a storage battery connected across its load, of sufficient amount to maintain full charge. The function of the battery is to supply surge current due to sudden changes in load and to supply current above the rating of the Rectícharger for temporary overload, and to act as a "stand-by" source of power in event of commercial power failure.

BRAND NEW..... $69.50

GE BATTERY CHARGER

Input, 115 V, 60 cy., 1 Ph. . . . . . Output. Charges 54 cell battery at from 1 to 10 ampere rate.

Complete with spare fan and fuses. Brand new in original packing cases. Shipping wt. approx. 305 lbs.

The model 6 RC 89F16 Copper Oxide Battery Charger consists of a transformer, a secondary reactor, a copper oxide rectifying element, a ventilating fan, control circuits and auxiliary equipment necessary for proper operation. Transformer tapped for various supply voltage. Eight secondary taps for adjusting charging rate.

BRAND NEW.... $155.00

Western Electric POTENTIOMETER

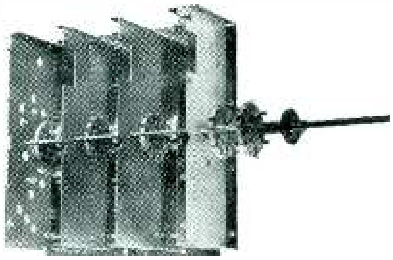
No. KS 15138

The d-c potentiometer consists of a closed type die-cast aluminum alloy frame consisting of a continuous resistance winding to which electrical power is supplied through two fixed taps 180 degrees apart. Two rotating brushes (180 degrees apart and bearing on the resistance winding) and two take-off brushes are provided for the output voltage. Varying the position of the brushes varies the output voltage in accordance with a linear sawtooth wave. The potentiometer is excited with 24-volt direct current, is arranged for panel or bracket mounting, is approximately 3-11/16 inches in diameter, 3 inches deep, 4¾ inches long, and has an approximate weight of one pound. External connections are made through a standard AN type connector.

Brand New $5.75

ALL-WAVE BANDSWITCH ASSEMBLY

Used in Hi-Quality Communications Receiver



8 gang ceramic switch on silver plated chassis. Overall size 15" L x 8¾" W x 4" H.

Brand New......... $3.75

SOUND POWERED TELEPHONES

Type TP-3

For two-way signalling or voice communication. No batteries needed. May be used on metallic or grounded circuits, open-wire lines, cables or circuits using local-battery telephones, switchboards; two-way-ring-down trunk circuits of common battery switchboards, etc. Contained in treated waterproof fabric cases with adjustable carrying straps.

Brand New $49.50

400 CYCLE SERVO AMPLIFIER

G. E. Type 2CV1C1

Brand New $29.50

R. F. LINE FILTERS

Solar Elimostats
115 volts, 20 amperes.

Brand new $2.25

ACME HI-VOLT TRANSFORMERS

Primary: 115 V, 60 cycles.
Secondary: 8000 V., C.T., 800 V.A.

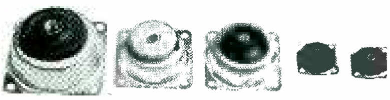
Brand new in sealed cans.... $27.50

SOUND POWERED TELEPHONE HANDSETS

W. E. Type TS-10M.
Complete with 7 ft. cord.

Brand New ... $16.95

SHOCK MOUNTS



A B C D E

A. Lord #20. 3" x 3" x 1¾" .... .40
B. U. S. Rubber #5150 C 2⅜" x 2⅜" x 1⅛" .... .30
C. Lord #15 2⅜" x 2⅜" x 1⅛" ...... .25
D. Lord #10 1¼" x 1¼" x ⅝" ...... .10
E. Lord #3 1¼" x 1¼" x ⅜" .... .10

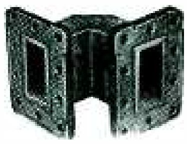
BRAND NEW

POTENTIOMETER

20,000 ohms, complete with engraved dial assembly.

Brand New.. $2.75

10 CM WAVEGUIDE



Solid bronze, 90° elbow flatwise bend.

Brand New $20

PHONE JACK ADAPTER P-106

Phone jack, one end, Coax Receptacle other end.

Price $1.35

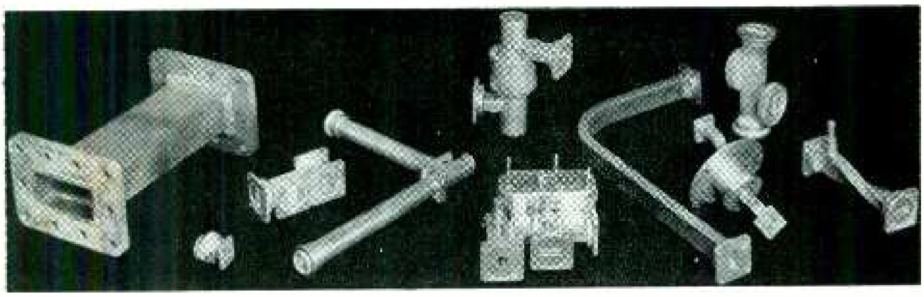
All prices quoted are fob Tuckahoe, N. Y. About 20 miles N. of N. Y. C.

ELECTRONICRAFT
INC.

All merchandise guaranteed Immediate delivery, subject to prior sale.

5 WAVERLY PLACE   PHONE—TUCKAHOE 3-0044   TUCKAHOE 7, NEW YORK

MICROWAVE PLUMBING



MICROWAVE PLUMBING

10 CENTIMETER

MAGNETRON TO WAVEGUIDE coupler with 721-A duplexer cavity, gold plated $45.00
10 CM WAVEGUIDE SWITCHING UNIT, switches 1 input to any of 3 outputs. Standard 1½" x 3" guide with square flanges. Complete with 115 vac or dc arranged switching motor. Mfg. Raytheon. New and complete $135.00
10 CM. END FIRE POLYRODS .... $1.75 ea.
"S" BAND Mixer Assembly, with crystal mount, pick-up loop, tunable output $3.00
721-A TR CAVITY WITH TUBE. Complete with tuning plungers $5.50
10 CM. McNALLY CAVITY Type SG $3.50
WAVEGUIDE SECTION. MC 445A, rt. angle bend. 5½ ft. OA. 8" slotted section $21.00
10 CM OSC. PICKUP LOOP, with male Homedell output $2.00
TS115/APS-2F 10 CM ANTENNA in lucite ball, with type "N" fitting $4.50
OAJ NAVY TYPE CYT66ADL, ANTENNA in lucite ball, with Sperry fitting $4.50
10 CM. FEEDBACK DIPOLE antenna, in lucite ball, for use with barabola $8.00

7/8" RIGID COAX—3/8" I.C.

RIGHT ANGLE BEND, with flexible coax output pick-up loop $8.00
SHORT RIGHT ANGLE bend, with pressurizing nipple $2.00
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
7/8" COAX. ROTARY JOINT $8.00
RT. ANGLE BEND 15" L. OA $2.00
FLEXIBLE SECTION. 15" L. Male to female ... $4.25
MAGNETRON COUPLING to 7/8" rigid coax 5/8" IC line, less "M" nut, with TR pickup loop, gold plated $7.50

7/8" RIGID COAX—1/4 I.C.

SHORT RIGHT ANGLE BEND $3.00
ROTATING JOINT with deck mounting $5.00
RIGID COAX slotted section CU-60/AP $5.00

1.25 CENTIMETER

MITRED ELBOW cover to cover $4.00
TR/ATR DUPLEX SECTION choke to cover $4.00
FLEXIBLE SECTION 1" choke to choke $5.00
KBAND Rotary Joint $45.00
ADAPTER, rd. cover to sq. cover $5.00
S SECTIONS choke to cover $4.50

MICRO WAVE GENERATORS

AN/APS-15A "X" Band compl RF head and modulator, incl. 725-A magnetron and magnet, two 723A/B klystrons (local osc & beacon), 1B24 TR, revr-ampl. duplexer, HV supply, blower, pulse xfmr. Peak Pwr Out: 45 KW apx. Input: 115, 400 cy. Modulator pulse duration .5 to 2 micro-sec. apx. 13 KV Pk Pulse. Compl with all tubes incl. 715-B, 829B, RKR 73, two 72's. Compl pkg. new ... $210.00
APS-15B. Complete pkg. as above, less modulator $150.00
"S" BAND AN/S-2. Complete RF head and modulator, including magnetron and magnet, 417-A mixer, TR, receiver, duplexer, blower, etc., and complete pulser. With tubes, used, fair condition. $75.00
10 CM, RF Package. Consists of: SO Xmtr.-receiver using 2J27 magnetron oscillator, 250 KW peak input. 707-B receiver-mixer $150.00
Modulator-motor-alternator unit for above ... $ 75.00
Receiver-rectifier power unit for above ... $ 25.00
Rotating antenna with parabolic reflector for above. New $75.00

COAX CABLE

RG 18/U. 52 ohm imp. armored .... $.51/ft.
RG 23/U. twin coax. 125 ohm imp. armored .. $.50/ft.
RG 28/U. 50 ohm imp. pulse cable. Corona min. starting voltage, 17 KV .... $.50/ft.
RG 35/U. 70 ohm. imp. armored .... $.50/ft.

COAX CONNECTORS

831R	$.35	UG 21/U	$.85
831SP	$.35	UG 86/U	$.95
831AP	$.35	UG 254/U	$.75
831HP	$.15	UG 255/U	$.85

HOME DELL male to type "N" male adapter ... $1.25
RT ANGLE Sperry fittings $1.00

VARISTORS—W. E.

D-171121	$.95	D-168549	$.95
D-171631	$.95	D-162482	$3.00
D-167176	$.95	D-99136	$1.65
D-170225	$.95	D-166271	$2.50
D-168687	$.95	D-162356	$1.50
D-171812	$.95	D-16187A	$2.85
D-171528	$.95	D-99946	$2.00
D-163298	$.95		

THERMISTORS—W. E.

D-167332 (bead)	$ .95	D-166228 (button)	$ .95
D-170396 (bead)	.95	D-166382 (tube)	.95
D-167613 (button)	.95	D-167018 (tube)	.95

3 CM. PLUMBING

(STD. 1" x ½" GUIDE UNLESS OTHERWISE SPECIFIED)

3" FLEX SECTION. Sq. flange to circ. Flange adapter $7.50
"X" BAND WAVEGUIDE, 1¼" x 5/8" OD. 1/16" wall, aluminum .... per ft. $ .75
WAVEGUIDE, 1" x ½" I.D. per ft. $1.50
TR CAVITY for 724-A TR tube, transmission or absorption types $3.50
TR tube (41-TR-1) $2.50
WAVEGUIDE SECTION, CG 251/APS-15A, 26" long choke to cover, with 180 deg. bend of 2½" rad. at one end $6.00
ROTARY JOINT with slotted section and type "N" output pickup $8.50
WAVEGUIDE SECTION, 12" long choke to cover, 45 deg. twist & 2½" radius, 90 deg. bend $4.50
STABILIZER CAVITY feeding waveguide section, with filtered output and attenuating slugs $20.00
SLUG TUNER/ATTENUATOR, W.E. guide, gold plated $6.50
TR/ATR DUPLEXER section with iris flange .. $4.50
TWIST, 5" 90 deg., choke to cover $5.00
WAVEGUIDE SECTIONS 2½ ft. long, silver plated, with choke flange $5.75
WAVEGUIDE, 90 deg. bend E plane, 18" long .. $4.00
ROTARY JOINT, choke to choke $6.00
ROTARY JOINT, choke to choke, with deck mounting $6.00
S-CURVE WAVEGUIDE, 8" long cover to choke. $3.50
DUPLEXER SECTION for 1B24 .... $10.00
CIRCULAR CHOKE FLANGES, solid brass .... .55
"T" SECTION (TR-ATR) choke to choke, supplied with circ. or sq. flanges $3.50

APS-10 MIXER 2K25/723AB. X band local oscillator mount with (1) choke coupling to beacon reference cavity; (2) choke coupling to TR and receiver; (3) Iris coupling with AFC attenuator to antenna waveguide; (4) Radar AFC crystal mount; (5) Receiver crystal mount; (6) Attenuating slugs. Mfg. DeMornay. Budd $22.50
TR/ATR Duplexer section for above $4.00

2" FLEXIBLE SECTION, cover to cover $5.00
SHORT ARM "T" section, with additional choke output on vertical section $4.00

MAGNETRONS

TUBE	FRQ. RANGE	PWR PK. OUT.	PRICE
2J31	2820–2860 mc.	265 KW.	$15.00
2J21-A	9345–9405 mc.	50 KW.	$25.00
2J22	3267–3333 mc.	265 KW.	$15.00
2J26	2992–3019 mc.	275 KW.	$15.00
2J27	2965–2992 mc.	275 KW.	$15.00
2J32	2780–2820 mc.	285 KW.	$15.00
2J38 Pkg.	3249–3263 mc.	5 KW.	$25.00
2J39 Pkg.	3267–3333 mc.	8.7 KW.	$25.00
2J55 Pkg.	9345–9405 mc.	50 KW.	$25.00
3J31	24,000 mc.	50 KW.	$35.00
714AY			$15.00
720BY	2800 mc.	1000 KW.	$50.00
725-A			$25.00
730-A			$25.00
KYLSTRONS: 723A/B			$12.50
726-A			$15.00
707B W/CAVITY			$20.00

MAGNETS

For 2J21, 725-A, 2J22, 2J26, 2J27, 2J31, 2J32 and 3J31 .... Each $8.00
4850 Gauss, 5/8" bet. pole faces, ¾" pole diam. $8.00
1500 Gauss, 1½" bet. pole faces, 1⅝" pole diam. $8.00

TUNABLE PKG'D "CW" MAGNETRONS

QK59 2675-2900 Mcs	QK61 2975-3200 Mcs.
QK60 2800-3025 Mcs	QK62 3150-3375 Mcs.
New—$45 each	New—$55 each

MICROWAVE TEST EQUIPMENT

W. E. I. 138 A. Signal generator, 2700 to 2900 Mc range. Lighthouse tube oscillator with attenuator & output meter. 115 VAC input, reg. Pwr. supply. With circuit diagram $50.00
TS-238 GP. 10 cm. Echo box with resonance indicator and micrometer adjust cavity, 2700 to 2900 Mcs calibrated $85.00
3 cm. wavemeter: 9200 to 11,000 mc transmission type with square flanges $15.00
3 cm. stabilizer cavity, transmission type $20.00
3 cm. Wavemeter, Micrometer head mounted on X-Band guide. Freq. range approx. 7900 to 10,000 Mc. $75.00

PULSE EQUIPMENT

MODULATOR UNIT BC 1203-B

Provides 200—4,000 PPS. Sweep time 100 to 2500 microsec. in 4 steps, fixed mod. pulse, suppression pulse, sliding modulating pulse, blanking voltage, marker pulse, sweep voltages, calibration voltages, fil. voltages. Operates 115 vac 50-60 cy. Sliding pulse variable in phase up to 2500 microsec. Amplitude of suppression pulse adjustable between 10 and 35 v, and width variable between the limits of 10 microsec. or less to 1800 microsec. or more at a recurrence rate between 200 and 300 cps. Provides various types of voltage pulse outputs for modulation of a signal generator such as GR #804B or 804C. New $125.00

MIT MODEL 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 1-715-B, 1-829-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 KV (1200 KW pk); pulse rate 200 PPS, 1.5 microsec; pulse line impedance 50 ohms. Circuit—series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New, with all tubes $49.50

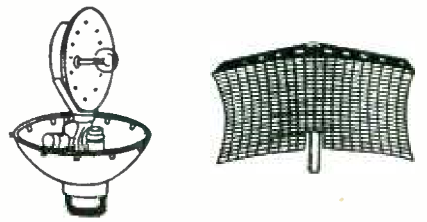
PULSE NETWORKS

G.E. #25E5-1-350-50P2T, 25 KV, 5 sections, "E" circuit, 1 microsecond pulse length, 350 PPS, 50 ohms impedance $45.00
G.E. #6E3-5-2000-50P2T, 6KV, "E" circuit, 3 sections, .5 microsecond, 2000 PPS, 50 ohms impedance $6.50

PULSE TRANSFORMERS

W.E. #D166173 III-Volt input transformer, W.E. Impedance ratio 50 ohms to 900 ohms. Freq. range: 10 kc to 2 mc. 2 sections parallel connected, potted in oil $12.00
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 $2.00
G.E. #K2731 Repetition Rate: 635 PPS, Pri. Imp: 50 Ohms, Sec. Imp: 450 Ohms, Pulse Width: 1 Microsec. Pri. Input: 9.5 KV PK, Sec. Output: 28 KV PK. Peak Output: 800 KW. Bifilar 2.75 Amp. $19.50
W.E. #D169271 Hi Volt input pulse Transformer .. $9.95
G.E. K2450A Will receive 13KV. 4 micro-second pulse on pri., secondary delivers 14KV. Peak power out 100KW GE $15.00
G.E. #K2748A Pulse Input, line to magnetron .. $12.00
Utah Pulse or Blocking Oscillator Transformer Freq. limits 790-810 cy-3 windings turns ratio 1:1:1 Dimensions 1 13/16 x 1⅛" 19/32 .... $1.50
WE # KS 9948 imp ratio 700 to 50 ohms 18 KVDC, Unpotted $6.50

MICROWAVE ANTENNAS



AN MPG-1 Antenna. Rotary feed type high speed scanner antenna assembly, including horn parabolic reflector. Less internal mechanisms. 10 deg. sector scan. Approx. 12'L x 4'W x 3'H. Unused. (Gov't Cost—$4500.00) $250.00
APS-4 3 cm. antenna. Complete. 14½" dish. Cutler feed dipole directional coupler, all standard 1" x ½" waveguide. Drive motor and gear mechanisms for horizontal and vertical scan. New, complete .. $65.00
AN/TPS-3. Parabolic dish type reflector approx. 10' diam. Extremely lightweight construction. New, in 3 carrying cases $89.50
RELAY SYSTEM PARABOLIC REFLECTORS: approx. range: 2000 to 6000 mc. Dimensions: 4½' x 3', rectangle, new $85.00
TDY "JAM" RADAR ROTATING ANTENNA, 10 cm. 30 deg. beam. 115 v.a.c. drive. New $100.00
SO-13 ANTENNA. 24" dish with feedback dipole 360 deg. rotation, complete with drive motor and selsyn. New .... $75.00 Used $45.00
DBM ANTENNA. Dual, back-to-back parabolas with dipoles. Freq. coverage 1,000-4500 mc. No drive mechanism $65.00
AN/128A ANTENNA. Two Vertical dipoles working against a square reflector apx. 3' x 4'. Range: 140-200 mc. .... NEW $40.00
AS 125/APR CONE type receiving antenna, 1000 to 3200 megacycles. New $4.50
140-600 MC. CONE type antenna, complete with 25' sectional steel mast, guys, cables, carrying case, etc. New $49.50

ALL MERCHANDISE GUARANTEED. MAIL ORDERS PROMPTLY FILLED. ALL PRICES, F.O.B. NEW YORK CITY. SEND MONEY ORDER OR CHECK. SHIPPING CHARGES SENT C.O.D. RATED CONCERNS SEND P. O.

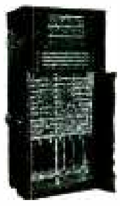
131-E Liberty St., New York, N.Y.

COMMUNICATIONS EQUIPMENT CO.

Cable "Comsupo" Digby 9-4124

SCR 610 11-10 METER PORTABLE/MOBILE XMTR-RCVR.

SCR 610 portable transmitter-receiver, 27 to 38.9 mc, crystal controlled, using FM for efficient operation. Unit consists of Xmtr-rcvr BC 659 and power supply PE 97 . . . operating from 6 or 12 vdc. Slightly used, excellent condition. Less xtals..........$21.00



SB 19/GT CONSOLE

Supervisors Panel. Includes jack and key panels, relays, and line terminating facilities. Originally used to monitor and patch up lines in plotting shelter, and to switch outside tp lines. Used with radar set AN/CPS-5. Dimensions: 60" H x 28" L x 18" W. New, export packed.

RADAR SETS

RC 145 IFF SET. Consists of BC 1267 xmtr-rcvr, remote antenna controller and indicator I-221, power supply RA 105-A. 1 kw. pulse oscillator operates on 154-186 mc. Operates from 117 v., 60 cy. New..............................$190.00

SN RADAR-GE, low power, 5 and 25 miles ranges. Uses GL446 as pulsed oscillator, 5" "A" scope. "S" band. Extremely compact, ideal for demonstration and laboratory work. 115V 60C operation. Used. Excel. cond..............................$600.00

SE 10 CM. SURFACE SEARCH RADAR, W.E. 20,000 to 80,000 yds. range. 250 KW. pk. power input to 706 magnetron. Thyratron modulator. variable pulse rate. Complete set including spare parts, tubes, waveguide and fittings. Send for price and additional information.

TELESCOPIC 30 FT. MAST SETS

Heavy duty rugged plywood. Crated in 3 sections with coupling and rigging material. Two masts per set for flat-top antenna. Unused........$40.00 per set

JUST ARRIVED!!

600,000 AIRCRAFT BULBS MAZDA #623, 24-28VDC, 6C.P. TUNG-SOL #1251, 24-28VDC, 3C.P.

VIBRATORS

TR 1218, 12 vdc, 5 pin
OAK V-6675, 24-32 vdc, 7 pin
Mal. Type G534C, 12 vdc, 5 pin
Mal. Type G629-C, 12 vdc, 4 pin

PRICE......$1.00 EA.

MFR'S. QUANTITIES AVAILABLE

GREAT TUBE VALUES

O1-A	$.45	7E5	1.00	814	4.95
1A3	.70	7E6	.72	815	2.50
1B24	4.85	10Y	.60	836	1.15
1H5	.55	12A6	.35	837	1.95
1N5	.69	12GP7	14.95	843	.59
1T4	.69	12K8Y	.65	860	15.00
2C21	.69	12SF7	.49	861	40.00
2C22	.69	12SR7	.72	874	1.95
2J21-A	25.00	15R	1.40	876	4.95
2J22	15.00	28D7	.75	889R	78.50
2J26	15.00	30 (Spec)	.70	1005	.35
2J27	15.00	35L6	.69	1613	.95
2J31	25.00	35Z5	.66	1619	.21
2J32	15.00	45 (Spec)	.59	1624	.85
2J38	25.00	50L6	.79	1629	.35
2J39	25.00	39/44	.49	1961	5.00
2J55	25.00	35/51	.72	8012	3.95
3J31	25.00	211	.75	9002	.65
2X2/879	.69	227A	3.85	9004	.47
3A4	.65	225	8.80	9006	.47
3BP1	2.25	250R	7.95	CEQ 72	1.95
3C24	.60	268-A	20.00	EF 50	.79
3C30	.70	255-A	19.50	E-1148	.75
3D6	.79	417A	22.50	F-127	20.00
3CP1/S1	3.50	530	90.00	FC 258A	165.00
3D21-A	1.50	531	45.00	FC 271	40.00
3DP1	2.25	532	3.95	GL 562	75.00
3EP1	2.95	559	4.00	GL 623	75.00
3FP7	1.20	562	90.00	GL 697	75.00
3GP1	.350	615	.89	ML 100	60.00
3Q5	.79	703-A	7.00	QK 59	45.00
5BP1	1.20	704-A	.75	QK 60	45.00
5BP4	4.95	705-A	2.85	OK 61	55.00
5CP1	3.75	707-B	†20.00	OK 62	55.00
5FP7	3.50	714AY	15.00	RCA 932*	.65
5JP2	8.00	715-B	12.00	VR 91	1.00
5J30	39.50	720BY	50.00	VR 130	1.25
6AC7	1.00	720CY	25.00	VR 135	1.25
6AK5	.69	721-A	3.60	VR 137	1.25
6C4	.58	723-A/B	7.75	VR 150-30	.75
6G	2.00	724B	1.75	VU 120	1.00
6J6	1.00	724-D	2.50	VU 134	1.00
6K7	.55	725-A	25.00	WL532	4.75
6L6GA	1.00	726-A	10.00	WN 150	3.00
6SC7	.70	800	2.25	WT 260	5.00
6SL7	1.00	801-A	1.10	† With Cavity.	
6V6GT	.79	804	9.95	* Photocell.	
7C4	1.00	811	1.95		

CROSS POINTER INDICATOR

Dual 0-200 microamp. movement in 3" case. Each movement brought out to 6-term receptacle at rear. Originally used in ILS equipment. New.........$2.50

VOLTAGE REGULATORS

Mfg. Raytheon: Navy CRP-301407: Pri: 92-138 v, 15 amps, 57 to 63 cy, 1 phase. Sec: 115 v, 7.15 amp, .82 KVA, .96 PF. Contains the following components:

REGULATOR TRANSFORMER: Raytheon UX-9545. Pri: 92-138 v. 60 cy, 1 PH. Sec: 260/580 v. 5.5/5.26 amps, 4000 v rms test.
FILTER REACTOR: .156 hy, 5 amps, 4000 v test. Raytheon UX 9547.
TRANSFORMER: Pri: 186 v, 5 amps; Sec: 115 v. 7.2 amps. Size: 12" x 20" x 29". Net Wt. approx. 250 Lbs.
Entire unit enclosed in grey metal cabinet with mounting facilities. New, as shown $99.50

POWER EQUIPMENT

Step down transformer: Pri: 440/220/110 volts a.c. 60 cycles, 3 KVA. Sec. 115 v. 2500 volt insulation. Size 12" x 12" x 7"..............................$40.00
PLATE TRANSFORMER. Pri: 117 v. 60 cy. Sec. 17,-000 v @ 144 ma. with choke. Oil immersed. Size: 26" x 29" x 13" Amertran..................$65.00
Fil. Transformer: Pri: 220 v.a.c., 60 cy; .05KVA. sec; 5 v.c.t., 34,000 v. test $24.50
Fil. Trans. UX6899, Pri: 115v. 60 cy. Sec: Two 5V 5.5A windings 29 KV Test $24.50
Plate Transformer: Pri: 115/230 v.a.c., 50-60 cy. sec: 21,000 v, 100 ma. $145.00
Voltage Reg. Transtat "Amertram" type PH 2KVA load. Input 90/130 v. 50/60 cycle output 115 v. $40.00

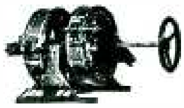
OIL CONDENSER
STANDARD BRANDS

1 mfd. 10 KVDC #14F191 ....$15.00
.06 mfd. 15 KVDC, 25F585-G2 ....$ 8.70
1.5 mfd. 6000 vdc $12.50
.25 mfd. 20,000 vdc $17.50
10 mfd. 1000 VDC ....$ 1.79
3x10 mfd. delta connected synchro-capacitor, 90 v 60 cycles ....$ 4.95
1 mfd. 6000 vdc, 25F509G2 ....$ 3.85

POWER CHOKES

Swing. Choke: 4.5 to .8 hy; .2 to 1 amp. $10.95
.03 hy, 2 amp. $1.45
8.5 hy, 125 ma. $1.50
25 hy, 65 ma. $1.10
6 hy, 150 ma. $1.50
Dual 7 hy, 75 ma, 11 hy, 60 ma. $1.65
Dual 2 hy, 100 ma..$ .75
.116 hy, .15 amp. ..$4.50
.01 hy, 2.5 amp..$ 1.50
.35 hy, .35 amp..$ 7.50
Dual 2.5 hy, 130 ma. ....$ 1.25
.1 hy, 12 amp, 40 ohms. $16.00
Dual .5 hy, 380 ma. ....$ .95
5 hy, 40 ma. 312 ohms. ....$ .65
2 hy, 200 ma..$ .75
Dual 120 hy, @ 17 ma. ....$. 2.45

TRANSTATS (AMERTRAN)



Input: 0.115 v. 50-60 cycle. Max. **output:** 115 v, 100 amp. All units are new, guaranteed **$75**

400 CYCLE TRANSFORMERS

352-7179: Pri: 115 v, 400 cy. Sec: 6.3 v, 2.7 amp; 6.3 v, .66 amp; 6.3 v, 21 amp.................$2.95
32332: Pri: 115 v, 400-2400 cy. Sec: 400 vct, 35 ma; 6.4 v, 2.5 amp: 6.4 v, .15 amp............$2.25
35-7179: Pri. 115 v, 400-2400 cy. Sec: 6.5 v, 12 amp ct. 250 v, 100 ma; 5 v, 2 amp.............$3.50
#9069: Pri: 115/80 v, 400-2600 cy. Sec: 650 vct, 50 ma; 6.3 vct, 2 amp; 5 vct, 2 amp.......$2.15
1.75 amp, 3 KV ins; 5 v, 3 amp; 6.5 v, 6.5 amp; 6.5 v, 1.2 amp $3.95
352-7096: Pri: 115/80 v, 400-2400 cy. Sec: 2.5 v, 1.75 amp, 3 KV ins; 5 v, 3 amp; 6.5 v, 6.5 amp; 6.5 v, 1.2 amp $3.95
KS 9607: Pri: 115 v, 400-2400 cy. Sec: 734 vct, 177 ma, 1710 vct, 177 ma......................$5.95
D-166333: Pri: 115 v, 400-2400 cy. Sec: 6.3 v, 0.9 amp, 7.7 v, 0.365 amp.....................$2.79
GE # 7471357: Pri: 100/110/120/130 v, 400-2400 cy. Sec: 2.5 v, 20 amp, HV ins.........................$4.85
D-163254: Pri: 115 v, 400 cy. Sec: 6.3 v, 12 amp. 6.3 v, 2 amp; 6.3 v, 1 amp. P/O AN/APQ-5..$5.85
KS 9685: Pri: 115 v, 400-2400 cy. Sec: 6.4 vct, 7.5 amp; 6.4 v, 3.8 amp; 6.4 v, 2.5 amp......$4.35
PLATE XFMR: Pri: 115 v, 400 cy. Sec: 9800 v, or 8600 v, @ 32 ma dc..........................$12.50
#12033, Plate Xfmr, Pri: 115 v, 800 cy. Sec: 4550 vct, 250 ma $4.50
KS 9445, Pwr Xfmr: Pr: 115 v, 400-2400 cy. Sec: 592 vct, 120 ma, 6.3 v, 8 amp; 5 v, 2 amp..$3.50
PLATE XFMR: Pri: 115 v, 400-2400 cy. Sec: 4500 v, 6 ma $6.50
#7143, Pri: 115 v, 400 cy. Sec: 6.3 v, 7 amp. 8.3 v, 8.8 amp, 6.3 v, 1.3 amp.................$2.50
FIL XFMR: Pri: 115 v, 400 cy. Sec: 6.3 v, 9 amp. 6.3 v, 65 amp, 2.5 v, 3.5 amp, 25 v, 3.5 amp..$3.25
KS 9584, Pri: 115 v. 400 cy. Sec: 5,000 v, 290 ma; 5 v, 10 amp, size: 7" x 10" x 6"..........$15.00
Pri: 115 v, 380-2800 cps. Sec: 2200 v, 350 VA, open frame $3.95
PLATE XFMR: Pri: 115 v, 400 cy. Sec: 1150-0-1150 v, 40 ma, GE. 68G631.........................$1.75

INVERTERS

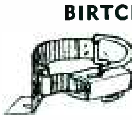
PE 206-A, Input: 28 VDC @ 38 amp, Output: 80 volts @ 500 volt-amps, 800 cycles, Leland, New, complete with enclosed relay, filter, instruction book $12.50
PE 218: Input: 25-28 VDC @ 92 amps, Output: 115 volts @ 1500 volt-amps, 380-500 cycles. Poor physical but good running condition.......$15.00

STANDARD BRANDS PRECISION CAPACITORS

D-160270: 1 mfd @ 200 vdc, —40 to plus 65 deg C
D-161659: 4 mfd @ 400 vdc, —50 to plus 85 deg C
D-163707: 0.4 mfd @ 1500 vdc, —50 to plus 85 deg C
D-163035: 0.1 mfd @ 600 vdc, 0 to plus 65 deg C
D-170908: 0.152 mfd, 300 v, 400 cy, —50 to plus 85 deg C
D-164960: 2.04 mfd @ 200 vdc, 0 to plus 55 deg C
D-168344: 2.16 mfd @ 200 vdc, 0 to plus 55 deg C
D-161555: .5 mfd @ 400 vdc, —50 to plus 85 deg C
#D-166602: 16 mfd @ 400 vdc, temp comp 50 to 85 deg C
D-161270: 1 mfd @ 200 vdc, temp comp —40 to plus 65 deg C
QBG-1. Echo Ranging Driver-Receiver, underwater sound signal transmission and reception unit with range of 200 to 600 yds. and freq. range of 16 to 27 kc. New, with battery box, less projector.$85.00

300000 SHOCK-MOUNTS STANDARD BRANDS AVAILABLE IN 20 WEIGHTS & SIZES SEND YOUR REQUIREMENTS

BIRTCHER TUBE CLAMPS



926-A, 926-A2, 926-B, 926-B1, 926-B5, 926-B33, 926-C
All sizes.................$.14 Each
Many other types and sizes available. Send your inquiries.

WIRE WOUND POTENTIOMETERS

20,000 ohms, 10%, 8 watt.........................$.95
5,000 ohms, 10%, 8 watt.........................$.95
15,000 ohms, 10%, 4 watt.........................$.69
Dual 250 ohms, 25 watt...........................$.98
50 ohms, 25 watt..................................$.69
1000 ohms, 50 watt, mod J........................$.98
800 ohms, 50 watt mod J.........................$.98
5 ohms, 250 watt, mod L.........................$3.25

RELAY DPDT, 12 V. D.C. DUNCO #CX3190 B

CONTACTS 16 V. @ 6 AMP D.C. Latching Type $2.25 ea.

A Complete Line of D.C. Relays in Stock. Send for Listing.

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set	Price*
BD 77KM	14	40	1000	.350	BC 191	$20.00 N $14.00 LN
PE 73	28	19	1000	.350	BC 375	$24.50 N
DM 21	14	3.3	235	.090	BC 312	$3.45 LN
DM 21CX	28	1.6	235	.090	BC 312	$3.45 N
DM 25	12	2.3	250	.050	BC 367	$2.49 LN
DM 28R	28	1.25	275	.070	BC 348	$5.75 N
DM 33	28	7	540	.250	BC 456	$5.50 N
DM 42	14	46	515 1030 2/8	.110 .050	SCR 506	$6.50 LN
PE 55	12	25	500	.400	SCR 245	$5.25 LN
PE 86	28	1.25	250	.060	RC 36	$3.95 N
PE 101 C	13/26	12.6/ 6.3	400 800 9 AC	.135 .020 1.12	SCR 515	$5.25 N
BD AR 93	28	3.25	375	.150		$4.95 N
23350	27	1.75	285	.075	APN-1	$3.50 N
35X045B	28	1.2	250	.060		$3.50 N
ZA .0515	12/24	4/2	500	.050		$3.95 N
B-19 pack	12	9.4	275 500	.110 .050	Mark II	$9.95 N

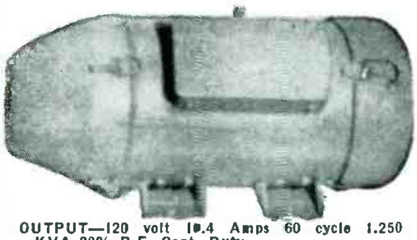
*N—New. LN—Like New.

MISCELLANEOUS COMPONENTS

SEL. RECTIFIER: Input: 115 vac. 60 cy. Out: 120 vdc. 1.66 amps. Full Wave Bridge, F. T. & R. #DE11 ....$9.95
SEL. RECTIFIER: Input: 30 vac, 60 cy. Out: 24 vdc, .5 amp. Full wave bridge, GE #SC10......$1.50
POWER SWITCH. 4 pos. 60 amps, 600 vac. Arrow H&H $4.25
ROTARY SPARK GAP. 24 vdc motor, 4 spark gap electrodes, p/o Xmtr BC 1081-TG..............$5.50
TELETYPE TAPE. Gummed, ⅜" WD. 4" Rolls. $.10 Roll
SELSYNS, 110 v, 60 cy. sizes..........$7.75 per pair

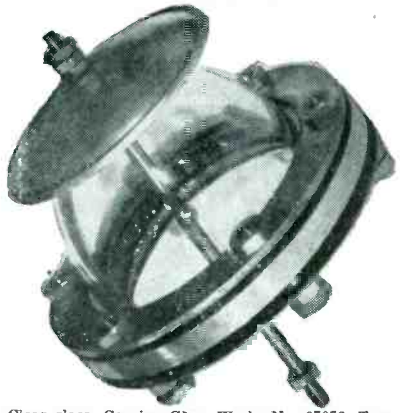
SURPLUS NEW EQUIPMENT

MOTOR GENERATOR



OUTPUT—120 volt 10.4 Amps 60 cycle 1.250 KVA 80% P.F. Cont Duty.
INPUT—115 Volt 14 Amps D.C.
Centrifugal starting, frequency adjustable to load, ball bearings, 3600 R.P.M. Fully enclosed splash-proof housing—measures approx. 26" L x 13" H x 13" W.
Mfg. by Allis Chalmers to rigid Navy Specs. @$100.00

BOWL INSULATORS

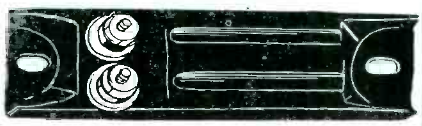


Clear glass, Corning Glass Works No. 67076. Type C Compromises flanged bowl 4⅜" h x 6-15/16 O.D. at base. Center lead-in pin ⅝" dia. x 11½" long. Mounts by means of 6 studs through mounting flange. Overall dia. 8¾" S.C. Stock No. 3G-1830-67076.1 .... @ $6.00

METER RECTIFIER

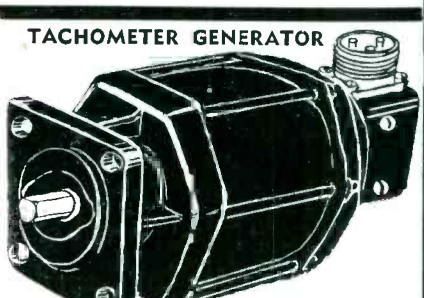
Full Wave Weston part number D89367. For use with model 301 meters. Terminals marked A.C., plus and minus .... @ $1.50
(Ten for $12.50)

STRIP HEATERS

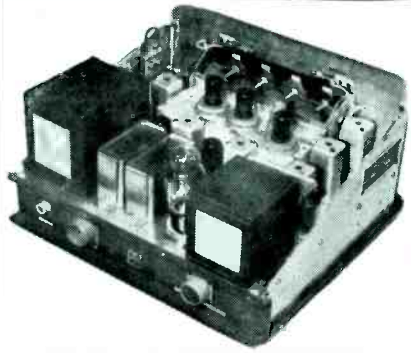


50 Watt, 115 Volt, 250 Ohms, 1½" x ½" x 6" G.E. Catalog No. 2A301. Minimum order 10 pieces at 60c each.

TACHOMETER GENERATOR



Three phase
.64, 65 & 89 volts at 1000 RPM 1 M.A., A.C., G.E. Type CM 5 Model 2CM5AEA .... @ $9.50



BC-1161-A RADIO RECEIVER

150 to 210 Megacycles. Operates off 115 volt 60 cycle Power supply. Inductance tuning for R.F., Antenna, detector and oscillator. With a few modifications this unit makes an ideal F.M. Receiver. Each set complete with circuit diagram and the 14 following tubes: 1—6SN7 Cathode Follower; 1—6H6 second Detector; 2—6SH7 1st and 2nd R.F. Amp.; 1—6SH7 Video Amp.; 3—6AC7/1852 1st, 2nd, 3rd IF Amp.; 2—6AB7/1853 4th, 5th IF Amp.; 1—9006 Mod.; 1—6J5 Osc.; 1—5U4G Rect.; 1—6E5 Tuning Indicator.
Complete in a metal cabinet 10" high 16½" wide and 15" deep. .... @ $34.50

BC-1160-A TRANSMITTER

157 to 187 Megacycles. Operates off 117 Volt 60 cycle. Contains 115 volt, 1525 R.P.M. Blower. General Radio 200 B 1.5 Amp. Variac 10 tubes, 0-5 Kilovolt 3½" meter transformers, relays, circuit breakers too numerous to list. Complete in metal cabinet 17⅜" x 18½" x 18" with circuit diagram. @ $29.50

CODE TRAINING SET AN/GSC-T1

Made by T. R. McElroy, Boston.
Operates off 6, 12, 24 or 110 V D.C. or 110 V or 230 Volt, 60 cycle.
An excellent unit for schools or clubs for code training. This unit is designed for group training of telegraph code to students whereby each student sends a message from any prepared text to the instructor. It provides a visual signal through a blinker or an audible signal through a monitoring speaker. Has volume control, variable frequency oscillator, a phone jack for a monitoring headset, pitch and tone control, rotary switch for selecting the operating voltage and power supply.
Complete with spare fuses, power cord and battery adapter; 10 Telegraph Keys with 10' line each, 1 #6 x 5 tube and 2 #6AG6 tubes.
Complete in chest 10½" x 17" L x 13½" H—Net wt. 49 lbs.
Can be used anywhere—batteries A.C. or D.C. Durable—Good for a lifetime of Service! NET $24.50

SPECIAL METERS

Frequency Meter—Dual Range—covers frequency ranges from 48 to 52 cycles and 58—62 cycles—J.B.T. 30-F—Dual element, Vibrating Reed type —115 V—3½", rd fl metal case $5.95

PHASE ROTATION INDICATOR

A rotating mechanical meter designed to indicate phase rotation on 110, 220 and 550 volt 25-60 cycle A.C. lines. Greatly simplifies the determination of the direction of rotation of motors, operation of controls, etc. A small portable 3½" round meter with push-for-test button and 36" three wire test leads.
Western Electro-Mechanical Co., Catalog #4600 @$4.50
Voltage Polarity Phase Rotation Tester—Triplett 337 AVP—Checks 115, 220 and 440 line voltage—locates open circuits, blown fuses, damaged wiring, etc. Indicates whether A.C. or D.C. and polarity of D.C.—Checks phase rotation to determine direction of rotation of motors, operation of controls, etc.—Consists of a 3" square meter and a small polarized vane movement in a small handy sized case—Complete with 36" leads with test prods $8.50
HOUR METER Totals to 99,999.9 hrs & repeats WH NH-35, 3½ rd fl case. Operates on 230 volt 60 cycle $8.50
D.C. MILLIAMMETER Weston 271 fan type, 1-0-1 MA & 60-0-60 M.V. mvt. Scale cal 600-0-600 RPM $12.50

PORTABLE CHRONOMETRIC TACHOMETER

To measure speeds from 0 to 20,000 R.P.M. with scale calibrations in 10 R.P.M. divisions. Divide scale reading by 2 when using the peripheral wheel and you can read surface speeds up to 10,000 F.P.M.
3 2" open face dial provides unequaled readability. Each division on large dial indicates 10 R.P.M. & each division on small dial indicates 1000 R.P.M. Readings are similar to those made on kilowatt hour meters. Results of tests remain on dial until next test taken.
Complete with 2 tips, peripheral wheel, & operating instructions—No stop-watch or other timing mechanisms required. Made by Jaeger Watch Co. model 43 A-6. Complete in velvet lined case 5" x 3½" x 1½". List price $75.00 .... @ $24.50

MULTIPLE RANGE, CONTINUOUS INDICATING PORTABLE TACHOMETER

Three ranges in R.P.M. & three ranges in F.P.M. 300-1200, 1000-4000, 3000-12,000 R.P.M.
Large 4" dial shows INSTANTANEOUSLY & CONTINUOUSLY the speed or change in speed of any revolving shaft or surface.
Complete with 4 tips, peripheral wheel, extension rod and operating instructions. No stop watch or other timing mechanism required.
Made by Jones Motorola, Stamford, Conn. Comes complete in velvet lined case 7⅛" x 4" x 5". List price $75.00. .... @ $24.50

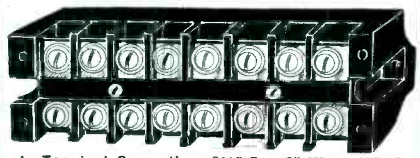
RADIO SET SCR 518 HIGH ALTITUDE ALTMETER

0-20,000 (& 30,000) feet, 515 m.c. 24 volt 300 watts. Complete with 29 tubes and accessories with OPERATING INSTRUCTIONS AND CIRCUIT DIAGRAMS .... @ $24.50

ACROSS-THE-LINE-STARTER

Manually operated, with adjustable compensated overload relay, and manual start and stop features. Adjustable compensation relay for 90, 100 and 100% overload. Supplied with one thermal overload element for motor rating of 1.32 Amps min. and 1.42 amps maximum. Can be used for any motors with ratings up to 17.2 Amps, and up to 440 volts, single or 3 phase with the use of the proper thermal elements. A complete list of elements available and a connection diagram is mounted inside of drip proof box which measures 7½" H x 5½" W x 5½" D.
Cutler Hammer type 6922H1A—meets Navy Specs. 17C10 .... @ $4.50

TERMINAL BOARDS



4—**Terminal Connections** 3¼" L x 2" W x 1½" H with cover, G.E. .... @ 40¢
6—**Terminal Connections** 4½" L x 2" W x 1¾" H no cover, G.E. .... @ 60¢
8—**Terminal Connections** 5¼" L x 2" W x 1½" H with cover, G.E. .... 80¢

AUTOMOTIVE GENERATOR

Autolite #GAF 4001, 6 Volt D.C. Approx. 12 Amps at 1200 R.P.M. Counter Clockwise rotation ⅝" shaft on one end and right angle gear drive for distributor timing on other end. With 6 volt cut-out and mounting base for 4 ⅜" bolts. ... @ $15.00

COMBINATION OFFER

150 VOLT A.C. METER
Triplett 331-JP, 3½" Rd flush case

30 AMP A.C. METER
Triplett 331-JP, 3½" Rd flush case

Both meters for $7.95

All items are Surplus—New—Guaranteed. C.O.D.'s not sent unless accompanied by 25% Deposit. Orders accepted from rated concerns, public institutions, etc., on open account.
The above is only a partial listing of the many items we have in stock. Send for free circular.
MANUFACTURERS, EXPORTERS, DEALERS—we invite your inquiries.

MARITIME SWITCHBOARD

336 Canal Street   Worth 4-8217   New York 13, N. Y.

We carry a complete line of surplus new meters suitable for every requirement, such as portable, panel, switchboard, laboratory standards, etc.

OVER 50,000 METERS IN STOCK

We also have in stock various surplus components, tubes, code keying and recording units, code training sets, tachometers, analyzers, tube testers, converters, precision resistors, current transformers, transmitters, receivers, condensers, and other electronic units, parts and accessories.

MICROMAX POTENTIOMETERS
L & N INDICATORS — CONTROLLERS — RECORDERS

Model S—RECORDER—CONTROLLER

2 Thermocouples—one control point—2 sets H.C.L. Contacts—115V. AC motor.
Ranges
0-1200°F C/A
0-1800°F C/A
$195.00

Model S—RECORDER—CONTROLLER

Single Point—Chart tear-off feature—H.C.L. Contacts—115 V. AC Motor.
Range
0-1500°F C/A
$195.00

Model S—RECORDER—CONTROLLER

H.C.L. Contacts—115 V. AC motor
Extra set on-off contacts.
Range
0-1500°F C/A
$195.00

SELENIUM RECTIFIERS

New—Fresh Stock—Not over 6 mos. old. Full wave bridge . . single phase . . resistive inductive load . . . continuously rated . . . conservative design.

Type	Max. R.M.S. Input	Max. D.C. Output at 35° C	Price
5B-1	24	18 V @ 3.1 A	$5.03
5B-1	24	18 V @ 5.2 A	6.73
10B-1	24	18 V @ 10 A	8.71
1B-1	24	19 V @ 1.6 A	4.04
16B-1	24	19 V @ 16 A	16.40
24B-1	24	19 V @ 24 A	23.76
1B-2	48	37 V @ 1.2 A	7.21
3B-2	48	37 V @ 3.1 A	9.60
5B-2	48	37 V @ 5.2 A	13.37
10B-2	48	37 V @ 10 A	17.18
16B-2	48	37 V @ 16 A	30.89
24B-2	48	37 V @ 24 A	44.67
5B-6	144	110 V @ 5.2 A	35.70
2B-6	144	112 V @ 2.4 A	21.86
1B-6	144	114 V @ 1.2 A	17.34
2B-7	168	131 V @ 2.4 A	25.51
1B-7	168	133 V @ 1.2 A	19.68
5B-7	168	133 V @ 5.2 A	41.10

MICROVOLTER—FERRIS Model 20B

.2 to 100,000 microvolts output, continuously variable . . . operates on 115 V. 60 cycle AC . . . push button selector for 18 frequencies from 455 K.C. to 22 M.C. . . . with or without 400 cycle 30% modulation . . . frequency may be varied ±2% by screwdriver adjustment.

Your Price......$100.00

WHSE PORTABLE GALVANOMETER

Type PX-12-7 M.A. movement, special scale, solid connecting terminals, contains a 1 volt internal cell which can be easily removed for conversion to DC AMMETERS & VOLTMETERS, with leather case & canvas carrying strap.

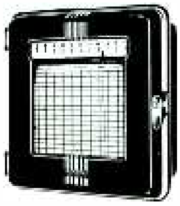
A buy at $4.95

AGASTAT TIME DELAY RELAY

Type ND-21, Diagram type, 24 V. mom. coil, SPDT, 0-5 sec. cont. duty, up to 15 sec. intermittent duty.
Dimensions 2¼" x 2¼" x 4¼" for 24 V. DC operation.

Price $4.50

Model S—RECORDER—CONTROLLER



H.C.L. CONTACTS—115 V, AC Motor.
Ranges
0-1000°F C/A
0-1500°F C/A
0-1800°F C/A
200-2000°F C/A
1000-2000°F C/A
Model S
$210.00

MODEL R RECORDER—CONTROLLER

H.C.L. Contacts — 115 V. AC motor.
Ranges
0- 800°F C/A
700-1400°F I/C
Model R
$175.00

RECTIFIER TRANSFORMERS

PRI—105/110/115/120 V.—50/60 Cycles—Open Frame Construction

SEC		Weight	Price
SEC—18 V @ 2.5 Amps		4 lbs	$3.35
18 V @ 5 Amps		5.5 lbs	5.25
18 V @ 10 Amps		10 lbs	6.75
18 V @ 25 Amps		25 lbs	14.95
18 V @ 50 Amps		30 lbs	24.75
36 V @ 2.5 Amps		7.5 lbs	5.25
36 V @ 5 Amps		10 lbs	6.50
36 V @ 10 Amps		20 lbs	10.95
36 V @ 25 Amps		30 lbs	22.50

PRI—115 Volts—50/60 Cycles
Open Frame Construction

SEC	Weight	Price
SEC—135/145/155/165 V @ .5 Amps	5 lbs.	5.25
135/145/155/165 V @ 1.5 Amps	15 lbs.	7.95
135/145/155/165 V @ 2.5 Amps	25 lbs.	13.50
135/145/155/165 V @ 5 Amps	35 lbs.	24.50

HIGH VOLTAGE CAPACITORS

1 MFD 20 KV DC 18"x13½"x5" $25.00
.1 MFD 25 KV DC-13"x7"x4" 9.85
.001 MFD 50 KV DC-5⅛"x7¾"x4" insulators 4" dia. x 7" high 12.50

Cap. Mfd.	Volts D.C.	Height	Width	Length	Price
10	1000	5-7/8 x	1-3/4 x	3-7/8"	$1.85
4	1000	5-7/8 x	2-3/4 x	1-1/4"	.85
1	1000	3-5/7 x	2 x	1-1/16"	.50
1	500	2" x	1-1/4" x	1-1/16"	.25
.25	1000	1-1/2 x	1" x	3/4"	.25

.001 Mfd.—50 K.V. DC.—5⅛" x 7¾" x 4" Insulators 4" Dia. x 7" High. $12.50
.1 Mfd.—25 K.V. DC.—13" x 7" x 4"......... $9.85

RHEOSTAT

Ohms	Amps	Size-Diam	Price
.87	13	3½"	$2.50
6	2	1½"	1.75
10	9.2	14"	5.95
22	4.5-3.1	6"	6.50
30	1.7- .9	2½"	1.50
32	2.4	3½"	4.95
40	1.12	2"	2.50
50	1.11	2"	2.50
75	3.5	6"	7.50
100	1	3"	2.95
200	.25	1½"	.75
250	2.5- .51	6"	7.50

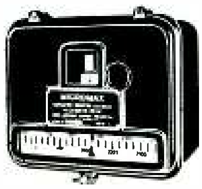
HEINEMAN CIRCUIT BREAKER

For use with low voltage, D.C., 100 Amps. Dimensions: 3¼"H x 4"D x 1" W $1.75
15 Amp, 115 V AC, Curve 3, CAT.AM 2511-15 $1.75
35 Amp, 120 V AC, Curve 2, CAT.AM 1510R-35 $1.75
1.5 Amp, 117.5 V AC, Instant Trip $1.75

MODEL S—2 PT. RECORDER

110 V. AC Motor Range 0-1800°F C/A
$235.00

MODEL C—INDICATOR—CONTROLLER



H.C.L. Contacts—115V. AC Motor Ranges: 0-1500°F I/C, 0-1800°F C/A, 0-2000° C/A, 200-2000°F C/A.
Model C $135.00

MODEL S—RECORDER

with alarm feature using relay & cam operated contacts. Can be used as on-off controller without temperature setting device. 115 V. AC motor.
Range 0-1800°F C/A.
$180.00

GE STEPDOWN TRANSFORMER

PRI 115/230 V 60 cycles.
SEC 32 V. Rating .5 KVA
Isolation type cat 61G60 enclosed, bell end, cont. duty.
Your Price $7.50

STRUTHERS-DUNN RELAYS

D.P.S.T., Normally open, 115V, 60 Cycle, A.C. coil, 30 Amp contacts, fibre base with 4 holes for mounting. Dimensions, 4½" L x 3" W x 3¾" H.
A Real Buy At $2.50

STEPDOWN TRANSFORMER—SPECIAL

Made by GE . . . heavy duty . . . considerable over-design . . . open frame . . . ideal for rectifier application . . . size 3½" x 3½" x 4".
Primary—115 V 60 cycles.
SEC—15 V. @ 12 amps . . . a buy at.....$3.75
SEC—10 V. @ 18 amps . . . a buy at..... 3.75

HEAVY DUTY STEPDOWN TRANSFORMERS

Input: 115 V. (with 8 taps in primary).
Output: from 16 to 10.5 V. (in 8 steps).
Capacity: 1.25 KVA—Sec. Amps: 100.
Size: 13"x10"x5". Approx. Weight: 30 Lbs.
Open Frame Construction.
Your Cost $12.50
10 for $100.00

POWER TRANSFORMER

Pri.—440/220 V 60 Cy Sec—125/115/105 V Rating .8 KVA RCA Open construction.
Bracket mounted, pri & sec terminal board.
Overall dimensions: 5¾"H x 7½"W x 8"D.
Mounting dimensions: 6⅞"x5⅞".
Price $12.50

TRANSTATS—3 K. V. A.

Type RH Input: 115 V. 10%. Output: 115 V. Max. Amps: 26 A. Made as a line voltage corrector 10% of input voltage, or can be connected to give plus 20% or minus 20% of input. Can also be reconnected to be used as an isolated type stepdown with variable secondary. Input: 115 V. Output: 0-30 Volts at 30 Amps. No Knob.
A Real Buy at......$18.00
(same type but .25 KVA. Input: 103-126 V. Output: 115 V.-2.17 A.)
Price.....$6.50

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BC 454
ARC5 RECEIVER
3-6Mc.
Less Dynamotor
$3.95

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1 K.W. POWER SUPPLY KIT

2500-0-2500 Volts @ 500 MA
or
2000-0-200 Volts @ 500 MA

(oil-filled Xformer from BC610)	$39.95
1—Swinging choke	14.95
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1—Filament Xformer	9.95
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All parts New! Reduced to **$79.50**

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Full Wave Bridge Type

INPUT	OUTPUT		
up to 18v AC	up to 12v DC	½ Amp.	$0.98
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up to 18v AC	up to 12v DC	3 Amp.	3.45
up to 18v AC	up to 12v DC	5 Amp.	4.45
up to 18v AC	up to 12v DC	10 Amp.	7.45
up to 18v AC	up to 12v DC	15 Amp.	9.95
up to 18v AC	up to 12v DC	30 Amp.	14.95
up to 36v AC	up to 28v DC	1 Amp.	3.45
up to 36v AC	up to 28v DC	5 Amp.	7.45
up to 36v AC	up to 28v DC	10 Amp.	12.45
up to 36v AC	up to 28v DC	15 Amp.	18.95
up to 115v AC	up to 100v DC	.25 Amp.	2.95
up to 115v AC	up to 100v DC	.6 Amp.	6.95
up to 115v AC	up to 100v DC	5 Amp.	19.95
up to 115v AC	up to 100v DC	3 Amp.	12.95

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NATIONALLY ADVERTISED BRANDS
All Ratings D. C.

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.5mfd.	600v	.35	4mfd.	2000v	3.75
1mfd.	600v	.35	16mfd.	2000v	4.95
2mfd.	600v	.35	4mfd.	2500v	3.98
4mfd.	600v	.60	2mfd.	2500v	2.49
8mfd.	600v	1.10	.1mfd.	2500v	1.25
10mfd.	600v	1.15	.25mfd.	2500v	1.45
3x.1mfd.	1000v	.45	.5mfd.	2500v	1.75
.25mfd.	1000v	.45	.05mfd.	3000v	1.95
1mfd.	1000v	.60	.1mfd.	3000v	2.25
2mfd.	1000v	.70	.25mfd.	3000v	2.65
4mfd.	1000v	.90	1mfd.	3000v	3.50
8mfd.	1000v	1.95	12mfd.	3000v	6.95
10mfd.	1000v	2.10	2mfd.	4000v	5.95
15mfd.	1000v	2.25	1mfd.	5000v	4.95
20mfd.	1000v	2.95	.1mfd.	7000v	2.95
24mfd.	1500v	6.95	3mfd.	4000v	6.95
.1mfd.	1750v	.89	2mfd.	3000v	3.45
.1mfd.	2000v	.95	2x.1mfd.	7000v	3.25
.25mfd.	2000v	1.05	.02mfd.	12000v	9.95
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Army PE-157 Vibrator-type power supply, 2 volt-6 volt type. Chuck full of transformers, resistors, condensers, relays, etc. One relay, which is a 10,000 plate type, is worth more than the sale price. Also a handy dual section selenium rectifier rated at 1½ amps. Has a handy, usable hinged lid metal case, size 6x6x12. A red hot value priced less vibrators and speaker.

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(STANDARD BRANDS)

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1B29	.89	801A	.75
1N21xtal	.59	802	2.95
1N23xtal	.59	803	5.95
1N34xtal	1.60	805	4.49
1P24	.89	807	1.25
2AP1	2.95	808	2.25
2C22/7193	.29	809	1.50
2C26	.29	810	5.95
2C40	.89	811	1.49
2C44	1.39	812	1.98
2C46/2C43	4.95	813	5.25
2D21	1.59	814	3.69
2J21	12.95	815	1.75
2J22	12.95	816	1.19
2J26	12.95	826	.49
2J31	24.95	829B	4.95
2J32	24.95	832A	3.45
2J36	24.95	833A	29.50
2J37	24.95	836	1.49
2J38	18.95	837	1.49
2J39	18.95	838	3.25
2J40	24.95	841	.50
2J46	18.95	843	.59
2J49	34.95	845	3.98
2J51	49.50	851	39.50
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2K25/723AB	24.95	865	.85
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2X2	.59	869B	49.50
3AP1	2.95	874	.69
3BP1	2.95	876	.59
3B22	.69	878	1.98
3B24	.69	884	.69
3B26	3.95	885	.98
3CP1	2.95	902P1	7.95
3C22	12.95	905	8.95
3C23	2.95	923	.89
3C24/24G	.59	954	.35
3C30	.69	955	.35
3C31	1.49	956	.45
3DP1	2.95	957	.35
3D21A	2.95	958	.35
3E29/829B	3.49	1611	.99
4B24	3.95	1613	.75
4E27/257B	11.95	1616	.98
5AP4	4.95	1619	.29
5BP1	1.98	1622	1.75
5BP4	4.95	1624	1.29
5CP1	3.95	1625	.42
5D21	18.95	1626	.25
5FP7	1.49	1629	.25
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5J29	18.95	1638	.79
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5T4	1.19	2051	.75
5U4G	.49	8005	3.65
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5X4	.59	8012	2.75
5Y3	.39	8013	2.75
5Z3	.59	8014	16.95
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6AB7	1.05	8020	2.95
6AC7	.79	8025	4.95
6AK5	.89	9001	.45
6AL5	.69	9002	.45
6C4	.25	9003	.45
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10Y	.89	CK1090	1.49
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316A	.79	ML101	99.50
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715C	18.95	6L6	1.23
717A	1.29	6L7	.99
721A	.59	6SL7	.99
723A/B	5.95	6SN7	.75
724A/B	1.95	30 Spec	.39
725A	7.45	45 Spec	.39

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HI-VOLTAGE INSULATION

1120-0-1120 @ .5A., 2.5v CT @ 10A., 32v @ .025A. 16v @ 2.5A. 12v @ 14.2A Pri 105 tapped to 250v AC	$24.95
3710v @ 10 ma.; 2x2½v @ 3A	9.95
2500v @ 15 ma	6.50
2500v @ 4 ma.; 2½v @ 2A. 6.3v @ 1 amp.	7.95
2150v @ 15 ma	5.50
1750v @ 4 ma.; 6.3v @ 3A	6.50
1600v @ 4 ma.; 700v CT @ 150 ma.; 6.3v @ 9A	7.95
525-0-525v @ 60 ma.; 925v @ 10 ma.; 2x5v @ 3A; 6.3v @3.6A; 6.3v @ 2A; 6.3v @ 1A	7.95
515-0-515v @ 175 ma.; 5v @ 3A; 2.5v @ 5A	5.95
500-0-500v @ 25 ma.; 262-0-262v @ 55 ma.; 6.3v @ 1A; 2x5v @ 2A	4.49
500-0-500v @ 100 ma.; 5v CT @ 3A	4.95
450-0-450 @ 200 ma.; 315v @ 10 ma.; 6.3v @ 7A; 5v @ 3A; 5v @ 2A; 110/220v Pri.	10.95
425-0-425 @ 200 ma.; 150-0-150 @ 100 ma.; 40v @ 1A; 6.3v @ 5A; 5v @ 3A; 110/ Dual Pri. tapped	7.50
400-315-0-100-315v @ 200 ma.; 2.5v @ 2A; 5v @ 3A; 6.3v @ 9A; 6.3v; 9A	6.50
400-0-400v @ 200 ma.; 5v @ 3A	4.95
350-0-350v @ 150 ma.; 5v @ 3A; 6.3v @ 6A; 78v @ 1A	4.95
385-0-385-550v @ 200 ma.; 2½v @ 2A; 5v @ 3A; 3x6.3v @ 6A—PRI. 110/220	7.95
350-0-350v @ 150 ma.; 5v @ 3A; 6.3v @ 7.5A; 6.3v @ 3A	4.99
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340-0-340v @ 300 ma.; 1540v @ 5 ma	5.95
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325-0-325v @ 120 ma.; 10v @ 5A; 5v @ 7A	3.49
300-0-300v @ 65 ma.; 2x5v @ 2A; 6.3v @ 2½A; 6.3v @ 1A	3.49
250-0-250v @ 100 ma.; 2x6.3v @ 4A; 6.3v @ 5A; 6.3v @ 1A	4.95
150-0-150 @ 80 ma.; 150 @ 40 ma.; 6.3v @ 3.5A; 6.3v @ 1A	1.98
150v @ 55A; 150v @ 2.13A; 5v @ 5A	5.95
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80-0-80v @ 225 ma.; 5v @ 2A; 5v @ 4A	3.95
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3x18v @ 2A	3.95
13.5v CT @ 3.25A	2.95
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6.3v @ 1A; 2½v @ 2A	3.45
5v @ 20A; Dual 110v PRI	3.49
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5v—190A ... $17.50 / 6.3v @ 1A	.98
5v—115A ... 14.95 / 8v CT 1A	.98
2.5v @ 20A ... 3.49 / .6v @ 15ARMS	2.98
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10,000 mfd.—25 WVDC	$6.95
2x3500 mfd.—25 WVDC	3.45
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1000 mfd.—15 WVDC	.99
200 mfd.—35 VDC	.59
100 mfd.—50 WVDC	.49
4x10 mfd.—400 VDC	.89

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HI-VOLTAGE INSULATION

8 hy @ 550 ma	$7.95	325 hy @ 3 ma	$3.45
8 hy @ 300 ma	3.95	1 hy @ 800 ma	14.99
25 hy @ 160 ma	3.49	10 hy @ 250 ma	2.45
12 hy @ 150 ma	2.25	10 hy @ 200 ma	1.98
30 hy @ 70 ma	1.39	10/20 @ 85 ma	1.59
.05 hy @ 15 amps	7.95	15 hy @ 125 ma	1.49
.1 hy @ 5 amps	6.95	15 hy @ 100 ma	1.39
4 hy @ 600 ma	5.95	3 hy @ 50 ma	.29
200 hy @ 10 ma	3.49	30 hy Dual @ 20 ma.	1.49
600 hy @ 3 ma	3.49	8/30 hy @ 250 ma.	3.50
.065 hy @ 2.5A	2.49	10 hy @ 100 ma	1.29

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1500-0-1500 volts at 1.5 amps. Tapped at 1350 and 1250. Pri. 110/220 volts 50/60 cycles in 2 Separate windings. Built to rigid Navy specs by Amertran. Suitable for broadcast transmitters, induction heating, etc. Size 10" x 10" x 7" s.w. 125 lbs. $67.50 each.

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1.5 to 7 MMF	.24	4 to 30 MMF	.24
3 to 13 MMF	.24	7 to 45 MMF	.24
5 to 20 MMF	.24	10 to 110 MMF	.39

AMERTRAN FILAMENT TRANS.

5.25 volts at 21 amps. plus 2 x 7.75 v at 6 amps. Pri. 110 v 60 cy. H.V. Ins. 6" x 5½" x 4½".. 7.75

SOLA CONSTANT VOLTAGE

Transformer, input 95 to 130 output 115v. 350 VA. 2.9 amps. 29.95

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Trans. 2.5 v 10A Pri. 110 v. 60 cy. H. V. insulation. Cased 4.95

AMERTRAN 500 VOLT PLATE

1000 volt ct at 300 ma. Pri. 110 v. 60 cy. 6" x 5½" x 4½" cased 7.95

FILAMENT TRANSFORMER

6.3 v 21 amps. Hermetically sealed. 110 v 60 cy Pri. 4.75

GENERAL RADIO VARIAC 2 KVA

Model 100 Q. 110 v. 60 cy. Inp. 0-135 v. out. 18 amps. 39.50

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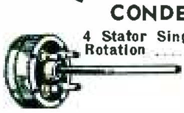

4 Stator Single Rotor. 0-360 Degrees Rotation ....Only 2.95 each

STEPDOWN TRANSFORMER

220/110 volts. 100 watts. Fully encased. 5⅛ x 4¼ x 5⅛. 110V. 60 cycle ....$2.49 each

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5 Watt type AA, 20-25-50-200-470-2500-4000 ohms	.09 ea.
10 watt type AB, 25-40-84-400-470-1325-1900-2000-4000 ohms	.15 ea.
20 watt type DG, 50-70-100-150-300-750-1000-1500-2500-2700-5000-7500 10000-16000-20000-30000 ohms	.20 ea.
30 watt type DI, 100-150-2500-3000-4500-5300-7500-18000-40000 ohms	.24 ea.

1% PRECISION RESISTORS

Standard Make

200-2500-5000-8500-10000 ohms	$.39 ea.
50000-95000 ohms	.49 ea.
100000-750000-1 meg	.89 ea.

U. H. F. COAX. CONNECTORS

UG12U—831R—831J—UG21U—831AP—831SP .39 ea.

W. W. POWER RHEOSTATS

25 Ohm 25 Watt	.39
300 Ohm 50 Watt	.69
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Dual 200 Ohm 50 Watt	.89

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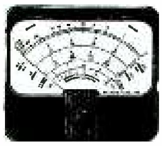
150 MMF .5 Spacing	$17.50
250 MMF .5 Spacing	19.50
75 MMF .3 Spacing	9.50
250 per section .051	3.95
250 per section .1	5.95

50 MICRO AMP METER



This is the exact meter utilized in the General Electric model YMW-1A Lab-Type Unimeter.

- 50 Microamp Movement ± 2%
- 2500 Ohms Resistance ± 2%
- Knife Edge pointer
- Uncrowded Multi-Range Scale
- 4 x 4½" Black Bakelite Case
- 50 Microamp scale available at 25c additional

BRAND NEW only $9.75 ea.

METER SPECIALS

1½" GE 0-1 MA Basic	$3.95
2" GE 0-30 amps, D.C.	2.95
2" GE 0-1 amp RF (internal thermo)	2.95
2" GE 0-5 ma (amp scale)	1.95
2" GE 0-1.2 ma (0-100 scale)	2.49
2" GE 0-1 ma (volt scale)	2.95
2" Gruen 0-3V DC (1000 ohms-volt)	2.45
2" Weston 150-0-150 Microamps	3.49
2" GE 0.30 volts D.C.	2.95
3" Weston -10 to 4 DB	5.45
3" Westinghouse 0.50 amps AC	4.95
3" Triplett 0-75 amps. AC	3.95
3" WE 0-80 ma DC	2.95
3" GE 200-0-200 volts DC	2.95
3" McClintock 0-1 ma	3.95
3" Westinghouse 0-2 ma DC	3.95
3" Westinghouse 0-20 ma DC	3.95
3" GE 0-15 ma DC (square)	3.95
3" Westinghouse 0-150V AC	3.95
3" GE running time, 110 v. 60 cy.	7.95

DAVEN AUDIO FREQUENCY METER MODEL 837E

Direct readings from 0-30 KC in 4 separate ranges on 6" Weston Model 271 Fan Meter. Built-in voltage regulated power supply operates from 115 volts 60 cycles, has high input impedance. With pick-up can be used to determine frequency in vibration tester. With suitable mixer can check deviation of R.F. carrier from standard. Mounts of 8¾"x19" rack panel. Complete with tubes. Slightly used but perfect. Only...........$59.50

"A POWERFUL BABY"

This plate transformer built to rigid Signal Corps spec. input 118 volts, 25 to 60 cycles. Has 2 separate 118 volt primaries and can be used on 110 or 220 volts. Secondary 800 volts center tapped at 775 mills. Exceptional regulation even when loaded to 900 mills! Fully cased—4 mtg holes, 37 lbs. net wt. 6½ x 6½ x 7⅛. Peak value at 7.95. 10 for $70.00

"BRUTE FORCE"

This fully encased choke 6 Henry at 550 mills. 28 ohms dc resistance. Built to rigid Signal Corps specs. Net weight 16 lbs. 5⅛ x 4¼ x 5⅞. A great buy at $4.95 each. 10 for $40.00.

FILAMENT TRANSFORMER

Two separate 118 volt, 25 to 60 cycle primaries. Can be used on 110 or 220 volts. Secondary 5 volts at 15 amps. Built to Signal Corps specs. Fully encased. 5 x 4¼ x 5⅝. Net wt. 10 lbs. $3.75 each. 10 for $30.00.

VERSATILE POWER

These transformers have many uses—filament, isolation, stepdown, bias, etc.

All have 2 separate primaries for 110/220 volt 25-60 cycle operation. Primaries. Can be used in series or parallel.

3 Choices of Secondaries:

Type 501 115 volts 500 mills and 6.3 volts 5 amps.

Type 505—115 volts 900 mills and 6.3 volts 2 amps.

Type 502—0.70-75 volts at 2.5 amps. (35-37 v. in. series)

Fully encased—4 mtg. holes, 5⅛ x 4¼ x 5⅛.

Your cost any type $1.95 each

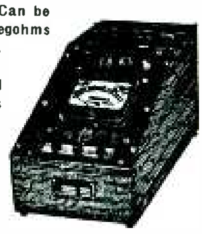
10 for $17.00

AN/APT—2 AIRCRAFT RADAR JAMMER

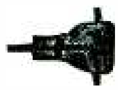
425-750 mcs. Contains 10 tubes: (1)—807 (2)—703A (2)—6AC7 (2)—6AG7 (2)—5R4GY (1)—2x2 (1)—931A Unit has blower motor and 400 cycle pwr supply complete with all tubes etc. BRAND NEW..$19.95 each

MEGOHM METER

Industrial Instruments Model L2AU 110/220 volts 60 cycle input. Direct reading from 0-100000 megohms on 4" meter. Can be extended to 500000 megohms with external supply. Sloping hardwood cabinet 15"x8"x10". Brand new with tubes plus running spare parts including extra tubes. Great value only $69.95.



SPERTI RF VACUUM SWITCH



9200 volts peak, 8 amps. Used as antenna switch in Collins ART 13. BRAND new $1.75

CHOKE BARGAINS

W.E. 4.3 hy 620 42 ohms	$ 4.95
N.Y.T. 8 henry 160 ma. 140 ohms D.C.	1.39
C.T.C. 1.5 henry 250 ma. 72 ohms	.60
R.C.A. 50 henry, 680 ma. high voltage	19.50

POWER PLANT (PE 197)

4-cylinder Hercules Gas driven engine. Output 110 volts 60 cycle, voltage regulated, 5KW-6.3KVA at 80% Pwr. Ptr. Single phase, complete with running spare parts, meter panel, battery, tools, remote cables, etc.
Weight 1200 lbs. Export Packed. Excellent for emergency power. Brand new.............$575.00

Scope Transformer hermetically sealed 1,800 volts, 4 ma, 6.3 volts, 9 amp., 2½ volts, 2.5 amps., 5 x 3¼ x 3¾......$5.95

Precision 15 Meg. 1% Accuracy Resistor. Non-inductive, 1 watt, hermetically sealed in glass .39c each; 10 for $3.50.

OIL CONDENSERS

11 mfd 250 vac— .85	.1X.1 mfd 7000 vdc —$2.45
5 mfd 150 vac— .49	.1 mfd 7500 vdc—1.95
1 mfd 600 vdc— .29	.15/.15 mfd 8000 vdc —2.75
2 mfd 600 vdc— .39	4 mfd 8 kv dc—19.95
4 mfd 600 vdc— .59	.01/.01 mfd 12 kv dc—5.75
3/3 mfd 600 vdc— .79	.005/.01 mfd 12 kv dc—5.50
10 mfd 600 vdc— .95	.03 mfd 16 kv dc—5.75
14 mfd 600 vdc—1.35	.65 mfd 12,500 vdc 12.95
2 mfd 1000 vdc— .79	.75/.35 mfd 8/16 kv—12.95
4 mfd 1000 vdc— .95	.02 mfd 20 kv dc—7.95
15 mfd 1000 vdc—2.95	
2 mfd 1500 vdc—1.25	
1 mfd 2000 vdc—1.45	
2 mfd 4000 vdc—5.50	
3 mfd 3000 vdc—3.95	
1 mfd 5000 vdc—4.50	

1 KW TRANSTAT

or Stepdown Transformer

110/220 volts 60 cycle input. Output variable plus or minus 10% of 115 volts at 8.5 amps. Also can be connected to give different voltage combinations. Brand new......Special 9.95

MIDGET VARIABLE BARGAINS

Hammerlund MC 250S 250 mmf	$ .60
Hammerlund MC 320S 320 mmf	.79
Hammerlund APC 100 100 mmf	.39
Bud MC 913 35 mmf. D.S.	1.25
Hammerlund HF 15 15 mmf	.39
National TMS 150 mmf	.79

Tremendous stocks on hand. Please send requests for quotas. Special quantity discounts. Price f.o.b. N. Y. 20% with order less rated, balance C. O. D. Minimum order $3.00.

PEAK ELECTRONICS CO.

188 Washington St., New York 7, N. Y.

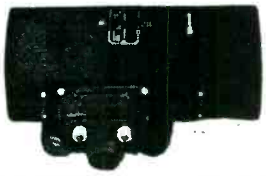
PHONE CO-7-6443

DEPARTMENT EA

SEND FOR BULLETIN

NEW GUARANTEED SURPLUS

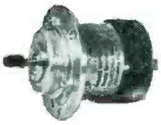
AIRCRAFT AMPLIDYNES



G.E.

5AM31NJ18A. Input 27 V.D.C. @ 44 amps. Output 60 V.D.C. @ 8.8 amps. max. 530 watts. Stock #SA-111. **Price $14.50 ea.** **5AM31NJ9**—Similar to above. Stock #SA-196. **Price $14.50 ea.**

Servo Motor



Pioneer Type CK-2. 2 phase 400 cycle. Fixed phase 26 V., var. phase. 49 V. max. 1.05 oz/in. stall torque. Stock #SA-97. **Price $4.75 ea. net.**

RATE GENERATORS

Elinco PM-2

2.0 v. DC per 100 rpm. Use to 2000 rpm. Stock #SA-53. **Price $7.50 ea.** **ELINCO F-16.** 2 Phase AC. 1.3 v AC per 100 rpm. 60 cy. output at 1800 rpm. Stock #SA-193. **Price $12.50 each.**

SPERRY PHASE ADAPTOR — 661102 115 volts 400 cy. Used for operating 3 phase equipment from single phase source. Stock #SA-194. **Price $6.75 each.**

Delco PM Motor—5068571

Alnico field. 27 v. DC. 10,000 rpm. 1" x 1" x 2" lg. 0.125 diam. shaft. 21/32" lg. Stock #SA-151. **Price $3.75 each.**

400 CYCLE WESTINGHOUSE FL BLOWER

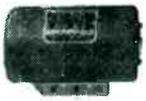
115 v. 400 cy. 17 c.f.m. Includes capacitor. Stock #SA-144. **Price $6.75 each.**

SWEEP GENERATOR CAPACITOR

Hi-speed bearings. Split stator. Silver plated coxial type. 5-10 mmf.

Stock #SA-167. **Price $2.75 each.**

DYNAMOTORS



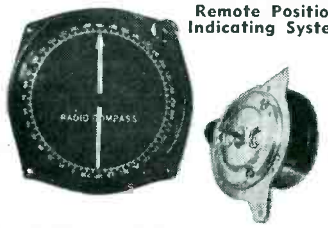
D-101. 27 v. DC in @ 1.5 amps. DC output 285 v. @ .060 amps. Stock #SD-187. **Price $1.50 each. DM-40A.** 14 v. DC in @ 3.4 amps. DC output 172 v. @ .138 amps. Stock #SA-188. **Price $3.25 each.**

MICROWAVE ANTENNA—

AS-217A/APG 15B. 12 Cm dipole and 13 inch Parabola housed in weatherproof Radome 16" diam. 24 V. DC spinner motor for conic scan. Stock #SA-95. Shipping wt. 70 lbs.

Price $9.50 ea.

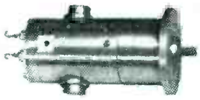
Remote Position Indicating System



6-12 V. 60 cycles 5 inch indicator with 0 to 360° dial. Heavy duty transmitter. Stock #SA-115.

Price $9.95 per system

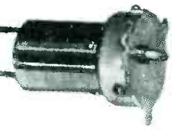
12 V D.C. MOTOR John Oster B-9-2



1.4 amps. 5600 rpm.

1⅞" Diam. x 3¾" Lg. Spline shaft. C. W. rotation. Stock #SA-46. **Price $3.75 each**

Timing Motor Synchron 10 RPM



24 V. DC.

Hanson Mfg. Co.

Stock #SA-110. **Price $3.75 each.**

DC Timing Motor—Hayden ½ rpm. 29 volts. 100 mils. Stock #SA-157. **Price $3.95 ea.**

28 VOLT DC DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 3600 rpm. Cont. duty. 2½" diam. x 5½" lg. ⅞" shaft extension. 5/32" diam. 4 hole base mounting. Stock #SA-94. **Price $6.50 each.**

NOTE

All merchandise is new and guaranteed to meet manufacturer's specifications. Delivery from stock.

SELSYN SPECIAL

W.E. KS-5950-L2 Size 5. 115 v. 400 cycles. Use on reduced 60 cycles. Stock #SA-182.

Price $3.75 each

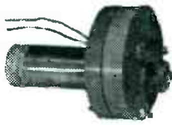
Blower Assembly MX-215/APG

John Oster C-2P-1L

28 V. DC. 7000 RPM 1/100 H.P. #2 L-R Blower.

Stock #SA-202. **Price $3.75 each.**

G.E. 10 rpm dc Motor 5BA10FJ12



Output 40 lb. in at 10 rpm. 24 V. @ 1.1 amps. Seriew-wound. 3 wire reversible.

Ideal for relay servo-systems. Stock #SA-17. **Price $8.75 each.**

Phase Shift Capacitor—4 stator single rotor 0-360° phase shift. (Use in complex wave synthesis.) Stock #SA-114. **Price $4.75 ea.**

400 Cycle Inverters

Pioneer—12116-2-A, 12123-1-A.
Holtzer Cabot—MG-149F. MG-149H.
General Electric—5D21NJ3A, 5AS131JJ-11A.
Leland—10563 and PE-218.

INVERTER—Wincharger PU7/AP—Input 28 v. DC at 160 amperes. Output 115 v. 400 cy. @ 2500 V.N. Voltage and frequency regulated. Cont. duty. Wt. 75 lbs. Stock #SA-164.

800 Cycle Inverter

Navy Type CRV-21AAR. GE. 5AS121LJ2. 27 v. DC input @ 45 amps. 120 v. 800 cy. output @ 750 V.A. P.F. 0.90. Wt. 22.5 lbs. Stock #SA-192 **Price $39.50 each.**

LP-21-LM Compass Loops

New

Original Cartons

Stock #SA-99.

Price $9.50 each.

110 RPM MOTOR

G.E. 5BA10J18D. 27 V. @ 0.7 amps. 1 oz/ft. torque. 1⅜" diam. x 3½" lg. Operates on AC or DC. Stock #SA-98.

Include 15¢ for P.P. and handling **Price $2.95 ea. net**

TWX Pat-199.

Write for complete listing, or call ARmory 4-3366

SERVO-TEK PRODUCTS CO.

Incorporated Surplus Division

Open account shipments to rated concerns. All prices F.O.B. Paterson, N. J.

4 Godwin Ave. Paterson, N. J.

RELIANCE HAS WHAT YOU WANT TOO — IN ELECTRONIC SPECIALS

OIL FILLED CAPACITORS

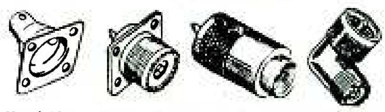
.1 mfd	25,000 V.DC	$14.95	.2 mfd	750 V.AC (2,200 V.DC)	$.49
.1 mfd	12,000 V.DC	4.95	10 mfd	2,000 V.DC	4.25
.2 mfd	10,000 V.DC	4.25	2 mfd	2,000 V.DC	2.65
.1 mfd	7,500 V.DC	1.95	4 mfd	1,000 V.DC	1.00
.1-.1 mfd	7,000 V.DC	2.45	3 mfd	1,000 V.DC	.80
.1 mfd	7,000 V.DC	1.95	1 mfd	800 V.DC	.40
.1 mfd	6,000 V.DC	1.65	10 mfd	600 V.DC	1.35
.03-.03 mfd	6,000 V.DC	1.65	4 mfd	600 V.DC	.69
.01-.03 mfd	6,000 V.DC	1.60			
.01 mfd	6,000 V.DC	1.45			

RG 8/U NEW-UNUSED
52 OHM COAXIAL CABLE

4¢ a foot

500-2,500 feet .... $40.00 per M
3,000-5,000 feet .... 35.00 per M
5,500-10,000 feet .... 30.00 per M
10,500-20,000 feet .... 27.50 per M
over 20,000 feet .... 25.00 per M
No charge for reels.

COAXIAL FITTINGS



Hood 10¢ — Socket 40¢ SO 239 83-1R — Plug 40¢ PL 259 83-1SP — Angle Adaptor 40¢ M-359 83-1AP

PL259A, 83-1SPN, 83-1J, UG21U, UG22U, CUF 49190 (83-1SP with small hole for RG59U Coaxial Fittings), UG85U Baby "N" plug, UG27U
40¢ each

UG87U Baby "N" Socket, Gold Plated with Hood Attached .... 50¢ each

83-1T—Tee Connector........ $1.25 each

BC 1072A IFF X'MITTER in MAPLE CHEST

150 to 200 Mcs
115 V., 60 Cyc.

POWER SUPPLY gives: 0-5000 v.d.c. (variac control) 312 v.d.c., 700 v.d.c., 6.3 vd.c. Also contains: 11 tubes 6J5, 826, 6SN7, 5U4G, etc.), 5 KV meter, Blower, Condensers and many other useful parts too numerous to list. Shipping Wt. 245 lbs.

Only .... (slightly used) $22.50

FILAMENT TRANSFORMER

WESTINGHOUSE #6D4298
Tested at 34,000 volts
Pri. 115 V.A.C., Sec. 5V @ 6.5 Amp.
ONLY $8.50

RELAYS

Coil	Contacts	Size (inches)	Stock No.		Price
10,000 ohm—10 Ma	Make-Break	1 1/2x1 1/2x2 1/8	1033	G.E.	$ .75
7,000 ohm—2 1/2 Ma.	SPDT	4x1 1/4x2	1012		1.20
1,800 ohm—20 Ma.	SPDT (2A)	2 3/4x2 1/2x1 5/8	1031	(Adjustable)	1.50
2,000 ohm— 5 Ma.	SPDT	2 5/8x2 5/8x1 1/2	1034	(Adjustable)	1.50
1,200 ohm—10 Ma.	SPDT	7/8x7/8x1 3/8	1032	Sigma	.55
1,200 ohm—10 Ma.	3 PST (N.O.)	4x1 3/4x1 1/2	1022		.75
250 ohm—25 VDC	DPST (N.O.)	2 3/4x1 3/4x1 1/2	1014	(Ceramic)	.80
200 ohm—25 VDC	4 PDT	1 3/4x1 3/4x1 5/8	1015	(Bakelite)	.75
60 cy. 115 VAC	4 PDT (6A)	3 1/2x3 1/4x2	1000	Struthers	2.95
60 cy. 60 VAC	4 PST (N.O.)	3 1/8x3 1/8x1 1/2	1002	Leach	1.25

Stepping Relay—6 Pole, 11 Position, 24 VDC coil, Federal — 3.95
Dual Air Valve—close one or other, 2000 ohm, 100 VDC coils — 3.00

PRECISION RESISTORS

1% or better
Any Order For
100 pieces........10% OFF
1000 pieces........20% OFF

1/4 WATT—25¢

6.68	12.32	16.37	123.8	414.3
10.48	13.02	20.	147.5	705
10.84	13.52	62.54	220.4	2193
11.25	13.89	79.81	301.8	10,000
11.74	14.98	105.8	366.6	59,148

1/2 WATT—25¢

.250	2.04	97.8	300	4,451
.334	2.25	125	400	5,000
.502	11.1	180	723.1	5,900
.557	13.15	210		6,500
.627	46	235	2,500	7,000
.76	52	260	2,850	7,500
1.01	55.1	270	3,427	8,000
1.53	75	298.3	4,000	8,500

10,000	15,000	17,000	25,000	100,000
14,825	15,750	20,000	37,000	150,000

1 WATT—30c

1.01	3.39	10.1	270	5,000
2.58	5.05	10.9	1,250	7,000
5	5.21	100	3,300	9,000

18,000	30,000	55,000	70,000	75,000
20,000	50,000			

1 WATT—40¢

100,000	128,000	180,000	470,000	600,000
120,000	130,000	250,000	522,000	700,000
125,000	160,000	320,000	525,000	

1Megohm, 1W, 1%, 65¢, 5%, 40¢

POSTAGE STAMP MICAS

5MMF	56MMF	220MMF	650*MMF	.003*MFD
8.2	60	300	680	.0033
10	68	360	800	.0039
20*	82*	390	820*	.0047
22	90*	400	.001MFD	.0068
25*	110*	470	.0015	.0082
33*	120*	500*	.0016	.01
39	150	510	.002	
47	185	525*	.0022	
50	200	630*	.0027	

*Silver Mica
Price schedule

5 MME to .001 MFD —5¢ Silver Mica 10¢
.0012MFD to .0027MFD—7¢ Silver Mica 20¢
.0029MFD to .0068MFD—12¢ Silver Mica 50¢
.0082MFD —16¢ .01MFD 18¢

HARDWARE

HOSE CLAMPS—AERO SEAL, QS 100M4—½" nom. dia. or QS100M8—¾" nom. dia........50/$2.50

UNIVERSAL JOINT, Aluminum, 1⅛" long x ¼" I.D. 35c

G. R. BANANA Plugs and Jacks small, uninsulated 6c pr.

SLUG Tuned Coil forms, ½" x 3 3/16" with very finely powdered iron slug (50 Mc) ....10/$1.00

Motor BRUSHES with pig tails and springs:
(A) ⅛" x ½" x ⅞".BP20 3/16" x ⅜" x ½".V4 5/32 x ¼" x 7/16" (B) 3/16" x 3/16" x ⅜" 3/32" x ¼" x 7/16" 3/16" round x ⅜"

Thousands in stock........20/$1.00
Insulated Holders for (BP20) or (B)......each 10¢

TELEPHONE FIELD WIRE (W-110-B). One Mile spools. 2 twisted wires, each 4 strands steel and 3 strands copper. Only ....$14 per mile

PULSE TRANSFORMERS

Western Electric Permalloy core 1 3/32", 150 turns No. 33 AWG each pri. & sec. 2 Toridal Windings, D 166638, 1 3/4x1 1/4x2 1/4" fully cased	$1.25
Western Electric Permalloy core, KS9800—A45, 1 3/4x1 3/4x3 1/2" fully cased, 3 windings ratios 1+01.1, 1+02	2.00
Westinghouse 352-7250-2A, 15/16 dia. x 1 5/8" high, DC Resistance 10 ohm 3 1/2 ohm, sine wave response—3db 140 cy to 175 kc.	1.25
Westinghouse 352-7287 Hypersil core, two windings,—3db 50 kc. to 330 kc., core approximately 1 1/2 x 7/8 x 7/16", fosterited	1.25
G.E. 7472407 two windings, core 5/8 x 1 3/8 x 3/16"	1.25
UTAH 9280 or 9262	1.50
G.E. 7467888, 3 windings, DC 1/2 ohm, 10 ohm, 20 ohm, 1 1/8 x 1 3/8 x 2 5/16" fully cased, rise time, 0.1 micro seconds	1.25
800 KVA, G.E. No. 7710417, 50 ohms pulse cable connection, 450 ohm output; 9,500 volt input, 28,000 V. pk. output, Bifilar	19.50
300 KVA, G.E. 7557296, 50 ohm pulse cable connection: 3,850 V. in 17,300 V out (250 KVA @ 1/4 micro second) cost $226, our price only	15.00

GEARS

Cat. No.		Pitch	Teeth	P.D.(In.)	Face(In.)	Hole(In.)	Material	Price
2301	Miter	48	18	3/8	7/64	3/16	Stainless	$ .20
2304	Miter	48	18	3/8	7/64	1/8	Brass	.10
2308	Worm	48	1	5/16	9/16	3/16	Stainless	.25
2310	Helical 45°		8	5/16	3/8	3/16	Steel	.15
2314	Helical (fits 2310)		18	23/32	1/4	1/4	Steel	.15
2334	Worm Gear (Anti backlash)	32	48	1 1/2	1/8	1/4	Brass	.40
2312	Worm (fits 2334)	32	4	9/16	9/16	1/4	Steel	.20
2330	Spur & Hub	48	78	1 5/8	5/64	3/16	Stainless	.20
2332	Spur (Anti backlash)	48	72	1 1/2	1/16	1/4	Stainless	.35
2340	Spur & Hub	48	36	3/4	1/8	3/16	Fibre (Alum. Hub.)	.10
2352	Spur & Hub	48	57	1 3/16	1/8	1/4	Fibre (Alum. Hub)	.10
2336	Spur & Hub	48	24	1/2	3/16	1/4	Brass	.10
2338	Spur & Hub	48	36	3/4	1/16	3/16	Aluminum	.10
2342	Spur & Hub	48	40	15/16	1/8	1/2	Steel	.10
2348	Spur & Hub	48	54	1 1/8	1/16	1/8	Brass	.15
2350	Spur	48	60	1 1/4	1/16	1/2	Stainless	.10
2356	Spur	48	60	1 1/4	1/8	1/4	Brass	.10
2370	Spur	48	102	2 1/8	5/64	1/2	Brass	.15

Cat. No.		Pitch	Teeth	Face (In.)	Stem (in.)	Material	Price
2321	Stem pinion	48	12	13/32	11/16x3/16	Stainless	$ .10
2322	Stem pinion	48	10	3/16	1 11/32x3/16	Stainless	.10
2324	Stem pinion	48	15	1/8	27/32x3/16	Stainless	.10
2328	Stem pinion	32	16	3/16	13/32x5/32	Stainless	.10

Special sample offer—2 each of above, plus 25 other types gears, bushings and bearings—A REAL BUY—$6.50.

SELSYNS

ONLY $7.25 pair
#C78248

115 V., 60 Cyc., 3¼" dia. x 4½" body. Used in Pairs for Remote Control.
Also 50 V., 50 Cyc. $4.75 pair.

SELSYN DIFFERENTIAL #C78249

ONLY $2.25 ea.

115 V., 60 Cyc.

Used between two #C78248's as dampener. Can be converted to a 3600 RPM Motor in 10 Minutes. Conversion sheet supplied.
Also 50 V., 50 Cyc. $1.50 ea.

RELIANCE *Merchandizing Company*
f.o.b. PHILA., PA.
Arch St. Cor. Croskey, Philadelphia 3, Pa.
MINIMUM $3 ORDER
Telephone RIttenhouse 6-4927

BIG VALUES IN SURPLUS

G. E. Motor Starting Reactors

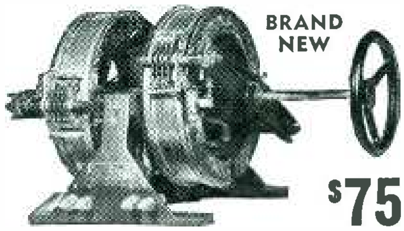
Type 11K2840G2

Rated at 440 Volts, 3 Phase, 60 Cycles, 16.8 Amperes. 15-20 HP. Waterproof steel case. 17" x 15" x 10". **Brand New! In original factory cases.**

$9.90

"TRANSTATS" *Amertran Voltage Regulator*

BRAND NEW

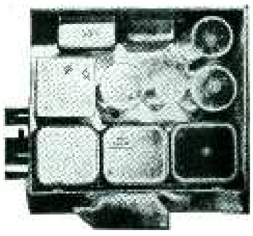


$75

11.5 KVA; 50/60 cy. Commutator Range 0-115 V. Max. Amp. 100. Can be reconnected for 230 volts @ 50 AMP.

Vibrator Power Supply

PE-204A



Input Voltage: 12 Volts DC

Output Voltages:
Two windings 4.3 VDC @ 50 MA
Two windings 45VDC @ 0.5 MA
Two windings 85VDC @ 5.0 MA

Parts alone worth double the money. **BRAND NEW** **$1**

Inter-Communication Sets *Manufactured by Dictograph*

Designed to bring to homes and offices the convenience of two-way conversation without the use of telephone, household electric current, or radio.

It can be set up in any two rooms you wish . . . being limited only by the length of the wire you use. Inter-Communication Sets will operate efficiently up to 800 feet using 14-gauge wire.

BRAND NEW, Pair **$9.95**

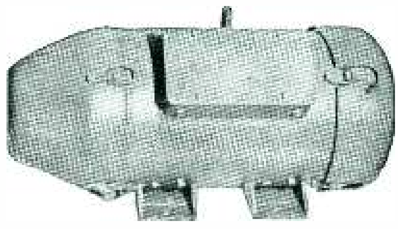
MOTOR GENERATORS

Built by Allis-Chalmers to U. S. Navy Specifications

Input: 115 Volts, DC at 14 amperes, 3600 speed, ball bearings. Output: 1.25 KVA; 80% P.F.; 120 VAC. 60 cy. single ph., 10.4 Amperes. With resistive control of voltage output and frequency built-in and with Centrifical automatic controller built-in, permitting line-start operation. Fully enclosed. Splash-proof.

BRAND NEW! In Original Factory Cases — *Price* **$100**

Same machine for 230 Volts, D. C. Operation **$120**



Spare parts kit of brushes, brushholders, ball bearings, field coils, etc. in steel case, **Price $10.**

ALL ITEMS LISTED BELOW ARE "BRAND NEW" UNLESS OTHERWISE SPECIFIED

SYNCHRO'S

Ford Instrument Synchro Generator, 7G, MK111 Mod. 3 115/90 Volts 60 Cycles.....**Price $16.50**
Arma Corp. Synchro Differential Generator, Type 5DG MK4 Mod. 1 90/90 Volts 60 Cycles **Price $7.95**
Diehl Synchro Transmitter, Type C78414 115 Volts 60 Cycles ....**Price $4.35**
Control Instrument Synchro Motor, Type 5F MK4 Mod. 3 115/90 Volts 60 Cycles......**Price $26.25**
Sperry Gyroscope Voltage Receiver, 76166, 115 Volts 60 Cycles ....**Price $4.35**
Delco Synchro Transmitter, C79331, Type I-4, 115 Volts, 60 Cycles ....**Price $4.35**

MOTORS AND GENERATORS

Western Electric Motor, KS8624, 20 VAC, 200 Cps, 2 ph. 9000 RPM..............**Price $4.95**
Oster Shunt Motor, Type E-7-5, 27½ Volts DC, 1/20 HP 3650 RPM...............**Price $7.50**
Oster Series Motor, Type C-2BP-1A, 27.5 Volts DC, 1/100 HP 7000 RPM.........**Price $2.50**
Universal Electric Shunt Motor, KS5603L02, 28 Volts, .6 Amps. 5000 RPM..........**Price $2.00**
Westinghouse Series Motor, 1171391, 27 Volts 6.5 Amps. ⅛ HP 5800 RPM...........**Price $5.00**
Elinco AC Generator, Type F-16 2 phase, 1.3 Volts per 100 RPM ....**Price $7.95**
Elinco DC Generator, Type PM-2, 1.75 Volts per 100 RPM ....**Price $5.75**
G. E. Permanent Magnet Generator, 5BY9E8, 140 Volts DC .025 Amps. 1800 RPM....**Price $5.50**
G. E. Motor, Mod. 5BA10AJ18D, 27 Volts 0.7 Amps. 1 oz/ft torque 110 RPM.....**Price $1.00**
Emerson Electric Motor, Style 1610212, 24 Volts 160 oz/ft 27 Amps. 100 RPM.......**Price $8.95**
Electric Specialty Co. AC Motor, Type BF51R, 440/3/60cy. 2.5 HP, 1750 RPM.....**Price $28.50**
G. E. Motor, Type BC 115 VDC 1/6 HP 1725 RPM Comp. wound Rebuilt.........**Price $9.50**
G. E. Series Motor, Mod. 5PS56HC18, 60 VDC 1/20 HP, 1.4 A. 5500 RPM............**Price $2.85**
G. E. Motor, 230 Volts DC, 6.75 HP, 1100 RPM flange mounting ....**Price $50.00**
General Industries Phono Motor, 23200, 115 VAC, 60 cy. 0.5 A. 80 RPM.............**Price $5.75**
General Industries Phono Motor, 23200, 115/220 VAC, 60 cycle, 0.5 Amps. 80 RPM...**Price $6.35**
Universal Electric Co., 115 VDC, 500 RPM, .12A **Price $4.50**

INVERTERS AND DYNAMOTORS

PE103 Ballentine Dynamotor, input 6-12 Volts, output 500 Volts, 160 Ma. without filter. **Price $9.95**
PE206 Inverter, input 27 Volts DC. output 80 Volts, 800 Cycle, 500 VA..........**Price $9.95**
PE218 Inverter, input 27 Volts DC. output 115 Volts, 400 Cycle, 1500 VA Rebuilt Like New **Price $22.50**
Dynamotors for SCR-522, input 28 Volts DC. output 13-150-300 Volts. Rebuilt Like New **Price $3.25**
G. E. Dynamotor, 5D48B8A, input 14 Volts DC, output 1000 Volts at 350 Ma. complete with filter ....**Price $5.00**
MG-132A Inverter, input 11.5 Volts DC, output 140 Volts AC, 1.2 Amps. 350 Cycle, 1800 RPM. 100% PF ....**Price $19.95**

METERS

Bristol Pyromaster Potentiometer Type 440MFL, 115 Volts, 60 Cycles, Range 0-2000° F. Used but Guaranteed ....**Price $125.00**
Hoyt Portable Ammeter, Mod. 515, 0-15 Amperes DC, complete with test leads........**Price $4.95**
G. E. Voltmeter, Mod. AB-13, 0-150 Volts AC, 400 Cycle, 4½" sq. complete with external resistor ....**Price $14.95**

MAGNETRONS

2J26 2992-3019 mc 275 KW.........**Price $10.00**
2J27 2965-2992 mc 275 KW.........**Price $10.00**
2J31 2820-2860 mc 285 KW.........**Price $15.00**
2J61 3000-3100 mc 35 KW..........**Price $25.00**
700 A, B, C, D, West. Elec. 100 KW..**Price $25.00**
720 AY, GY, West Elec. 1000 KW...**Price $25.00**
728 AY, BY, CY, DY, EY, FY, GY, 300 KW **Price $25.00**

KLYSTRONS

Westinghouse, Type 417A............**Price $9.00**
Westinghouse, Type 723A/B..........**Price $5.00**

TRANSFORMERS

Stepdown Transformer 575/230/115, 60 cycle, 100 VA, air-cooled ....**Price $3.10**
Westinghouse Transformer Primary 110 Volts, 60 cycle, Secondary 20 Volts, 200 watts **Price $3.95**

BATTERIES

8 Volt Dewar Wet Cell Battery, 15 amp.-hours. Complete with electrolyte and filler syringe. May be used as four 2 volt batteries **Price $8.00**
2 Volt Willard Battery, replacement for G. E. portable radio model LB530........**Price $1.50**
4 Volt Searchlight Battery, 80 Ampere hours **Price $10.65**
(all batteries shipped dry)

AMPLIDYNES

G. E. Amplidyne, Mod. 5AM45DB20, input 115 Volts, single phase, 60 Cycle 5.0 Amps. output 250 Volts, 0.6 Amps. 150 watt, 3450 RPM, continuous duty ....**Price $53.50**
G. E. Amplidyne, Mod. 5AM21JJ7, input 27 Volts, DC, 16 Amps, 4600 RPM, output 60 Volts, 2.5 Amps. 150 watt ....**Price $9.95**

VOLTAGE REGULATORS

Eclipse Voltage Regulator, Type 1001, set at 115 Volts AC ....**Price $3.25**
Eclipse Voltage Regulator, Type 1002, set at 27.7 Volts DC ....**Price $1.75**
Leland Voltage Regulator, 11651, set at 18 volts **Price $1.29**

An Outstanding Value
List price $3000—Our price $475
WESTINGHOUSE INDUCTION HEATER
450 KC, 10 KW, Radio Frequency Generator. 450 MC, 140 Amps. Input 220/440V 3 Ph. 60 cy. 48" W x 48" H x 30" D complete with following tubes: 1 WL-5604, 3 WL-872, 3 WL-678, 1 5W4. Water cooled. **USED BUT LOOKS LIKE NEW..... $475**

IMPOSSIBLE TO LIST ALL OF OUR ITEMS AND COMPONENTS. TELL US YOUR NEEDS.
All prices F.O.B. Boston. Orders accepted from rated concerns on open accounts. Net 30 days.

Write for 112 Page Catalog on company letterhead

Electro Sales Company

Dept. E-10, 110 Pearl Street, Boston 10, Mass.

Build YOUR OWN TEST EQUIPMENT

$39.50
Nothing
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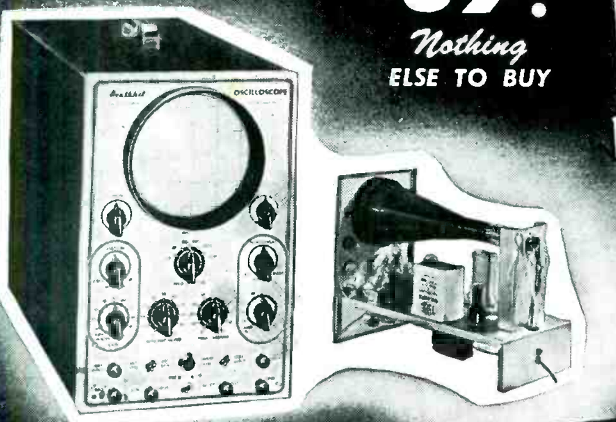


NEW 1948 HEATHKIT
5" OSCILLOSCOPE KIT

A necessity for the newer servicing technique in FM and television at a price you can afford. The Heathkit is complete, beautiful two color panel, all metal parts punched, formed and plated and every part supplied. A pleasant evening's work and you have the most interesting piece of laboratory equipment available.

Check the features — large 5" 5BP1 tube, compensated vertical and horizontal amplifiers using 6SJ7's, 15 cycle to 30 M cycle sweep generator using 884 gas triode, 110V 60 cycle power transformer gives 1100 volts negative and 350 volts positive.

Convenient size 8½" x 13" high, 17" deep, weight only 26 pounds.

All controls on front panel with test voltage and ext. syn post. Complete with all tubes and detailed instructions. Shipping weight 35 pounds.

Order today while surplus tubes make the price possible.

$34.50
Shipping Wt., 13 lbs.

HEATHKIT SINE AND SQUARE WAVE
AUDIO GENERATOR KIT

The ideal companion instrument to the Heathkit Oscilloscope. An Audio Generator with less than 1% distortion, high calibration accuracy, covering 20 to 20,000 cycles. Circuit is highly stable resistance capacity tuned circuit. Five tubes are used, a 6SJ7 and 6K6 in the oscillator circuit, a 6SL7 square wave clipper, a 6SN7 as a cathode follower output and 5Y3 as transformer power supply rectifier.

The square wave is of excellent shape between 100 and 5,000 cycles giving adequate range for all audio, FM and television amplifier testing.

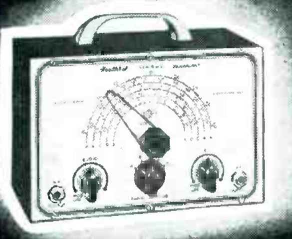
Either sine or square waves available instantly at a toggle switch. Approximately 25V of sine AC available at 50,000 ohm output impedance. Output ±1 db. from 20 to 20,000 cycles. Nothing else to buy. All metal parts are punched, formed and cadmium plated. Complete with tubes, all parts, detailed blueprints and instructions.

$19.50
Nothing
ELSE TO BUY

HEATHKIT SIGNAL TRACER KIT

Reduces service time and greatly increases profits of any service shop. Uses crystal diode to follow signal from antenna to speaker. Locates faults immediately. Internal amplifier available for speaker testing and internal speaker available for amplifier testing. Connection for VTVM on panel allows visual tracing and gain measurements. Also tests phonograph pickups, microphones, PA systems, etc. Frequency range to 200 Mc. Complete ready to assemble. 110V 60 cycle transformer operated. Supplied with 3 tubes, diode probe, 2 color panel, all other parts. Easy to assemble, detailed blueprints and instructions

Small portable 9" x 6" x 4¾". Wt. 6 pounds. Ideal for taking on service calls. Complete your service shop with this instrument.

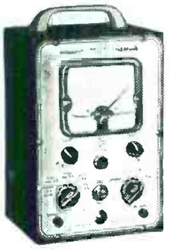


$19.50
Nothing
ELSE TO BUY

HEATHKIT SIGNAL GENERATOR KIT

Every shop needs a good signal generator. The Heathkit fulfills every servicing need, fundamentals from 150 Kc. to 30 megacycles with strong harmonics over 100 megacycles covering the new television and FM bands. 110V 60 cycle transformer operated power supply.

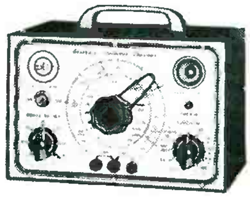
400 cycle audio available for 30% modulation or audio testing. Uses 6SN7 as RF oscillator and audio amplifier. Complete kit has every part necessary and detailed blueprints and instructions enable the builder to assemble it in a few hours. Large easy to read calibration. Convenient size 9" x 6" x 4¾". Weight 4½ pounds.



$24.50
Nothing
ELSE TO BUY

THE NEW HEATHKIT VACUUM TUBE
VOLTMETER KIT

The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for $75.00 or more. Features 500 microamp meter, transformer power supply, 1% glass enclosed divider resistors, ceramic selector switches, 11 megohms input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6H6 as AC rectifier and 6 x 5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time less than four pleasant hours and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC and DC. Ohmmeter has ranges of scale times 1, 100, 1000, 10M and 1 megohm, giving range .1 ohm to 1000 megohms. Weight 8 lbs.



$19.50

HEATHKIT
CONDENSER CHECKER KIT

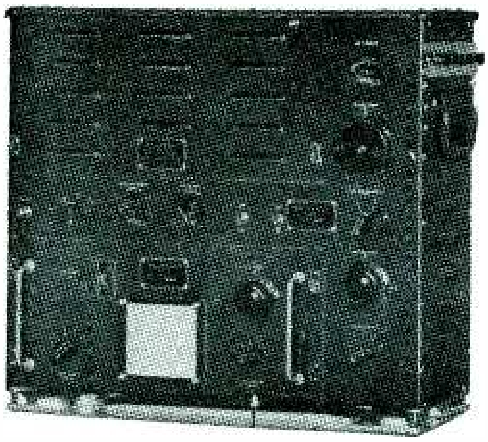
A condenser checker anyone can afford to own. Measures capacity and leakage from .00001 to 100 MFD on calibrated scales with test voltage up to 500 volts. No need for tables or multipliers. Reads resistance 500 ohms to 2 megohms. 110V 60 cycle transformer operated complete with rectifier and magic eye indicator tubes.

Easy quick assembly with clear detailed blueprints and instructions. Small convenient size 9" x 6" x 4¾". Weight 4 pounds. This is one of the handiest instruments in any service shop.

The HEATH COMPANY
DEPT. E . . . BENTON HARBOR, MICHIGAN

Sales Bulletin

Desirable Select Surplus Items of Electronic Equipment, New, Unused



BC-375E TRANSMITTERS

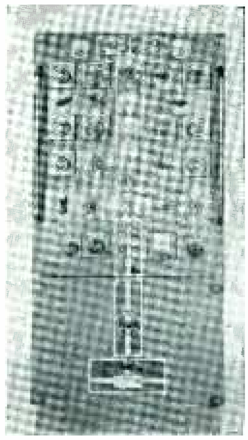
TYPE BC-375E AIRCRAFT RADIO TRANSMITTERS, 100 WATT FREQUENCY RANGE 200-500 KC AND 1,500-12,500 KC EACH. Complete as follows:

Quan. Type No.	Description
1—BC-375E	Transmitter
1—FT-115-B	Mount
1—FT-151-A or C	Mount
1—TU-5B	Tuning Unit (1500-3000 KC.)
1—TU-6B	Tuning Unit (3000-4500 KC.)
1—TU-7B	Tuning Unit (4500-6200 KC.)
1—TU-8B	Tuning Unit (6200-7700 KC.)
1—TU-9B	Tuning Unit (7700-10000 KC.)
1—TU-10B	Tuning Unit (10000-12500 KC.)
1—TU-26B	Tuning Unit (200-500 KC.)
1—BC-306-A	Antenna Tuning Unit
1—FT-142	Mount
1—PE-73-C	Dynamotor
1—FT-107	Mount
2—PL-59	Plug
2—PL-61	Plug
1—PL-64	Plug

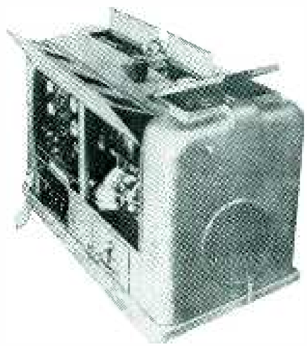
war surplus units all new and packed in original crate.

NAVY TDE TRANSMITTER

Navy Model TDE Radio Transmitter is designed for medium and short wave telegraph and telephone operation. Frequency range 300 to 18,000 Kc. Output CW 125 watts. Phone 25 watts operates on 230 volts D.C. Transmitter motor generator filters and controls all located in one steel cabinet as shown in illustration.



GASOLINE AND DIESEL ENGINE GENERATORS



We have available gasoline and Diesel engine generators of all types. Contact us if interested in any of these remarkable new surplus units.

RADIO TELEGRAPH TRANSMITTER MODEL ET-8023 D1

This Radiomarine Transmitter has a power output of 200 watts and is either master oscillator or crystal control in operation. Emission CW or MCW. Frequency range 2,000 to 24,000 Kc. in nine overlapping bands. New in original export packing. Supplied complete with one set of operational tubes and typewriter table.

All material offered subject to prior sale

FRENCH-VAN BREEMS, Inc.

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Electronic Engineering Experts

RELAYS
FOR EVERY PURPOSE
Over a Million in Stock!

Whether you require large quantities of relays for production runs or single units for laboratory or amateur work, Wells can make immediate delivery and save you a substantial part of the cost.

Our capable engineering staff is prepared to offer assistance in the selection of correct types to suit your exact requirements.

Each relay is brand new, standard make, inspected, individually boxed and fully guaranteed.

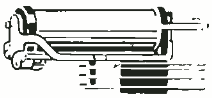
The following list represents only a tiny portion of our relay stock. Write or wire us for information on types not shown.

STANDARD DC TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-101	24V	1500.	DPST (NO)	Auto. Elec.	$1.35
R-102	24V	400.	SPDT	Auto. Elec.	1.10
R-103	24V	DUAL-1000	3PST (NO)	Auto. Elec.	1 35
R-105	24V	600.	3PST (NO)	Clare	1.20
R-106	24V	1300.	3PST (NC)	Clare	1.25
R-152	12V	50.	DPDT-SPST (NO)	Guardian	1.10
R-153	12V	200.	SPDT-SPST (NO)	Stromberg	1 25
R-154	12V	200.	SPST (NO)	Clare	1 20
R-155	12V	100.	SPST (4NO4NC)	Auto. Elec.	1.15
R-158	6V	50	4PST (NO)	Stromberg	1.10
R-159	6V	50	DPST (NO)	Stromberg	1 10
R-160	6V	12	3PDT-3PST (NO)	Auto. Elec	1.05
R-161	6V	10	3PST (2NC-1NO)	Auto Elec.	.90
R-121	150V	5000.	2PST (NO) SPDT	Clare	1.65
R-123	150V	6300	SPST (NO)	Clare	1.75
R-602	150V	6500	3PST (NO)	Clare	1.75
R-515	24V	750	SPST (NO)	Clare	1.25
R-517	12V	250	DPST (NO)	Clare	1.20
R-519	250V	14000.	SPDT	Auto. Elec.	1 95
R-520	250V	14000	DPDT	R B M.	2.10
R-521	32V	1000.	DPDT	Kellogg	1.20
R-166	24V	DUAL-200.	DPDT-SPST (NO)	Stromberg	1.59
R-168	24V	DUAL-200.	4PST (NO)	Auto. Elec.	1.20
H-240	250 350V	40000	DPST (NO)	Auto Elec.	2 95
H-241	48V	650	SPDT-SPST (NO)	Clare	1.25

TYPE 18 DC TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-109	24-48V	4000.	SPDT	Auto. Elec.	$1.50
R-110	24-32V	3500	SPDT	Auto. Elec.	1.50
R-112	90-120V	6500	SPST (NC)	Auto. Elec.	1.75
R-114	24V	500	4PST (NO)	Auto. Elec.	1 30
R-603	24V	400	DPST (NO)	Auto. Elec	1 25
H-238	24V	150	DPDT-SPST (NC)	R.B.M.	1 25
H-239	24V	180	DPST (NO)	Auto Elec.	1.25



SEALED DC TELEPHONE RELAYS

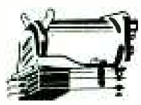
Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-125	24V	300.	DPDT	Clare	$2.75
R-126	90-120V	2000	DPDT	Clare	3 00
R-504	24-70V	2800	SPDT	GE-C103C25	3.00

V TYPE DC TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-164	24-32V	1000.	SPST (NO)	W. E.	$1 20
R-512	24-48V	3500	DPDT	W. E.	1.30
R-513	12-24V	300	DPDT-DPDT (NC)	W. E.	1.20
R-514	4-6V	60	SPDT	W. E.	1 05
R-526	6V	35	DPDT-SPST (INC-1NO)	W. E.	1 05

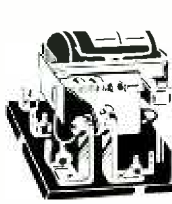
AC-STANDARD TELEPHONE RELAYS

Stock No	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-212	90-135V	—	NONE	Clare	$0.95
R-213	5-8V	—	DPST (NO)	Clare	1 50
R-605	24V	—	3PST (NO)	Auto. Elec.	.95
R-606	24V	—	DPST (1NO-1NC)	Auto. Elec.	.95
R-607	24V	—	SPST (NO)	Auto. Elec.	.95



DIRECT CURRENT MIDGET RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-132	24V	300	DPDT	Clare	$1.20
R-133	24V	300	NONE	Clare	.60
R-134	24V	250	4PDT	Clare	1.20
R-135	24V	300	SPST (NC)	Clare	1.15
R-137	24V	300	SPDT	Clare	1.15
R-138	24V	300	4PST (NO)	Clare	1.15
R-139	24V	200	4PDT	Clare	1.15
R-140	24V	280	SPDT	R.B.M.	1.15
R-141	24V	280	3PST (NO)	R.B.M.	1.15
R-142	24V	400	DPDT	Allied Cont.	1.20
R-143	24V	280	SPST (NO)	R.B.M.	1.15
R-144	24V	250	SPST (NO)	Allied Cont.	1.15
R-145	24V	300	DPST (NO)	Allied Cont.	1.15
R-146	12V	126	DPST (1NO) (1NC)	Clare	1.10
R-147	9-14V	75	SPDT	Guardian	1.05
R-148	12V	100	DPDT-SPST (NC)	Price Bros.	1.10
R-149	6-8V	45	SPST (NC)	Clare	1.00
R-150	6V	30	SPST (NO)	E-Z Elec.	.95
R-522	2-6V	2.	SPST (NO)	R.B.M.	.65
R-523	90-125V	6500	DPDT	Clare	1.90
R-222	12V	100	DPST (NO)	P & B	.95
H-242	24-32V	300	DPDT	R.B.M.	1.20
H-243	24-32V	300	4PDT	R.B.M.	1.20



SENSITIVE DC RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-218	4-6V	1800.	SPDT	Kurman 220C	$1 95
R-220	75V	5000	SPDT	Allied Cont.	1.20
R-221	18-24V	5000	SPST (NO)	Allied Cont.	1.15
R-174	250V	5000	DPST (NO)	G.M.	1 85
R-175	350V	11000	DPDT-DPST (NO)	G.M.	2.95
R-176	24V	250	DPST (NO)	G.M.	1.50
R-177	24V	300	4PDT	G.M.	1.65
R-600	8-12V	5000	SPDT	S-Dunn-KS	2.10
R-507	24-48V	1000	SPDT-DPST (NC)	Guardian	1.15

TYPE BO DC RELAYS

Stock No	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-169	24V	250	SPST (NO)	Allied Cont	$1.95
R-171	24V	230	DPDT	Allied Cont.	2 15
R-172	5-8V	30	DPDT-SPST (NO)	Allied Cont.	1.70
R-173	2-6V	5	SPST (NO)	Allied Cont	1.25
R-529	24-48V	1000	DPDT	Allied Cont.	2.50

TYPE BJ DC RELAYS

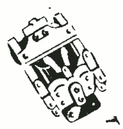
Stock No	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-204	12V	65	DPST (NO)	Allied Cont.	$1 15
R-205	24V	260	DPDT	Allied Cont.	1.25
R-224	12V	75	SPST (NO)	Allied Cont.	1 15
H-237	27V	230	DPDT	Allied Cont.	1 25

HEAVY DUTY KEYING RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-248	28V DC	150	SPST (NO) 10A.	Guard. 36471	$1.05
R-244	75V AC	265	SPST (NO) 20A.	Leach 1327	1 75
R-206	24V DC	150	5PDT-3 AMP.	P&B-KL	1 20
R-207	24V DC	210	4PDT-3 AMP.	P&B-KL	1 10
R-219	50V DC	1500	DPST (NO) 15A.	P&B-SP	1 25
R-217	115 AC	600	SPDT-10 AMP.	St. Dunn 1XAX	2.25
R-525	24V DC	200	DPDT-10 AMP.	Guard. 34464	1 25
R-508	110 AC	600	SPDT-6 AMP.	Guard. 37189	1.95
R-506	24 V DC	300	DPST (NO) 6A.	—	.95
R-510	24 V DC	200	3PDT-10 AMP.	Guard 516983	1.05
R-604	24 V DC	200	SPST (NO) 30A.	St. Dunn-B2A	1.25
H-608	115 AC	—	SPST (NO) 20A.	St Dunn-1HXX	2 25
R-620	12V DC	35	3PST (NO) 10A.	Guard-BK2	1.05
R-223	28V DC	150	SPST (NO) 40A	Price Bros.	1.35
H-230	12-24V DC	80.	DPST (NO) 10A.	—	1.20
H-231	24V	230.	DPST (NO) 5A.	R.B.M.	1 15

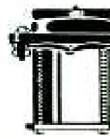
DC-TYPE 76 ROTARY RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-197	9-16V	70	DPDT	Price Bros.	$1.65
R-198	9-16V	125	6PST (3NO) (3NC) SPDT	Price Bros.	1.65
R-199	24-32V	250	SPDT-DPST (NC)	Price Bros.	1 65
R-200	24-32V	275	3PDT-SPST (NC)	Price Bros.	1.65
R-201	24-32V	250	DPST (NO) SPDT (NC) DPDT	Price Bros.	1 65
R-601	9-14V	60.	3PST (NO)	Price Bros.	1.65



DIRECT CURRENT KEYING RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-190	12V	65	DPDT 10 AMP	Advance Elec. Type 2000-A	$1.15
R-191	28V	125	DPDT 10 AMP	Guardian	1.20
R-192	12V	44	3PDT 10 AMP	Allied Cont. Type NB5	1.35
R-193	5-8V	11	DPDT 10 AMP SPST (NO)	Leach Type 1027	1.05
R-194	24V	265	DPST (NO) 10 AMP	Leach Type 1054SNW	1.25
R-195	6V	32	DPDT 3 AMP	G.E.Co.	1.15
R-196	12V	.50	DPDT 10 AMP SPST (NC)	Guardian	1.15
R-242	24V	170	SPDT 2 AMP	Leach Type 1253DEW	1.25
H-236	5-8V	18 5	SPDT 10 AMP	Leach-HFM	1.05



CUTLER HAMMER HEAVY DUTY CONTACTORS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-178	24V DC	100	SPST (NO) 100A.	6141H34A	$3 85
R-179	6V DC	6.5	SPST (NO) 50A.	6041H83A	3 00
R-180	12V DC	25.	SPST (NO) 50A.	604H308	3 25
R-181	24V DC	65	SPST (NO) 100A.	6041H88	3 85
H-232	24V	55.	SPST (NO) 50A.	Metal Cased	3 25
H-233	6V	15	SPST (NO) 50A.	Metal Cased	3.15
H-235	24V	70.	SPST (NO) 100A.	Type B6	3 85

DIRECT CURRENT AIRCRAFT CONTACTORS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-182	28V	80	SPST (NO) 25 A.	Guardian	$1.85
R-183	24V	60	SPST (NO) 50 A.	Allen Bradley Type B6A	2 75
R-184	28V	50	SPST (NO) 100A.	General Elec.	2 95
R-185	24V	100	SPST (NO) 50 A.	Leach 5055ECR	2.75
R-186	24V	132	SPST (NO) 50 A.	Leach 7220-3-24	3 50
R-187	24V	100	SPST (NO) 50 A.	Allen Bradley	2 95
R-188	24V	200	SPST (NO) 75 A.	Allied Cont.	2 95
H-234	14V	45	SPST (NO) 30 A.	—	1.65

ANTENNA CHANGEOVER RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-192	6-12V DC	44	2PDT 10 AMP	Allied-NB5	$1 35
R-231	12VDC	100.	DPDT 6 AMP	G. E.	1.95
R-256	24-32V DC	—	SPDT-DPST (NC) 1KW	Guardian	1 45
R-501	110 AC	4.	DPDT (1KW)	G. E.	2 45
R-503	12-32V DC	100	SPDT-5PST	G. E.-500 W.	1.95

COMBINATION PUSH BUTTON AND REMOTE RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
H-244	12-24 V DC	Dual-60	SPDT	CR2791-R106C8	$1 65

ADJUSTABLE TIME DELAY RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-246	115 AC	—	SPST (NO) or (NC) 10 AMPS	R. W. Cramer 1-120 Sec.	$8 95

DC MECHANICAL ACTION RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-245	12V	25.	4" Lever	G.M.	$0 95
R-527	6-12V	200.	2" Lever	—	.95

TYPE C.M.S. RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-511	24V DC	200	MICRO-SW. SPST (NO)	Clare	$2 45

DC CURRENT REGULATOR

Stock No	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-509	6-12V DC	40	SPST (NC)	G. E.	$0.85

LATCH AND RESET RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-500	12V DC	10.	DPDT-10 AMP	St. Dunn-CX-3190B	$2.85

DC-ROTARY STEP RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-621	6-12V	30.	3 POLE 23 POSITION	W. E.	$10.95

DC-RACHET RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-230	5-8V	2.	SPDT-DPST (NO)	Guardian	$2.15

Special Sample Engineering Offer

Any ten relays listed (one of each type) with the exception of Stock Nos. R-621 and R-246—only $10.00.

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3C24/24G. Transmitting Triode.................. **Each** **39¢** **6 for $1.80**

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E1148*	$0.95	5BP4	$3.95	807	$1.15	954	$0.49
EF50*	.79	5CP1*	3.75	809	1.65	955	.49
HY615*	.95	5D21*	8.95	810	6.95	957	.49
VR105*	.89	6AK5	.89	811	1.79	958A	.49
VR150*	.89	10Y	.59	813	7.95	959	.49
2AP1	2.49	211	.69	814	2.95	1616*	2.95
2C40	.89	285A*	.75	815	1.69	1619	.49
2C43*	4.95	286A*	.69	826	.79	1624*	.90
2C44	1.35	304TH*	3.95	829B	4.95	1625	.49
2D21	.98	304TL	1.39	830B	3.95	1626	.49
2E22	1.50	331A/805*	4.95	832A	2.65	1665/2050*	1.18
2X2A*	.99	705A	2.95	836*	1.25	2051*	.69
2X2/879	.49	717A	1.65	838	3.95	7193	.49
3AP1	2.39	723AB*	5.95	843	.45	8005*	4.95
3B24	1.95	801A	1.49	845W	3.45	9001	.49
3CP1	.99	803	8.95	866A*	.98	9002	.69
3CP1S1	.89	804	8.95	872A	1.75	9003*	.49
3E29	3.49	805	4.95	931A	2.39	9004	.69
6AC7/1852	.99	6C4	.29	12A6	.29	9006	.49
6AG5	.99	6J6	.89				

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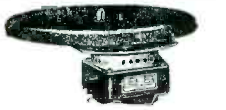
NEW DUAL SPEED PHONO-MOTOR

For Recording or Playback!



Heavy Duty, Rim Drive Motor—built by a leading mfr. for RCA. Will Play or Record on either 33⅓ or 78 RPM. Ideal for playing new Micro-Groove records. Weighted 10" Turntable assures good recording and playbacks. Complete parts including Motor, Turntable, switch, drive wheels etc. less mtg. plate. Sensational value! **Cat. No. S-895**........... **$5.95**

Sensational General Electric FM TUNER

Model XFM-1

$49.50

Complete with 8 Tubes

This amazing new GE FM Tuner is a superb instrument, offered by Newark at a sensational price! It's easily connected to any AM receiver or audio amplifier. Covers complete F-M range from 88 to 108 Mc. Full view 12" slide rule dial. Two controls: on/off, volume-control, and tuning. Handsome cabinet 15¾" W, 10¾"H, 11½"D. Universal 6 tap Power Trans. for all line voltages 103 to 260 volts 50/60 cycles, AC. Shpg. wt. 20 lbs. **Cat. No. A-302.**

TRANSFORMER SPECIALS

POWER TRANSFORMER—Pri: 120V, tapped at 110V, 60 cycles. Sec: 768V, CT at 305 Ma. Electrostatically shielded. Flush Type Mtg. 4⅟₁₆ x 3³⁄₁₆ x 5⁵⁄₁₆" overall Hgt. 12 lbs. **No. S-851**.................. **$3.95**

FILAMENT TRANSFORMER—Electrostatically shielded. Flush mtg. Pri: 117V, 60 cycles. Sec: 5V at 6 amps. and 6.3V at 6 amps. 3¹¹⁄₁₆ x 3³⁄₁₆ x 3¹³⁄₁₆" H overall. 5 lbs. **No. S-852**.................. **$1.95**

CHOKE—4.2 Hy at 300 Ma. DCR 78 ohms. Fully enclosed in metal case. Four stud mtg. 2500V breakdown. 4 x 4 x 4½" H. 8 lbs. **No. S-853**.................. **$2.95**

50 MA POWER TRANSFORMER—Fully enclosed, flush mtg. Socket for 5Y3 Rectifier built into top and internally wired. Pri: 117V, 60 cy. Sec. #1: 530 V, CT at 50 ma. Sec. #2 supplies 5V at 2 amps. to socket. Sec. #3: 6.3V at 1.9 amps. Electrostatically shielded. 2½ x 3 x 3¼" above chassis. 8 lbs. **No. S-837**.................. **$2.19**

UNIVERSAL 55 MA POWER XFORMER—Has Tap Switch to adjust primary input from 110 to 245 volts, 60 cycles, in 6 stages. Fully enclosed, flush mtg. Sec: 530V, CT at 55 Ma, 5B at 2 amps.; 6.3V at 3.15. Electrostatically shielded. Mtg. Cntrs. 2¼ x 2¹³⁄₁₆". 5 lbs. **No. S-835**.................. **$2.49**

160 MA POWER XFORMER—Pri: 110V, 60 cycles. Sec: 720V, CT at 160 Ma; 6.3V at 4 amps.; 5.0V at 3 amps. Fully enclosed, flush mtg. Overall: 4¼ x 3¾ x 3⅛". 8 lbs. **No. S-793**.................. **$3.49**

POWER TRANSFORMER—1345V each side of CT at 500 ma. Primary tapped 105/115/125V. Fully encased, inverted flange mtg. Screw Terminals. **No. S-877**.................. **$14.95**

MULTIPLE FILAMENT TRANSFORMER—Primary 105/115/125V at 60 cycles. 6 separate secondaries all CT as follows: 3 windings at 6.4V at 8 amps.; 2 windings at 2.6V at 2.5 amps.; 1 winding at 2.6V at 10 amps. Inverted flange mtg. 4¼ x 5 x 5¼" H. 14 lbs. **No. S-880**.................. **$5.95**

SPECIAL VALUES—PANEL METERS

Cat. No.	Description	EACH
S-614	0-8V AC 3" Rd. Bakelite Case Weston Type 476	$2.99
S-615	50-0-50 Ma. DC, Zero Center, 3" rd. Bakelite Case	$2.95
S-616	0-1 amp. RF—3" square Bakelite Case	$4.45
S-437	0-150 DC Microamps 2" rd. Bakelite Case	$3.45
S-777	0-100 DC Ma 2" rd. Bakelite Case	$2.95
S-166	150-0-150 DC Microamps, Zero Center, Bakelite Case (Separate blank scale supplied)	$3.95
S-664	0-10 DC Ammeter, 3" rd. Bakelite Case. Switchboard type	$2.95
S-874	0-5 ma. DC 4" square. Bakelite Case, (Scale marked 0-150%)	$5.95
S-875	0-500 ma. DC 2" rd. Bakelite Case	$2.95
S-917	0-1 amp. 4" square Bakelite Case. 3¾" Body dia.	$5.95

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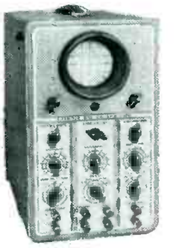
Cover all 13 Channels. Hairpin type dipoles with reflectors—high over low frequencies. Sturdy, tempered aluminum elements. 5 ft. mast, with hardware and instructions. 10 lbs. **No. A-30400**.......................... **$9.71**

High Frequency Attachment Hairpin Dipole and Reflector (Channels 7-13) for any standard antenna. 14" mast, hardware, instructions. 5 lbs. **No. A-30401**.......................... **$3.83**

Send Orders to New York or Chicago



Famous Make 3" SCOPE

Reduced to **$84.50** **Reg. $115.00** **SAVE $30.50**

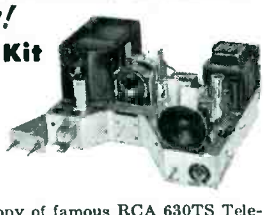
We made a fortunate purchase from a world-famous manufacturer of test equipment! Now you can afford this fine instrument . . . save $30.50! This oscilloscope has many outstanding features not found in run-of-the-mill scopes — such as: Built-in Light Shield, and Removable Graph Screen. Sweep frequency 10 cps to 60 kc. Sine Wave response of vertical amplifier ±10% from 10 cps to 40 kc. Usable range 10 cps to 200 kc. Grey crackle cabinet 14¼D x 8W x 14⅜"H. Shpg. Wgt. 30 lbs. **No. A-2**

Terrific Television Buy!

Tech-Master 630-TK 10" Kit

Complete with All Parts, Instructions, and 30 RCA Tubes (including 10-BP4.) Duplicates in every respect the famous RCA 630TS, generally accepted as best engineered TV set available!

$198.50



This Soundview 630TK kit is an exact copy of famous RCA 630TS Television set. Contains efficient RCA front end 13-channel tuner—completely factory wired and aligned with 3 RCA matched tubes, plus built-in wave trap. Complete with 30 RCA tubes (12" or 15" tube can be substituted for 10BP4 if desired). Dual controls for picture and FM sound, and for horizontal and vertical control. Kit is supplied with RCA schematic and service manual, but less wire, solder, and mtg. screws. **Cat. No. A-19752.** Shpg. wt. 85 lbs.

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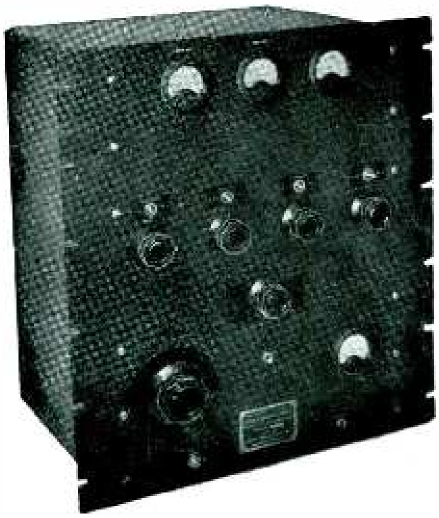

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- Designed to operate from a 100-260 volt, 25-60 cycle single phase power source
- Power consumption approximately 70 to 80 watts
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- Overall dimensions: 19" wide x 14" deep x 21" high—Export packed 21" wide x 20" deep x 36" high
- Equipment weight: 111 lbs. Export packed 211 lbs.

2 COMPLETE INSTRUCTION BOOKS SUPPLIED WITH EACH UNIT.

PRICE

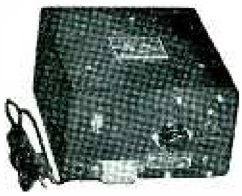
Special $149.50

BRAND NEW BC 223AX

Latest model of the 223 series. Has built-in phantom antenna. Frequencies from 2 to 5.25 mc with three plug-in tuning units, complete as shown less xtals, tubes, and power supply. Tube line up consists of 2—801A and 3—46; output 25 watts CW, 10 watts phone. Shipping wt. 160 lbs.

SPECIAL $29.95

Complete set of tubes for above unit $4.95



BRAND NEW ATR DC. AC. INVERTER

Specially designed for operating AC Radios, Public Address Systems, Small Television Sets, Amplifiers, Intercall Systems and Radio Test Equipment from 12 Volt DC source. 125 Watt, 60 Cycle, 110V output.

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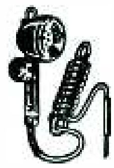

S.B. carbon with push-to-talk switch on handle. Brand new. Shpg. wt. 3 lbs.

Special $1.25

Case of 40 $48.00 *Outstanding buy*

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MC131 Ringers.............	79 ea.
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2X2	.59	5CP1A	5.45	559	.75	HY115	.95
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3B24	1.25	12GP7	12.95	864	.59	ML502	200.00
4AP10	5.95	304TH	6.95	878	1.95	ML503	150.00
5AP1	4.50	293A	6.95	954	.65	MX408U	.50
5AP4	4.95	394A	3.95	1630	6.95	WL468	9.95
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VACUUM TUBE VOLT-OHM-CAPACITY METER

There are more features engineered into this all purpose instrument than in any other instrument on the market regardless of price. It was designed not only to meet present conditions but to be readily adaptable to future needs. At the sensationally low price of this precision instrument no school, plant, lab or service shop need deprive itself of the "new look" in measuring equipment. Here are a few of the many features of this outstanding meter:

- 5 inch easy to read meter.
- 6 DC voltage ranges from 0 to 1000 V (Input resistance as high as 1 megohm pr volt.)
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- A zero center range for balancing FM discriminators.
- Isolating resistor built into probe.
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This outstanding development of one of the leading manufacturers of test equipment costs only $39.95 complete with all leads, as illustrated.

RADIO SET SCOOP. Product of a famous aircraft radio manufacturer that has abandoned the manufacture of table model radios because of the flood of recent govt. orders. All in 5 ply genuine mahogany cabinets, both regular and bleached. 6 tube models have tone control. Original list price given first—then your cost. Sensational discounts.

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SPEAKERS—These PM speakers are the finest that are available. All have heavy oversize Alnico V magnets.

3½"		$1.15	6 for $6.60
4"		$1.15	6 for $6.60
5"		$1.15	10 for $9.50
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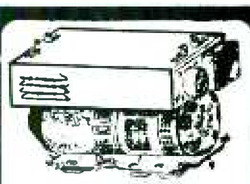
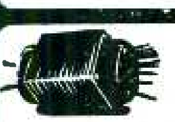
7"	(Car Radio Size)	$4.50	6 for $21.00
8"	10 oz.	$3.95	6 for $20.50
8"	21 oz.	$4.95	6 for $26.50
10"	21 oz.	$5.50	6 for $30.00
12"	21 oz.	$7.95	6 for $42.00

Minimum order $3.00—All prices subject to change—25% deposit with COD orders.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 9-E BUFFALO 3, N. Y.



400 cy INVERTERS — 1500VA 115v. single phase input 24v. D.C. Mfr. LELAND ELECTRIC **$27.50 ea.**



Power Transformer: 1500v C.T. at 150ma, 6.3v 2.5a, 6.3v 1.6a, 5v 3a, 115v 50-60c. pri G.E. **$4.89 ea.**

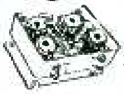
Filament Transformer: 6.3v 8a. 115v 50-60c pri G.E. **$1.95 ea.**

500v D.C. G.E. Generator, .085 amp. and 12.6v D.C. at 2.0 amp. 1725 RPM. **$14.95 ea.**

SOLID SAVING SALE!

Take advantage of the solid savings in every item listed. You pay less for everything you buy because *WE BUY BIG!* Get the Universal buying habit. There's solid saving in every order!

Current Transformers. 50 to 5A. 240v, 60c circuits. **G.E. JY. $7.50 ea.**

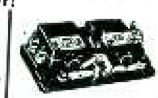


1st RF Trans. Ass'y MN26 & ARN-7 Stk#2C-3035-5/T7. Ship wt. 3½ lbs. **$1.95 ea.**

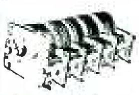
ANT Trans Ass'y MN26 & ARN-7 Stk#3CK-1084C-24. Ship. wt. 3½ lbs. **$2.50 ea.**

Class B Modulation Trans 25 Watt Driver Plate to P.P Class B grids. Ratio: Pr: To ½ sec. 1 to 0.9. 2½x2¾x3¼h. No. T38. Ship. wt. 6 lbs. **$1.79 ea.**

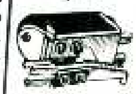
G.E. Antenna Changeover relay. DPDT & SPST-N.C. 50 ohms. 12v DC. 10 amp contacts. No.37843 R57. Ship wt.



Cutler Hammer Overload relay #306. SPST normally open. 600v max A.C. or D.C. Adjustable thermal overflow. Duplex type. No. R19. Ship. wt. 4 lbs **$2.95 ea.**



Variable Condensers 5 gang, .000375 mfd. Ceramic insul. Ship. wt. 5 lbs. MV-216. **$2.89 ea.**



Clare 200 ohms 24v SPST Normally open. No. R13, 15 amp contacts. Ship wt. 1 lb. **49c ea.**

Clare 3500 ohms, SPST 6MA Plate circuit relay No. R30. **89c. ea.**

Edison Thermal Time Delay. 45 sec. delay. SPST Normally Open. 115v ac/dc heater, No. R69 40 amp contacts **$1.79 ea.**

Sigma Sensitive Relay; 3ma in 2ma hold; SPDT, 8,000 ohms. Adjustable 3A contacts. **$1.25 ea.**

Min. Order $2.50. Prices Net FOB Our Plant

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same with "Volt-Ohm-M.A." scale .. 12.00
0-100 ua. 2½" Gruen 4.00
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0-200 ua. 4½" round Weston 643 .. 10.00

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0-100 Ma. 3½" Weston 425 .... $ 9.00
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150 or 240 Amps-50 Mv-aircraft type $1.00

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COMPLETE RADAR SETS:
APR/1 with Tuning Unit—$150.00
Also available—10 cm—SL-1; 3 cm—APS/3 & APS/4.
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TN/54 for APR/4—$125.00 (New)
TUBES:

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3E-1	3.50	725	15.00
531	2.50	726A	12.50
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Minimum order $5.00; F.O.B. New York
Write for listings of other surplus bargains

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LABORATORY EQUIPMENT

We have in stock, for immediate delivery, the following surplus Laboratory Instruments, fully tested and guaranteed.

General Radio: 107M Variable Inductors; 224A, 724A, Wavemeters; 716B, 740BG Capacitance Bridges; 736A Wave Analyzer; 619E Heterodyne Detector; 821A Twin-T Bridge; 775A Frequency Limit Monitor. 620A Het. Freq. Meter.

Ferris: 18B Signal Generator; 33A, 34A Crystal Calibrators.

Boonton: 120A V.H.F. Circuit Checker; 140A Wide Range BFO; 155A FM Signal Generator.

Hewlett-Packard: P-6255B Interpolation Oscillator 510-1000 & 1280-2520 CPS.

L & N: 4223 Precision Resistor; 7655 Portable indicators and Standard Cell.

Millen: P4E Synchroscopes.

Western Electric: RA 90A High Voltage Power Supplies; SID 353384 VT Regulated Power Supplies; TS/5AP Range Calibrator (Sweep Marker Generator); 15154, D 152213 Modulator Oil Units; TS9/APQ-5 Range Calibrator Modulator; 157A Output Transformers; Breakdown Testers, 500 volt.

Weston: Model 1; 0-300 M.A.; 0-500 Volt D.C. Model 45; 0-75 Volt; 0-300 Volt; 0-1500 Volt; 0-150 M.A.; 0-300 M.A. D.C.; 785 Industrial Analyzer.

Dumont: 213 Modulation Monitor.

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Off the regular list price
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TS268/U CRYSTAL TEST SETS FOR MICROWAVE & RADAR USE

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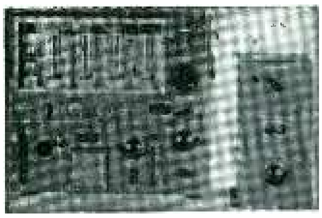


GENERAL ELECTRIC 150 WATT TRANSMITTER

Cost the Government $1800.00 • Cost to You—BRAND NEW—$100.00

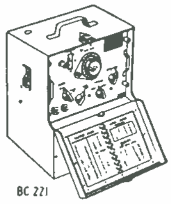
This is the famous transmitter used in U.S. Army bombers and ground stations, during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of plug-tuning units which are included. Each tuning has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits — all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: FREQUENCY RANGE: 200 to 500 KC and 1500 to 12,500 KC. (Will operate on 10 and 20 meter band with slight modification for which diagrams are furnished). OSCILLATOR: Self-excited, thermo compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA. from either 12 or 24 volts. Complete instructions are furnished to operate set from 110V AC. SIZE 21½x23x9¼". Total shipping wgt. 300 lbs., complete with all tubes, dynamotor power supply, seven tuning units, antenna tuning unit and the essential plugs.

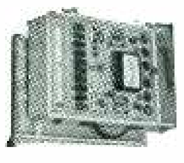
GENERAL ELECTRIC RT-1248 15-TUBE TRANSMITTER-RECEIVER

TERRIFIC POWER—(20 watts) on any two instantly selected, easily pre-adjusted frequencies from 435 to 500 Mc. Transmitter uses 5 tubes including Western Electric 316 A as final. Receiver uses 10 tubes including 955's, as first detector and oscillator, and 3—7H7's as IF's with a 4 slug-tuned 40 Mc. IF transformers, plus a 7H7, 7E6's and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12 volt operation, power supply is not included, as it is a cinch for any experimenter to connect this unit for 110 AC, using any supply capable of 400 DC at 135 FA. The ideal unit for use in mobile or stationary service in the Citizen's Radio Telephone Band where no license is necessary. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice in AM or FM transmission or reception, for use as a mobile public address system, on 80 to 110 Mc, as an FM broadcast receiver, as a Facsimile transmitter or receiver, as an Amateur Television transmitter or receiver for remote control relay hookups, for Geiger-Mueller counter applications. It sells for only $29.95 or two for $53.90. If desired for marine or mobile use the dynamotor which will work on either 12 or 24V DC and supply all power for the set is only $15.00 additional.

BRAND NEW BC-221 FREQUENCY METERS

with calibrating Crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, service man, amateur, and experimenter at the give away price of only **$75.00.**





1949 MODEL MUTUAL CONDUCTANCE TUBE TESTER

with new 9 pin socket to handle all future tube developments **$49.95**

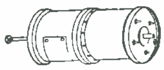
No possibility of good tubes reading "Bad" or bad tubes reading "Good" as on dynamic conductance testers or other ordinary emission testers. Attractive panel and case equal to any on the market in appearance . . . Large 4½" meter . . . Calibrated Micromho scale as well as a Bad-Good scale . . . Front panel fuse . . . Individual sockets for all tube base types—voltages from .75 volts to 117 volts and complete switching flexibility allow all present and future tubes to be tested regardless of location of elements on tube base . . . Indicates gas content and detects shorts or opens on each individual section of all loctal, octal and miniature tubes including cold cathode, magic eye and voltage regulator tubes as well as all ballast resistors. Name of the nationally kn reading "Good" as on dynamic conductance testers or other

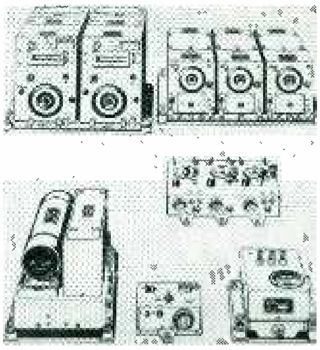
Model "C"—Sloping front counter case $49.95
Model "P"—Handsome hand-rubbed portable case 54.95
Built-in roll chart with either of above $5.00 extra.

$5.95 Takes Both BIG BARGAINS

1. ALUMINUM GEAR BOX 18x8x7 that contains two powerful electric motors and two matched gear trains, 62 gears in all varying in size from ½ to 4 inches in diameter. This unit is readily converted to rotate a beam antenna or any other similar use $3.00

2. SENSATIONAL FASCINATING, AMAZING SELSYNS. Brand new selsyns made by G. E. Co. Two or more connected together work perfectly on 110 VAC. Any rotation of the shaft of one selsyn and all others connected to it will rotate exactly as many degrees in the same direction, following unerringly as if the units were connected together by shafting instead of wires. This is true whether you twist the shaft of the master unit a fraction of a revolution or many revolutions. Useful for indicating the direction of weather vanes, rotating directional antennas, or controlling innumerable operations from a distance. Complete with diagram and instructions. Per matched pair $4.95





SCR-274N COMMAND SET

The greatest radio equipment value in history

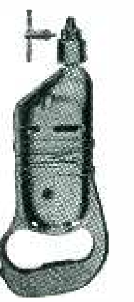
A mountain of valuable equipment that includes 3 receivers that use plug-in coils, and consequently can be changed to any frequencies desired without conversion. Also included are two Tuning Control Boxes; 1 Antenna Coupling Box; four 28V Dynamotors (easily converted to 110V. operation); two 40-Watt Transmitters including crystals, and Preamplifier and Modulator. 29 tubes supplied in all. Only a limited quantity available, so get your order in fast. Removed from unused aircraft and in guaranteed electrical condition. A super value at $34.95, including crank type tuning knobs for receivers.

RT1711 Brand New 12 Tube, 110 Volt Receiver-Indicator-Oscilloscope complete with all tubes and power supply. Has telescoping hood over scope tubes, which is equipped with a detachable calibrated screen. Has centering and amplitude controls and two video inputs. A natural for television.......................$39.95

RT-1579 consists of a three stage, cascade 6S17's and 6F6 output stage high gain, high fidelity amplifier with 60 cycle, 110V power supply on the same 13½x14½ chassis, which is protected by a substantial steel cover over tubes and parts. Made by Western Electric with typical quality components such as a husky power transformer and oil condensers, this unit is obviously intended to give years of trouble-free service with no more need for repairs than a telephone. Disconnecting one wire each, from the special input and output filters, will result in as high a fidelity amplifier as can be obtained. Your cost with tubes, diagram and parts list included—**$14.95.**

1000 CYCLE AUDIO FILTERS

Navy PD52010-1 low pass audio filters as mentioned in the "Peaked Audio" article in June CQ, and designated by the above number, are the exact electrical and physical equivalent of commercial audio filter units selling for **$35.00** wholesale. They are infinitely better than the surplus "Radio Range Filters" being solid for reducing QRM, and at 2 KC off resonance for example, a 2 section filter using PD52010-1 is capable of twice the selectivity available through the use of the Q5-er, (the BC453 section of the 274N which has provided the amateur's previous highest standard of interference elimination). **EXTRA SPECIAL—NAVY PD52010-1** with diagram.—**$5.00.**



Super Special***Highest quality all chrome bullet shaped **CRYSTAL MIKE** of topflight nationally known brand—**$5.95**

TERRIFIC VALUE— PORTABLE ELECTRIC DRILL

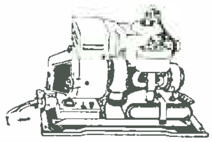
(Sold at less than established factory price so we cannot mention brand name.)
Only $20.95 equipped with ¼" Jacobs Geared Chuck and Key.
Not an intermittent duty drill, but a full size rugged tool.
Most convenient type switch, natural grip handle, and balance like a six-shooter.
Precision cut gears—turbine type cooling blower—extra long brushes.
No stalling under heaviest pressure because of powerful 110 Volt AC-DC motor and multiple ball thrust bearing.
Other bearings self-aligning life-time lubricating Chrysler Oilite type.
Made for toughest year-in and year-out service in Plant or on construcion jobs.
Amazing perpetual factory guarantee assures you of a lifetime of trouble-free use.
25% deposit on C.O.D.'s. Full refund if returned prepaid within five days.

SPLATTER CHOKES

These Tapped "**SPLATTER CHOKES**" are used between Class C stage and Modulator to eliminate objectionable side band splatter. DC resistance 50 ohms. Our part No. 8660—**$1.50**

PE-109 32-VOLT DIRECT CURRENT POWER PLANT

This power plant consists of a gasoline engine that is direct coupled to a 2000 watt 32 volt DC generator. This unit is ideal for use in locations that are not serviced by commercial power or to operate many of the surplus items that require 32 volts DC. The price of this power plant is only $75.00. We run and test every unit before shipment. We can also supply a converter that will supply 110 V AC from the above unit or any 16-32 V DC source for $12.95.



Cable Address: BUFRAD   FOB BUFFALO UNLESS NOTED

Minimum order $3.00—All prices subject to change—25% deposit with COD orders.

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Industrial Power Supply Equipment

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TRANSMITTING		THYRATRONS		RECTIFIERS	
RK75/307A	4.50	2D21 Min.	1.25	FG32	4.00
450TH/6C21	22.50	3C23	4.75	371B	5.95
750TL	47.50	FG81A	4.75	531	18.00
WL533 750W U.H.F. Triode	17.50	C6A	8.50	872	1.75
714AY Magnetron	9.50			3B22	2.95
730A Magnetron	10.75			4B28/289414 6 Amp. Rectigon	3.95

All Tubes New, Boxed and of Standard Mfg.

RECTIFIERS — Dry Disc Type — Continuous Duty Ratings

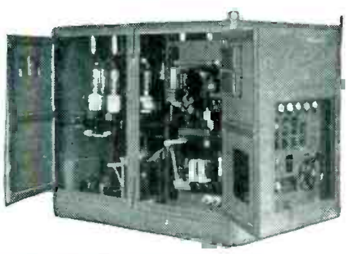
- 3.5V. A.C. 1.8V. D.C. 1.0 Amps Full Wave Bridge .90
- 6.5V. A.C.—2.2 V. D.C. @ 3.0 Amps. Full Wave Center Tap 1.20
- 36V. A.C. 200 Mil D.C. H.W. .75
- 36V. A.C. 2.2 Amps. D.C. Full Wave Bridge 3.75
- 54V. A.C.—1.6 Amps. D.C. G.E. Full Wave Bridge 4.40
- 154V. A.C.—600 Mil D.C. Full Wave Bridge 6.85
- 180V. A.C.—400 M.A. D.C. G.E. Full Wave Bridge 6.90

CONDENSERS

500 Mfd 200V dry Electrolytic .95
2 Mfd 600V Tubular Oil .39
10 Mfd 600V Oil .95
2 Mfd 2500V Oil 2.40
2 Mfd 3000 Oil 2.75
.25/.25 6000V D.C. or .125 Mfd—12000V D.C. Oil 3.75
1.0 Mfd 25 KV 36.00
.001/25 KV Mica 25.00
50 MMF 32 KV Tubular vacuum 4.95

RELAY

RC-117—Westinghouse Time Delay Current Relay, Type SC-M .2 to 1 amp A.C. or D.C. .8 amp continuous rating. Rating 20-40% drop out ratio. Net Wt. 3 lbs. Dim. 3" W x 5" D x 5⅜" H 12.95



NEW RA38 POWER SUPPLIES

115V., 60 cyc. input adjustable output 0-15,000V. A.C. or D.C. @ 500 Mils. Complete with extra set of new tubes and remote control. Shipping weight 2100 lbs. **$250.00**

METERS

Weston Model 476-3" A.C. Ammeter, 3 Amps. full scale, Calibrated 0-120 Amps., with 40/1 current trans $8.50
Net wt. 3 pounds

M-143 A.B. Weston Kilovoltmeter-3". Model 301, 20 KV. @ 1000 ohms per volt, flush type calibrated for steel panel mountings with 20 meg. 20 KV Weston resistor complete with clips and standoff insulators $18.00
Net wt. 4 pounds.

Multimeter, Supreme model 543-S $12.95
R. F. ammeter Weston 425-0-3 amps $5.95

TRANSTATS

- 115 V. 50/60 cycle input 103-126 V. output @ 2.17 amps $9.50
- 115/230 V. 50/60 cycle input 0-260 V. output @ 2½ amps $21.50
- GR Variac, 115 volts 50/60 cycle input 0-135 V output @ 5 amps cased $14.50
- 115 V. 50/60 cycle input, 0-135 V. output @ 10 amps $24.50

THERMOSTAT SWITCH
Fenwall —50°+400° F. 110-220 V. 2500 watt contacts, adjustable $1.60
KV Meter Multiplier resistor 1 meg. 1/10% noninductive Wire Wound $1.25

TRANSFORMERS

T-103—Voltage regulator Transtat, American Transformer Co. Spec. 29145 Max KVA output 11.5 50/60 cyc. 0-115 V. 100 amps. or 230 V. 50 amps. **$75.00**

Net Wt. 134 lbs. Dim. 25" W x 16" D x 17½" H (Encl. 8" shaft ext.)

T-102—Filament Transformer, American Transformer Co. Spec. 29106, Type WS .050 KVA, 50/60 cyc. Single phase, 35 KVA test, 12 KV D.C. operating. Primary 115 V., secondary 5 V., 10 amps with integral standoff insulator and socket for 250T, 371, 872, 5563, etc rectifier tubes **$12.50**

Net Wt. 15¾ lbs. Dim. 6½" W x 6" D x 12" H.O.A.

MOTOR GENERATORS

G.E. Type CC-21991 Input 115 volts D.C., @ 5.7 amps. Output 115 V. A.C. 60 cycle, single phase 350 V.A. @ 85% $58.00

G.E. Type CC-21990 Input 32 V. D.C. @ 22 amps. Output 115 V. A.C. 60 cycle, single phase, 350 V.A. @ 85% P.F. $63.00

Leland Type CLL-21985 Input 115 V. D.C. @ 4.2 amps. Output 115 V. A.C. 60 cycle, single phase, 240 V.A. @ 86% P.F. $47.00

WESTINGHOUSE—Type "AB"

De-ion circuit breakers

Thermal trip—without enclosure 3 pole—50 amp frame size
Style 545-389 D 15 amp rating 9.50 ea.
Style 545-391 D 25 amp rating 9.50 ea.
Style 545-393 D 50 amp rating 9.50 ea.

HEATERS

H-149—Chromolox strip heaters, 300 W., 115 V. (¼x1½x12") $1.00

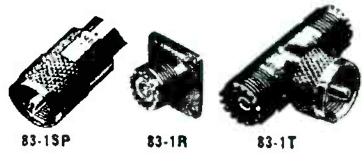
All merchandise in "as new" condition. Add approximately 20% to net weights for estimated shipping weights. Terms are 30% with order, balance C.O.D. All prices f.o.b. Los Angeles Warehouse. Write for additional detailed information on any of the above items and for special quantity discounts.

1527 E. Seventh Street **EPCO** Los Angeles 21, California

LIFE ELECTRONIC SALES

OFFERS

"UHF" COAXIAL CABLE CONNECTORS

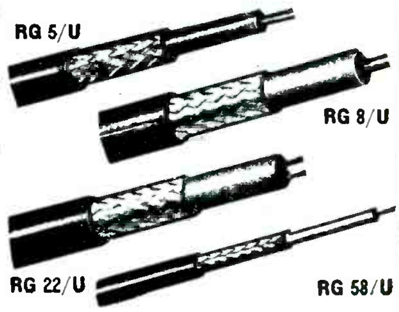


83 SERIES

No.	An. No.	Description	Price
83-1SP	(PL259)	Plug	ea. 22¢
83-1SPN	(PL259A)	Plug	ea. 22¢
83-168	(UG176U)	Reducing adapter for RG 29, 55 and 58U. Use with 83-1SP or 83-1SPN	ea. 12¢
83-1R	(S0239)	Receptacle	ea. 28¢
83-1AP	(M359)	Angle Plug adapter	ea. 22¢
83-1T	(M358)	Connector	ea. 98¢
83-22R	(UG103U)	Receptacle	ea. 35¢
83-22SP	(UG102U)	Plug	ea. 35¢

Minimum Quantity — 100 of a type

COAXIAL CABLES



RG5U	per 1000 ft.	$ 45.00
RG8U	per 1000 ft.	$ 40.00
RG11U	per 1000 ft.	$100.00
RG12U	per 1000 ft.	$175.00
RG22U	per 1000 ft.	$125.00
RG29U	per 1000 ft.	$ 37.50
RG58U	per 1000 ft.	$ 59.00
RG59U	per 1000 ft.	$ 45.00
RG62U	per 1000 ft.	$ 45.00

Prices based on minimum quantity of 500' of a type.

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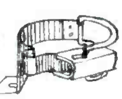

926 A	19¢ ea.	926 B5	19¢ ea.
926 A2	19¢ ea.	926 B33	19¢ ea.
926 B	19¢ ea.	926 C	19¢ ea.
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Original Gov't. Cost $750.00

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Price includes tubes, spare fuses, co-ax test cables, and circuit plan.

This versatile, accurate, precision built instrument is designed for precise measurement of short time intervals with circular sweep, and for test 'scope applications with linear sweep.

CIRCULAR SWEEP

Sweep rate: 1.5 microseconds per inch; 12.2 microseconds per revolution.
Sweep accuracy: —0.03 microseconds; stable crystal oscillator holds sweep accuracy.
Range of measurement: time intervals from 0.5 to 600 microseconds can be measured by utilizing the delayable intensity gate and selecting any one of the first 100 revolutions after triggering.
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Trigger stability: 0.1 microseconds with respect to circular sweep; can be operated at recurrence frequencies from 300 to 1500 per second.
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Signal deflection: radial by center wire; sensitivity—225 volts per inch.
With circular sweep, the TS-100/AP is useful for calibrating pulsers and coincidence circuits, for measuring radar ranges (to an accuracy of 5 yards), for measuring delay lines, pulse lengths, pulse separations, and for measuring time duration of any event not exceeding 600 microseconds.

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Sweep rate: 12, 120, and 360 microseconds for 3-inch sweep.
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Sweep synchronization: sweep starts at trigger or after delay adjustable from 2 to 500 microseconds.
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CHARACTERISTICS:
1—Intended to work from a cathode follower or low impedance winding into a class "A" grid.
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Mirrored scale 3½" long, knife-edge pointer. Molded bakelite case dimensions 4¼" x 5¼" x 2¼". Snaps in place in black wrinkle-finished steel case 5¼" x 6" x 2⅜". Furnished with 3 ft. color-coded rubber insulated clip leads.

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2x2/879	.49	FG-172	14.80	811	1.71	1636	$3.77	9001	.42
3API	2.44	204A	17.90	832A	2.33	2050	.83	9002	.39
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5BPI	1.48	WE-249C	1.88	1625	.19	7193	.18	9004	.29
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This instrument was developed by the Boonton Radio Corp. to permit checking at VHF: Capacitance, Inductance and complete Resonant Circuits. Ideal for Television and FM Tuners, Quality control, etc. Three Frequency Ranges. Available for immediate delivery.

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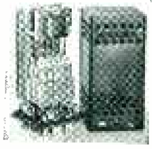

Hi-freq. extra-heavy duty, Rauland #JV-0014. Input 6, 12 or 24 volts; output 200 cycles ±1%; 20 extra-heavy contacts, rated at 35 amps continuous duty, each brought to separate base pin. In case 2 1/2" x 2 1/2" x 5 1/2".

BRAND NEW, in orig. boxes . . $4.95

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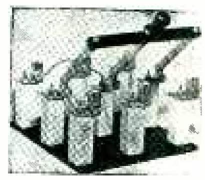

Extra-heavy contacts porcelain stand-offs; on base 7" x 8" x 1/4"; insulators alone worth more than price of switch.

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was approximately double that of
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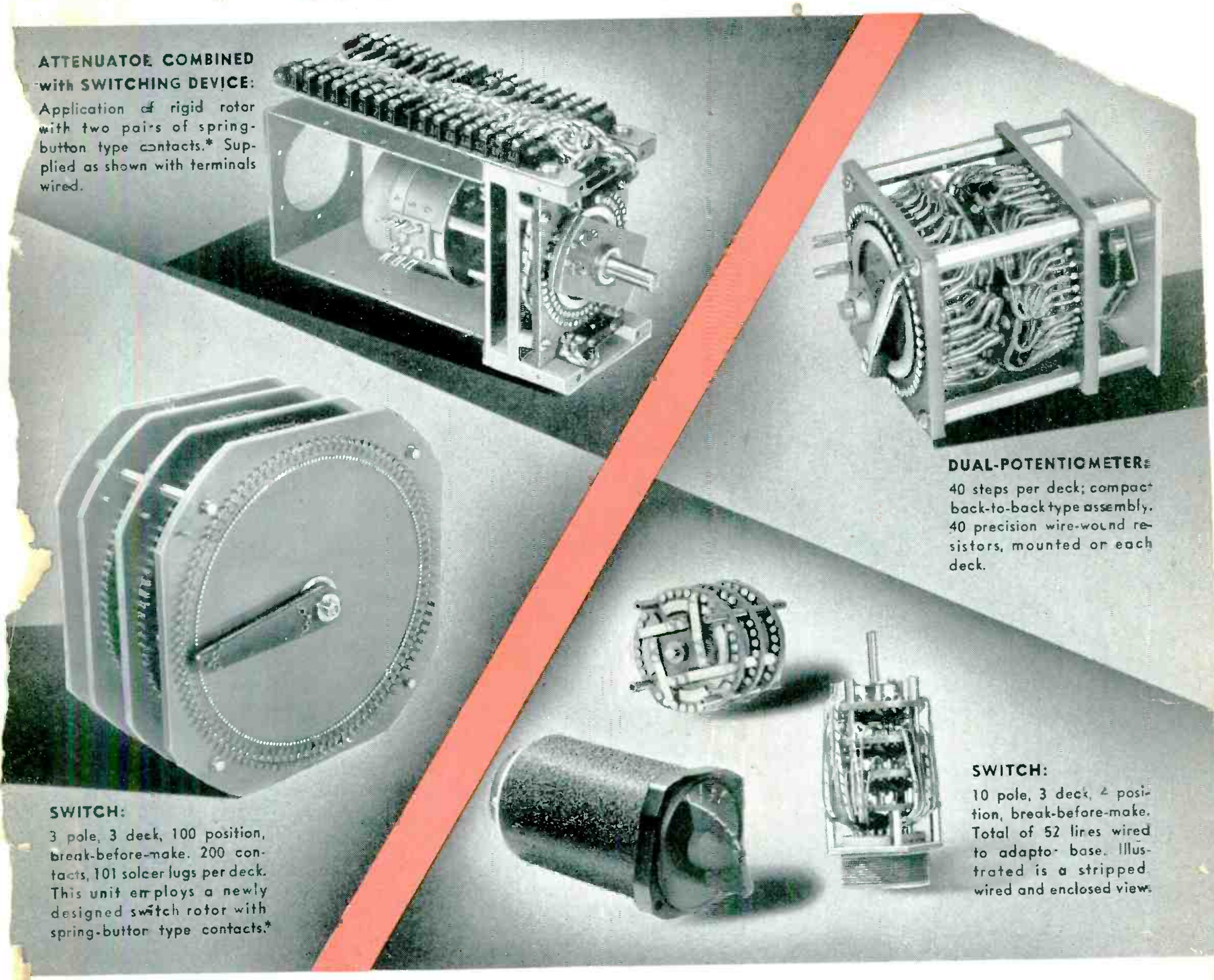

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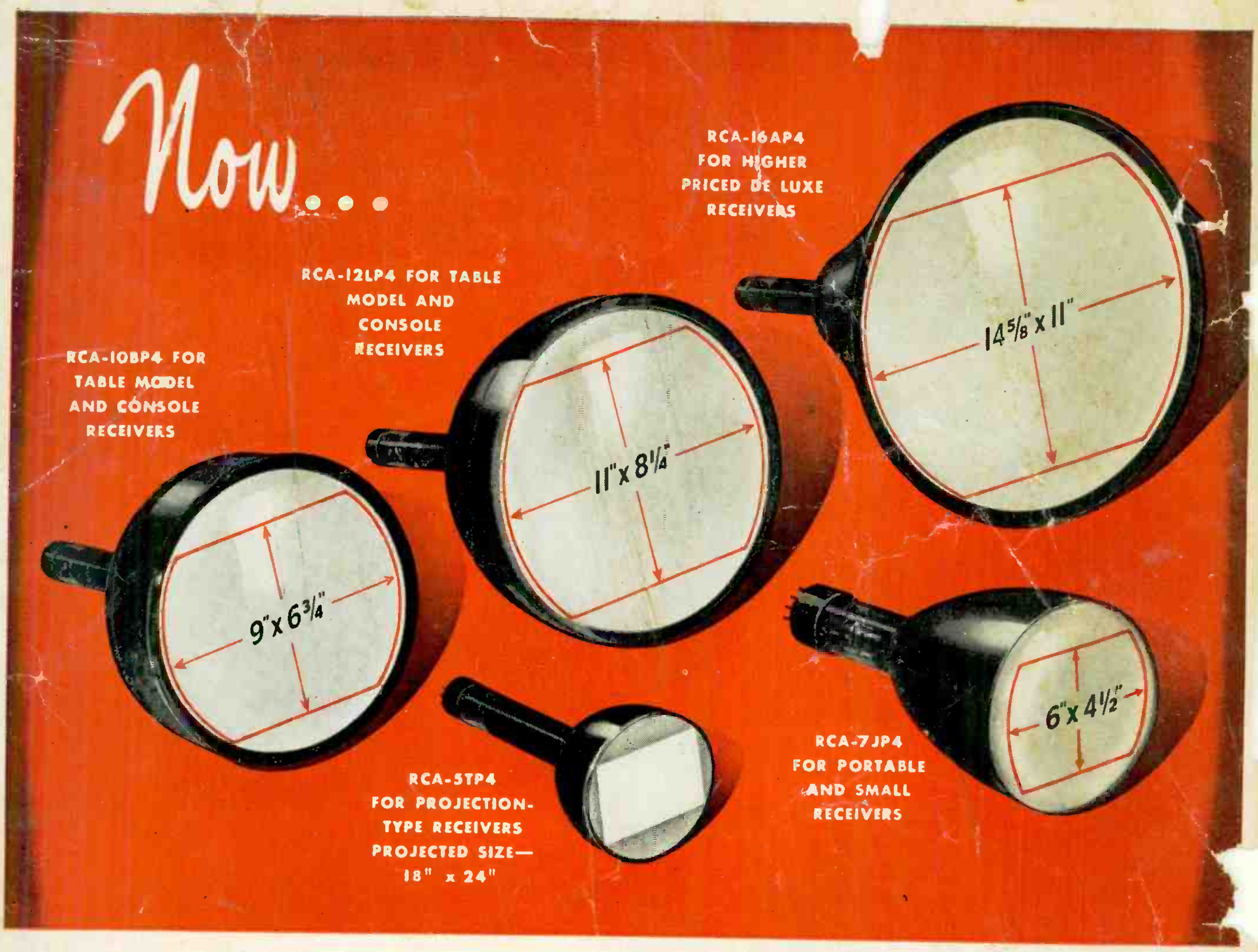

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Concentrated production on these five accepted types results in longer production runs, which in turn, make possible lower cost, more uniform, and better quality tubes for our customers.

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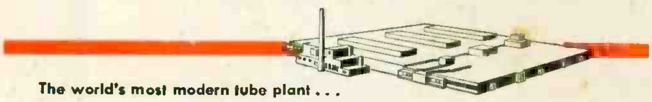
RCA Application Engineers are ready to cooperate with you in applying these kinescopes and their associated components to your specific designs. For further information write RCA, Commercial Engineering, Section 42HR, Harrison, N. J.



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