MEASURING TANK WALL THICKNESS
UTC was the largest supplier of transformer components in World War II. Present UTC production is on a similar basis. Illustrated below are a few of the thousand military types in UTC 1950 production.

- Carrier frequency filter
- Aircraft low frequency filter
- Plate Transformer

- Typical hermetically sealed power transformers for 60 cycle service.

- Hermetically sealed audio and pulse transformers.

- 60 cycle and 400 cycle components hermetically sealed and fosterized.

- Miniaturized and a units, magnetic amplifiers, etc.
SEPTEMBER • 1950

MEASURING TANK WALL THICKNESS
Ultrasonic "Audigage" does the job from outside the tank with 1 percent accuracy at Shell Chemical's Houston plant. Photo courtesy Branson Instruments, Inc. (see p 118)

THE CASE FOR VHF TELEVISION
Condon Committee "Annex C" on UHF vs VHF

LONG-LIFE TUBES FOR INDUSTRY, by Elwood K. Mears
Airline program points way toward improved types for other industries

FREQUENCY INTERLACE COLOR TELEVISION, by R. B. Dome
Compatible system uses standard 6-mc channel

INTEGRATION NOISE REDUCER FOR RADAR, by W. Cunningham, J. May, J. Skalnik
Receiver is gated to accept only reflections like transmitted pulses for discrimination against noise

TELEVISION RECEIVER TRANSIENT ANALYSIS, by Joseph Fisher
Overall response of television receivers to 100-kc square waves is convenient method of production quality control

AN ANTENNA ANALYZER, by Alva C. Todd
Radiation patterns are produced on the screen of a cathode-ray tube by 38-tube instrument

WIDE-RANGE R-C OSCILLATOR, by Peter G. Sulzer
New circuit produces 15 volts rms from 20 cycles to 2 megacycles

UHF INDUSTRIAL COMMUNICATIONS SYSTEM, by Frank B. Gunter
Crystal controlled 5-watt transmitter and double-superheterodyne receiver operate in 940-960 mc band

AUTOMATIC BEAM BLANKER FOR OSCILLOSCOPES, by A. Dunn, A. McIntyre, A. Bennett
Attachment turns on beam of oscilloscope only during mid-period of sweep

LEAK DETECTORS FOR INDUSTRIAL VACUUM SYSTEMS, by Andrew Guthrie
Analysis of eight methods of locating and measuring leaks, with emphasis on the helium leak detector

PHASE-TO-AMPLITUDE MODULATION FOR UHF-TV TRANSMITTERS, by Wm. E. Evans, Jr.
Experiments with 150-watt 530 mc transmitter show advantages of system

ELECTRONIC CONTROL OF ANESTHESIA, by R. G. Bickford
Servoanesthetist maintains desired degree of anesthesia by using brain potentials to control other pump

PHOTOMETER FOR ELECTRON MICROSCOPE, by Francis W. Bishop
Multiplier phototube and vtm determine correct exposure from illumination of fluorescent focusing screen

MICROWAVE DIFFRACTION CHARTS, by Earl D. Hilburn
Two alignment charts for determining clearance required for good microwave path

BUSINESS BRIEFS
60 ELECTRON ART
65 NEW PRODUCTS
110 NEWS OF THE INDUSTRY

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ELECTRONICS—September, 1950
For jobs involving specifications and uses of magnet wire, you need this new General Electric magnet wire manual.

Packed with helpful, hard-to-get information, this 34-page book clearly and concisely covers all types of General Electric magnet wire — G-E Formex for Class A applications, temperatures up to 105 °C, and G-E Deltabeston, both for Class B applications, temperatures up to 125 °C; and for Class H applications, temperatures up to 180 °C.

Here are just a few of the subjects covered by the G-E magnet wire manual:

- Properties of Formex and Deltabeston magnet wires
- Tables of types and sizes of stock magnet wires
- Application procedures
- Information on special glass and silicone-impregnated insulations
- Tables covering electrical specifications, dimensions, weight, and other pertinent specification data

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Section W13-931
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Please send me free copy of "General Electric Magnet Wire."

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Company ____________________________

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September, 1950 — ELECTRONICS
SUBJECT: HIGH POWER, HIGH TEMPERATURE RF CAPACITORS

PROBLEM: 200 mmf. capacitor to carry 4½ amperes of current at 1Mc at an ambient temperature of 90°C. Small size was imperative.

SOLUTION: This customer was unable to find a mica capacitor to meet the required specification. A wax-filled porcelain-cased mica capacitor having a 20°C rise weighs 8 lbs. and is 5½" high and 5½" x 5" base. This is too large. Moreover, mica capacitors must be derated to 70% of current rating even at 70°C; at 90°C, they cannot be used.

A Type TSG Glassmike was designed for the above application. Type T plastic film at 1Mc has a power factor of less than .0002. The Silicone fluid impregnant has similar low losses. The FR losses of the electrodes were kept to a minimum so that the overall power factor was slightly over .0002.

The finished Type TSG assembly weighed .35 lbs and was 1½" in diameter and 3½" long, with axial mounting studs on each end. With a current of 4.5 amperes at 1 Mc flowing, the temperature rise is 15°C. Total heating loss is equivalent to 3.3 watts. Volt-amperes handled are approximately 16,000 which indicates a Q of approximately 5,000.

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for Impregnating and Dip Coating

won't flow under extreme high heat
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MELTING POINT (DROP)................. 260/265 F
COLD FLOW (M-R)................. 250/255 F
PENETRATION 60/32/100/50/15.................. 15-16
APPLICATION TEMPERATURE................. 300/350 F
SPECIFIC GRAVITY...................... 0.90
VISCOSITY (SAYBLT. UNIV.).............. 40-42 seconds
FLASH POINT......................... 500 F
POWER FACTOR........................ 0.023 (104 cycles; 77 F)
DIELECTRIC CONSTANT................. 2.19 (104 cycles; 77 F)

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POWER FACTOR........................ 0.023 (104 cycles; 77 F)
DIELECTRIC CONSTANT................. 2.19 (104 cycles; 77 F)

SPECIFICATIONS

COLD FLOW (M-R)................. 272/277 F
SOFTENING POINT (BRR).............. 190/195 F
DIPPING TEMPERATURE................. 325/375 F
MELTING POINT (DROP)................. 275/285 F
COLOR.................................... Tan
ADHESION................................. Good
PENETRATION 77/100/5................. 8-10
SPECIFIC GRAVITY...................... 1.01
FLASH POINT............................ 480 F

ELECTRICAL PROPERTIES (Representative Sample)

Dielectric Strength................. 368 V/mil (77 F; 60 Cycles)
Dielectric Constant................. 2.51 (77 F; 104 Cycles)
Power Factor........................ 0.0069 (77 F; 104 Cycles)

3767-A CORONA SUPPRESSING PLASTIC
for Dip Coating

won't sag or sweat under extreme heat
won't crack under extreme cold!

3767-A, CORONA SUPPRESSING PLASTIC, was developed to reduce
or eliminate corona around certain points on television components, and
similar electrical parts, which operate at high potentials. Application
in the form of a corona suppressing "tie" on the periphery of "flyback"
transformer coils and similar units is the primary function of 3767-A.
The customary method for applying 3767-A is to dip or roll the units
to be coated in a molten bath of the insulation.

Since low power factor and high dielectric strength are particularly desirable in
this type of insulation, this material combines the best possible
electrical properties consistent with the necessary physical properties.
The surface obtained with this corona suppressing plastic is particularly smooth and free from ridges and bumps. This feature of itself reduces the
evolution of corona. During the development of 3767-A particular attention
was given to the physical stability of applied coatings at extremes of high and low temperatures.

FUNCTIONAL TESTS of this material applied in moderately heavy coatings
on flyback transformer coils SHOWED THAT 3767-A WILL WITHSTAND
A CYCLE OF 24 HOURS AT -40 C FOLLOWED BY 24 HOURS
AT 125 C WITHOUT THE APPEARANCE OF CRACKS AT THE LOW TEMPERATURE OR SAGGING AND SWEATING AT THE HIGH TEMPERATURE.
RF NOISE SUPPRESSION FILTERS DESIGNED FOR YOUR SPECIFIC PROBLEM...DELIVERED WHEN YOU NEED THEM

FILTRON has positive quality control!

FILTRON coil structures represent the finest engineering in wire wound inductors.

FILTRON core structures are the result of many years of research to develop the best materials suited for your RF Interference Suppression Filter.

FILTRON capacitor sections are designed and manufactured specifically for your filter, eliminating resonant frequencies commonly found in capacitors.

FILTRON'S metal fabrication department permits us to give you a filter in the size and shape you need to fit the space you have.

FILTRON design assures you of the smallest size and the least weight for your filter.

FILTRON'S completely equipped shielded laboratory is available to you for the RF interference Testing and filter design for your equipment—to the required specification.

RF INTERFERENCE FILTERS FOR:

| Electronic Controls | Signal Systems |
| Electric Motors | Business Machines |
| Electric Generators | Electric Appliances |
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An inquiry on your Company letterhead will receive prompt attention

THE FILTRON CO., INC.
BAYSIDE, LONG ISLAND, N. Y.

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS

ELECTRONICS — September, 1950
For adequate supplies of resistors in an ever-widening market, depend on IRC logistics. Already the largest manufacturer of resistors in the world, IRC has increased its output tremendously to meet your requirements. And in addition, IRC capacity is now being supplemented by licensees in Canada and Denmark—while English, Australian and Italian licensees provide resistors for other world markets formerly supplied from the United States. IRC availability extends even to your urgent, small-order requirements for standard resistors. Through our Industrial Service Plan, your IRC Distributor can supply these promptly from full stocks of the most popular types and sizes.

Stock-piling of advanced BT's

has been proved practical by IRC's study of resistor-use patterns. A recently completed three-year profile shows that 80% of the BT resistors used in TV and radio equipment include only 30 values. This holds true despite design changes and shifts in the industry's emphasis on sets. And these facts prove that you can now simplify purchasing, stocking and expediting practices by placing long-term orders covering your basic, recurring needs for BT's. Engineered to meet JAN-R-11 specifications for fixed composition resistors, IRC BT's have established their superiority in all important characteristics. Bulletin B-1 brings you full details of IRC BT's, and a copy of our study is yours for the asking.
The right Resistors...

for precision applications often require a combination of characteristics. IRC Deposited Carbon PRECISTORS combine accuracy and economy in:—Circuits in which the characteristics of carbon composition resistors are unsuitable and wire-wound resistors too expensive — Metering and voltage divider circuits requiring high stability and close tolerance of the resistance values — High-frequency applications. The two sizes of IRC PRECISTORS are manufactured to customers' specifications, rather than to standard RMA values (subject, of course, to minimum and maximum values for each type). For complete data on characteristics and values, mail coupon for Bulletin B-4.

Dependable source of small-size controls...

IRC meets your requirements with the new ¾" Type Q. Mechanization of production and testing assures increased supplies of these miniature controls. And elimination of hand operations provides complete uniformity of construction and performance. New IRC Type Q Controls are rugged and compact. Resistance element is the best IRC has ever produced. Increased arc of rotation permits the same resistance ratios used in larger IRC Controls. IRC Type Q's are characterized by low noise level, negligible changes in resistance even after long exposure to humidity, unusual durability and efficiency, and adaptability to a wide variety of small-space applications. Bulletin A-1 gives full information.

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Modern mass production equipment... plus exclusive manufacturing techniques, make IRC Insulated Chokes relatively inexpensive — and offer considerable savings over ordinary types. Available in two sizes, IRC chokes are insulated in molded phenolic housings for full protection against high humidity, abrasion, damage during assembly, and danger of shorting to chassis. "Q" improves with rise in frequency and is sufficiently high for broad-band tuning in FM and TV regions. Resistance is low enough to permit use as filament chokes for moderately high power tubes. Coupon brings you full information in Bulletin H-1.

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☐ IRC Study of Resistor Use  ☐ [ ] Name and Address of local IRC Distributor

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September, 1950 — ELECTRONICS
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May Solve a Problem for You

In a busy Washington office during the past war hung a sign which said—"We do the miraculous every day—the impossible takes just a little longer." Today, that sign could hang in the offices of Centralab. For example, someone wanted a small speech amplifier—Centralab's answer—Ampec, a full 3 stage unit, two of which can fit inside of a regular pack of cigarettes! A radio manufacturer wanted a small audio-detection unit. Centralab's answer Audet, a unit one-third size of an ordinary soda-cracker! How were these things done? With Centralab's Printed Electronic Circuits—a pioneered development of Centralab. Yes, and here are some of the benefits that many manufacturers of radio TV sets and other electronic gear have reaped from using PEC's. They've eliminated numerous individual parts their handling, inventory and assembly. They've gotten more consistent and better performance results. They've reduced finished product size and weight. They've eliminated wiring errors and cut down on the number of soldered connections. What's more, they've been able to stretch their resistor supplies... an important factor in meeting current volume demands for TV and radio production. Look over your own situation. Want to cut costs? Speed up assembly? Then on the next two pages you may see a Centralab Printed Electronic Circuit unit that will help you do just that! If you don't see what you want—contact us. Tell us your problems. Maybe we can do the miraculous or take a little longer and accomplish the impossible!
Choose From This List!

Centralab Printed Electronic Circuits

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42-3 - BC TUBULAR HI-KAPS - capacitors for use where temperature compensation is unimportant.
42-4R - BC DISC HI-KAPS — miniature ceramic BC capacitors.
42-10 - HI-Vo-KAPS — high voltage capacitors for TV application.
42-59 - CERAMIC TUBULAR TRIMMERS — designed for TV and VHF application.
695 - CERAMIC TRIMMERS — CRL trimmer catalog.

Centralab Switches

42-19 — MODEL "I" RADIOHM — world's smallest commercially produced control.
42-85 — MODEL 2 RADIOHM — CRL's new line of 3/8" diam. controls for TV — AM — FM

Centralab Controls

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975 722 720

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CENTRALAB

Division of GLOBE-UNION INC. - Milwaukee
AN IMPORTANT MESSAGE FROM Federal FOR USERS OF RG TYPE CABLES

Federal Telephone and Radio Corporation has received approval to manufacture—and can supply—RG type cables with the

NEW LOW-TEMPERATURE NON-CONTAMINATING THERMOPLASTIC JACKET

(An original development by Federal)

This modification is in accordance with “Exceptions to Specification JAN-C-17A,” dated March 21, 1949, and amendments thereto.

THESE ARE THE TYPES APPROVED TO DATE—


Review your requirements now—to insure prompt delivery!

For further details on present and subsequent approvals, write or wire Dept. D-413, or telephone NUtley (N.J.) 2-3600

ANOTHER "Federal FIRST"

Federal Telephone and Radio Corporation
Copper Wire, Tube, Sheet
Used in Electric Motor

Copper wire, sheet and tube as well as free machining brass rod are an integral part of the illustrated 110-volt, 60-cycle induction motor.

Enamelled copper wire is used for the windings of the stator which set up the magnetic fields. As a means of concentrating the magnetic flux in these fields, extruded and drawn rectangular copper tube is cut into narrow sections and two pieces are inserted opposite each other in the laminations as shading bands.

In the rotor, two blanked and pierced copper washers are used as shorting rings. Cold-headed copper pins are inserted through these discs and laminations and both ends are copper welded.

Two free machining brass bushings are used as spacing elements between the rotor ends and the bearings on the shaft.

Three main types of copper are commercially available:
Electrolytic tough pitch is used in greater quantities than the other two grades of copper for bus bars, conductivity wire, switches, terminals, contacts, etc. This metal contains a small quantity of copper oxide and its conductivity is set at 101%.

Deoxidized copper has a conductivity of 85% and is used for various tube applications. In the sheet form, it is suitable for operations where extra deep draws and flanging are required.

Oxygen-free copper does not contain cuprous oxide or phosphorus. It has an exceptionally high ductility and is an exceptionally high degree of electrical conductivity of the three types mentioned. Where a high degree of electrical efficiency is necessary, this metal is normally utilized.

Phosphor Bronze Vital to Switch

Stop light switches for cars with hydraulic brake systems use phosphor bronze and free turning brass for both electrical and mechanical applications.

This unit is expected to operate for the life of the car without attention or maintenance.

When brake pressure is applied, oil is forced against a composition rubber diaphragm, applying pressure to a phosphor bronze diaphragm which in turn closes a phosphor bronze switch leaf, making electrical contact. When the brake is released, the bronze diaphragm acts as a cricket, snapping back to open the switch by combatting the residual pressure of the hydraulic system.

Due to the countless making and breaking of contact of the switch in the normal use of a car, spring temper phosphor bronze was selected because of its exceptional resistance to fatigue.

Free-cutting brass rod is used for the terminal pins because of its machinability and ability to withstand corrosion from moisture and petroleum oils.

Such parts in both electrical and mechanical equipment play a far more important role than is indicated by their size and cost alone. With satisfactory performance of a complex assembly so dependent upon a small but vital spring part, it is essential that the material selected fully meets the requirements of the application. Bridgeport's Laboratory will be glad to work with manufacturers in the selection of alloys of the composition, temper and surface quality that will assure long, trouble-free service.
announcing

the new DuMont Type 303

a quantitative 10-megacycle CATHODE-RAY OSCILLOGRAPH

EXCELLENT FREQUENCY RESPONSE with a sensitivity of 0.1 volts, peak to peak, per inch — down 3 db at 10 megacycles.
Here, woven around the quantitative investigation of a 0.25 microsecond pulse, is a graphic account of the performance features which make the Type 303 an exceptionally fine, high-frequency cathode-ray oscillograph.

A. **SIGNAL DELAY** built into the Y-axis amplifier insures complete display of the steep pulse rise. As illustrated by the portion "A", the 10% point of rise does not occur until sometime after the sweep starts. Y-axis frequency response, shown on reverse side, includes the performance of the signal-delay line.

B. **EXCELLENT TRANSIENT RESPONSE**—wholly essential to the proper study of high-speed phenomena—is depicted by the rise time which is reproduced without appreciable degradation. A rise time of 0.01 microsecond, or greater, will be reproduced as a rise time not exceeding 0.03 microsecond.

C. **NO OVERSHOOT** is observed even on extremely steep wavefronts. The low-frequency response limit is a 3% slope on a 30-cycle squarewave. As shown on the frequency-response curve, there is no positive slope above the mid-frequency range. Since the response tapers off so slowly, the Type 303 is usable at frequencies beyond 10 megacycles. The synchronizing circuits will lock in sine-wave signals as high as 20 megacycles.

D. **UNDISTORTED DEFORMATION** provided by the Y-axis amplifier is 2.5 inches for unidirectional pulses. An equivalent undistorted deflection of 5 inches is available for symmetrical signals and may be positionned over the useful area of the cathode-ray tube. Even at the highest attenuation ratios, the Y-axis input is not frequency sensitive, as shown by the illustrated pulse which has been attenuated 4000 times. The direct-coupled X-axis amplifier of the Type 303 will provide over 5" of undistorted deflection.

E. **SWEEP SPEEDS** available in the Type 303 make possible a presentation which is practical for qualitative and quantitative analysis of a pulse as short as 0.25 microsecond. Both driven and recurrent sweeps are continuously variable from 0.1 second to 5 microseconds. Through sweep expansion, sweep length is variable from a fraction of an inch to an effective 30 inches, any portion of which may be positioned on the screen. As shown above, even at the fastest sweep range, the sweep is extremely stable and linear. Notice the absence of jitter.

F. **TIME CALIBRATION** in the Type 303 is accomplished by substituting a damped sinewave for the signal. Double exposure by photographic recording of calibrating sinewave and signal provides a permanent quantitative analysis of the signal. In addition to the 10-megacycle signal shown above, calibrating frequencies of 10 KC, 100 KC, and 1 MC are also available. Accuracy of time calibration is within 3%.

G. **AMPLITUDE CALIBRATION** completes the precise, quantitative analysis of the signal. A built-in, regulated, voltage-calibrator provides peak-to-peak signals of 0.1, 1.0, 10, and 100 volts. Similar to time calibration, the amplitude calibrating square wave is substituted for the signal. Amplitude calibration is accurate within 5%.

**price $820.00**

FOR COMPLETE DETAILS WRITE FOR BULLETIN TYPE 303

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Now you can plot $X$ vs. $Y$... automatically

**TYPICAL CURVES**

- Differential Thermal Analysis of Clay Sample
- Average Plate Characteristics of 6567 Vacuum Tube
- Static Forward and Reverse Current Characteristics of Selenium Rectifier
- Thermal Expansion & Transformation of Steel

with the

**New Speedomax 2-Function Recorder**

Boon to engineering and research laboratories, this new Speedomax Recorder automatically plots a continuous, accurate curve showing the relationship between any two variables brought to the instrument in the form of d-c signals. Gone are those hours of tedious compilation and point-by-point plotting of data.

Just glance at these typical curves and note the instrument's remarkable versatility. Its big 10" chart provides remarkably complete detail. Potential applications are as broad as a researcher's imagination.

This new X-Y Recorder has two electronic circuits, one for each function. $X$ corresponds to horizontal pen travel; $Y$ to up-and-down movement of the chart. Input voltage can be as low as 2.5 mV for $X$; 10 mV for $Y$. Response time is amply fast—just 2 sec for full scale pen travel ($X$); 4 sec per 10" of chart ($Y$).

3 TYPES OF VICKERS Standard MAGNETIC AMPLIFIERS

...designed to give you better control—at lower cost

Whatever your specific control operation needs in power...performance...and economy...you'll find a Vickers Standard Magnetic Amplifier that is tailored to give your control requirements these benefits:

- NO MAINTENANCE
- HIGH PERFORMANCE
- RUGGED CONSTRUCTION
- No Moving Parts
- NO WARM-UP TIME
- A-C OR D-C CONTROL
- A-C or D-C Output
- RESPONDS TO SUM OR DIFFERENCE OF SEVERAL SIGNALS
- ALLOWS ELECTRICAL ISOLATION BETWEEN CIRCUITS

HIGH PERFORMANCE

For 60 cps power sources — 28 styles — maximum output powers from milliwatts to 108 watts.
For 400 cps power sources — 20 styles — maximum output powers from 30 watts to 385 watts.

HIGH GAIN

For 60 cps power sources — 22 styles — maximum output powers from ½ watt to 1200 watts.

HIGH POWER

For 60 cps power sources — 20 styles — maximum output powers from 65 watts to 3660 watts.

TYPICAL APPLICATIONS

Servo Mechanisms • Line-to-line Voltage Regulators • Hydraulic Transmission Controls • A-C and D-C Generator Voltage Regulators • Speed and Frequency Regulators • Lamp and Furnace Controls Temperature Regulators Time Delay Devices

NOW AVAILABLE

BULLETIN 20-A, which lists condensed characteristics of the complete line of Vickers Standard Magnetic Amplifiers. Write for your copy today! Please make request on your letterhead.

VICKERS ELECTRIC DIVISION

1801 Locust Street • St. Louis 3, Missouri

September, 1950 — ELECTRONICS
Mr. Isberg Proves A Point . . .

. . . regardless of how tough the service, Eimac 4E27A pentodes perform better—longer.

The 4E27A is by no means limited to service in TV transmitters. Its rugged internal structures and pyrovac plate provide, in conventional amplifier or oscillator service, even far greater tube life than is indicated in the severe tests reported by Mr. Isberg.

This new Eimac pentode is rated at 125 watts of plate dissipation. Low grid-plate capacitances make it exceptionally stable and its high power-gain characteristics enable delivery of relatively large output with low driving power.

Follow the Leaders to
Eimac
Tubes
The Power for R-F

EITEL-McCULLOUGH, INC.
San Bruno, California

Export Agents: Fratar & Hansen, 301 Clay St., San Francisco, California

COMPLETE DATA ON THE EIMAC 4E27A BEAM POWER PENTODE IS AVAILABLE UPON REQUEST.
The newest Crosley Television Cabinets are striking examples of how copper and brass can be used to give products sales appeal as well as serve a utilitarian purpose.

All models, two of which are shown above, are equipped with gleaming bezels which frame the television screens. They are made for the Crosley Corporation from Revere 90-10 Commercial Bronze. The table model shown is equipped with two control escutcheons drawn from this same metal by the Rex Engineering Company, Cincinnati, Ohio. The table model also has two strips of .0016" Revere Soft Copper of 5½" width on the under side of the top of the cabinet. This acts as an insulator by conducting any heat generated, away from the wooden cabinets. For, although copper is the best heat conductor of the commercial metals, when highly polished it dissipates rather than absorbs heat.

Note on the console model, shown above, how the three Revere Brass Tubes add a touch of luxury and richness to the cabinet.

Perhaps Revere Copper or Brass or one of its other metals or alloys can help in the development and improvement of your product. Why not call the nearest Revere Sales Office and see?
For Building or Rebuilding Transformers...

The Tierney Electrical Manufacturing Company, Seattle, Washington, founded in 1933, repairs and manufactures distribution, power, and special transformers, and also repairs and rewinds any type or size of motor.

Like many other repair shops and smaller manufacturers, Tierney has discovered what the larger manufacturers already know—that it is profitable to standardize on Natvar products.

All Natvar flexible insulations are consistently uniform, no matter when or where purchased. They are immediately available either from your Wholesaler’s stocks or direct from our own.

THE NATIONAL VARNISHED PRODUCTS CORPORATION

201 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY
These sturdy little Stackpole LR type controls handle higher wattages more dependably than most controls that are a good bit larger in size. Less than an inch in diameter, they’re conservatively rated at .5 watt for use where voltage across the units does not exceed 350 volts for linear tapers, or for non-linear ones having a taper of no less than 10% of the total resistance at 50% rotation, provided that 225 volts is not exceeded. Thus there is plenty of wattage capacity for a wide variety of present day uses including many television applications. Stackpole LP type controls, slightly larger, are rated .6 watt at linear taper if 500 volts is not exceeded and also at .6 watt if the resistance is not less than 10% at 50% rotation, provided that 250 volts is not exceeded.

LR controls are available as concentric shaft duals.

Electronic Components Division.

STACKPOLE CARBON COMPANY
ST. MARYS, PA.
the Karp story is this:

We are specialists in sheet metal fabrication with over 25 years' experience in our craft.

We have some of the most ingenious men in the industry—especially in our engineering department and among our technicians.

We have 70,000 square feet of ultra-modern plant, with every up-to-date aid in the way of tools, dies and machinery.

We have the most modern painting and finishing department, which is completely dust proof, and equipped with the newest water-washed spray booths and baking ovens.

We are geared to produce—at the right cost for its specifications—anything from a simple box or chassis to the largest transmitter housing—and in any quantity.

In short, we're at your service for sheet metal fabrication at its best. And we mean service!

KARP METAL PRODUCTS CO., INC.

215-63rd STREET, BROOKLYN 20, NEW YORK

ELECTRONICS — September, 1950

Specialists in Sheet Metal for the Industry
A leading television manufacturer*, in a run of over 60,000 sets, has had only 25 complaints resulting from faulty tuners. There are good reasons for this. One of them is the fact that Corning Metallized Glass Inductances are included in the design. The integral contact of fired-on metallizing with the special glass form makes Corning Inductances inherently stable. Drift is negligible, even under unusual temperature changes.

Tough and durable, Corning Inductances are not damaged by repeated handling. They are unaffected by vibration. The smooth glass wall assures noiseless tuning. They will give years of trouble-free service. When a receiver is shipped from the factory you know it will stay in alignment—complaints are minimized.

That's just part of the story. Corning Inductances make assembly rapid and easy. Installed by ordinary soldering or grommeting methods, they can be obtained with any length leads or just solder spotted. Tracking is assured by fine trimmer adjustments and consistently accurate inductance ratings. There is no time-consuming adjustment of coils as with inaccurate or less substantial inductances.

All of the above quality points regarding Corning metallized coils afford a precision inductance section of the tuner at an overall cost comparable to less stable coils plus compensating units.

Whatever your high frequency inductance requirements, Corning Metallized Glass Inductances can be designed to fit them exactly. Uniform, variable or double pitch windings are as easily manufactured as are fixed tuned, permeability tuned or permeability tuned inductance-trimmer combinations.

Let Corning engineers help you reduce tuner complaints and improve quality. Write for further information today.

*Name on request.
Any Resistance-Rotation Curve
can be permanently molded into the Type J Bradleyometer

The Type J Bradleyometer can be built to produce any resistance-rotation curve because, during manufacture, the solid molded resistor can be varied in resistance throughout the circumference of the ring.

It is not a film or paint type resistor. The resistor unit is molded as one piece with terminals, face plate, and threaded bushing imbedded in the molded piece. After molding, the resistor material is no longer affected by heat, cold, moisture, or age. The contact brush actually improves with age.

Type J Bradleyometers can be supplied in single, dual, or triple unit construction for rheostat or potentiometer applications. A built-in line switch is an optional feature on single and dual models. Specifications sent upon application.

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

ALLEN-BRADLEY
FIXED & ADJUSTABLE RADIO RESISTORS
Sold exclusively to manufacturers of radio and electronic equipment.
7 super-thin tapes in this compact TV coil!

Crowded TV deflection coils get complete insulation with “SCOTCH” Electrical Tapes. At the Crosley Division of AVCO Manufacturing Corp., Cincinnati, Ohio, ninety-six inches of 7 different types of “SCOTCH” Electrical Tape protect three miles of wire inside the coil housing!

You get high dielectric and mechanical strength combined with thin caliper in “SCOTCH” Electrical Tapes. They’re pressure-sensitive, clean to handle, take up little room. There are over 30 different tape formulations—many types of backings and electrical type adhesives, including vinyl plastic, acetate, cloth, treated paper, glass cloth and neoprene. In addition, there is new No. 880 Filament Tape—practically unbreakable, with strong fibers running lengthwise. It holds the channel retainer and nut in place—takes the place of a steel band—rapidly and easily applied. For full information mail coupon to Dept. ES-950.

MINNESOTA MINING & MFG. CO.
900 Fauquier Ave.
St. Paul 6, Minnesota

Please send full information on the complete line of “SCOTCH” Electrical Tapes.

NAME
FIRM
ADDRESS
CITY ZONE STATE

Made in U. S. A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn.

General Export: DUREX ABRASIVES CORP., New Rochelle, N. Y.  In Canada: CANADIAN DUREX ABRASIVES LTD., Brantford, Ontario

September, 1950 — ELECTRONICS

www.americanradiohistory.com
-hp- 614A UHF Signal Generator

Direct reading output, accuracy ±1 db...Constant internal impedance, SWR 3 db...Direct frequency control...External modulation 0.5 microseconds pulses to square waves...CW, FM, pulsed output.

This new -hp- signal generator will save you hours of time and work in making UHF measurements between 800 and 2100 mc. Its many different modulation and pulsing capabilities mean these man-hour economies can be applied to a wide variety of measurements—receiver sensitivity and alignment, signal-to-noise ratio, conversion gain, standing wave ratios, antenna gain and transmission line characteristics, to name but a few.

Carrier frequency in mc can be set and read directly on the large central tuning dial. R-f output from the klystron oscillator is also directly set and read in microvolts or db. No calibration charts or tedious interpolations are necessary. And thanks to the unique -hp- automatic tracking mechanism, no voltage adjustments are needed during operation.

R-f output ranges from 0.1 volt to 0.1 microvolt. Output may be continuous, pulsed, or frequency modulated at power supply frequency. The instrument may be modulated either externally or internally and may be synchronized with positive or negative pulses or sine waves.

Because of its wide range, high stability and versatile usefulness, this new -hp- signal generator is adaptable to almost any uhf measuring need. The instrument is available for early delivery. Contact your -hp- field representative or write direct to factory for complete details and technical specifications.

HEWLETT-PACKARD CO.
1874-D Page Mill Road, Palo Alto, California
Expert Agents: Frazor & Hansen, Ltd.
301 Clay Street • San Francisco, Calif., U.S.A.

SPECIFICATIONS

FREQUENCY RANGE:
800 to 2100 mc. Selection is made by means of a single directly-calibrated control covering entire range. No charts are necessary.

FREQUENCY CALIBRATION ACCURACY:
± 1%

OUTPUT RANGE:
1 milliwatt or .223 volts to 0.1 microvolt (0 dbm to -127 dbm). Directly calibrated in microvolts and db; continuously monitored.

ATTENUATOR ACCURACY:
Within plus 1 db without correction charts. A correction chart is provided when greater accuracy is desired.

50 ohms. SWR 3 db (VSWR 1.4).

EXTERNAL MODULATION:
By external pulses, positive or negative, peak amplitude 40 to 70v., 0.5 microseconds to square wave.

FM MODULATION:
Oscillator frequency sweeps at power line frequency. Phasing and sweep range controls provided. Maximum deviation approximately ±5 mc.

INTERNAL MODULATION:
Pulse repetition rate variable from 40 to 4000 per second; pulse length variable from 1 to 10 microseconds. Pulse rise and decay approximately 0.1 microseconds.

TRIGGER PULSES OUT:
1. Simultaneous with r-f pulse.
2. In advance of r-f pulse, variable 3 to 300 microseconds.
   (Both approximately 1 microsecond rise time, height 10 to 40 volts.)

EXTERNAL SYNC PULSE REQUIRED:
Amplitude from 10 to 50 volts of either positive or negative polarity and 1 to 20 microseconds width. May also be synchronized with sine waves.

Data subject to change without notice.
...as production steps up in NEW WILLIMANTIC PLANT

American's pipelines are being pumped full of ample supplies of all types of Phillips and slotted fasteners. Industrial supply distributors and hardware jobbers from coast to coast are set to serve you now.

For American's new high-production plant in Willimantic is now geared up to meet all demands promptly and efficiently. And this production is further augmented by the American plant at Norristown, Pa., while distribution is kept on a "delivery now" basis by large warehouse stocks in Norristown and Chicago.

So today, if you want action on orders for Phillips and slotted fasteners...just mark those orders "AMERICAN"!

AMERICAN SCREW COMPANY
Plants at:
WILLIMANTIC, CONN. and NORRISTOWN, PA.
Warehouses at:
589 E. ILLINOIS ST. 502 STEPHENSON BLDG.
CHICAGO 11 DETROIT 2

Chicago Warehouse in North Pier Terminal, 589 E. Illinois St., Chicago, Ill.
Consecrated to Quality Output and Golden Rule Service

DRY ELECTROLYTIC CAPACITORS
MOLDED PAPER TUBULAR CAPACITORS
"METALITE" METALLIZED PAPER CAPACITORS
RADIO INTERFERENCE FILTERS
HERMETICALLY SEALED OIL PAPER CAPACITORS

Illustrated... just a few of the precision-engineered ASTRON components for Television, Electronic and Industrial applications. May we suggest that you send for complete illustrated catalog.

C O R P O R A T I O N
255 Grant Avenue  East Newark, New Jersey

H I G H Q U A L I T Y  F I X E D  C A P A C I T O R S  A N D  F I L T E R S
Your answer, too, for extreme precision in remote indication and control systems

Instant responsiveness, complete smoothness of operation and a high torque/rotor inertia ratio make Kollsman Induction Motors ideally suited for use as servo or follow-up motors in control mechanisms. These miniature two-phase units have fast starting, stopping and reversing characteristics and deliver maximum torque at stall. Designed with distributed wound stators and squirrel-cage type rotors, they perform smoothly from zero to maximum r.p.m., with no "cogging" action in the low speed ranges. They may be energized by two-phase AC or by single-phase, using a phase-splitting condenser in series with one winding.

The Induction Motors constitute one series in a complete line of special purpose AC motors designed and manufactured by Kollsman, leader in the field of precision aircraft instrumentation and control. Among those available, you may find the exact answer to your control problem. If not, the skill and experience of Kollsman engineers may be relied upon to produce a unit that fulfills your particular specifications. For further information regarding these motors, address: Kollsman Instrument Division, Square D Company, 80-08 45th Avenue, Elmhurst, New York.
TUNG-SOL

for the ultimate in reliability where the 6L6 is called for...

BEAM POWER AMPLIFIER

see other side for additional information

www.americanradiohistory.com
Absolute reliability!

There, in two words, is the net result of all the engineering which TUNG-SOL has put into the 5881. This completely new tube is designed to operate in circuits for which the 6L6 is specified and is completely interchangeable wherever the 6L6 is now in use. Full utilization of the design and production techniques which have proved themselves over the past 15 years, has created this exceptionally reliable tube. The 5881 has tremendous overload capacity. It maintains high efficiency throughout its life and provides low cost operation through reduced maintenance.

The 5881 is manufactured under laboratory conditions accompanied by the most severe tests. It is rugged both mechanically and electrically. Here are six major features which assure its premium performance:

1. Glass button stem permits compact construction with high resistance to mechanical shock.
2. Rugged micanol low-loss base provides full lifetime electrical insulation and minimizes base leakage.
3. Cathode materials of exceptional stability give more uniform emission with greater life expectancy. Cathode is not poisoned by inactivity during standby periods.
4. Maximum control of grid emission achieved by gold plating and carbonizing.
5. Zirconium anode coating is most active under overload conditions providing ample gettering action to prevent accumulation of gases.
6. Life tests are made under severe overload conditions to assure adequate safety factor.

Where reliable service is essential in audio circuits, the TUNG-SOL 5881 is a "must." Order it from your regular TUNG-SOL supplier.

**MECHANICAL DATA**

<table>
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<tr>
<th>Envelope</th>
<th>Glass RMA T-11</th>
</tr>
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<tbody>
<tr>
<td>Base</td>
<td>Short shell micanal</td>
</tr>
<tr>
<td>Overall length</td>
<td>3-15/32&quot;</td>
</tr>
<tr>
<td>Seated height</td>
<td>2-29/32&quot;</td>
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<tr>
<td>Maximum diameter</td>
<td>1-7/16&quot;</td>
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**ELECTRICAL DATA**

<table>
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<td>Plate dissipation</td>
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<tr>
<td>Screen dissipation</td>
</tr>
<tr>
<td>Plate voltage</td>
</tr>
<tr>
<td>Screen voltage</td>
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<tr>
<td>Heater-cathode potential</td>
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<tr>
<td>Heater voltage</td>
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**ELECTRICAL DATA**

<table>
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<tr>
<td>Plate voltage</td>
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<tr>
<td>Screen voltage</td>
</tr>
<tr>
<td>Grid voltage</td>
</tr>
<tr>
<td>Peak A-F signal voltage</td>
</tr>
<tr>
<td>Transitconductance</td>
</tr>
<tr>
<td>Plate resistance</td>
</tr>
<tr>
<td>Zero signal plate current</td>
</tr>
<tr>
<td>Zero signal screen current</td>
</tr>
<tr>
<td>Maximum signal plate current</td>
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<tr>
<td>Maximum signal screen current</td>
</tr>
<tr>
<td>Load resistance</td>
</tr>
<tr>
<td>Power output</td>
</tr>
<tr>
<td>Total harmonic distortion</td>
</tr>
</tbody>
</table>

The TUNG-SOL engineering which has produced the 5881 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types are available on request to TUNG-SOL Commercial Engineering Department.

TUNG-SOL ELECTRON TUBES

TUNG-SOL LAMP WORKS INC., NEWARK 4, NEW JERSEY

SALES OFFICES: ATLANTA  CHICAGO  DALLAS  DENVER  DETROIT  LOS ANGELES  NEWARK

Also Mfrs. of: RECEIVING TUBES, MINIATURE INCANDESCENT LAMPS, ALL-Glass Sealed Beam Headlight LAMPS and Current Interritors

SEPTEMBER, 1950
Atmosphere unlimited...

TESTING makes the difference!

Northern-Zaleski Test Chambers Ensure Precise Control of Temperature • Pressure • Humidity for All Test Purposes

- To continue the accelerated development of all-weather devices and accurately calibrated instruments.
- Standard and special test machines for any temperature range with or without fully automatic humidity control and with or without automatic altitude control.
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- Complete rebuilding, repair and maintenance service of obsolescent test chambers.
- Rapid delivery to speed reconversion to stand-by status.

Write for further information or, better still, request that one of our field engineers call to discuss your problem.

Northern-Zaleski, Limited

PRATT OVAL, GLEN COVE, LONG ISLAND, N. Y.
How to get to the bottom of VIBRATION troubles...fast!

DETECT and measure vibration with this MB PICKUP

You'll find many tough vibration problems greatly simplified by the information an MB Pickup supplies. This sensitive instrument tells you how much vibration is being generated in your product. It enables you to check the efficiency of vibration isolation suspensions. It offers you a means for analyzing troubles from disturbing frequencies. As a quality control tool, it can also be used to check whether vibration is within acceptable limits.

This precision-built MB Pickup has virtually no lower limit to the amplitudes it can detect. Yet, it will withstand rough treatment and can be used for study of high energy vibrations as well. Attached to equipment under test, it transforms vibratory motions to electrical waves which you then feed to oscilloscope for visual inspection; or to vibration meter or analyzer for quantitative data.

Write for full details and specifications.

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SEND FOR BULLETINS
No. 210-K5 gives you full details on the line of MB Exciters; No. 124-K5 on MB Vibration Pickups.

THE MB MANUFACTURING COMPANY, Inc.
1060 State St., New Haven 11, Conn.

PRODUCTS FOR MEASUREMENT...REPRODUCTION...AND CONTROL OF VIBRATION

September, 1950 — ELECTRONICS
MEMO TO WELDER MANUFACTURERS

FOR PLUS VALUES
Specify G-E Ignitrons

- More tube-design know-how! General Electric pioneered electronic controls for welding.
- More precise G-E manufacture, using highest-grade materials.
- More step-by-step tube inspections—more top-rating final tests before the product reaches your hands.

GL-5551/FG-271
One of the most widely used G-E ignitrons—an established favorite in the welding industry. With max kva demand 600, the average anode current is 30.2 amp. Max average anode current of 56 amp checks with a kva demand of 200. . . . Other popular G-E ignitrons for resistance welding are the GL-5550/IGL-415, GL-5552/FG-235-A, and GL-5553/FG-258-A. Ratings sent promptly on request.

GL-5822
Newest of the G-E igniton line, and expressly designed for the rapidly growing 3-phase welding field. Peak voltage forward and inverse is 1,200 v, with peak and avg anode currents of 1,500 and 20 amp, or 420 and 70 amp . . . or 1,500 v, with currents of 1,200 and 16 amp, or 336 and 56 amp. Straight-line interpolation on log-log paper is allowed between similar current points. . . . Other G-E ignitrons for 3-phase welding are the GL-5554/FG-259-B and GL-5555/FG-238-B. Ratings gladly furnished.

EXPERIENCE is the best guide to dependable tube design. Because electronic welding control is a G-E "first," General Electric experience excels. Twenty years ago—to name but one example of leadership—the first electronic welder used in the automotive industry was built by General Electric. Thousands of similar welders speed car and truck production today.

Backed by this big fund of practical welding knowledge, G-E control ignitrons should lead in quality. And they do!

A check of component materials, shows instance after instance of choice based solely on quality. Precision manufacture shapes these selected materials into sturdy, long-serving G-E ignitrons which—having passed a series of rigid inspections—then are subject to extensive tests under actual welder conditions at max ratings.

G-E ignitrons are right when you install them, and they stay right! Let expert G-E tube engineers work with you on their application. Wire or write Electronics Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC
ELECTRONICS — September, 1950
FIVE FOLD PROTECTION
For This High Vacuum Unit
Is Secured by use of

HEINEMANN MAGNETIC CIRCUIT BREAKERS

Model R 2 High Vacuum Unit
Manufactured by
Optical Film Engineering Co.,
of Philadelphia

Circuit protection in a wide amperage range is provided by the set of Circuit Breakers shown here. No. 1 at far left guards the circuit to meter and heating unit. No. 2 protects filaments. No. 3 protects gauge circuits. No. 4 covers oil diffusion pump and meter, and No. 5 protects circuit to 1½ H.P. motor on mechanical vacuum pump.

In case of sudden overload on any circuit, the corresponding breaker trips INSTANTLY. Being entirely magnetic (no thermal unit), no time is lost waiting for element to heat. An inverse time delay prevents unnecessary tripping. High Speed Blowout, through magnetic action, gives instant arc interruption.

Send For Catalog With Complete Information

HEINEMANN ELECTRIC COMPANY
97 PLUM STREET
TRENTON, NEW JERSEY
Divides a second into 1,600,000 parts—

1.6 MEGACYCLE COUNTER—CHRONOGRAPH

APPLICATIONS:

PROJECTILE VELOCITY MEASUREMENTS
CAMERA SHUTTER TIMING
FREQUENCY MEASUREMENTS
PRECISION TACHOMETER
RELAY CONTACT TIMING
GEOPHYSICAL MEASUREMENTS
GAS TUBE MEASUREMENTS

FEATURES:

- High Resolution and Accuracy—1/1,600,000 second.
- Direct Indication of intervals up to one second—recycling of counter can be observed or recorded for longer intervals.
- Retains Indication of measurement until reset.
- Easy to actuate—pulses from common or separate sources can be used.
- Dependable and stable—no adjustments required.
- Accepted standard in practically all government proving grounds.

PRINCIPLE OF OPERATION:

A quartz crystal, continuously oscillating at 1.6 mc, is used as a time base. During the time interval to be measured the cycles are gated into four binary counting stages having a capacity of 16 counts. The neon indicator lights of these stages are numbered 1/16, 2/16, 4/16, and 8/16 (sixteenths of 10 microseconds or 0.625 microsecond). Following the binary stages are five decade counting units having a capacity of 100,000 counts. Each count entering the decades from the binary stages represents 10 microseconds. Therefore, the time interval between 10 microseconds and 1 second is registered in the decades and the remainder is registered in the binary stages. For instance a time interval of .5374825 second would be indicated as follows: .53748 on the decade indicators plus 4/16 (of 10 microseconds) on the binary indicators.

INSTRUMENT COMPANY

HIGH SPEED ELECTRONIC COUNTERS, COMPUTERS AND PRECISION INTERVAL TIMERS FOR ALL APPLICATIONS—ADDRESS INQUIRIES TO DEPT. 6-V

POTTER INSTRUMENT COMPANY

INCORPORATED

115 CUTTER MILL ROAD * GREAT NECK * NEW YORK

ELECTRONICS—September, 1950
A NEW SERVICE TO TV MANUFACTURERS

A NEW MARKET FOR TV SERVICEMEN

with General Electric TV Components

EM-PM FOCUS COIL—These units combine the effects of Alnico 6 permanent magnet and an electromagnet to provide uniform focus with a minimum of circuit power.

NEW DEFLECTION YOKE—Sweeps 70° with only 20 watts of power from a 260-volt supply. Ferrite core units available for high efficiency applications.

HORIZONTAL SWEEP TRANSFORMER—When used with high efficiency yokes, these ferrite core transformers provide 70° deflection at 13 kv.

You can put your confidence in—

GENERAL ELECTRIC...
RECEIVER MANUFACTURERS

You can cut replacement parts servicing problems to a minimum...keep your sets in the field with the assurance of ready serviceability...reduce material and handling costs...by designing General Electric TV components into your product.

More than twenty TV receiver manufacturers are now using G-E components. Big makers like them because they’re expertly fabricated, dependable, backed by a name you can depend on.

Smaller manufacturers turn to G.E. for components specially adapted to fit particular designs. Remember—when you use G-E parts, duplicates are stocked by G-E distributors and dealers everywhere—automatic assurance that your sets will be repaired in the field, not returned to the factory.

SERVICEMEN

Estimates peg the TV market at ten million sets in use by the end of 1950...that’s your opportunity!

Millions of G-E parts are now in receivers everywhere...and more manufacturers are turning to General Electric every day...Be sure you get your share of the skyrocketing replacement business that supports these receiver sales...that’s your market!

Now—for the first time—dealers and servicemen can stock the complete line of General Electric components shown here! They’re available through parts jobbers and distributors in your area.

Put yourself in the replacement business for keeps—and for profit. Call your jobber or distributor for full details. Meanwhile, send for the complete G-E Parts Catalog, just off the press. Mail the coupon and the catalog will be rushed to you—free!

ARE YOU READY?
MAIL THIS COUPON TODAY!

General Electric Company, Section 490, Electronics Park, Syracuse, N. Y.

I want my share of the new TV replacement market. Send me complete catalog of TV components and facts on service sales.

NAME ____________________________

ADDRESS ____________________________

CITY _______ STATE _______

ELECTRONICS — September, 1950
INSUROK

T-725

Retains Its Properties

...even AFTER SANDING

That's why it is used in this Tarzian Tuner . . .
standard in TV sets of 17 leading manufacturers

Most laminated insulation that can be punched depends largely upon high-resin content surface for the maintenance of its electrical properties under conditions of varying humidity. When sanded to close tolerances, this surface is removed — seriously impairing the electrical behavior of the material.

INSUROK T-725, however, is uniformly top-quality insulation throughout the sheet. Sand it and it is still better than most unsanded materials.

This is one of the reasons why Oak Manufacturing Company selected INSUROK T-725 for the components it makes for Sarkes Tarzian, who supplies tuning heads to 17 leading TV manufacturers. Investigate INSUROK T-725 for your product. Full information upon request.

3 POPULAR ELECTRICAL GRAD
ES OF LAMINATED

INSUROK

T-725 An outstanding paper-base laminate that can be hot-punched to intricate shapes. Its excellent electrical and physical properties, is stable under moisture and heat.

T-800 Has unmatched electrical properties, yet punches with ease. It has a sensational ability to retain these properties in high humidity.

T-812 A further development in the electrical sheet field with insulation resistance on the order of T-840 and mechanical properties comparable to T-725.

The RICHARDSON COMPANY
FOUNDED IN 1858

2797 Lake St., Melrose Park, Illinois (Chicago District)
Sorensen ELECTRONIC EQUIPMENT FOR AVIATION

EQUIPMENT: Sorensen equipment (400 cycle line voltage regulators, Inverters, Regulated DC supplies, Frequency changers and Phase Adapters) are lightweight, designed for conformity to JAN specifications.

TEST EQUIPMENT AIDS: Sorensen's voltage regulating equipment (400 cycle Line Regulators, DC supplies or "Nobatrons") can facilitate the use of test equipment by providing regulated AC or DC power.

SORENSEN: offers the Aviation field three principal types of product:

COMPONENTS: Sorensen has a wide range of products which can be used to great advantage in aviation manufacturers' equipment. Chief among these are the 400 cycle variable auto transformers, the Saturable Core reactors and other power components. Equipment units can be designed to meet JAN specifications.

FOSTERITE: In airborne units, Sorensen seals its wound components against humidity by the Fosterite process, a method which adds little to weight or size, and is, therefore, ideal in aircraft electronic design.

TYPICAL SORENSEN AIRBORNE UNITS

- **400 CYCLE REGULATOR**
  - ± 0.5% regulation; 400 cycles ± 10%; 5% distortion; 50 VA to 3 KVA capacities.

- **ELECTRONIC INVERTER**
  - Inverters and Frequency changes under development. Specifications on request.

- **DC SUPPLY**
  - 0-325 VDC; 0-500 VDC;
  - 300-1000 DC regulated ± 0.5%;
  - 125, 300, 500 ma.

- **NOBATRON**
  - 6-12-28-48-125 VDC from 5.350 amperes; regulated ± 0.25%; 60 or 400 cycles input.

- **400 CYCLE AUTO TRANSFORMER**
  - 0-130 VA; 400 Cycles 5 and 15 amperes.

- **SATURABLE CORE REACTOR**
  - For magnetic amplifier circuits. Request data book.

The following literature is available on request: Catalog A 1049 (AC regulators); Catalog B 1049 (Nobatrons and DC supplies); Catalog C 1049 (wound components and fosterite); Saturable Core Reactor Technical Data sheets; "Aircraft" issue of "Currently."

LITERATURE: Catalog A 1049; Catalog B 1049 (Nobatrons and DC supplies); Catalog C 1049 (wound components and fosterite); Saturable Core Reactor Technical Data sheets; "Aircraft" issue of "Currently."

POWER Sorensen and company, inc.

375 FAIRFIELD AVE. • STAMFORD, CONN.

MANUFACTURERS OF AC LINE REGULATORS, 60 AND 400 CYCLES; REGULATED DC POWER SOURCES; ELECTRONIC INVERTERS; VOLTAGE REFERENCE STANDARD; CUSTOM BUILT TRANSFORMERS; SATURABLE CORE REACTORS

September, 1950 — ELECTRONICS
1. **SUB-MINIATURE "GUIDED MISSILES" FILTERS**
   For security reasons details of this development in miniaturization must be omitted. It can be told, however, that all six channels are contained in a total volume of 18 cubic inches or 3 cubic inches per channel.

2. **TONE CHANNEL FILTERS**
   Available for either 170 or 340 cycles spacing between channels. These filters have received wide acceptance and are extremely popular among manufacturers of carrier telegraph equipment. In addition to the many standard types of tone filters we are supplying, special characteristics can readily be incorporated into designs to suit your application.

3. **HIGH Q TOROIDAL COILS**
   "Actually the first essential requirement in the design and manufacture of high quality audio filters, these toroids wound on molybdenum permalloy cores have provided the almost impossible solution for many network problems. As the leading independent manufacturer of toroids, our products are backed by years of experience and specialized knowledge."

4. **TELEMETERING FILTERS**
   Among the earliest to be employed in the improved telemetering system now in general use. Particular attention has been paid to linearity of phase shift and good transient suppression as well as high inter-channel attenuation in order to eliminate distortion in telemetering reception.

---

*"Filters such as these are included in a wide variety of types which we are now producing for manufacturers and users of microwave communications and relay equipment. We would be pleased to discuss your application for filters in this field and bring you up to date on the latest developments in the application and design of filters which have resulted from our close association with the carrier communications industry."

---

Exclusive Manufacturers of Communications Network Components

---

ELECTRONICS — September, 1950
Serving Two Important

Brown products are incorporated in many of the tools for research produced by these companies.

PERKIN-ELMER CORPORATION
BAIRD ASSOCIATES
PODBIELNIAK, INC.
LANE WELLS COMPANY, INC.
GENERAL ELECTRIC COMPANY
PRECISION SCIENTIFIC COMPANY
E. H. SARGENT COMPANY, INC.
RUBICON INSTRUMENT COMPANY
BAUSCH AND LOMB COMPANY
DISTILLATION PRODUCTS, INC.
GEORGE E. FREDERICKS COMPANY
MINE SAFETY APPLIANCES COMPANY
STATHAM LABORATORIES, INC.
BAKER AND COMPANY
SCOTT TESTERS, INC.
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HENRY A. GARDNER LABORATORY
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SHEPHERD GAUGE COMPANY
CAMBRIDGE INSTRUMENT COMPANY
NORTH AMERICAN PHILIPS COMPANY, INC.
NATIONAL TECHNICAL LABORATORIES, INC.
DAVIS EMERGENCY EQUIPMENT COMPANY

Expensive and far-reaching programs for scientific research and development are profiting by the precision and accuracy of thousands of modifications of the *ElectroniK* Potentiometer. And great numbers of special Brown Electronic Components are daily playing a vital role in the efficient and effective performance of a variety of servos.

These instruments and components are being utilized both as precision measuring devices and as integral elements of various analytical systems. Their versatility is recognized and valued not only in the laboratory but also by manufacturers of spectrometers, polarographs, densitometers, gas analyzers and other highly sensitive equipment for research . . . products of companies such as those listed at left.

Research is vital to man's progress . . . in many instances, Brown special instruments and components have become vital to research. Their unmatched precision and accuracy serve as important links in the search for knowledge.

Your development program may benefit from such specialized instrumentation. Your inquiry is invited.

MINNEAPOLIS-HONEYWELL REGULATOR CO., Industrial Division, 4428 Wayne Ave., Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

Visit Headquarters For Instrumentation For Research

Booths 55 and 56
National Electronics Conference Exhibition, Chicago
September 25, 26, 27

September, 1950 — ELECTRONICS
SPECIAL ELECTRICAL MEASURING INSTRUMENTS...

such as the Brown-Rubicon Precision Indicator. This instrument is ideal for use where it is desired to measure minute voltages with extremely high accuracy ... for the checking, calibrating and standardizing of meters, potentiometers and thermocouples ... or for obtaining large numbers of frequent, repetitive readings. It does not have to remain stationary and is not affected by vibration.

Needs Of Research

SPECIAL ELECTRONIC COMPONENTS...

such as the Brown 400-Cycle Converter. Housed in a dust and moisture-proof case, this unit is a precision, vibrator-type converter for use with any system requiring the conversion of low power direct voltage signals of the order of 100 microvolts to 400 cycle alternating voltages. It is unaffected by atmospheric pressure, is finding a host of applications in various electronic and electrical apparatus. 60-cycle unit also available.

WRITE FOR NEW BROCHURE ...
"Instruments Accelerate Research"

MINNEAPOLIS HONEYWELL
BROWN INSTRUMENTS

www.americanradiohistory.com
With the VARICELL, any D-C voltage in the range of 0 to 30 volts is at your fingertips. Rotation of the handwheel provides the D-C voltage you require — and the output is stabilized and regulated. The VARICELL compensates for line voltage fluctuations and load current changes. Stabilization and regulation is ± 0.25 volts for any output voltage setting in the range of 6 to 30 volts. R. M. S. ripple voltage never exceeds 0.1 volts for the 6-30 volt range.

The VARICELL is easy to operate. It plugs into any output receptacle of the proper voltage, frequency and phasing. The load is connected to either of two sets of SUPERIOR 5-WAY Binding Posts. A voltmeter and ammeter indicate output voltage and load current.

WRITE THE SUPERIOR ELECTRIC COMPANY, 409 MEADOW STREET, BRISTOL, CONNECTICUT

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

ONE SOURCE FOR ALL VOLTAGE CONTROL REQUIREMENTS

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

September, 1950 — ELECTRONICS
High capacity in extremely compact size is the distinguishing feature of Erie Disc and Plate Ceramicons. Illustrations are exact size, and their shape as well as their compactness make them amazingly easy to install in small spaces. They simplify soldering and wiring operations and speed up the assembly line.

Erie Disc and Plate Ceramicons consist of a flat ceramic dielectric with silver plates fired onto the dielectric. Lead wires of 24 gauge tinned copper wire are firmly soldered to the silver electrodes and the unit is given a protective coating of phenolic.

Such simplicity of construction results in low series inductance and unusual efficiency in high frequency by-passing.

For complete information and samples to meet your particular needs, write us today.

**STANDARD AVAILABLE CAPACITIES**

<table>
<thead>
<tr>
<th>STYLE</th>
<th>SIZE</th>
<th>CAPACITY</th>
<th>STAMPING</th>
</tr>
</thead>
<tbody>
<tr>
<td>831</td>
<td>1/8&quot;</td>
<td>.001 MFD</td>
<td>R .001</td>
</tr>
<tr>
<td>801</td>
<td>5/32&quot; Max. Dia.</td>
<td>.0005 MFD</td>
<td>R .005</td>
</tr>
<tr>
<td>811</td>
<td>3/32&quot; Max. Dia.</td>
<td>.002 MFD</td>
<td>R .002</td>
</tr>
<tr>
<td>821</td>
<td>1/4&quot; Max. Dia.</td>
<td>.01 MFD</td>
<td>R .01</td>
</tr>
<tr>
<td>812</td>
<td>5/32&quot; Max. Dia.</td>
<td>Dual .001 MFD</td>
<td>R 2 x .001</td>
</tr>
<tr>
<td>822</td>
<td>3/32&quot; Max. Dia.</td>
<td>Dual .002 MFD</td>
<td>R 2 x .002</td>
</tr>
<tr>
<td>883</td>
<td>3/16&quot; x 3/4&quot; Max.</td>
<td>Triple .0015 MFD</td>
<td>R 3 x .0015</td>
</tr>
</tbody>
</table>

**SPECIFICATIONS**

**Voltage:** Units are rated at 500 VDC. Dielectric strength test: 1,500 VDC.

**Power Factor:** 2.5% max. at 1 K.C. at not more than 5 volts RMS.

**Insulation Resistance:** 7,500 meg. Ω min.

**Capacity:** Capacity measurements are made at room temperature (25°C) at 1 K.C. and at not more than 5 Volts RMS. Standard tolerance is +100%,-0%.

**Temperature Characteristics:** Capacitance shall not decrease more than 50%, nor increase more than 25% from its value at room temperature (25°C), as the temperature is varied from +10°C to +75°C.
A member of the well known SB-1 switch family can find a useful place on almost any large electronic control panel. The precision-built parts of this all-purpose switch permit as many as 40 stages—four banks of ten stages each—to be operated in tandem. Switches with up to 16 stages and 12 positions are commonly furnished. Over 10,000 circuit-sequence combinations are possible. Ratings go to 20 amperes at 600 volts a-c or d-c. See Bulletin GEC-270.

SAVE PANEL SPACE
WITH ONE-UNIT PUSH-BUTTON
AND INDICATING LIGHT

This space-saving pilot-circuit switch consists of a sturdy push-button unit, 2½ inches high, with a hollow translucent cap and 6-volt lamp. The switch is the momentary contact type, single-pole, with one normally open and one normally closed circuit. It uses movable-disk type contacts. Buttons are supplied in clear, red, green, blue, amber, and white. For more data on this and other G-E push-button units, see Bulletin GEA-4254.

SOLVE DESIGN PROBLEMS
WITH THE SWITCH
OF 10,000 USES

A member of the well known SB-1 switch family can find a useful place on almost any large electronic control panel. The precision-built parts of this all-purpose switch permit as many as 40 stages—four banks of ten stages each—to be operated in tandem. Switches with up to 16 stages and 12 positions are commonly furnished. Over 10,000 circuit-sequence combinations are possible. Ratings go to 20 amperes at 600 volts a-c or d-c. See Bulletin GEC-270.

ELECTRONICS
Panel Instruments—A Complete Line
Accurate and Reliable

FOR MEASURING D-C, A-C, RF, AF, VU

General Electric panel instruments have long been known for their reliability and accuracy. Recent design changes provide for better performance, readability, durability, and appearance. G-E voltmeters, kilovoltmeters, ammeters, milliammeters, microammeters, and vu volume-level indicators; thermocouple types and rectifier types; round or square, with conventional or long 250-degree scales—all will give your measurements the accuracy required and your panel that smooth, modern appearance. To bring you up to date on the latest improvements in cases, faces, and mechanisms, G.E. offers a comprehensive 24-page bulletin containing all information necessary for ordering. Write for Bulletin GEC-368. For vu indicators, see Bulletin GEC-369.
PERMAFIL CAPACITORS

NO DERATING AT 125°C OPERATION

For operation at high ambient temperatures, these standard-line G-E Permafil capacitors are naturals. They're paper dielectric units and can be used at temperatures up to 125°C without derating. All are metal encased, compression-sealed, and have long-life silicone bushings. Ratings: up to 2 muf for operation at 400 volts d-c and below. Case styles: 53, 61, 63, and 65 (JAN-C-25 specifications). For more data, write Capacitor Sales Div., General Electric Co., Pittsfield, Mass.

INDUCTROLS

STEPLESS VOLTAGE VARIATION

Inductrols are G-E dry-type induction voltage regulators for 120 and 240-volt operation. Hand-operated models provide smooth and extremely precise voltage adjustment for such uses as instrument calibration and rectifier control. Motor-operated models are used with automatic control to maintain voltage within narrow limits, irrespective of supply variations. Sizes range from 10 1/4 x 6 1/8 x 7 7/8 inches for the smallest hand-operated unit to 14 x 6 x 10 7/8 for the largest motor-operated unit. One unit provides a voltage range of 10% raise and lower on 3 and 6-kva circuits, another gives 100% raise and lower for 2.4 and 3.6 kva circuits. Complete information in Bulletin GEA-4508.

HIGHPRESSURE SELENIUM RECTIFIERS

WITH LIFE EXPECTANCY OF 60,000 HOURS!

Now available from G.E. are 26-volt RMS selenium rectifier cells with a continuous-service life expectancy of over 60,000 hours. Their initial forward resistance is very low and samples show an average increase in resistance of less than 6% after 10,000 hours of operation. General Electric knows of no other high-voltage selenium cell on the market that can even approach their performance.

The high output voltage permits the design of smaller stacks while the low resistance means cooler operation and the space saving that goes with it.

Stacks made with the new G-E cells may be obtained with rated outputs from 18 to 126 volts d-c at .15 to 3.75 amps. Write now for Bulletin GEA-5280.
Sensitivity Plus Dependability!
The new Allied SW relay offers an economical combination of both these important qualities. Here are the facts on this newest relay in the famous Allied line.

**SENSITIVITY:**
- S.P.D.T. .012 watts d.c.
- D.P.D.T. .05 watts d.c.

**COIL:**
- Acetate insulated, bobbin or layer wound, 12,500 ohms max.

**CONTACTS:**
- Silver, one ampere non-inductive load at 24 volts d.c. or 115 volts a.c. Armature contact at frame potential.

**MOUNTING:**
- One hole with locating lug. Also available with dust cover or hermetically sealed, plug-in or solder terminals.

**DIMENSIONS:**
- Open Relay—1-19/32", 1-1/16", 1.7/16" long, including plug, 1-13/32" wide, 1-19/32" high.
- Sealed Relay—3-3/16", long, including plug.

**WEIGHT:**
- 2.5 oz.

**WEIGHT HERMETICALLY SEALED:**
- 4.5 oz.

**SPECIAL APPLICATIONS:**
- Sensitivity down to .003 watts S.P.D.T., or .012 watts D.P.D.T. Palladium or other precious metal contacts for audio or low voltage circuits, tungsten or alloy contacts for higher current or voltage circuits. Maximum input 4.0 watts at 20°C for 85° rise.

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

Bulletin SW gives complete details. Send for your copy today.

Be sure to send for your copy of Allied's new Relay Guide. It shows 24 small, compact relays with a detailed table of characteristics and specifications.
SENSATIONAL...

* Records on discs

* Records on tape

* Plays back both tape and discs

* Plays any 78 R.P.M. Record

GENERAL INDUSTRIES MODEL 250

TAPE-DISC RECORDER

Sensational, indeed... at a cost which enables it to be incorporated in moderately-priced radio and TV combinations... the first complete home recording and play-back assembly for both tape and disc use.

The Model 250 Tape-Disc Recording Assembly is General Industries' newest development in the sound reproduction field. Already thoroughly tried and tested in actual use, it contains many new design innovations, including fool-proof operating features that anyone can understand.

A new catalog sheet, describing all of the recording and play-back features of the GI Model 250, will be sent upon request. Write, wire or phone for your copy today.

The GENERAL INDUSTRIES Co.

DEPARTMENT B • ELYRIA, OHIO

ELECTRONICS — September, 1950
YOU CAN BE SURE... IF IT'S Westinghouse

All of these sizes, shapes and types of mounting are made available to you in Westinghouse Panel Instruments—the most complete matched line in the industry. For all your panel instrument requirements refer to Westinghouse Catalog Section 43-300—or ask your nearest Westinghouse Representative.
Slash Instrument Inventory!

★ The most complete line
★ Meets A.S.A. standards
★ Shipments in 10 days

Cut overhead on instruments. Maintain production without costly stocks.

Westinghouse now offers the most complete matched line of panel and switchboard instruments in the industry . . . every one built to the rigid standards of "The American Standards Association". Shipment can be made to meet practically every electrical requirement within ten days of receipt of order at the factory.

Westinghouse Instrument Specialists are ready to help you plan. These men have nationwide experience in solving instrument application problems of all kinds. For application help on instrument problems, phone, write or wire your nearest Westinghouse Representative, or Westinghouse Electric Corporation, 95 Orange Street, Newark, N. J.

Specify Westinghouse - get more for your instrument dollar!

Westinghouse INSTRUMENTS
**Frequency Standards**

**Guaranteed Accuracy**
1 part in 100,000
(.001%)

**Uses**
Time bases, rate indicators, clock systems, chronographs, geo-physical prospecting, control devices and for running small synchronous motors.

**Features**
1. Bimetallic, temperature-compensated fork, no heating or heat-up time is required.
2. Fork is hermetically sealed, no barometric effects on frequency.
3. Precision type, non-ageing, low coefficient resistors used where advantageous.
4. Non-linear negative feedback for constant amplitude control.
5. No multi-vibrators used.
6. Synchronous clock simplifies checking with time signal.

**Specifications**
Accuracy—1 part in 100,000 (.001%).
Temperature coefficient—1 part in 1,000,000 per degree centigrade (or better).

**Outputs**
1. 60 cycles, sine wave, 0-110 volts at 0 to 10 watts (adjustable).
2. 120 cycle pulses, 30 volts negative.
3. 240 cycle pulses, 30 volts positive and negative. Pulse duration, 100 micro-seconds.

**Product of**
AMERICAN TIME PRODUCTS INC., New York 19, N.Y.
Operating under patents of the Western Electric Company

---

American Time Products, Inc.,
580 Fifth Ave., New York 19, N. Y.

Gentlemen:
Please send descriptive folder, No. 212

Name
Company
Address
City State

September, 1950 — ELECTRONICS
A Problem?
The Answer May Be

AlSiMag

APPLIANCE PARTS AND INSULATORS
RADIO AND TELEVISION PARTS
ELECTRONIC COMPONENTS
MACHINE PARTS

THREAD GLIDES
EXTRUSION AND DRAWING DIES
OIL BURNER IGNITION INSULATORS
GAS BURNER TIPS
FIRING PINS AND PADS
HEAT SHOCK AND CHEMICAL RESISTANCE
ELECTROPLATING HOLDERS

Your use may be similar to, or completely different from, those listed here... yet AlSiMag may solve your problem.

This versatile material is solving production, design and technical problems for many industries. For your business, AlSiMag may offer lower costs, improved manufacturing processes, increased production, or possibilities of a new product.

CAN YOU USE ALSIMAG? AlSiMag is the trade marked name of a large family of technical ceramic compositions. They are now being used in production machines, electronic equipment, chemical processing equipment, gas and electric appliances and in many other consumer products. AlSiMag ceramics are custom made as to physical characteristics, size and shape. Special combinations of raw materials, fluxes, pressures, processes and firing temperatures produce ceramics with characteristics to meet individual requirements. These compositions are fabricated by us into finished parts, ready for your production line.

Given your requirements, our Research Division can frequently develop a special composition to suit your need. Carefully cross-indexed research records usually permit a prompt and accurate reply to inquiries, even if they involve most unusual requirements. If you have a problem that can be solved by a special component of unusual physical characteristics, outline that problem to us. We can indicate the possibilities of its solution by the use of AlSiMag Technical Ceramics. Your inquiry involves no cost or obligation.

AMERICAN LAVA CORPORATION
CHATTANOOGA, TENNESSEE

49th YEAR OF CERAMIC LEADERSHIP

OFFICES: METROPOLITAN AREA: 671 Broad Street, Newark, N. J., Mitchell 2-8159 • CHICAGO, 9 South Clinton Street, Central 6-1721 PHILADELPHIA, 1649 North Broad Street, Stevenson 4-2823 LOS ANGELES, 232 South Hill Street, Mutual 9076 NEW ENGLAND, 38-B Brattle Street, Cambridge, Massachusetts, Kirkland 7-4498 • ST. LOUIS, 1122 Washington Avenue, Garfield 4959
85° BELOW ZERO
would freeze an eskimo
... WON'T FREEZE VARGLAS SILICONE
500° ABOVE
would roast the devil
... WON'T ROAST VARGLAS SILICONE

Efficient at 500° F. or more in some applications—yet completely flexible at -85° F. Resistant to moisture and lubricating oil—flame resistant and self-extinguishing—this pioneer silicone tubing and sleeving developed by Varflex is available in various NEMA colors where required.

Varglas Silicone is a combination of Varglas—continuous filament Fiberglas; moisture and fungus proof; will not burn; strong and flexible at high and low temperatures; chemically inert . . . and Silicone High Temperature Resin—which has a natural affinity for Fiberglas; renders it abrasion-resistant, flexible and non-fraying. Normalizing process removes binder and organic inclusions from the Fiberglas; improves electrical qualities and allows uniform impregnation.

Investigate the NEW, low cost VARGLO Sleeving and Tubing if you do not have to allow for an unusually high operating temperature. Samples and prices on request. It's flexible. It takes rough handling without loss of dielectric. It won't fray out. Made with a Fiberglass braid, it won't support combustion—YET COSTS NO MORE THAN COTTON.
Precise Accuracy + Maximum Versatility + Space-saving Compactness

The potentiometers illustrated above are typical examples of the tough problems HELIPOT engineers are solving every day for modern electronic applications. If you have a problem calling for utmost precision in the design, construction and operation of potentiometer units—coupled with minimum space requirements and maximum adaptability to installation and operating limitations—bring your problems to HELIPOT. Here you will find advanced "know-how," coupled with manufacturing facilities unequaled in the industry!

The HELIPOTS above—are now in production for various military and industrial applications—include the following unique features:

1. This 10-turn HELIPOT combines highest electrical accuracies with extremes in mechanical precision. It features zero electrical and mechanical backlash—a precision-supported shaft running on ball bearings at each end of the housing for low torque and long life...materials selected for greatest possible stability under aging and temperature extremes...special mounting and coupling for "plug-in" convenience...mechanical and electrical rotation held to a tolerance of 1/2°...resistance and linearity accuracies, ±1% and ±0.025%, or better, respectively.

2. This four-gang assembly of Model F single-turn potentiometers has a special machined aluminum front end for servo-type panel mounting, with shafts supported by precision ball bearings and having a splined and threaded front extension. Each of the four resistance elements contains 10 equi-spaced tap connections with terminals, and all parts are machined for greatest possible stability and accuracy.

3. This standard Model B, 15-turn HELIPOT has a total of 40 special tap connections which are located in accordance with a schedule of positions required by the user to permit external resistance padling which changes the normally-linear resistance vs. rotation curve to one having predetermined non-linear characteristics. All taps are permanently spot-welded and short out only one or two turns on the resistance element—a unique HELIPOT feature!

4. This six-gang assembly of standard Model F single-turn potentiometers has the customary threaded bushing mountings, and has shaft extensions at each end. The two center potentiometers each have 19 equi-spaced, spot-welded tap connections brought out to terminals. Each tap shorts only two turns of 309" diameter wire on the resistance element.

5. This Model B, 15-turn HELIPOT has been modified to incorporate, at the extreme ends of mechanical and electrical rotation, switches which control circuits entirely separate from the HELIPOT coil or its slider contact.

6. This 10-turn HELIPOT has many design features similar to those described for unit No. 1, plus the following additional features—a servo-type front end mounting...splined and threaded shaft extension...and a center tap on the coil. All components are machined to the highest accuracy, with concentricities and alignments held in some places to a few ten-thousandths of an inch to conform to the precision of the mechanical systems in which this HELIPOT is used. Linearity accuracies frequently run as high as ±0.010%.

7. This single-turn Model G Potentiometer has been modified to incorporate a ball bearing shaft and a servo-type front end mounting. Special attention is given to contact designs and pressures to insure that starting torque does not exceed 0.2 inch-ounces under all conditions of temperature.

The above precision potentiometers are only typical of the hundreds of specialized designs which have been developed and produced by HELIPOT to meet rigid customer specifications. For the utmost in accuracy, dependability and adaptability, bring your potentiometer problems to HELIPOT!
Fast and Reliable TV Receiver Testing—makes this scope particularly useful in head-end position work. Unsurpassed for stability and fine trace... excellent definition... no bounce when shifting bands. Where the sweep generator does not have a baseline, measurements can be taken on the DC amplifier. Delivers maximum sensitivity without sacrifice of frequency response. Low capacity input probe is provided for trouble shooting.

In Broadcast Stations, It Pin-points Trouble—helps you stay on the air with maximum performance. Use it to check hum, noise, distortion, modulation, phase relationships; measure gain and sweep generator output; isolate defective components; determine frequency response of audio circuits.

In Laboratories, It's Versatile—fits many applications where waveform study is essential. Built-in voltage calibrator permits calibration of the scope for voltage measurements. Gives you wide frequency response without recourse to peaked amplifier coupling circuits. Straight resistance coupling is used, and the scope can be employed on frequencies up to 3 mc. Excellent transient response within the frequency range of the instrument.

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Frequency Response</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Amplifier Probe and AC: (+0,-20%) from 20 cycles to 500 kc (Square Wave response 60 to 40,000 cycles). (+0,-50%) from 20 cycles to 1 megacycle with gradual reduction in response beyond 1 mc. DC: (+0,-20%) from 0 to 500 kc at full gain setting.</td>
<td>Vertical: 1. AC Input—0.015 volts RMS per inch 2. DC Input—2.0 volts DC per inch 3. Probe—20 volts RMS per inch Horizontal—0.4 RMS volts per inch</td>
</tr>
<tr>
<td>Sweep Range: 10 cycles to 100 kc in six overlapping ranges.</td>
<td>Calibrating Voltages: Seven AC voltages of power line frequency—3, 1.5, 3, 15, 30, 150 and 300 volts with (\pm 15%) accuracy.</td>
</tr>
</tbody>
</table>

TV SCOPE ST-2A
STATIONS ★ FOR DEVELOPMENT LABORATORIES

UHF coverage

TEST EQUIPMENT

VARIABLE PERMEABILITY SWEEP GENERATOR—ST-4A
Completely Electronic. No Moving Parts. Using an exceptionally wide linear sweep, this instrument is ideal for television receiver maintenance, TV production and development laboratories, wide band amplifier study, and transmission line impedance measurements. The front panel is slotted, permitting the equipment to be removed and mounted in a standard 19-inch relay rack. A new Balanced Output Adaptor (Type ST-8A), also available, provides balanced 300 ohm output from the sweep generator.

SPECIFICATIONS
Frequency Range: Continuously variable from 4 to 110 mc and 170 to 220 mc. Can be used through 900 mc on harmonic operation.
Sweep Width: Linear from 500 kc to greater than 15 mc.
Output Voltage: Greater than 0.1 volts from 4 to 110 mc.
Greater than 0.5 volts from 170 to 220 mc.
Output: Single-ended or balanced 300 ohm output.

MARKER GENERATOR TYPE ST-5A
Functions as a crystal referenced calibrator from 10 mc to 300 mc. When used with the G-E sweep generator, it provides a multiple of markers spaced 1.5 or 4.5 mc apart or can be used to supply a marker or markers at any frequency from 10 mc to 900 mc.

SPECIFICATIONS
Picture Carrier Oscillator: 15 position rotary selector switch selects 12 crystal-controlled frequencies plus 3 tuneable ranges covering intermediate frequencies.
Channel Crystal Accuracy: .02%
IF Ranges: 3 Bands—20 to 27 mc; 27 to 37 mc; 37 to 50 mc
Accuracy: dial hand calibrated, crystal calibrator ± .05%.
Crystal Modulator: Provides audio and intermediate frequency locations simultaneously with picture carrier.
Crystal Accuracy: 4.5 mcs .05%; 1.5 mcs .15%.

ILLUSTRATED BULLETINS
Complete information will be furnished on any of the General Electric test instruments listed here. Check those you are interested in... then fill in and mail the coupon today.

- TV Scope ST-2A
- Sweep Generator ST-4A
- Marker Generator ST-5A
- Balanced Output Adaptor ST-8A
- Regulated Power Supply YPD-2
- Industrial Tube Analyzer YTW-3
- Distortion and Noise Analyzer YDA-1
- Square Wave Generator YWA-4

General Electric Company, Section 480 Electronics Park, Syracuse, New York
Please send me further information on products checked at left.

NAME: ____________________________
COMPANY: _________________________
ADDRESS: _________________________
CITY: ____________________ STATE ______

ELECTRONICS — September, 1950 59

www.americanradiohistory.com
As Military Requirements for electronic gear step up, principal fear of the industry is that civilian production may be shut down too fast, before specifications and materials are available for military production. Hope is that a graduated transition can take place. Otherwise some plants may face shut downs of several months on certain lines, with possible loss of labor force to other industries not yet affected.

First Quarter sale of radio and television components to set manufacturers increased 60 percent over the same period in 1949, and the sale of parts to jobbers increased 17 percent, according to A. D. Plamondon, Jr., chairman of the RMA Parts Division.

Industry Shipment of television sets in the first quarter of 1950 totalled 1,556,000, broken down as follows by RMA:

<table>
<thead>
<tr>
<th>State</th>
<th>Shipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>2,091</td>
</tr>
<tr>
<td>Arizona</td>
<td>1,217</td>
</tr>
<tr>
<td>California</td>
<td>90,313</td>
</tr>
<tr>
<td>Connecticut</td>
<td>24,129</td>
</tr>
<tr>
<td>Delaware</td>
<td>5,047</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>26,357</td>
</tr>
<tr>
<td>Florida</td>
<td>5,247</td>
</tr>
<tr>
<td>Georgia</td>
<td>11,961</td>
</tr>
<tr>
<td>Illinois</td>
<td>116,561</td>
</tr>
<tr>
<td>Indiana</td>
<td>11,722</td>
</tr>
<tr>
<td>Iowa</td>
<td>3,065</td>
</tr>
<tr>
<td>Kansas</td>
<td>5,047</td>
</tr>
<tr>
<td>Kentucky</td>
<td>10,452</td>
</tr>
<tr>
<td>Louisiana</td>
<td>8,478</td>
</tr>
<tr>
<td>Maryland</td>
<td>55,919</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>89,605</td>
</tr>
<tr>
<td>Michigan</td>
<td>60,018</td>
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<tr>
<td>Minnesota</td>
<td>15,044</td>
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<tr>
<td>Missouri</td>
<td>40,552</td>
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<tr>
<td>Nebraska</td>
<td>2,662</td>
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<td>New Jersey</td>
<td>96,771</td>
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<td>New York</td>
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<td>110,720</td>
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<td>Oklahoma</td>
<td>4,209</td>
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<td>Pennsylvania</td>
<td>145,763</td>
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<td>13,728</td>
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<td>South Carolina</td>
<td>176</td>
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<td>Tennessee</td>
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<td>Utah</td>
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<tr>
<td>Virginia</td>
<td>12,688</td>
</tr>
<tr>
<td>Washington</td>
<td>3,544</td>
</tr>
<tr>
<td>West Virginia</td>
<td>1,161</td>
</tr>
</tbody>
</table>

Proposed New Publication called Television Service Guide Book is intended for free distribution to purchasers of television sets by dealers and maintenance firms. Obviously designed to reduce the number of false-alarm calls and to improve dealer-consumer relations, it contains significant chapters entitled “What to Expect From Your Service Contractor”, “Partial and Freak Service Contracts” and “C.O.D. Service Calls.”

Philadelphia contractors are reported to have placed pre-publication orders for 20,000 copies of the booklet, which will have 20 to 24 pages and will fit in a No. 10 business envelope.

Total TV Investment of the public, manufacturers and broadcasters will exceed the $24-billion now invested in the entire motion-picture industry by the end of 1951, thinks H. C. Bonfig of Zenith.

Howard Sams says his next three Photofact service folders will cover 55 television models and 16 radios, and that this ratio reflects current production schedules.

The Latest nation to announce plans for tv is Colombia, South America. Negotiations are said to be going on between the Director of Cultural Extension and unnamed British firms for a station in Bogota. The installation is planned for the end of this year.

Time required to assemble a television set at Westinghouse is 6½ hours, of which 1½ hours is devoted to inspections and tests. There are 19 of the last-mentioned operations.

What equipment does an electronic research lab need? Here’s the list of laboratory items currently available at the Western Union’s Electronics Research Division at Watermill, N. Y.:
The **A-B-C's** of SYLVANIA SILICON DIODES

**Applications**

**Band Coverage**

**Characteristics**

Here's a fund of up-to-the-minute information about Sylvania Silicon Diodes that belongs in the file of every electronics engineer. This new 16-page booklet describes crystal rectifiers covering the frequency range from 1000 to 25,000 mc per second. It explains the various types of Silicon Diodes with their

ratings and common applications.

The booklet discusses mixer crystals, including the new matched pairs, microwave video detectors and Silicon Diode use in UHF and SHF instrument applications. For your free copy of this new booklet, simply clip the coupon and mail today.

---

Sylvania Electric Products Inc.
Dept. E-1009, Emporium, Penna.

Please send me your new FREE booklet "Microwave Crystal Rectifiers." Also send me information on Sylvania Magnetrons.

**Name**

**Company**

**Street**

**City**

**Zone**

**State**

---

ELECTRONICS — September, 1950
SHOCK AND VIBRATION NEWS

The new Sperry flight control instrument which has stirred the aircraft world is mounted on air-damped BARRYMOUNTS.

Literally a super-instrument, the ZERO READER promises to revolutionize instrument flying in that it presents, on a simple two-element indicator, information which is ordinarily supplied by five separate instruments, and directly tells the pilot how to move his controls. Its two coordinating cross-lines dictate the pre-set plan of flight to the pilot who merely acts as the "muscles" at the controls.

To protect this sensitive electronic "nerve center" from aircraft shock and vibration, Sperry Gyroscope Company mounts the ZERO READER on a base equipped with air-damped BARRYMOUNTS.

BARRY bases permit virtually instant installation and removal of the instruments they hold. Unit air-damped BARRYMOUNTS are also available for direct installation to airborne instruments.

Whatever your shock or vibration problem, Barry experience and consulting engineering facilities offer a sure solution. Write for our free catalog listing stock BARRYMOUNTS; for special information, call our nearest office or write to

THE BARRY CORP.

Main Office 177 Sidney St. • Cambridge 39 Massachusetts

New York Rochester Philadelphia Washington Cleveland Dayton

Chicago Minneapolis St. Louis Los Angeles Toronto

BUSINESS BRIEFS (continued)

Capacitor, Decade, General Radio (5)
Chronograph, High-Speed
Densitometer, Projection Comparator, Dietert Company
Electro-Copier, Hunter
Furnace, Electric High-Temperature, Cenco
Furnace, Electric Multiple-Unit Type, Hevi Duty Elect. Co.
Furnace, Hydrogen, High-Temperature, Callite Tungsten Corp.
Galvanometers, Weston and General Radio (28)
Inductances, Standard, General Radio (6)
Inductometer, Brooks L & N
Machine, Basing, Kahle Engineering Company
Machine, Developing, Dietert Company
Machine, Exhaust, Kahle Engineering Company
Machine, Plane-Kahle Engineering Company
Machine, Sealing, Kahle Engineering Company (2)
Machine, Stem, Kahle Engineering Company

Megger, Biddle
Meter, Audio-Frequency, General Radio (2)
Meter, Capacitance, General Radio
Meter, DH (2)
Meter, Frequency, General Radio
Meter, Frequency, Micrometer, Lamping Labs (2)
Meter, Graphic, Single and Twin Recorder, Heterline-Angus (2)
Meter, Heterodyne Frequency, General Radio
Meter, Output, General Radio (2)
Meters, Various ammeters, voltmeters, milliammeters, microammmeters, Weston and Simpson (219)
Microscope, Bausch & Lomb (2)
Microscope, Binocular, Bausch & Lomb
Oscillator, Audio, Clough Brengel
Oscillator, Audio, Hewlett Packard (3)
Oscillator, Beat-Frequency, General Radio
Oscillator, High-Frequency, Lepel-Lab (3)
Oscillator, Interpolation, General Radio
Oscillator, Low Frequency, General Radio
Oscillator, RP & UHF, General Radio (4)
Oscillograph, Cathode-ray, Du Mont (3)
Oscillograph, Cathode-ray, RCA (5)
Oven, Annealing, Kahle Company
Oven, Constant Temperature, Cenco
Oven, Vacuum
Polariscop, R. Fues
Polisher, Metallographic, Elmer & Amend
Pumps, Diffusion, Cenco
Pump, Diffusion, Distillation Products Company (2)
Pumps, Vacuum (16)
Recorder, Portable Table Model, Presto Recording
Signal Generators, General Radio, Hewlett Packard (5)
Standard, Frequency, General Radio Company
Standard, Frequency, Gibbs Company
Still, Electric Stokes Automatic Company
Strobolux, General Radio
Stroboscope, General Radio
Stopwatch, Rockwell Hardness, Wilson Instrument Company
Transmitters, RCA
Transmitter and Receiver, Portable FM, Radio Engineering Labs (2)
Transmitter and Receiver, RCA (4)
Unit, Glass Working, Eisler Engineering Company

We wonder if makers of a-c operated soldering guns know that you can demagnetize a watch by "shoving it through the loop? No charge for the sales idea.

Here's The Picture on the total number of broadcast stations in the United States, as of June 1950:

<table>
<thead>
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<th>AM</th>
<th>FM</th>
<th>TV</th>
<th>Total</th>
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</thead>
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<td>Comm. Ed.</td>
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<tr>
<td>Alabama</td>
<td>71</td>
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<td>Arkansas</td>
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<tr>
<td>California</td>
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<tr>
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<tr>
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<tr>
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<td></td>
</tr>
<tr>
<td>Wyoming</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

September, 1950 — ELECTRONICS
Reading Our Own Ads again, we note that:

The print-a-minute Polaroid-Land camera has been adapted to the job of photographing oscilloscope traces.

At least two companies offer to make almost any size or shape dry battery in quantities large or small.

The word "manufactured," defined in our super-duper dictionary as meaning "made by hand," has been corrupted to mean "manufacturing facts."

We note, also, that our consistent editorial use of the word "capacitor" to distinguish electronic components from those used in the steam business goes unnoticed by many copywriters, who still use "condenser," and sometimes use both "capacitor" and "condenser" in the same ad.

In Your Wanderings through surplus-equipment stores if you see a piece of equipment inscribed with the letters BBG better buy glasses. According to the latest AN-system definitions such a device would be an underwater mobile item designed for installation on a carrier pigeon for the purpose of directing a gun or searchlight.

District of Columbia 1 8 0 4 19
Florida 75 21 1 3 100
Georgia 75 22 1 3 102
Idaho 75 0 0 0 75
Illinois 75 16 5 5 130
Indiana 45 20 6 2 77
Iowa 52 20 2 2 76
Kansas 29 0 1 0 46
Kentucky 43 12 3 2 66
Louisiana 42 16 3 2 61
Maine 16 0 0 0 16
Maryland 22 18 0 3 43
Massachusetts 61 25 2 2 53
Michigan 63 55 4 6 93
Minnesota 45 10 2 2 63
Mississippi 43 5 1 0 49
Missouri 21 15 2 2 50
Montana 25 0 0 0 25
Nebraska 33 3 0 2 37
Nevada 10 1 0 0 11
New Hampshire 12 4 0 0 16
New Jersey 20 10 2 1 33
New Mexico 43 0 1 1 27
New York 55 56 4 13 170
North Carolina 25 22 3 2 133
North Dakota 14 0 0 0 14
Ohio 49 15 6 12 122
Oklahoma 46 10 3 2 61
Oregon 42 18 2 3 53
Pennsylvania 111 63 4 7 163
Rhode Island 15 5 1 1 18
South Carolina 11 11 0 0 53
South Dakota 14 1 0 0 15
Tennessee 57 13 1 2 73
Texas 153 70 4 2 222
Utah 18 3 1 2 34
Vermont 9 0 0 0 9
Virginia 17 20 3 2 79
Washington 53 7 1 1 62
West Virginia 35 15 0 1 54
Wisconsin 55 15 1 0 90
Wyoming 13 0 0 0 13
Alaska 10 0 0 0 10
Hawaii 12 0 0 0 12
Puerto Rico 25 0 0 0 25
Virgin Islands 3 0 0 0 3

2,295 710 52 109 2,225

Electronics — September, 1950
MALLORY NP CAPACITORS

Mallory NP Capacitors are non-polarized and designed for heavy-duty applications where extreme dependability is essential. Priced competitively at ordinary capacitor levels, they are ideal for controls and other unusual circuits. Write for your copy of the Mallory NP Capacitor data folder.

Mallory Capacitors Deliver Extreme Dependability in Critical Applications!

Long trouble-free service has become so synonymous with Mallory Capacitors that customers have come to assign critical responsibilities to them without hesitation.

For example... a complex rpm control for diesel-electric locomotives. The failure of a single component would stall the train, blocking rail traffic for hours. For absolute safety and dependability, the manufacturer specified Mallory NP Capacitors in this control.

The Mallory-originated NP Capacitor is widely used in such important applications. This complete confidence is the result of years of demonstration of Mallory superiority. Yet Mallory Capacitors cost you no more.

That’s results beyond specifications!

And whether your problem is electronic or metallurgical, what Mallory has done for others can be done for you!

SERVING INDUSTRY WITH
Capacitors Contacts
Controls Resistors
Rectifiers Vibrators
Special Power
Switches Supplies
Resistance Welding Materials
MOBILIZATION . . . Military events are moving at such a pace that it is impossible to predict, as we write, what the electronics industry will be faced with two weeks later when this issue reaches the subscribers. But the trend is unmistakable. There are going to be cutbacks of civilian production and a sharp stepup of military production, whatever the outcome of our Asiatic involvement. This should come as no surprise, and should be met with no reluctance whatever. The place of electronics in military operations today is near the top. So our responsibility to assume a major portion of the load is not only unavoidable, it is an opportunity to participate in what may well be the biggest and most constructive project of our generation.

While participating wholeheartedly in whatever program is laid out for us, we can hope that the transition from civilian to military production will be carried out as skillfully as possible. Cutbacks should be geared closely to the actual ability of plants to absorb military work. Otherwise unemployment is inevitable, temporary to be sure, but an interruption of production nonetheless. Fortunately, men of the caliber of Fred Lack have been planning for this eventuality for many months, as civilian advisers to the Munitions Board. If their advice is taken, we have little to fear.

FCC/IRAC . . . The Condon Committee (see p 66, this issue) has brought to the attention of Senator Edwin C. Johnson, for whom they labored, the fact that the FCC and IRAC do not operate under a common policy, and has cast doubt that any allocation of the vhf and uhf bands can be in the best interest of the country unless such a common policy is adhered to. We hope this view prevails, among the members of the Communications Policy Board and elsewhere among the President’s advisers. Now, of all times, we must be sure that these important frequencies are used, actually and fully, not squatted upon.

CHICAGO . . . The Chicago section of the IRE is currently observing its 25th anniversary with a four-months program culminating in the National Electronics Conference. Of the striking trends in the electronics business since 1925, not the least is the steady increasing concentration of electronic manufacturing in the Chicago area. Four of the ten biggest producers of television sets, for example, are located in Chicago, three in the New York area, two in or near Philadelphia. It’s refreshing to note that the IRE, thought of as a stodgy outfit in some quarters, has had the get-up-and-go to tell the people of Chicago that their town is the center of the wonder industry. Other sections could profit by the example.

LAMPREYS . . . Speaking of Chicago, the Cook Research Laboratories there have just been awarded a contract by the Department of the Interior to develop electronic instruments to exterminate sea lampreys. These eel-like fish attach themselves to other fish, sucking their blood, and have all but destroyed the lake-trout fishing industry in the Great Lakes. According to Fish and Wildlife Service scientists, the lamprey displays selective reactions to visual and audible stimuli which may be used to drive them into electrocution devices, while not affecting fish of other species. The contract calls for development of “radar-type instruments, submarine sound generators and other electronic devices”. One idea is to tune the sonic generators to the heart beat of the lampreys; this appears to have a fatal effect if the intensity is high enough. The eel-killers hope to catch ‘em going upstream and downstream. Quick, Cook, the (underwater) Flit!
The Case for VHF TELEVISION

"ANNEX C"

Hidden away in the Annexes of the report of the Senate Advisory Committee on Color Television, where it has attracted little public attention, is a cogent statement of the vhf-vs-uhf argument over new television channels. Annex C is an inquiry directed by the Committee to Senator Edwin C. Johnson, prior to the formation of President Truman's Communications Policy Board. Since this brief and forthright statement of the problem is a matter of deep concern to every television engineer, it is reprinted in full herewith—The Editors

EARLY in the deliberations of the Senate Advisory Committee on Color Television (the "Condon Committee"), the question of the proposed expansion of the television service on uhf channels was brought up, as stated in the final report:

"At its meeting of November 21, 1949, the Committee discussed the question of the basic terms of reference of the report, particularly regarding the availability of additional channels not then contemplated by the FCC proposals. As a result of this discussion, an inquiry was prepared and forwarded to Senator Johnson as of February 2, 1950. A copy of this inquiry is appended as Annex C."

"Shortly thereafter, the formation of the President's Communications Policy Board was announced. In view of the contemplated activity of this Board, Senator Johnson advised the Committee to proceed within the terms of reference proposed by the FCC, namely to consider channels in the vhf band from 54-88 and 174-216 mc, and channels in the uhf band from 475 to 890 mc."

Annex C

The full text of Annex C, referred to above, follows:

The plan for expansion of the television service, whether for additional black-and-white stations or for a color service, must be evaluated in terms of the radio spectrum now reserved for television and other services. Television broadcast stations are currently allocated in 12 channels in the vhf spectrum in the following bands: 54-72 mc, 76-88 mc, 174-216 mc.

In expanding the television service it would appear to this Committee that it would be highly advantageous to allocate additional vhf channels between 72 and 300 mc. But the space in the vhf spectrum is currently occupied by, or nominally allocated to, other services. These are:

- 72-76 mc—Government aeronautical navigation and non-government fixed
- 88-108 mc—F-M broadcasting
- 108-144 mc—Aeronautical navigation and communication
- 144-148 mc—Amateur
- 148-152 mc—Aeronautical communication
- 152-156 mc—Police
- 156-162 mc—Nongovernment fixed and mobile
- 162-174 mc—Government fixed and mobile
- 216-220 mc—Government fixed and mobile
- 220-225 mc—Amateur
- 225-400 mc—Government aeronautical communication and navigation.

In view of this extensive occupancy of the vhf spectrum by non-television services, the FCC allocated a portion of the uhf spectrum, from 475 to 890 mc, for experimental television service, looking toward the development of improved television systems including high definition black-and-white and color systems. The FCC has recently issued a proposal to allocate a large segment of the uhf band to commercial black-and-white television broadcasting. The proposal, to be debated shortly in hearings before the Commission, is to allocate approximately 42 channels, each 6 mc wide, extending from 475 mc to 727 mc (or from 500 to 752 mc, if the band 475-500 mc is allocated to common-carrier fixed-mobile communications).

The proposal to allocate uhf channels is open to a number of serious objections which stem from differences in the performance of transmitters and receivers and in the propagation of radio waves. The available power of transmitters and the sensitivity of receivers are lower, in any given state of the art, in the uhf band than in the vhf band. The performance of the uhf system is impaired further than the vhf system by natural impediments to transmission over the earth's surface. These technical factors have important implications, which may be summed up in the statement that uhf television stations cannot cover as large an area (by a factor of the order of 3
Condon Committee, in its report on the status of color TV, recommends new VHF channels, states arguments against UHF, and calls for review at highest administrative level of allocations policies of FCC and IRAC.
LONG-LIFE TUBES for INDUSTRY

Commercial airlines have worked closely with manufacturers to produce types that fit the service. Experience over the past three years indicates that the extra cost is more than absorbed in reduced maintenance and fewer flight cancellations. Program points the way to improved tubes for other applications.

By ELWOOD K. MORSE
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Electron tubes have been used for many industrial purposes for years. Yet other industrial applications for which they have long seemed ideal remain in the experimental stage. Why?

Certainly the lag between experimental application and commercial acceptance is not because tubes cannot be developed to do the work. They can be given a very wide variety of characteristics. So it must be that tubes are still considered unreliable. Yet radio stations operate 24 hours a day and the vast telephone service of this country is using more and more tubes each year.

Perhaps the answer lies in the fact that many tube manufacturers have been reluctant to invest in the development of tubes to meet the needs of industry while the lucrative large volume and less exacting business of supplying tubes for radio and television receivers exists.

Perhaps industry itself does not really know what it needs.

Aviation Shows the Way

One branch of industry did know what it needed in electron tubes. That branch was commercial aviation. It presented its requirements to tube manufacturers. Other users of mobile communications equipment with like requirements and manufacturers of equipment were contacted and the whole problem was jointly discussed. The outcome was the selection of a minimum number of tube types deemed necessary to perform the required functions, and which tube manufacturers agreed could be improved.

The selections were from the miniature group of tubes. Improvement was to include design changes for improved performance and reliability as well as physical ruggedization. A list of ten types to be initially improved was made and this list is shown in the accompanying table.

As part of the improvement program and to provide manufacturers with information regarding the performance of the types produced, Aeronautical Radio Inc., representing the airlines, agreed to return to the manufacturers all tubes which became defective from any cause, accompanied with complete data stating nature of failure, hours of service, type of equipment in which the tube was used and function for which it was used. The manufacturer agreed to analyze returned tubes and, on the basis of the reports and their analysis, modify design and construction to remedy any faults shown in service.

Program Brings Results

As a result of three years of operation of this improved tube program, nine of the ten types initially chosen are now in production and use and the tenth (5727) is under consideration. Sufficient information is on hand to evaluate the progress of the first tube to be improved. The 6AK5 is used in larger quantities by the airlines than any other miniature type. Data from one airline showed failure of one equipment every 50 hours, on the average, due to failure of this tube type. After almost three years of production, improvement and operation of the substituted 5654 it is evident that considerable progress has been made toward obtaining a reliable tube. Compilation of data received from the airlines as well as from the manufacturer indicates that the 5654 is 100 percent better...
than the 6AK5. This improvement is based on a comparison of life.

Since engineering time is required to produce an improved tube, it was at first suggested by manufacturers that selection of existing tubes be tried to reduce failures in the field until an improved type could be produced. The airlines purchased 2,000 type 6AK5's. After tests, which included filament on-off cycling, vibration, shock and glass strain, less than 60 remained. These were assumed to be reliable tubes, tubes which would give long service without failure. Service records later showed them to be no better than those picked at random from stock. This proved the ARINC contention that you can't test quality into tubes—it must be built in.

Ideally, industrial tubes should operate a predetermined number of hours before failure, thus permitting a before-failure replacement schedule to be established. The actual number of hours a tube will last is not nearly so important as knowing how long it can be depended upon. Of course, reasonably long life is desirable to hold down replacement costs; 10,000 or 20,000 or 50,000 hours are desirable goals. Such tubes would cost more initially but savings in service cost and, for the air carriers, elimination of flight delays would pay for any reasonable increase many times over. Increased demand for such tubes would also lower their cost in time.

Present Practices

There is a practical limit to the improvement of industrial electron tubes but most of the types of tubes now produced for radio and television receivers fall far short of this limit because the competitive market does not permit wholesale adoption of more exacting and costly manufacturing practices.

Differences in the design of the 5654 as contrasted with the 6AK5 include ruggedization developed under the Navy W program and an improved filament that withstands the many on-off cycles encountered in aircraft service. The tolerances to which critical dimensions are held are smaller than in regular tube production and a 100 percent check of all parts is made before assembly. As part of the manufacturing process all tubes are given a 50-hour burn-in run under rated conditions. This process tends to stabilize emission and eliminate early failures.

Production-line workers making long-life tubes are compensated on a daily wage scale and are not dependent upon the quantity of production for their earnings. They are encouraged to discard any part or assembly which does not measure up to the highest quality of workmanship. A small group of tubes of each week's production, selected to include each day's production, is given a 500-hour life test. The production represented by these tubes is held from shipment until the test is satisfactorily completed.

The improvement resulting from electrical and mechanical changes in design and the employment of rigid quality control is reflected in the 5 to 1 ratio of rejects during the final tests in the production of the regular tubes and the improved tube.

Tubes of the Future

The aircraft industry has shown the way toward tube improvement. Other branches of industry can look forward to increased reliability in electronic equipment and the utilization of more electronic devices, with their many advantages, if more tubes are designed and manufactured to meet the conditions under which they must operate.

Of course, both the user and the manufacturer of electronic tubes must understand the problem and make an honest effort to solve it. If this is done, time need not be lost by the stoppage of an assembly line because a tube failed in the electronic control of a welder or other equipment.

Electron tubes and electronic devices will then achieve the same order of reliability as other man-made equipment upon which our lives depend every day.
Frequency-Interlace

Red, blue and green picture signals are transmitted simultaneously, with good fidelity, over the standard 6-mc channel. System is completely compatible and requires addition of only six tubes to convert conventional monochrome circuits for tricolor tube.

Any system for the transmission and reception of images in natural color by television in the same frequency bandwidth as is employed in a monochrome system must in some way attempt to transmit up to three times as much information as is contained in the monochrome channel. This premise is based upon the assumptions that at least three primary colors are employed in the color composition and that substantially the same overall picture definition or detail is to be portrayed at the receiver.

Multiplex Systems

Since there are in effect three messages to be transmitted, some method of multiplexing must be devised. There are in general two means available for multiplexing, namely time-division multiplex and frequency-division multiplex.

In a time-division multiplex system only one message is dealt with at any given instant. The rapidity with which messages (or colors) are switched in rotation may vary over very wide limits. The longest interval of time devoted to one color may be as long as one complete field of scanning. An intermediate interval corresponding to the length of time required to transmit one scanning line may be the next logical switching interval. Finally, a very rapid switching may be used wherein only a small portion of a line (such as a dot) forms the switching interval.

Any one of these three choices may form the basis of a system of color television. Each of these systems has its own attendant problems. In general, however, it may be stated that all time-division multiplex systems require a total elapsed time varying from two to three times that required to transmit a monochrome picture of equal definition. A longer elapsed time, however, means that the flicker problem may become a serious limiting factor.

Viewed from the economic standpoint, time-division multiplex is not too attractive. The receiver must be equipped with suitable gating apparatus to switch the incoming information into the correct reproducing channels. Means must also be provided for identifying which of the three colors is being transmitted at any given instant so that at the same instant the correct color is reproduced. These two functions add to the complexity of the receiver and tend to make the receiver less attractive as an article of merchandise because of increased price, less reliability, and greater difficulty of adjustment.

An examination of the possibilities of frequency-division multiplex therefore seems to be in order. If the bandwidth available for the television signals were arbitrarily divided into three equal segments, one for each message (or color), the rate of transmission of the entire information would have to be slowed down to one third that used in monochrome. This could be done, of course, but the flicker problem would enter and would be a serious limiting factor to commercial acceptance. A way should therefore be sought to transmit the three messages simultaneously in the same frequency spectrum. This method forms the basis of the system to be described and which has

DARK HORSE

A few weeks ago the simultaneous system of color television was considered as dead as the dodo, because it could not fit into the 6-mc channel on a compatible basis. Or so people thought. Within weeks of the end of the FCC color hearing, a wholly new approach to simultaneous transmission was conceived by Bob Dome. Presented herewith, in essentially complete form, is the text of the report on the new system forwarded to the FCC on July 24th.

The Editors
Color Television

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been given the name "Frequency Interlace Color Television System."

Frequency Interlace
As the name frequency interlace implies, the frequencies employed by the three messages are sandwiched so as to be noninterfering. This can be done in scanned information systems such as in television because the video frequencies associated with a television signal are bunched around harmonics of the line frequency and a large part of the available spectrum is unused. It has been estimated that about 46 percent of the space between harmonics is not occupied.

Suppose the video-frequency bandwidth available is 4 megacycles. Furthermore, let it be assumed that scanning frequencies compatible with monochrome television are to be used, namely, a vertical or field frequency of 60 per second, and a line rate of 15,750 per second. This results in the standard 525-line system employing two-fold interlace. Suppose that the three primary colors to be used in the system are green, red, and blue.

At the camera the composite television picture being televised is split by electro-optical means into three separate groups of signals associated with the three primary colors. Each channel may contain frequencies extending up to 4 mc. The signals associated with the color green may be regarded as the basic signals and may be used to modulate the picture carrier in the same manner as in a monochrome transmitter. Since the line frequency is 15,750 cps, it will be found that the sideband energy is chiefly bunched at frequencies spaced from the carrier by 15,750 cps, 31,500 cps, 47,250 cps, and so on out to 4 mc. It is planned to use the spaces between these harmonics to transmit the information associated with the two remaining colors.

Green and Red Interlace
The video frequencies associated with a second color, for example red, may be utilized as modulating frequencies for a video-frequency subcarrier. This subcarrier frequency is carefully selected to lie exactly midway between two harmonics of the line frequency, or in other words, at an odd multiple of half the line frequency. Half of 15,750 cps, is 7,875 cps; so that a frequency of 3,583,125 cps, which is the 455th multiple of 7,875 cps, may be selected. This subcarrier is modulated with video signals of the red channel, and the modulated wave is superimposed on the green channel signals. It is evident, then, that the red video signals will lie halfway between green-signal line-frequency harmonics in unused parts of the spectrum.

The entire red spectrum does not have to be used. A number of investigators have found that acceptable color reproduction may be obtained by identifying only the lower video frequencies with their respective colors. The higher video frequencies may be transmitted either by green alone or by the principle of mixed highs. Good reproduction will be obtained if red is transmitted as red out to only 1 mc. Furthermore, use may be made of vestigial side-band transmission of the red signal, so that the lower sideband is the dominant one. The spectrum of the combined green and red signals may therefore be as shown in Fig. 1A. This signal may be received by a conventional monochrome receiver insofar as the r-f.
would have to be as shown in Fig. 1B.

A more detailed view of the frequency spectrum in the vicinity of the red subcarrier is shown in Fig. 1C.

**Separating Green and Red**

The way in which the signals associated with the two colors are interleaved is now clearly revealed. It is necessary now to provide some means at the receiver for separating the signals for portrayal on the picture tube of the correct color. One way of accomplishing this would be to employ an elaborate wave filter having multiple pass bands for the desired frequencies and multiple elimination bands to exclude the undesired frequencies. Such a filter would probably be too expensive for home receivers because of the large number of sections indicated.

Fortunately a cheap natural filter is available in the form of the human eye. The satisfactory operation of the system depends to a considerable extent on the physiological phenomenon known as the persistence of vision. Any one line of the green television picture will be modulated in intensity at the rate of the red subcarrier. But two fields later in time, in 1/30 of a second, the modulation effect will be 180 degrees out of phase with the modulation of the first field. Thus a lighter dot on field 1 will appear as a darker dot on field 2 and vice versa. In the eye the mean illumination tends to average out to a medium background.

This principle is illustrated in Fig. 2 in which are depicted light intensities along a single green line in field 1 and in field 3. The sine wave is the red subcarrier and is shown here to be amplitude modulated by low-frequency red picture signals. If the eye were a perfect long-time integrator the visual sensation would be represented by the line marked mean intensity which corresponds in this case to the desired green signal.

The repetition rates involved here are not fast enough to give perfect integration, but the practical result is believed to be sufficiently close to the ideal to be commercially acceptable.

The superposition of fields yields twice the number of dots per line as one field alone gives so that a very fine dot structure results. Its fineness is comparable to horizontal scanning line structure and disappears at substantially the same distance away from the picture tube that normal line structure disappears. Thus although both the red and green signals appear on the green gun, the red is effectively filtered out by the eye and only the green remains.

The information contained in the red camera signal above 1 mc and up to 4 mc may be superimposed on the green signal to yield a mixed-high signal above 1 mc.

**Addition of Blue Signals**

The video frequencies associated with the third color, blue, may be transmitted as modulation on a second subcarrier. As in the case of the red signals, only the lower blue frequencies need be transmitted, so that a comparatively narrow channel is required. A blue video band up to 0.2 mc may be sufficient. Figure 3 shows several possible locations for the blue subcarrier. It is not known at this writing which one of these various methods is likely to provide the best all around performance. Consider for example the third alternative in which the red subcarrier is shown moved down to about 3.2 mc, or to 3.189375 mc, the 405th multiple of 7.875 cps. The blue carrier may be located just under 4 mc at 3.898125 mc, the 495th multiple of 7.875 cps. (The 3.189375-mc signal may be derived from the 3.898125-mc signal by dividing the latter by 11 and then multiplying the quotient by 9.)

Again, as was the case with red and green, the blue signal appearing on the green gun is effectively filtered out by the eye, as are the green signals appearing on the red and blue guns. The blue and red signals, since they do not overlap in frequency, do not exhibit this effect.

**Video Components**

As stated before, the high video frequencies may be represented by the green channel alone. In order to avoid a greenish tinge to high frequencies, the green highs may be taken off the green video channel by the shunt connection of a suitable high-pass filter and added to the blue and red guns (as well as direct connection to the green gun) of the reproducing means to produce black-and-white fine detail. Alternatively, blue and red highs may be added to the green channel at the transmitter and taken off from the green video channel in the receiver to feed the blue and red guns as well as the green gun. The cutoff frequency of the high-pass filter would be selected at approximately the cutoff frequency of the
undesirable in band. The presence of because the pear shows action be positive picture. Alternatively, the phase those detectors reduced able combination and -white and connected guns. The mixed -highs signals whichARRIER.

Receiver Refinements

The simple receiver shown in Fig. 4, while it contains sufficient circuit elements to receive color pictures, has for simplification two features omitted which may be desirable in a commercial product. These are d-c restorers and agc's. The green age and the green restorer are the same as for black-and-white receivers and need not be discussed in detail. The red and blue d-c restorers are likewise conventional.

Automatic gain control for the red and blue channels will probably be needed in a practical receiver to take care of receiver i-f response variations due to tuning and effects of age on the i-f response shape.

Many methods of transmitting reference signals for use by the age systems will suggest themselves, but one of the simplest is that adopted by communication services which employ suppressed-carrier channels. This method is to transmit a pilot signal of fixed amplitude which may be continuous except for blanking intervals, but which lies outside the normal communication channel frequencywise.

Thus in the red channel, a continuous unmodulated wave at a frequency of 1.1 mc from the red carrier might be used as a pilot frequency. Another pilot frequency 220 kc from the blue channel carrier could be used for blue age. In a practical receiver however, it is quite likely that the red and blue signals would maintain their relative magnitudes fairly well but that the green might change with respect to them depending upon the position of the green carrier along the slope of the i-f response characteristic. Therefore a single age for the red and blue channels may prove to be adequate, and in which case a pilot frequency may be radia-
ated in the vicinity of 3.65 mc in the guard band between the blue and red channels shown in Fig. 3C.

The exact frequency for the pilot may be 3,646,125 mc, the 463rd harmonic of 7,875 cps. This frequency may be generated by subtracting the eighth harmonic of 31,500 cps from 3,898,125 mc. This pilot would then lie 252 kc below the blue carrier or 456.75 kc above the red carrier in a position so that the pilot carrier can be eliminated from the blue and red low-frequency signals by the use of suitable traps, and so that its effect on the green picture will be cancelled by the eye.

The pilot agc signal may be amplified and rectified to obtain an agc-d-c control voltage which may be applied to the 3.9-mc blue-signal amplifier as control-grid bias. The d-c may also be applied to an amplifier which may be inserted in the system shown in Fig. 4 just prior to the red detector. A d-c delay voltage may be employed on the agc rectifier to make the output become quite uniform regardless of variations in input over a suitably wide range in magnitudes. Since the receiver as a whole has its gain controlled by the green channel, it is not likely that very extreme ranges in input variations to the red and blue channels would occur.

The d-c delay voltage may be made adjustable if desired so that the service man at the time the receiver is installed may adjust this control (as well as the individual red and blue gain controls) for best color balance.

Time-delay networks may be required in the green and red channels to give a resultant overall uniform time-delay equal to the time-delay of the blue low-frequency channel because the blue channel is the narrowest and therefore will probably have the greatest inherent time-delay.

A block diagram of the color portion of a receiver incorporating some of the finer points mentioned in the above discussion is shown in Fig. 5. This receiver employs the following tube functions above what is required for a black-and-white television receiver: (1) 2.2 to 3.5-mc red i-f amplifier, (2) red diode detector, (3) 0 to 1-mc red video amplifier, (4) red restorer diode, (5) blue second detector diode, (6) 3.6 to 4.0-mc blue i-f amplifier, (7) blue third detector diode, (8) 0 to 0.2-mc blue video amplifier, (9) blue restorer diode, (10) 3.64-mc age carrier amplifier, and (11) age rectifier diode.

These 11 tube functions can be obtained by employing fewer than 11 separate tubes when use is made of suitable double-purpose tubes. The following combination is a suggestion: (1) 2.2 to 3.5-mc red i-f amplifier and red diode detector, 6SF7, (2) 3.6 to 4.0-mc blue i-f amplifier and blue third detector diode, 6SF7, (3) red restorer diode and blue restorer diode, 6AL5, (4) 3.64-mc amplifier and 3.64-mc detector diode, 6SF7, (5) blue video amplifier and red video amplifier, 6SN7GT, and (6) blue second detector, 6AL5.

Thus approximately 5½ or 6 tubes are needed in addition to the tubes employed in a black-and-white receiver.

**Picture-Tube Types**

The picture tubes which may be employed as an electro-optical transducer in the receiver may be any of the forms described in the literature including (1) Three separate tubes, one for green, one for red, one for blue, (2) A three-gun single tube as demonstrated by RCA, (3) A single-gun single tube as demonstrated by RCA.

The first two forms of the transducer require no additional apparatus, but the third form would require a circular sweep generator and an auto-sampler, the total number of added tubes possibly being as high as six. For this reason, and for reasons of avoiding the problems attendant to optical registration, the three-gun single tube would appear to be the preferred form for the transducer.

**Transmitter**

The transmitter for the frequency-interlace color system would be a standard transmitter with some modifications. A block diagram is shown in Fig. 6.

An adder having 6 input terminals is shown in this diagram into which may be fed: (1) green video signals, (2) red lows on a subcarrier, (3) red highs direct, (4) blue lows on a second subcarrier, (5) blue highs direct, and (6) age pilot signal. The adder output frequency spectrum would then look like that shown in Fig. 7.

Time-delay networks may also be required in the transmitter and if so would probably go into the green.
and red channels since once again the blue channel will be retarded the longest inherently because of the relatively narrow bandwidth devoted to blue low-frequency components. Time-delay networks may also be required in the red high and blue high circuits as indicated in Fig. 6.

Relaying and Propagation

The video signal is capable of being transmitted over cable and radio relay networks without loss of fidelity providing the characteristics of the network are such as to provide good transmission up to 4 megacycles. If the cable or radio link has a band pass of only 2.8 mc, the picture is still usable as a black-and-white picture but not as a color picture because the blue and red information would be missing or incomplete.

Anomalous transmission vagaries at uhf are rare and hence it is not anticipated that any difficulties will be encountered which would temporarily blot out a portion of the radiated band thereby removing a blue or a red carrier and their sidebands. Instead, it is to be expected that a continuous flow of all of the information would be received.

Compatibility

The color system is compatible in that present black-and-white receivers regardless of video bandwidth may be used to receive color transmissions in black-and-white. The green picture would constitute the signal employed in reception. Crosstalk would cause no trouble because it is geometrically in the same position on the screen as the green signal itself. If the polarity of modulation is chosen carefully, the black-and-white tube may actually be aided by the crosstalk to give lights and shadows even when the green component is weak.

When the color receiver is tuned to a black-and-white transmission, all of the guns may be fed from the main signal. The operator of the receiver may do this manually in low-priced receivers. Switching would be indicated because the red and blue channels would be dead and the picture would be green. On the other hand, if the receiver were switched for standard black-and-white reception, and a color signal were tuned in, the operator would have no positive signal that the transmission was in color and would have to try the color switch to see if it were in color. On a more expensive receiver, the switching could be accomplished automatically. For example if the pilot signal at 3.64 mc is employed its presence in color transmissions could be used to operate a relay to do the color switching. An absence of signal at 3.64 mc would fail to close the relay so that the receiver would automatically be set up for black-and-white reproduction.

Tests

As yet the system has not been completely set up and color pictures as such transmitted and received. This is due to the relatively short time available. Preliminary laboratory tests have been made however to verify some of the basic principles.

For example, a continuous wave oscillation frequency representative of a red carrier has been superimposed on a black-and-white picture and it has been determined that the best frequencies for it are any of those lying between line-frequency harmonics. When the injected frequency coincides with a line-frequency harmonic, vertical black and white bars are visually evident. When the frequency of the injected wave is shifted to lie midway between harmonics of the line frequency two effects are noticed: A dot pattern replaces the vertical line pattern, and the intensity of the variations in light are reduced. These points substantiate the theory.

Secondly, low-frequency amplitude modulation has been applied to the injected carrier and low-frequency crosstalk observed; but the low frequencies at the output of a detector, tuned to the injected frequency, when inserted into the video channel in the proper corrective phase substantially removed all traces of low-frequency crosstalk. This experiment therefore verified the anticrosstalk possibilities referred to in the description.

When the injected carrier frequency is above 3 mc the fine dot pattern has about the same quality as normal line structure and disappears from view at about the same viewing distance from the picture tube. No observable twinkle, flicker, or crawling could be obtained in any of the tests, indicating freedom from these particular types of disturbances.

Advantages and Disadvantages

The proposed frequency-interlace color television system appears to offer the following advantages over other known systems: (1) All precision equipment is localized at the transmitter, so that the receiver can be relatively low in cost, reliable in operation, easy to adjust and maintain, and simple in construction. It is estimated that only 6 more tubes are required than in a monochrome receiver. (2) The receiver should be free from color shifts due to noise interference. (3) The system is inherently compatible with present monochrome standards. (4) The receiver should exhibit a complete absence of twinkle, crawl, or flicker and of field-sequential color fringing.

The anticipated disadvantages of the proposed system are: (1) The requirement of either (a) more accurate receiver alignment and tuning, or (b) an effective automatic gain control on each color. (2) Possible color fringing due to differential time-delay in propagation between color carrier frequencies. (This is not expected, but tests ultimately should be made to check it.) (3) Full 4-mc bandwidth is required in relaying. (4) Possible second-order color fringing due to incomplete physiological filtering in rapidly moving objects.

Reference

Device developed for repetition rates between 60 and 800 cycles, covering wide range of pulse durations, shows minimum improvement of 5 db in noise for 5-microsecond pulses at 200 cycles. Pulses from radar receiver are gated at twice repetition rate and converted to zero frequency. A d-c integrator drives conventional or special indicators.

The signal returned from a target to the receiver of a radar system consists of a train of pulses having a definite repetition frequency. In addition to these pulses, extraneous noise is introduced during transmission of the signals and in the receiver itself. If an attempt is made to observe a target at a great distance, the noise may well be sufficient to prevent observation of the returned signals. It is possible to minimize the effect of noise and to increase the useful range of the radar through the use of an integrating device located in the receiver.

One type of integrating device consists of a filter having a narrow pass band centered about the repetition frequency of the signal pulses. Such a filter eliminates energy from those components of the noise having frequencies located outside the pass band of the filter. The filter accepts energy from the fundamental component of the pulses. If the filter has a very narrow pass band, an appreciable time, called the integration time, is required for it to attain its final response following the application of a train of signal pulses. In other words, energy from successive pulses is integrated to give a large response. On the other hand, the noise energy being of a random character tends to build up at a slower rate than the signal. The process is one in which the ability to improve the separation of signal from noise is obtained at the expense of a longer time of observation. The process is relatively inefficient, since the only energy utilized is from that component of the signal having the fundamental repetition frequency.

The duration of a signal pulse is but a fraction of the period between successive pulses, so that a signal is present only a small portion of the time. Noise is present at all times. Considerable noise energy can be eliminated from the system if the receiver is turned on by a suitable gating circuit only at the time when a signal is expected. During the remainder of the time the receiver is turned off. In order to allow a search for a signal at any location on the time scale, corresponding to targets at various distances, the position of such a gate must be continuously adjustable in time.

**Gating Disturbances**

Disturbances are always introduced in circuits by such a gating action. If the gate operates at the repetition frequency of the signal pulses, the disturbances produced by the gate will be integrated by the narrow-band filter, and a spurious response will be indicated. In order to prevent such a spurious response, the gate must operate at an integral multiple of the repetition frequency, preferably at twice this frequency. In this way, the gate will allow the receiver to be on at the time the signal is expected, but will introduce no component of.
its own at the repetition frequency.

An integrating device has been designed and constructed employing this principle of a narrow-band filter. The specifications for the design were such that the integrator could be used with many existing radar systems. In particular, the repetition frequency of the signal pulses was to be continuously adjustable between 60 and 800 cycles per second. The bandwidth of the integrating filter and the duration of the gate were to be continuously adjustable within relatively wide limits. The position of the gate in time was to be adjustable over a complete period of the signal pulses.

It is obviously desirable to keep the number of controls on the device to a minimum, and to allow a change of the repetition frequency with the least number of readjustments. In order to achieve this end, the circuits of the integrator are designed to operate with pulse-type timing signals that require no tuning of the various portions of the circuit. A block diagram of the complete system is shown in Fig. 1. The components in the upper part of the figure are those that produce the narrow-band filter forming the actual integrator. The components in the lower part of the figure generate the necessary timing voltages. The complexity of the device is brought about mainly by the necessity for operation over a wide range of repetition frequencies.

**Block Diagram**

The components in the actual integrator will be considered first. A video signal, consisting of signal pulses with accompanying noise, is supplied from the radar receiver to a gated amplifier. The signal pulses have a repetition frequency \( f \). These pulses are those which were sent out originally by the radar transmitter and which have been reflected from some target. The radar transmitter is synchronized with the integrating device by suitable voltages supplied from the integrator. The gated amplifier is turned on and off by a gating voltage obtained from the timing signal generator. The gating voltage is a train of pulses of repetition frequency \( 2f \), twice that of the signal pulses. The duration of the gating pulses and their position in time are both adjustable. The gated amplifier contains a balancing circuit to minimize disturbances from the gating action.

An adjustable band-pass amplifier tuned to the repetition frequency \( f \) follows the gated amplifier. Its tuning is achieved by means of a resistance-capacitance circuit with feedback. The effective Q of the amplifier is about 10, so that it provides only a small amount of selectivity. The main purpose of the tuned amplifier is to smooth large fluctuations in the signal, and to provide at its output terminals a voltage that is approximately sinusoidal at the repetition frequency.

The filter that provides most of the integrating action must have a very narrow pass band, only a fraction of a cycle per second wide. If the integrating time is to be controlled, the bandwidth of this filter must be adjustable. It is difficult to build such a filter with both its mid-frequency and its bandwidth continuously adjustable. For this reason, the integrating device was designed with a frequency converter that shifts the energy of the signal from the repetition frequency down to zero frequency. Integration is then accomplished by means of a simple resistance-capacitance circuit used as a d-c integrator. The frequency converter is a ring modulator using four crystal diodes. A square-wave switching voltage of the repetition frequency \( f \) is supplied to the diodes, along with the sinusoidal signal from the tuned amplifier. The phase relations of the square wave and the sinusoidal signal must be correct in order to give maximum d-c voltage of a given polarity at the output terminals of the converter.

Integration is accomplished in a resistance-capacitance circuit. The capacitor is made adjustable so that the integration time (the reciprocal of the bandwidth) can be varied. The d-c voltage controls a current amplifier that may supply a recording milliammeter, used to provide a
permanent record. The d-c voltage is used in a circuit that produces a pattern for observation on an oscilloscope. If there is no integrating action, the oscilloscope pattern is that of the incoming signal from the radar receiver. If integration occurs, synthetic pulses of large amplitude appear on the oscilloscope.

In the lower part of Fig. 1 are shown the components that generate the timing voltages for the integrator and the radar transmitter. Since the gating voltage must be accurately of frequency 2f, twice the repetition frequency, with no component at f, it was decided to use as the basis for all the timing an adjustable oscillator providing a sinusoidal voltage of frequency 2f. The voltage from this oscillator is supplied to a phase splitter that produces two voltages of opposite phase relations. The first of these voltages is converted into a train of pulses in the upper channel of the timing signal generator. This train of pulses is passed through a delay circuit in which the time delay relative to the period of the pulses can be controlled by an d-c voltage. At the same time, an adjustable differentiating circuit allows the width of the pulses to be controlled. The voltage resulting from this sequence of operations is a train of pulses of frequency 2f, adjustable in width and in position on the time scale. This voltage is the gating voltage used to control the gated amplifier.

The sinusoidal voltage from the second part of the phase splitter is converted into a train of pulses in the lower channel of the timing signal generator. This second train of pulses is interleaved in time with the train in the upper channel of the generator. The second train is delayed by a time-delay circuit exactly like that in the first channel. The d-c control voltage for the two delay circuits is the same and is obtained from a single potentiometer, so that delays in the two channels are identical. Pulses from the second delay circuit are used to control a trigger circuit that trips from one stable state to the other for each incoming pulse. The output voltage of the trigger circuit is a square wave of the repetition frequency f. This square wave is related to the gating voltage in such a way that the gating pulse is centered within the flat portion of the square wave. This relation is maintained as the delay circuits are adjusted and the gate is moved in time. The square wave is, therefore, of the proper phase to serve as the switching voltage for the frequency converter.

The train of pulses in the lower channel of the timing signal generator is supplied with no delay to a second trigger circuit. The square wave from this trigger circuit is differentiated to give pulses, and integrated to give an approximate sinusoid. These voltages of repetition frequency f can be used to synchronize the radar transmitter.

**Operations**

The procedure for operating the integrating system is as follows. The sine oscillator is set to twice the desired repetition frequency and the tuned amplifier is set to the repetition frequency. The pulse repetition frequency of the radar transmitter is synchronized by the proper voltages from the integrator. The duration of the gating interval is adjusted to be about the same as that of the signal pulses. The integration time of the d-c integrating circuit is set to the desired value. In order to locate a signal through the use of the integrator, it is necessary merely to search for the reflected signal pulses by adjusting the time delay of the gating voltage. The presence of a signal is indicated by a rise in the d-c voltage produced by the integrating circuit, as observed with any of the indicating devices. Since the integration time is usually in the order of several seconds, it is necessary that the search be carried out slowly and carefully.

The improvement in performance of the radar system produced by the integrator in laboratory tests is shown in Fig. 2. The tests were made with a sensitive receiver providing the signal for the input of the integrator. The sensitivity of the receiver was such that considerable noise was present; the receiver bandwidth was fixed. Pulse-type r-f signals were supplied to the receiver through an attenuator. An oscilloscope connected to the output of the receiver was used to provide a type-A presentation. The amplitude of the r-f pulses at the input of the receiver was reduced until the pulses were just visible in the midst of noise as seen on the oscilloscope. A strong indication of the presence of the signal is given by the integrator under this condition. The amplitude of the r-f pulses can be reduced further before it is just barely possible to recognize the presence of a signal from indications of the integrating system. The additional attenuation allowed the r-f pulses is plotted as improvement in decibels in the figure. All of this figure were obtained with equal widths for the gate and the signal pulses. A fixed integration time of five seconds was used in all cases. It is seen that significant improvements are produced by the integrator, but at the expense of a longer time of observation.

If an integrating system were to be used with only one radar operating at a single repetition frequency, the system could be simplified considerably. For single-frequency operation probably sinusoidal timing signals would be more convenient than the pulse-type signals used here.

The integrating system described in this paper was designed and constructed under contract W-19-122ac-10 between Yale University and the Air Materiel Command. We wish to acknowledge the assistance in this work of Dr. E. W. Samson of the Air Force Cambridge Research Laboratories and of the members of his staff. Much of the mechanical work on the device was done by C. B. Wakeman of our laboratory.

**References**

4. Reference 1, p 945.
Television Receiver Transient Analysis

Response of entire television receiver to 100-kc square waves provides convenient method of production quality control. Results, normally plotted on graph paper, can be shown as composite video on picture tube

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The ability of a television receiver to reproduce fine detail and sharp transitions without excessive ringing or smear may be judged by the response of the receiver to a 100-kc square wave. In order that the transient response of the entire receiver from antenna terminals to the picture-tube grid may be determined, this equipment provides means of modulating a standard television picture carrier with the square wave. In addition, a marker generator places time dots upon the oscilloscope presentation so that rise time, transient ringing, and smear can be accurately measured.

Equipment

The transient analyzer comprises four units used in conjunction with three pieces of commercial test gear. The analyzer itself is made up of a regulated 150-volt power supply, a square-wave clipper, a modulator and a marker generator. The complete test setup employs in addition a Ferris model 18C r-f signal generator, a Measurements Corp. model 71 square-wave generator and a Tektronix model 511 cathode ray oscilloscope. For accurate measurement of the transient response of the receiver, the inherent distortion in the measuring equipment must be minimized.

In operation, a 100-kc square wave (5-µsec pulse) produced by the generator operating at maximum output is applied to the input of a three-stage clipper shown in Fig. 1. The rise time of the signal produced by the square-wave generator is 0.2 µsec. The clipper unit reduces this rise time to 0.05 µsec. Signals of either polarity are available at the output, and the amplitude may be varied from zero to two volts peak-to-peak.

The output of the clipper unit is connected to one of two balanced modulators. One of these is for an intermediate frequency of 26.6 mc. The other is for television channel 2 (55.25 mc).

The r-f generator is connected to the modulator input as shown in the circuit diagram of Fig. 2. The bandwidth of the input circuit is ± 10 mc, while the bandwidth of the output circuit is ± 15 mc. Modulation is applied to the cathodes of the two 6BH6 tubes. For overall transient tests the depth of modulation should be about 30 percent, so that any peculiarities of vestigial side-band transmission near 100-percent modulation are avoided. A signal input of 0.6 volt peak-to-peak applied to the cathode circuit produces 30-percent modulation.

With the r-f generator attenuator

Response of one receiver (A) is poor, as predicted by transient response curve plotted below picture of test pattern. Whereas another receiver's response (B) is much better in accordance with its characteristic curve.
set to 100,000 µV, the open circuit voltage across the 300-ohm balanced output of the modulator is approximately 20,000 µV. Since the percentage modulation of the analyzer remains constant as the r-f input voltage is changed, the output level of the modulator may be changed by means of the r-f attenuator on the generator. If desired, the r-f generator may be left at 100,000 µV and resistance pads having known attenuation inserted in the 300-ohm balanced line connecting the output of the modulator to the antenna terminals of the television receiver under test. The modulator unit can be used as a double-sideband r-f picture generator by impressing a composite video signal on the modulation input terminal. The video signal must have negative sync.

The two-stage vertical amplifier in the test oscilloscope has a rise time of 0.05 µsec, a frequency response within 3 db from 5 cycles to 8 mc, and a minimum amount of overshoot. The probe supplied with the oscilloscope has an input resistance of 10 meghoms shunted by 12 µµf. The input capacitance of a picture cathode-ray tube such as the 12LP4 is about 6.0 µµf.

At first thought, it would seem possible merely to replace the c-r tube with the probe when measuring overall transient response. However, most television receivers use series peaking between the final video amplifier tube and the c-r tube grid, and circuits of this type are critical to end capacitance. To eliminate this source of measurement error, c-r tube bases are supplied that have a built-in R-C compensated attenuator, consisting of a 7-megohm resistor shunted by a 15-µµf capacitor. To make measurements, the tube socket is unplugged from the tube base and the socket is plugged into the adapter. The scope probe is then connected to the adapter output connection. This method of measurement insures that the capacitance terminating the lead to the picture-tube grid is the same when either the picture tube or the adapter is used.

A marker generator shown in Fig. 3 is incorporated to place time dots on the oscilloscope presentation so that rise time and transient ringing can be measured accurately. The 20-mc oscillator voltage, producing dots spaced 0.05 µsec apart, is connected to the cathode input of the test oscilloscope. To insure that the dots will remain stationary a quenched oscilloscope is used. The positive gate, a pulse lasting for the duration of the triggered sweep, is connected to the input of the marker oscillator from the test oscilloscope. The 20-mc oscillator employs a 12AU7 tube held in a non-oscillating state by means of the diode damping across the plate coil. The positive gate pulse raises the cathode potential of the diode damper and the circuit goes into oscillation for the duration of the pulse.

When measuring over-all transient response from antenna terminals to cathode-ray tube grid, for receiver comparison, the following standards have been used:

1. modulation depth of 30 percent
2. transition from black to white
3. 2 µsec sweep
4. synchronous time dots spaced 0.05 µsec apart

The photograph (A) shows the transient response and test pattern of a receiver in a misaligned condition. The rise time is approximately 0.2 µsec with a definite smear axis lasting for approximately 0.6 µsec. The distance between dots in 0.05 µsec and corresponds to approximately one-hundredth of an inch displacement on a ten-inch picture tube.

The illustration (B) shows the transient response and test pattern of a receiver that is in better alignment. The rise time is approximately 0.17 µsec and the angle of the smear axis is much less than for the first receiver. The transient analyzer was used as a double-sideband television signal generator and was modulated with composite video from a monoscope signal source to obtain the picture illustrated in these photographs.

**Recording Transients**

A permanent record of the transient response of a given receiver can be obtained either by photographing the oscilloscope presentation or by transferring the response indicated on the scope to graph paper.

A Paillard Bolex Model H-16

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**FIG. 1—Diagram of the square-wave clipper that reduces rise time of test pulses**

**FIG. 2—Modulator for television channel 2 is driven by r-f signal generator and modulated by output of square-wave clipper, Fig. 1**
camera using Super XX 16-mm reversible film is used to photograph the trace. A hood between the camera lens and the screen eliminates ambient light. The distance between the camera lens and tube face is 42 cm, and pictures have been taken at f:1.5 with an exposure time of 1/30 sec. The oscilloscope used has a green filter and piece of transparent plastic mounted in front of the tube face. The top edge of the plastic is coated with red lacquer and illuminated by a small lamp. Lines scribed in the face of the plastic sheet appear red and are used as calibration marks. To indentify the photograph a small square area is sanded so as to transmit red light, and a semitransparent piece of paper with the identifying number marked in ink is pasted over this area. The illustrations show a receiver identifying number at the lower left-hand corner. The oscilloscope presentation is held to 2 cm to prevent over-load on any receivers having an excessive amount of overshoot.

A faster method of recording the information is to transfer the scope presentation to graph paper. It is most conveniently done by scribing nine short horizontal lines on the left side of the plastic between the 2-cm calibration lines. The time dotted transient response curve can then be moved bodily through these calibration lines by adjustment of the oscilloscope controls. The vertical position of each dot as it is moved past the calibration lines is then recorded on graph paper. The X axis of the graph used contains forty equal divisions spaced 3/16 inch apart, each equal to a time interval of 0.05 μsec. The Y axis contains ten equal divisions also spaced 3/16 inch apart. After some experience is gained using this method it is possible to plot the transient response in a few minutes.

**Single-Pulse Testing**

For more detailed studies of transient response it is advantageous to modulate the analyzer with a composite video signal containing mixed sync, mixed blanking and a single 5-μsec pulse located in the center of each scanning line. The block diagram of the equipment used to produce this signal is shown in Fig. 4.

Horizontal driving pulses from a standard sync generator are applied to two cathode-coupled multivibrators indicated as MV 1 and MV 2. The first multivibrator produces a rectangular pulse with a duration of 30 μsec while the second multivibrator produces a pulse having a duration of 35 μsec. These pulses are differentiated and inverted and the trailing edge of MV 2 is used to trigger MV 3, which produces the 5-μsec test pulse. The trailing edge of MV 1 is used as a trigger for the oscilloscope. The pulse output of MV 3 is applied to a two-stage clipper to achieve a rise time of 0.05 μsec with a minimum amount of overshoot. This test signal is applied to a specially designed line mixing amplifier to produce a composite video signal including sync and blanking. This signal can be used to modulate the transient analyzer or may be applied directly to the input of a video amplifier for measurement of its transient response.

Since the scope trigger impulse leads the test pulse by 5 μsec the same dotted type of presentation is obtained.

The equipment described is a double-sideband generator. All transmitters operating in this country employ vestigial-sideband transmission in which all modulation frequencies three-quarters of a megacycle below picture carrier are rapidly attenuated. Our measurements have shown that receivers having a good transient response from the double-sideband generator produce a good quality picture from a standard television transmitter.

**Equal Performance**

The original television standards were formulated on the premise that a receiver having the standard RMA selectivity curve, in which picture carrier is located at the 50-percent response point should work equally well whether receiving a double-sideband signal or a vestigial-sideband signal. As reported by others, the presence of the sideband filter in the transmitter gives rise to a slight leading signal and some smear.

Other writers have advocated the use of phase correction in television transmitters to correct both the distortion introduced by the sideband cutting and the high-frequency cutoff of standard television receivers. The use of such circuits would require industry agreement, a standard station monitor, and the establishment of definite transient standards for television broadcast stations. It would certainly represent an avenue of improvement for television.

**REFERENCES**


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**FIG. 3** — Marker generator puts time dots on trace accurately to measure rise time and transient ringing effects

**FIG. 4** — Method of single-pulse testing using composite video signal
An Antenna Analyzer

Radiation patterns of standard broadcast antenna arrays are produced on the screen of a cathode-ray tube by an improved electronic computer employing only 38 tubes. Polar or rectangular presentation of the array pattern can be displayed.

Panel of instrument contains three units, a five-inch cathode-ray indicator, electronic computer chassis and power supply.

FIG. 1—Simple array consisting of two parallel elements and equation for distant field.

FIG. 2—Horizontal projection of the two-element array is shown at A and the ZO p' plane projection at B.

The radiation equation for the multi-element parallel antenna array does not lend itself readily to analysis in broadcast antenna radiation pattern problems. The task of synthesis of an array to produce a certain desired radiation pattern is much more difficult. A trial and error process must be followed and the task is both tedious and time consuming.

To reduce the problem to practical proportions, numerous mechanical computers and electromechanical computers have been constructed. The mechanical computers have been limited by mechanical complexity to three antenna elements, but no apparent limit exists for the curve-drawing electromechanical devices. Any one of these machines is capable of giving the relative distant field pattern for a given array fed in a proper prescribed manner.

One of the most recent contributions in the field of antenna array computer design was made by Brown and Morrison. They built an entirely electronic device capable of giving a continuous picture of the antenna array radiation pattern on the screen of a cathode-ray tube. With the aid of such a computer, the problem of antenna array synthesis was reduced to dial adjustment until the desired radiation pattern was observed on the screen of the cathode-ray tube. The
approximate solution obtained from the computer then could be improved to the desired degree of accuracy by a much shorter trial and error process.

A similar electronic calculator that was designed for classroom antenna array demonstration, as well as for array analysis and synthesis, will be described.

Control of element parameters is effected by potentiometer adjustment of direct current and 60-cps voltages, and by the use of selsyn control transformers as 60-cps voltage phase shifters. Each dial is calibrated in terms of the parameter it controls. Provisions are included for polar or rectangular presentation of the array radiation pattern.

As was pointed out by Brown and Morrison, the electronic reproduction of the radiation pattern of an antenna array depends upon the fact that the array factor can be represented exactly by the magnitude of the sum of a sine wave voltage, representing the field contribution of the reference element, and a series of phase-modulated sine-wave voltages, representing the field contributions of the other elements. Consider an array of parallel elements erected vertically on a perfectly conducting plane earth as shown in Fig. 1. The vertical component of the electric field at point p, located at distance R (R very large compared with the wavelength λ) from the reference element is given in Eq. 1, where $F_n(\theta)$ is the element factor, $A(\phi, \theta)$ is the array factor, R is the distance in meters to the point of measurement, $\theta$ is the angle from the top of the element to the point of measurement, $\phi$ is the bearing angle from true north of the point of measurement, and $I_n$ is the effective value of current in the reference element at the point of maximum current along the element. The horizontal plane and ZOy plane projections of the antenna array are shown in Fig. 2.

If the distance to the point of measurement is much greater than the spacing between elements, rays from the elements to the point of measurement may be considered parallel and the array factor for a two-element array is as shown in Fig. 2.

The array factor for a five-element array is shown in Fig. 3, where $k_n$ is the ratio of current in element n to current in the reference element, $\Delta$, is the phase difference between current in element n and current in the reference element in electrical degrees, $\alpha_n$ is the azimuth of element n in degrees, and $S_n$ is the spacing between element n and the reference element in electrical degrees.

If the elements are not of equal length, $k_n$ becomes the ratio of the product of the current maximum and the element factor of element n to the product of the current maximum and the element factor of the reference element.

To duplicate the array factor electrically, let the component of the electric field produced by the reference element be represented by the expression of Eq. 6 in Fig. 4. Let the component of the relative electric field produced by element n be represented by Eq. 7.

If five elements are the maximum number to be considered, the

Horizontal radiation patterns for a two-element array
sum of the simulating voltages becomes Eq. 8 and expansion of one expression allows the sum of the simulating voltages to be written as shown in Eq. 10. Grouping of terms and substituting as shown, the sum of the simulating voltages becomes Eq. 14.

If $B = y_n$, Eq. 14 has an amplitude identical to $A_1(\phi, \alpha)$, Eq. 5, and is phase modulated in a very complex manner. If the simulating voltages are combined in a mixing circuit with a bandwidth sufficient to accommodate all significant sideband components, and the resulting sum is applied to a linear detector, the array factor will be simulated by the output of the detector.

Thus to produce a complex voltage whose envelope magnitude simulates the array factor of the multielement parallel antenna array erected vertically on a perfectly conducting plane earth, for arrays with not more than five elements, we require a sine-wave voltage of constant amplitude and frequency, and up to four phase-modulated voltages of arbitrary magnitude and arbitrary average phase, maximum phase deviation, and phase of phase deviation.

Let us again consider the expression for the phase deviation of the voltage intended to represent the distant field contribution of element $n$.

$$B_n = \delta_n + S_n \cos(\phi - \alpha_n) \quad (4a)$$

Element current phase angle $\delta_n$ must have a range of $\pm 180$ degrees. If spacing $S_n$ between element $n$ and the reference element has a maximum value of 900 degrees, the total phase swing $B_n$ may be as large as $\pm 1,080$ degrees. Several wide-range phase modulators employing conventional electron tubes have been developed. Systems of phase modulation by Kell and by Day give good linearity over a range of $\pm 120$ degrees. The system due to Day was found to give a somewhat more linear phase-modulation characteristic and a higher output voltage; therefore that system was used in the electronic computer. Two tripler-amplifiers in cascade increase the $\pm 120$-degree variation capability to $\pm 1,080$ degrees.

Reference is made to the circuit diagram of the computer unit, Fig. 5. A type 6S7T pentode is employed in a modified Pierce crystal oscillator circuit. The quartz plate has a nominal frequency of 100 kc. The circuit is arranged to allow plate current flow during only a very small fraction of the oscillation cycle. A 39,000-ohm resistor isolates the plate from the oscillating circuit. The resulting plate-voltage wave is a pulse about -50 volts high and one-half microsecond wide. The output voltage of the oscillator is applied to a type 6SN7 tube in a differentiator cathode-follower circuit in which the pulse phase is reversed, the pulse width is reduced to a very small fraction of a microsecond, the pulse amplitude is reduced slightly, and the impedance level is reduced to about 450 ohms.

The output voltage of the cathode follower is applied to a pulse bus which feeds the reference-element cascade-tripler amplifier and the four element-phase modulators. Two type 6S7T pentodes are employed in the two-stage cascade-tripler amplifiers. The reference-element tripler amplifier introduces a 900-kc voltage of constant amplitude in series with the common resonant circuit employed for voltage mixing.

**Phase Control**

The element-phase modulators use the positive pulse from the pulse bus to key one-half of a 6SN7 in a hard-tube sawtooth oscillator circuit. The time constant of the sawtooth circuit is 2.5 times the wave period; therefore, the resulting sawtooth voltage has a peak value of 0.32 $E_n$ or 70 volts.

A second 6SN7 is employed in a variable clipper-differentiator circuit; the clipper grid is directly coupled to the plate of the sawtooth-generator tube. The cathode bias of the clipper is adjusted to allow grid conduction when the sawtooth voltage rises to 35 volts. Shortly before grid conduction begins, clipper plate conduction produces a sudden drop in clipper plate voltage.

The clipper plate voltage drives a differentiator - phase - reverser which gives a sharp 40-volt positive pulse, the position of which is determined by the clipping level. Fairly linear pulse position variation with clipper cathode-voltage variation was obtained over a range of $\pm 130$ degrees. The average clipping level, which is deter-
determined by the d-c cathode potential of the clipper, is made adjustable over a ±20-degree range, and the dial of the 5,000-ohm wire-wound potentiometer used to control the cathode d-c potential is calibrated linearly in terms of average channel output phase, which corresponds to antenna element current phase, over a range of ±180 degrees. The two 5,000-ohm rheostats in series with the calibrated potentiometer are used to adjust the 180 and −180-degree phase positions. The control dial is labeled PHASE.

**Spacing**

Modulation at a frequency of 60 cps simulates variation in φ and was achieved by means of a low-gain modulating amplifier, directly coupled to the cathode of the clipper. The second half of the first 6SN7 in the modulator section was used for this purpose. Excitation of the modulating amplifier was furnished by the secondary of a selwyn control transformer whose delta connected primary was excited by a three-phase 60-cps power source in the power-supply unit. The level of the 60-cps modulation was controlled by a 10,000-ohm wire-wound potentiometer in the grid circuit of the modulating amplifier. At the maximum setting of this potentiometer, the position of the modulator output pulse is sinusoidally varied over a range of ±100 degrees. This corresponds to a crest phase modulation of 900 degrees in the output of the element cascade-tripler amplifier, and therefore the dial controlling the potentiometer is linearly calibrated from 0 to 900 degrees. Crest phase modulation represents the spacing between the element and the reference element; hence the dial is marked SPACING. A series 5,000-ohm rheostat allows initial calibration of the spacing control.

The phase position of 60-cps modulating voltage is controlled by the shaft position of the selwyn control transformer. Deviation between rotor mechanical angle and secondary-voltage phase angle for 6.3 volt, balanced three-phase 60-cps excitation of the primary was found to be very small, and therefore permitted direct phase-shift calibration of the selwyn transform-
The control dials of the selsyn transformers were marked azimuth, as variation in the phase of the 60-cps modulating voltage corresponds to changes in the azimuth of the element $z_o$.

The output pulse voltage produced by the element phase-modulator drives the control grid of a 6SJ7 pentode operating as a class-C tripler amplifier. The sine-wave voltage produced across the tripler-amplifier plate parallel-resonant circuit has a center frequency of 300 kc and a phase-modulation crest three times as large as present at the output of the modulator.

The second tripler amplifier is capacitance coupled to the plate of the first and also uses a 6SJ7. The second tripler amplifier performs the function of output voltage control for the element channel. A linear 10,000-ohm wire-wound potentiometer is employed to control the screen grid d-c potential and hence the output voltage. A series 5,000-ohm rheostat is provided for initial adjustment.

The output voltage of the tripler was found to vary almost exactly with the square root of the screen-grid voltage; a linear dial calibrations was used for the voltage-amplitude control, and as the output-voltage magnitude simulates the antenna-element current magnitude (for equal-length elements), the dial was labeled CURRENT SQUARED.

The secondaries of the second tripler-amplifier plate transformers are connected in series and the combination is tuned to resonate at 900 kc. Although five tripler amplifiers are coupled to a common 900-kc mixing circuit, almost no cross-channel modulation exists; the angle of plate-current flow for the type 6SJ7 pentodes is very small and therefore their effective plate resistance is very high.

The indicator unit occupies the top chassis of the antenna analyzer. This unit, Fig. 6, includes a 5BP4 cathode-ray tube and high-voltage power supply, a linear sweep generator, a computer signal amplifier, and a polar converter.

If the rectangular presentation of the antenna-array radiation pattern is desired, the polar-rectangular switch is placed in the rectangular position. A 6SN7 in a direct-coupled amplifier circuit increases the computer output voltage. A potentiometer in the grid circuit permits control of the output signal voltage.

The computer signal amplifier is directly coupled to the vertical plates of the cathode-ray tube. Direct coupling is necessary to preserve the d-c component of the complex voltage wave that may be produced by the computer. The 60-cps linear sweep voltage applied to the horizontal plates of the cathode-

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**Vertical Radiation Pattern of an Unsymmetrical Three-Element Array**

Vertical radiation pattern of an unsymmetrical three-element array.
Ray tube is furnished by a type 884 gas-triode sawtooth generator followed by a 6SL7 amplifier.

Means are provided for the initial synchronization of the sawtooth generator and for the initial adjustment of sweep-voltage amplitude. Double potentiometers provide centering control for the cathode-ray tube. The cathode-ray tube is equipped with a rectangular coordinate scale, drawn on a blue plastic filter, to assist in pattern evaluation. If polar presentation of the antenna-array radiation pattern is desired, the rectangular-polar switch is turned to the polar position. The plate voltage of the linear oscillator and its amplifier is interrupted and screen voltage is applied to a double-balanced modulator circuit employing four 6L6-G tubes. The plates of the cathode-ray tube are directly coupled to the double-balanced modulator. The push-pull connected control grids of the balanced modulators are fed in quadrature from a 6.3-volt transformer secondary by means of a 90-degree phase-shifting network. The control grids are biased to produce plate-current cutoff for a screen voltage of about 20 volts. Screen voltage for the modulator tubes is provided by the computer signal amplifier.

If all antenna current-squared controls are set at zero, and the gain control of the indicator unit is set at about one-third full rotation, a circle will be produced on the screen of the cathode-ray tube. If other elements are introduced, the resulting figure will be more complex if the spacing controls are not set at zero.

The cathode-ray tube is equipped with a polar coordinate scale to assist in pattern evaluation. Sufficient gain has been provided in the unit to permit enlargement of minor lobes in complex array patterns. The polar presentation is not linear enough for computing work, but it is satisfactory for classroom demonstration and for first approximations in array design.

Power Supply

The power unit of Fig. 7 furnishes 6.3-volt 60-cps filament voltage, 6.3-volt 60-cps 3-phase for the four selsyn transformers, 220 volts d-c plate voltage, 165 volts control voltage, and 75 volts bias voltage for the computer and indicator units. The rectifier, voltage-regulator section is conventional.

Three-phase voltage for the selsyn transformers is obtained from two 6.3-volt transformers connected in open delta. One of the transformers is fed directly from the 117-volt line and the second is fed through a 60-degree constant-voltage phase shifter connected to the line. Switches provide separate control of filament and plate voltage.

Oscillograms of horizontal radiation patterns are given for two-element, three-element, four-element and five-element arrays.

If the oscillograms of the WBAA night antenna array radiation pattern are compared with the computed pattern, it may be seen that the error is relatively small. It is believed that the device will continue to be of value as a classroom teaching aid in antenna array study, and that the equipment is accurate enough to be employed for first approximation work by the broadcast-array design engineer.

The writer gratefully acknowledges the encouragement and guidance of Robert P. Siskind of the School of Electrical Engineering at Purdue University, under whose supervision this project was carried forward.

References

**RESISTANCE-CAPACITANCE oscillators** have seen wide use in the laboratory and elsewhere because of several important features, among which are compactness, excellent frequency stability, and a wide tuning range. Unfortunately their application has been restricted to audio and ultrasonic measurements with a top frequency of approximately 200 kilocycles. It is the purpose of this paper to describe a new but simple circuit that functions over the range from 20 cycles to 2 megacycles with good waveform and constant output.

In developing the new oscillator, the limitations of previous types were considered. The first, Fig. 1A, consists of an amplifier with two feedback paths; regeneration occurs at all frequencies, while the degenerative loop contains a parallel-T null network. Thus oscillation takes place at the null frequency. The principal disadvantages are that three circuit elements must be varied to change frequency, and that a two-stage amplifier is required to provide proper phasing. Phase shifts become important at the extremes of the frequency range, affecting frequency calibration.

A second oscillator, Fig. 1B, is somewhat similar to the first. However, degeneration is provided at all frequencies, while regeneration occurs through a half-Wien bridge, which exhibits a broad maximum in its response. Oscillation tends to occur at the frequency of the maximum, but the Q of the Wien circuit—about 0.8—is so low that phase shifts in the amplifier will affect the frequency calibration.

The phase-shift oscillator, one form of which is shown in Fig. 1C, contains a 180-degree network in a single feedback loop. Although it is the simplest of the oscillators described, functioning with a single tube, a minimum of three circuit elements must be varied to change frequency. Furthermore, it is found that an additional tube is required to provide suitable amplitude regulation, and that high-frequency operation is limited by the low impedance of the phase-shift network at the high frequencies.

**Circuit Development**

In an attempt to improve the oscillator of Fig. 1A, the bridged-T network of Fig. 2A was investigated. This simple network, which has been used for the measurement of high resistances at radio frequencies, has but four circuit elements, as compared with six for the parallel-T. Although a true null is not produced, a fairly-sharp minimum, accompanied by zero phase shift, occurs at

\[ R = \frac{1}{CR_2} \]

It is seen from Fig. 2B, that the selectivity is improved by increasing the ratio \( R_1/R_2 \). It can be shown that, for large values of \( R_1/R_2 \), the equivalent Q of the network approaches \( \frac{1}{R_1/R_2} \). Thus phase characteristics superior to those of the network of Fig. 1B are easily obtained, with consequent reduction in the effects of amplifier phase shift when employed in an oscillator.

A very useful feature of the bridged-T is that a trimmer capacitor (shown dotted) placed across the vertical arm will permit minor adjustment of \( w_0 \), where the capacitances \( C \) are small. Therefore, if capacitive tuning is used.
A simple resistance-capacitance oscillator with good waveform and constant output uses two tubes to produce 15 volts rms output. It covers the frequency range from 20 cycles to 2 megacycles in five decade ranges.

it is possible to adjust the upper end of a frequency range nearly independently of the lower end. This is helpful when the circuit is employed in an oscillator where a single dial calibration must suffice for two or more decade ranges.

Figure 2C is a simplified schematic diagram of the new oscillator, which consists of an amplifier, $V_n$, driving a cathode-follower, $V_f$. Regeneration is provided at all frequencies by cathode-to-cathode feedback through a lamp as a series resistor, while the degenerative loop contains the bridged-T network. Oscillation tends to take place at $\omega_0$, the frequency of minimum degeneration, while amplitude stabilization is provided by the positive-resistance-current characteristic of the lamp. The combination of amplifier plus cathode follower is ideal for this application because it provides wide-band operation with small phase shift and low output impedance.

Figure 3 is the schematic diagram of the compact oscillator illustrated. The frequency range, 20 cycles to 2 megacycles, is covered with a small dual variable capacitor, $C_C$, of the type used in broadcast receivers. A frequency ratio of 10 to 1 is covered in each range, while ranges are changed by switching resistors $R_s$ and $R_c$. The output is 15 volts rms from the cathode of $V_n$, remaining constant within one decibel at all frequencies. Although the distortion was not measured, it is believed to be very low, since oscillation will stabilize at an amplitude approximately one-third of that at which clipping occurs.

Certain circuit details are of considerable importance in obtaining proper operation of the oscillator. In making the initial adjustments the points marked $A$ and $B$ were opened to permit the voltage gain from the grid of $V_f$ to the cathode of $V_n$ to be checked. Positive feedback peaking is provided by $C_v$ which was adjusted for constant gain through two megacycles. In this manner, good phase response is obtained. The points $A$ and $B$ were then closed, and $R_s$ which controls positive feedback, was set for constant output with low distortion on all ranges. The low-frequency end of each range was set by trimming $R_s$, assuming that $R_s$ had the indicated value. It was found that the two low-frequency ranges covered the dial properly; however, it was necessary to employ $C_v$ to align the upper end of each of the high-frequency ranges. Additional switching was not involved because it was possible to leave a separate trimmer capacitor $C_v$ connected across each of the resistors $R_s$.

It should be noted that it is essential that the oscillator be well shielded to prevent synchronization with the line frequency and sub-multiples thereof. The unit described is built into a cabinet that also contains a power supply and output amplifier.

REFERENCES

(3) E. L. Ginotson and L. M. Hollingsworth, Phase-Shift Oscillators, Proc. IRE, 29, Feb., 1941
(4) P. G. Sulzer, The Tapered Phase-Shift Oscillator, Proc. IRE, 33, Sept., 1945
(6) P. M. Hornell, Bridged-T Measurement of High Resistances at Radio Frequencies, Proc. IRE, 28, Feb., 1940
(7) F. G. Sulzer, Circuit Techniques for Miniaturization, ELECTRONICS, Aug., 1945
EXPANSION of the facilities of industrial organizations such as power companies, railroads and pipe lines has created an increasing demand for point-to-point communication facilities for voice communications, supervisory control, telemetering, load control, protective relaying and allied functions. These functions can be carried out by using carrier equipment on power transmission lines, by telephone equipment on wire lines, or by the use of h-f and vhf radio. However, the crowding of the lower-frequency spectrum and the susceptibility of wire lines to outages in sleet storms and other bad weather make it desirable to perform many of these functions by using uhf radio equipment.

Many industrial firms view their electronic equipment as just another tool, such as a circuit breaker or lathe, with which to do a job. They do not expect to hire highly trained electronic personnel as operators and maintenance personnel. This user philosophy demands utmost dependability, maximum ease of adjustment, excellent accessibility for maintenance and low maintenance cost.

An analysis of possible customer applications indicated that most customer needs could be met with seven voice channels and that a large number could be met with as low as four voice channels. Based on this investigation, it was decided to develop microwave equipment operating in the 940–960 mc band, having a signal bandwidth of 30 kc, and to develop audio multiplexing equipment which could transmit seven voice channels in the 30-ke band. In applying the voice channels, several tones can be used in each channel to permit several functions to be carried out simultaneously.

A block diagram of the uhf transmitter and receiver is given in Fig. 1. The 6-mc phase-modulated crystal oscillator is followed by four tripler stages and a doubler output stage to get to the desired output frequency. The receiver is a double superheterodyne type with crystal-controlled oscillator and a tunable-cavity preselector at the input.

**UHF Transmitter**

A phase modulator was chosen for the transmitter because of circuit simplicity and because it permitted direct crystal oscillator control of frequency. A reactance tube may be used for phase modulation,
Communications System

Crystal-controlled microwave transmitter and companion double-superheterodyne receiver operating in 940-960 mc band provide seven voice channels for communication, telemetering and remote control, with maximum bad-weather reliability for public utility systems

but it has a disadvantage. The output circuit of such a reactance tube will ordinarily have inductive and capacitive components of admittance which are individually large compared to the conductive component. To minimize harmonic distortion, however, the variable reactive admittance introduced by modulation must at maximum modulation be small compared with the conductive component and therefore very small compared with the individual reactive component of the circuit admittance. Thus a very accurate tuning adjustment of the tank circuit is required to maintain the entire output circuit, including the reactance tube, normally conductive.

Variable Conductance

The phase modulator used is a variable-conductance type in which the reactive components of the output circuit admittance do not directly enter into the phase deviation. This results in a phase modulator which is not highly critical in adjustment for very low percentages of harmonic distortion. This phase modulator is inherently regenerative since its function is to provide a variable negative conductance, but circuit constants were selected which eliminated the possibility of oscillation.

The variable-conductance phase modulator is represented in the simplified diagrams of Fig. 2. Modulator tube $V$, varies the conductance of the load offered to the crystal oscillator tube by tank circuit $C_r-T_r$. The equivalent circuit in Fig. 2B shows that the modulator presents an admittance to terminals 1 and 2 that contains a negative conductance vector whose magnitude is proportioned to the transconductance $G_m$ of $V$. This admittance vector is then combined vectorally with the admittance of the load circuit to produce a susceptance vector whose angle is a function of the $G_m$ of the modulating tube. If the operating point of the phase modulator tube is selected so that $G_m$ is a linear function of modulation, then the phase of the current in the load circuit is a linear function of modulation.

Figure 2C is equivalent to Fig. 2B with $E'$ representing the modulating voltage. The following equations can be set up:

$$I_l = \frac{E}{R + j(\omega L' - 1/\omega C')} \quad (1)$$
$$I_p = G_m E' + E \quad (2)$$
$$E' = \frac{E}{R + j(\omega L' - 1/\omega C')} \quad (3)$$

If we combine these equations and, by proper design, make $1/\omega C'$ very much greater than $R + j\omega L'$, we obtain

$$Y = I_l + I_p = \frac{1}{R_p} - G_m \omega L' C' + j \omega C' \quad (4)$$

Since $G_m R$ is very much less than 1 and $\omega C'$ is very much greater than $G_m R \omega C'$, there remains

$$Y = \frac{1}{R_p} - G_m \omega L' C' + j \omega C' \quad (5)$$

We can now replace Fig. 2A with Fig. 2D, with $G_m$ representing the equivalent parallel conductance of $T$, including secondary loading. Here $-j/\omega L$ is the inductive susceptibility of the transformer, $j\omega C$ is the capacitive susceptance of all capacitances involved. $1/R_p$ is the positive conductance of the modulator tube, and $-G_m \omega L' C'$ is the negative conductance of the modulator circuit.

The vector diagram of Fig. 2E shows the addition of all of these admittances, giving a resultant sus-

Table 1—System Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuning range</td>
<td>940-960 mc</td>
</tr>
<tr>
<td>Transmitter output</td>
<td>5 watts</td>
</tr>
<tr>
<td>Transmitter spurious output</td>
<td>-60 db</td>
</tr>
<tr>
<td>Frequency stability</td>
<td>better than 0.005%</td>
</tr>
<tr>
<td>Receiver sensitivity</td>
<td>10 microvolts input</td>
</tr>
<tr>
<td>Receiver noise and distortion</td>
<td>-70 db</td>
</tr>
<tr>
<td>System intermodulation</td>
<td>less than 1%</td>
</tr>
<tr>
<td>Maximum channel attenuation permissible</td>
<td>-125 db</td>
</tr>
</tbody>
</table>

FIG. 2—Phase modulator, with equivalent circuits and admittance vector diagram
ceptance $R$ which varies by the angle $\theta$ as $G_\theta$ is varied by modulation. If $\theta$ is kept small enough so it is approximately equal to $\tan \theta$, then the phase of the oscillator current varies linearly with modulation.

The low-power multiplier (tripler) stages of the transmitter consist of push-pull triode tubes. Push-pull operation was chosen to eliminate even-order harmonics. A small amount of regenerative feedback (well below that required for oscillation) in each stage improves efficiency. Tuning components are selected so that the multiplier stages cannot be tuned to the wrong harmonic.

Mechanical and electrical features of the driver and output stages both using Lighthouse-type planar-element triodes, are shown in Fig. 3. The input (cathode) circuit of the driver stage extends outside the plumbing assembly and is adjustable inductance by positioning of the crossbar which connects between the cathode posts of $V_1$ and $V_2$. The heater and cathode d-c leads are contained inside the plumbing assembly and leave it at the r-f ground potential. The 480-mc output circuit of $V_1$ is a cavity tuned by $C_\omega$. An adjustable regenerative feedback control $C_\omega$ is provided to improve efficiency.

The 480-mc output of $V_1$ couples to the cathode input circuit of doubler amplifier $V_2$ through an orifice connecting the two cavities. This cathode input circuit is fixed tuned and is designed to be resonant below normal operating frequency. The $V_2$ output circuit is tuned by $C_{\omega}$ and also has a regenerative feedback control $C_{\omega}$ to improve efficiency. Output (940–960 mc) from this cavity is taken from loop $L_\omega$, which is normally connected to the transmitting antenna through coaxial cable. An additional loop, $L_{\omega}$, is provided for monitoring.

**UHF Receiver**

At the input of the receiver is a double-tuned cavity-type preselector. This unit, together with the last tube in the local oscillator multiplier chain and the detector crystal, is shown in Fig. 4. The inductances and capacitances indicated symbolically here actually consist of posts and diaphragms extending into and across the walls of a rectangular cavity. Thus, $L_{\omega}$ and $C_{\omega}$ represent one tuned circuit which is coupled by diaphragm $M_{\omega}$ to another tuned circuit represented by $L_{\omega}$ and $C_{\omega}$. These two tuned coupled circuits provide the selectivity desirable for discrimination against strong off-frequency signals from radar sets and other high-powered equipment which might shock-excite the cavity and damage the detector crystal.

Radio-frequency input to the cavity is obtained by means of a post represented by $L_\omega$, which is coupled to the two tuned circuits by another post represented by $M_\omega$. The plate

![FIG. 3—Mechanical and electrical details of plumbing used with Lighthouse tubes for driver and output stages of transmitter](image-url)

![FIG. 4—Receiver preselector, crystal mixer and last tube of local oscillator multiplier chain](image-url)
tank circuit of local oscillator multiplier tube $V_1$ comprises a post and tuning screw represented by $L_n$ and $C_n$. The incoming r-f signal from the double-tuned preselector circuit and the output from the local oscillator are coupled to the detector circuit by another post represented by $L_n$. To give further protection to the crystal detector against the possibility of excitation of the cavity by higher-frequency signals which might cause the cavity to resonate under some other mode, a low-pass filter consisting of $L_n$, $C_n$, and $C$, is inserted between the cavity output post and the crystal detector.

To facilitate tuning the preselector, a loading resistor can be placed in each tuned circuit of the cavity to load it so that the other section can be tuned independently. The cathode cavity of $V_n$, which acts as a tripler, is excited at about 340 mc from the local oscillator multiplier chain. The output of the crystal detector is at 67 mc.

Generally speaking, the larger the power output from a uhf tube, the shorter its life. This makes it desirable to limit transmitter power output to a minimum and obtain maximum range by increased receiver sensitivity. At lower frequencies, atmospheric noise usually limits sensitivity of receivers and we are forced to operate at very high transmitted power levels to get great range. In the uhf band, however, there is little atmospheric or man-made noise and the limiting noise usually is that generated in the receiver itself. With this in mind, the low-noise-figure amplifier of Fig. 5 was used as the first i-f amplifier of the receiver. The amplifier input circuit consists of a triode-connected 6AK5 which drives a grounded-grid 6J6 stage. This combination has the gain and stability of a pentode and the low input impedance of a triode, giving a very low noise figure.

The amplifier tank circuits are tuned by adjustable brass slugs. The coils are shunted by capacitors to minimize variations in tuning with variations in tube characteristics. These circuits are damped by 6,800-ohm resistors in the grid circuits of succeeding stages to obtain desired band-pass characteristics.

![FIG. 5—Details of 67-mc i-f amplifier, which feeds into second mixer stage to produce 10.7-mc second i-f value for further amplification](image)

The overall gain at 67 mc from the crystal to the second mixer grid is about 90 db. Remote-cutoff tubes are used and avc voltage is applied to prevent nonlinear operation of the receiver, giving adjacent-channel performance comparable with the overall selectivity.

The second mixer is a type 6J6 dual-triode, with the output signal from the 67-mc i-f stages fed to one grid and a local oscillator signal fed to the other grid. A common cathode inductance mixes the two signals to give a 10.7-mc output which is fed to the second i-f amplifier.

The 10.7-mc i-f amplifier assembly is largely conventional in design, using three 6AU6 amplifier stages operated with fixed bias. The gain per stage is about 25 db. The i-f transformers for these stages are slightly under-coupled and loaded to give the desired pass band.

The avc voltage for the 67-mc i-f amplifier is obtained from a dynamic limiter circuit, which is effectively a voltage doubler operating across the output of the last 10.7-mc i-f transformer. The avc voltage is delayed by the connection of a 1-megohm resistor to +150 volts. The avc bus is prevented from going positive by half of a 6AL5 diode connected to it.

Additional limiting at 10.7 mc is obtained in a grid bias limiter using a 6AU6 tube. This limiter is operated with a short time constant in its input grid circuit to enable it to handle high-frequency amplitude modulation produced by adjacent-channel signals.

The frequency discriminator is of the ratio-detector type. The transformer is tuned by a variable air dielectric capacitor in the primary and a powdered iron slug in the secondary. The fixed secondary capacitor is of the zero-temperature-coefficient type to minimize effects of changing temperature. A bifilar winding is used for the secondary to maintain good balance.

The audio-frequency amplifier consists of three stages—a pentode voltage amplifier, a pentode phase inverter, and push-pull pentode output tubes with cathode circuits provided with a means of balancing anode currents for minimum harmonic distortion. The amplifier is designed to give outputs up to +16 dbm with low distortion at frequencies up to 30,000 cycles.

After extensive laboratory tests, preproduction models of this equipment were installed on the property of the Pennsylvania Electric Corp. near Johnstown, Pennsylvania, and put in operation in February 1949. These sets have been operating on a 24-hour-a-day basis to supply voice communications, telemetering, supervisory control and protective relaying. The performance of the equipment in this field installation has proved its suitability for industrial communications applications.
MODERN commercial oscilloscopes in the medium price range are usually provided with a single sweep feature which makes possible the initiation of the sweep by an external triggering impulse. They are equipped with suitable arrangement for blanking the return trace but, where high writing speeds are required with consequent high beam intensity for photographic recording, the sensitized paper or film is exposed to an extremely strong background illumination caused by scattered electrons impinging on the screen when the beam is not actually producing a trace. The resultant fogging of the photographic material makes it difficult to obtain a clean-cut record.

This effect can be minimized by blanking the electron beam and releasing it only for the precise time interval required for the desired trace. A method for producing this result by the use of a flip-flop circuit has been described in the literature. This system depended on external triggering impulses to release the beam and to blank it subsequently. In the interest of greater convenience of operation, a method has been devised whereby the sweep itself can be used to release the beam and to blank it when the trace is completed.

**Circuit Diagram**

The complete circuit is shown in Fig. 1. It consists essentially of an isolating amplifier $V_1$, coupled to a cathode follower $V_2$ through a circuit composed of $C_3$, $C_5$, $R_3$, and $R_5$ which, in conjunction with $C_2$, controls the length of the release interval. In the cathode circuit of $V_2$, capacitor $C_5$ delays the release of the beam until the nonlinear portion of the beginning of the trace has passed. Tube $V_3$ is a double triode with the elements paralleled to yield a cathode follower which will develop a high amplitude pulse in the low impedance circuit which it drives.

The cathode of $V_3$ is direct coupled to one grid of the flip-flop tube $V_4$. The values of $R_6$ and $R_4$ are selected so that $V_4$ receives proper grid bias, and at the same time the cathode of $V_3$ is at the correct potential for the input grid of $V_4$ when the left side of $V_3$ is in the nonconducting condition. Tube $V_4$ couples the flip-flop tube to the grid of the c-r tube and at the same time allows for the introduction of a Z-axis signal when desired.

The operation of the instrument is straightforward. When $R_4$ is adjusted properly and no sawtooth wave is coming through from the oscilloscope sweep circuit, the right side of $V_4$ is conducting, which causes the potential at the plate of this section to assume a relatively low value. This potential appears at a terminal which is connected to the grid of the c-r tube, making this grid about 100 volts negative with respect to its cathode. As a result the beam is blanked.

The negative segment of the oscilloscope sweep sawtooth is used to release the beam; the positive segment blanks the beam after an adjustable delay. Figure 2 shows the approximate release and blanking times. Potentiometer $R_7$ controls the input from the oscilloscope sweep circuit and should be adjusted to give $V_4$ sufficient drive but not enough to cause it to draw power from the positive portion of the sawtooth. The timing circuit made up of $C_3$, $C_5$, $R_7$, and potentiometer $R_8$ controls the duration of the beam release interval by varying both the amplitude and the buildup time of the positive pulse on the grid of $V_4$. The positive pulse developed in the cathode circuit of $V_4$ is unblanked only for center portion of the sweep.

---

**FIG. 1**—Because of direct connection to high voltage CRT elements, isolating capacitors are required. Circuit B— is not connected to chassis

**FIG. 2**—Cathode-ray tube beam is unblanked only for center portion of the sweep
For Oscilloscopes

Eliminates background fogging caused by scattered electrons impinging on sensitized paper before and after trace in high-speed high-intensity single-trace oscillography. Unit may be attached to standard oscilloscope. Also provides for Z-axis modulation.

Choice of Capacitors

Since most commercial oscilloscopes are arranged so that the second anode and the deflection plates are essentially at ground potential, it follows that the grid and cathode must necessarily operate at a large negative potential with respect to ground. For this reason considerable care must be used in insulating the beam-blanking device from ground and from the power line. Capacitors C1 and C2 in Fig. 1 should have ample voltage rating; in the present instrument they are 2,000-volt oil-filled units. The B+ supply could use a special power transformer with primary-secondary insulation adequate for 2,500 volts. In this instrument a 1-to-1 isolating transformer was used in conjunction with an ordinary small power transformer. The beam-blanking device was assembled in a metal cabinet. The top of the metal chassis was cut away leaving only a narrow rim to support a sheet of Bakelite on which were mounted the various components. The two controls which project through the front panel were carefully insulated from the chassis and the front panel. As a final precaution the metal chassis and cabinet were grounded.

A word of caution is in order with regard to the possibility of capacitors being incorporated in the grid-cathode circuit of the oscilloscope on which the beam blanking device is to be used. The presence of any considerable amount of capacitance at this point will affect the shape of the square wave from the flip-flop circuit so that the intensity of the trace will vary markedly during the time the beam is released. The ideal situation is obtained with a pure resistance network supplying the c-r tube grid bias, and on which the bias from the beam blanking device is superimposed.

The present version of the instrument was provided with standard Amphenol fittings so that it could be attached to any one of several oscilloscopes as the need arose. Removal of the beam-blanking device from an oscilloscope simply leaves it operating in the conventional manner. The delay circuits can be modified to suit individual requirements. The work for which this instrument was constructed required trace durations ranging from 0.001 to 0.020 second with a repetition rate of three traces per second.

Figure 3 shows samples of records made with and without the blanking device.

REFERENCE

Checking valve threads of industrial vacuum system for leaks, using helium-emitting probe and helium leak detector made by Consolidated Engineering Corp.

Interior of helium leak detector. Cold trap is being filled with refrigerant.

LEAK DETECTORS
for Industrial Vacuum Systems

Analysis of eight methods of locating and measuring leaks, and repair techniques. Major emphasis is on the helium leak detector, which rapidly indicates by meter and audio tone the presence of helium ions inside a leaky system when helium gas is applied outside

The locating and repairing of leaks in vacuum systems is probably the most troublesome aspect of high-vacuum technique.

The ideal leak-detecting method should be capable of measuring total leakage and isolating individual leaks, should be rapid in response, should not seal the leak more than momentarily, should be highly sensitive, should be capable of application to any vacuum system without loss of vacuum if necessary, and should make use of equipment that is relatively simple and inexpensive to procure, maintain and operate. It is also highly desirable that the instrument used be selective, so that it gives nearly a zero reading for air and residual gases and responds only to a probe material.

A large number of leak detection methods have been reported in the literature or have come into use in various laboratories without being made generally available. Some of the most useful of these methods are summarized in Table I. Several are limited in sensitivity primarily by the type of indicating device used. Most of the methods are not particularly suitable for obtaining an accurate determination of the size of a leak. However, in many cases this is not too important, the problem being to locate and repair the leaks as rapidly as possible.

Each of the eight methods listed in Table I has its place in vacuum technique, but the helium leak detector is the most generally useful for locating vacuum leaks rapidly.

By ANDREW GUTHRIE
Associate Professor of Physics
San Jose State College
San Jose, Calif.

September, 1950 — ELECTRONICS
Table I—Methods of Locating Leaks in Industrial Vacuum Systems

<table>
<thead>
<tr>
<th>Method</th>
<th>Technique</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spark coil over outside of system</td>
<td>Pass high-potential electrode of spark coil over outside of insulated, transparent portion of system. Find leak: (a) spark passing through leak; (b) change in color of discharge when material such as ether, alcohol or CO₂ passes through leak.</td>
<td>Cannot be used on all-metal systems. Useful pressure range limited by need for glow discharge (few mm Hg to around 5 × 10⁻⁷ mm Hg).</td>
</tr>
<tr>
<td>Discharge tube</td>
<td>Tube is attached to system, usually between mechanical and diffusion pumps (adequate pressure). Find leaks as in method (b) above.</td>
<td>Same pressure limitation as above. Greatest sensitivity for probe material with high rate of diffusion (CO₂ is satisfactory).</td>
</tr>
<tr>
<td>Rate-of-rise measurement</td>
<td>Isolate portion of system in which leak is suspected and measure rate-of-rise of pressure. Can be used to determine presence of leaks in pumping system.</td>
<td>Slow in application. Great sensitivity if sufficient time allowed. Must use suitable pressure-indicating device.</td>
</tr>
<tr>
<td>Over-vacuum or evacuated hood</td>
<td>Pressure is reduced on portions of outside surface of system. Leak is indicated by drop in pressure of system. Must use appropriately shaped hoods to seal outside surface. (pumped down by roughing pump).</td>
<td>Must use suitable pressure-indicating device. Application limited by problem of devising hoods to fit irregular or curved surfaces.</td>
</tr>
<tr>
<td>High-pressure inside system, appropriate indicator outside</td>
<td>Increase pressure inside system (determined by mechanical construction). Large leaks are found with gas hissing or wavering of flame over leak, or with liquid-wetting of surface around leak. For small leaks, use gas and: (a) Soap surface bubbles; (b) immerse portion of system in water bubbles; (c) halide vapor inside, torch over outside, and note change in color of flame. Also, with one chemical vapor inside, another outside, observe reaction at leak.</td>
<td>Immersion in water very good for testing parts before assembly. With gas, greatest sensitivity is for gas with high rate of diffusion (He, H₂). Soap solution likely to clog small leaks temporarily.</td>
</tr>
<tr>
<td>Partial vacuum inside system, soap solution applied inside</td>
<td>System is partially evacuated. Observer (with oxygen mask) goes inside and applies soap solution to suspected portions. Leak is indicated by soap bubble.</td>
<td>Limited to large vacuum systems. Need for great care to avoid danger to observer.</td>
</tr>
<tr>
<td>Sealing substance on outside, change of pressure inside</td>
<td>Apply sealant (permanent or temporary) over outside surface and observe change in pressure inside. Permanent sealants are glyptal, lacquers, aliphatic in alcohol, etc. Temporary sealants are water, acetone, ether, etc. For ether, vapor replaces air. Effect on pressure depends on indicating device.</td>
<td>For temporary sealants. Best results with material having high diffusion rate. Permanent sealants not dependable.</td>
</tr>
<tr>
<td>Change in pressure or nature of gas inside system, probe gas outside</td>
<td>Similar to previous method. Use permanent gas instead of vapor. Observe change in pressure inside. Helium leak detector is example.</td>
<td>Sensitivity depends on gas used—should have high rate of diffusion. Also depends on nature of pressure—indicating device.</td>
</tr>
</tbody>
</table>

For this reason, emphasis in this article will be on the helium leak detector and its predecessor, the vacuum analyzer.

**Vacuum Analyzer**

In certain processes a knowledge of the residual gases in a vacuum system may be of great value to an understanding of the process in question. The apparatus giving this information should be semi-quantitative in action and should be suitable for continuous operation. Such an apparatus was developed at the Radiation Laboratory, University of California, in connection with the electromagnetic separation of uranium isotopes. This instrument provided much useful information regarding the nature of gases and vapors inside the vacuum system, but it was not particularly suited to routine leak hunting. Modifications resulted in the helium leak detector, which was designed specifically for routine leak hunting.

Since the vacuum analyzer is the forerunner of the helium leak detector and the basic principle involved is the same, it will be worth-while discussing the former instrument briefly. The vacuum analyzer is a small-radius spectrometer using a cold-cathode ion source for the production of positive ions, and cathode-ray scanning for a detector.

Figure 1 illustrates the general nature of the instrument. The analyzer was designed to be mounted on a port in a large vacuum tank, which was in a uniform magnetic field. Two collector slots are provided so that an extended mass spectrum (mass 1 to 50 approximately) can be obtained without an excessively large range.
of ion accelerating voltage.

The vacuum analyzer is operated as a 180-degree mass spectrometer with a sweep voltage superimposed on the ion accelerating voltage so as to sweep the various mass peaks across the collector slots, for observation with an oscilloscope.

**Helium Leak Detector**

The design of this instrument is directed toward obtaining a portable self-contained unit for the detection of helium atoms introduced into a vacuum system in the process of leak hunting. To satisfy this requirement, a portable magnet and pumping system must be provided.

Only one collector slot is used, since only helium ions are detected. These ions are collected at about 180 degrees, as shown in Fig. 2. The output current is approximately $5 \times 10^{-4}$ amperes per 1 part of helium in 75,000 parts of air. These values and the description to follow are based on the helium leak detector developed and used at the Radiation Laboratory, University of California. Commercially available instruments differ in detail but the fundamental principles of operation are the same.

The tank of the helium leak detector is supported by the vacuum line, as indicated in Fig. 2. The ion source and collector, as well as a baffle at the 90-degree position, are attached to the tank faceplate which is constructed of nonmagnetic material (brass). The inside of the chamber is covered with a silicone lacquer baked so as to minimize the cleaning problem and reduce the absorption of moisture. The sidewalls of the chamber are constructed of magnetic iron $\frac{1}{2}$ inch thick, which constitute the magnetic-pole faces. The inside spacing of the walls is 1$\frac{1}{8}$ inches.

To obtain maximum sensitivity, a suppressor grid is put in front of the collecting slit as shown in Fig. 3 and tied electrically to the anode. Grounded shields must be used on both sides of this grid. The grid serves to block out low-energy ions due to gas scattering and increases the signal-to-background ratio by a factor of about 5.

The magnet consists of two four-inch-long Alnico slugs, each 4 inches in diameter on one end and 5 inches in diameter on the other, which are mounted on an iron return path having a cross-section of about 16 square inches. The slugs are wound with 100 feet of No. 12 wire, or about 125 turns, which can be used to give up to 2,700 gauss over a 1-inch gap 6 inches in diameter. The overall weight of the magnet is about 200 lb.

The positive-ion source consists of two cathodes separated by about $\frac{1}{8}$ inch in the direction of the magnetic field (length of discharge), with a hollow cylinder between these cathodes serving as an anode. The principle of this ion source is simply that of the Philips ionization gage. The cathodes are tantalum or tungsten to minimize wear. The ions enter the grounded spectrometer box through a ½-inch long slot in the anode (along the magnetic field) with an energy given by the potential of the discharge plasma (essentially anode potential) with respect to ground, plus or minus their random energies. The accelerating slit is about $\frac{1}{4}$ inch long and $\frac{1}{4}$ inch wide. The ion
source must give a sufficient supply of ions at pressures at least down to \(10^{-7}\) mm Hg, and the ion beam must be sufficiently homogeneous in energy so that the desired resolution is obtained.

The arrangement used for the main units of the vacuum system is shown in Fig. 4.

### Circuits

Amplifiers and power supplies for the helium leak detector are arranged as in Fig. 3, for use with the pumping system of Fig. 4. The high-voltage supply for the ionization gage should give voltages up to about 2,000 volts; a half-wave supply with RC filtering is adequate. The accelerating supply voltage is determined by the field and radius chosen; current requirements are quite low, but voltage regulation should be good to within a few percent. The preamplifier, shown in Fig. 5, is in a spring-suspended box near the leak detector tank, thus damping out vibrations and keeping the input capacitance low. The signal is fed to a 9001 pentode, followed by a 9002 tube used as a cathode follower. Feedback is used to give an improved signal-to-noise ratio.

The main amplifier consists of three stages of conventional resistance-coupled amplification (not shown), feeding the vertical deflecting plates of a cathode-ray tube. In addition, a double-diode rectifier tube is used to block one-half of the signal cycle so that both the forward and return sweeps will not appear simultaneously on the c-r tube. The horizontal sweep of the c-r tube is a sine wave in phase with the sweep inside the leak detector tank, which is also a sine wave. When an external scope is used, it is synchronized to 60 cycles, and the helium peak appears as a single peak but not necessarily in the middle of the trace.

The squealer and meter circuits used as indicators are shown in Fig. 6. The output signal from the a-c amplifier is fed to triode \(V_1\), which serves as a signal limiter to protect the meter that follows. The output of \(V_1\) goes into a filter circuit that removes all frequencies but the signal frequency. The net effect of this circuit is that random frequencies average to zero on the two sides of the meter, but a 60-cycle signal in phase with the 60-cycle voltage on the grids of \(V_1\) averages positive on one side of the meter and negative on the other and hence gives a net d-c deflection. The effects of signals of various frequencies are shown in Fig. 7.

The signal from one of the plates of \(V_1\) in Fig. 6 is put into one half of \(V_2\), and the output voltage then goes to a relaxation oscillator made up of \(C_1\) and a neon lamp. The oscillator tone signal, about 1,000 cps, goes through one stage of amplification for phones and two stages for a speaker.

### Leak Detector Sensitivity

Using reasonable care in operation, the helium leak detector should be capable of detecting 1 part of helium in 200,000 parts of air. The sensitivity is limited by base noise level, which is due to noise inherent in any a-c amplifier, pickup of stray frequencies near the signal frequency, ion background from elements other than helium, and a helium background of at least 1 part in 670,000 (normal atmospheric concentration) and often greater due to contamination and leaks.

An arbitrary criterion for the limiting sensitivity has been the mixture ratio of helium in air that gives a deflection twice the noise level. To determine the sensitivity...

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**Fig. 4—Pumping system used with helium leak detector**

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**Fig. 3—Electrical system of helium leak detector**

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preciable response at the indicating meter. Delay may occur in the regions outside the vacuum wall, inside the vacuum system and in the indicating circuits.

Any large volume between the point of application of the helium and the leak itself may result in very long time delays. For example, in the case of water lines hours may be involved. However, if helium flows in one end of the line and out the other until the line is filled, then the response is immediate. The line can then be cleaned out by blowing air through it. With a pump-out a good procedure is to apply helium under pressure, release the pressure and repeat the cycle. The helium can then be removed by a roughing pump. By noting the speed of response and cleanup it is often possible to say immediately that the leak is or is not at a certain place, thus greatly speeding up the leak hunting.

The exact methods to be used in applying helium depend on the circumstances and the alertness and ingenuity of the operator. For rapid movement of helium from leak to detector, it is necessary to have small volumes, low pressure, fast pump lines, and fast pumps. A compromise must be made between small volume and fast pump line.

**Leak Hunting**

The helium leak detector tank must operate at a pressure of about 1 \( \mu \) Hg. By connecting the leak detector between the mechanical and diffusion pumps of the system being studied, enough gas can be bled off to raise the leak detector to its operating pressure. The pressure is adjusted to its proper value with the bleeder valve (Fig. 4). Although the gas going through the main mechanical pump is many thousand times greater in amount than that going through the leak detector, the compositions are the same. The instrument actually continuously samples the gas in the main vacuum system for helium. The instrument could be set for gases other than helium. Helium is used because it is light and hence diffuses rapidly into a leak, is relatively cheap and readily available, and cannot explode or catch fire.

The overall leak of any unit is most conveniently found by using a hood and flooding the interior of the hood with helium. The reading of the leak detector will depend on a number of factors, including size of leak and amount of helium in hood. Specific rules as to procedure must be set up for each installation where hood testing takes place and these should be followed exactly by the operator.

For specific leaks, a probe should be used. This should be designed with a long flexible line from the helium supply, with means for control of the flow and with a long narrow tip for differentiation between near-by parts. The hunt should usually be started by using a moderate flow of gas that is easily felt on the hand. It can then be played over broad areas without too close attention to detail. When some indication is noted, the helium stream can be turned down to a fine one and the indication followed to the leak itself.

Helium being lighter than air, it is necessary to start at the top and work down. Various means of isolating portions of the system, including the use of hoods, can be used. Because of the rapid diffusion of helium, it is necessary to use a small stream of gas and move the probe slowly in the vicinity of a leak to get a maximum indication. The method of applying helium will depend to some extent on the mechanical design of the vacuum system being studied.

For convenience in observing the response of the instrument, the observer can use a portable meter in series with the fixed one or a headphone or portable speaker connected to the squealer circuit. A headphone is particularly convenient since it is effective in a noisy environment and it frees the eyes and hands of the operator for leak hunting. The speaker or headphone should be provided with volume and threshold adjustments. The threshold adjustment allows the operator to set the base tone to something not too objectionable to his ears.

**General Procedure**

Suppose that a large all-metal industrial vacuum system is roughed down after having been let down to atmospheric pressure or after some major accident. If the pressure is much over 100 \( \mu \) Hg, the diffusion pump cannot be turned on. The first step is to try to find the general region of the system in which the leak is located. This is best done by isolating certain parts of the system from the fore pumps by

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*FIG. 5—Preamplifier with high input impedance, fed directly from collector electrode of leak detector.*

*FIG. 6—Arrangement used for meter and leak-indicating squealer. Input is from output of three-stage amplifier fed by preamplifier of Fig. 5.*
means of valves and taking rate-of-rise measurements. The main part of the vacuum system, including the diffusion pump, should first be isolated from the fore pump. If there is no indication of a leak in the main vacuum system, the oil in the mechanical pump should be inspected, since it may be low or contaminated.

Once it is fairly clear that there is a leak in some portion of the main vacuum system, check such obvious sources of leaks as gasket seals, which should be tightened. If this gives negative results, a Pirani gage and a gas such as methane, propane or helium could be used. Also, the system can be tested under pressure, using air or helium and soap, helium and a leak detector, or any of the other methods already discussed. Once the pressure indicated by the McLeod or Pirani gage reads below about 100 μ Hg, the diffusion pumps can be turned on.

If, after the diffusion pumps have been on for an adequate length of time, the pressure is too high to be read on a pressure-measuring device such as an ionization gage or for the operation of a helium leak detector directly connected to the system, it will be necessary to resort to one of the other types of leak-hunting procedures in Table I. If the difficulty lies in the diffusion pumps, this can usually be proved by isolating the vacuum system from the diffusion pumps and taking a rate-of-rise measurement. After the pressure has dropped to a point where such gages as the ionization gage can be used but is still too high for operating the process in question, probably the most rapid method is the use of helium for probing the outside surface of the system in conjunction with a leak detector. If such an instrument is not available, one of the other methods such as the application of a gas outside with an ionization gage or other suitable gage reading the response inside can be used.

A knowledge of pumping speed and the geometrical form and arrangement of the vacuum system can be used to get some idea of leak size by calibration against a known leak. Experience with a given system is useful in estimating leak size.

Probably the best method for determining accurately the size of leak is the rate-of-rise measurement. This involves pumping down the system, closing it off, and noting the rise in pressure in the known evacuated volume over a period of time.

**Repairing Leaks**

The most frequent sources of leaks in a vacuum system are the gasket seals, flare fittings, solder seals and welded joints. If a leak is located in a rubber gasket, the gasket should be tightened but not too much. When this procedure fails to stop the leak, the system should be shut down and the gasket examined. If the gasket is in bad shape, it should be replaced. However, it is often sufficient simply to clean it and the surfaces that it meets. Vacuum greases can be used if the pumping speed of the system is adequate. It is advisable to try to stop leaks in gaskets with some sealing material such as glyptal, as such a repair is usually only temporary and ruins the gasket.

Flare fittings are constructed of a soft metal, usually copper, which gives enough when two surfaces are compressed against each other to provide a vacuum seal. If a leak is found in a fitting, the nut by which the compression is obtained can be tightened moderately. Tightening too much is likely to twist the tubing passing into the fitting. If tightening fails to stop the leak, it will be necessary to break the joint open. Annealing the copper flare will almost always give a tight seal. If this is not practical, a thin coating of glyptal can be applied to the surfaces that make contact.

In solder seals and welds, if the leaks are small enough so that the vacuum system is very near operating pressure, clear glyptal can be used. On leaks too large for that, but small enough so that the pressure goes down to diffusion-pump operation, red glyptal can be used sparingly. It is advisable to make every effort to locate the leak accurately before applying glyptal indiscriminately. Leaks that are too large to be stopped by the above methods should be repaired by remaking the solder seal or weld that is at fault or by replacing a portion of the vacuum system that includes the leaks.

In the case of glass components of a vacuum system, leaks usually occur in glass-to-metal seals, glass-to-glass joints, cracks in the glass, and stopcocks. In the case of glass-to-metal seals, the repairing procedure depends on the nature of the seal. For wax seals it is sometimes necessary to rework the seal or replace it. In other cases the application of some sealing compound such as glyptal is adequate.

Leaks in glass-to-glass joints or through cracks and pinholes in a glass section of the system, if small enough, can be repaired by the use of materials such as glyptal, which can be applied at room temperature. Often a wax can be used (such as picein) by heating the glass and pouring the wax over the leak. If the leak is too large, it will be necessary to rework the glass or replace the part of the system where the leak is located.

Much of the material in this paper is based on Chapter V of “Vacuum Equipment and Techniques”, by A. Guthrie and R. K. Walkerling, a volume in the National Nuclear Energy Series, published in 1949 by McGraw-Hill Book Co.
Phase-To-Amplitude Modulation

System saving cost, size and weight, applied experimentally to a 150-watt 530-mc television transmitter, shows promise for use with high-power tubes such as the resnatron. Dual phase-modulator tube simplifies equipment.

Phase-to-amplitude or out-phasing modulation offers an effective means for amplitude modulating very large amounts of power using small receiving-type tubes as modulators. For example, KFBK in Sacramento, California, employs six 6JS receiver triodes to modulate a standard 50-kilowatt a-m broadcast transmitter with resulting economy of space, initial cost and operating expense.

This system was invented nearly twenty years ago by Henri Chireix, who successfully applied the principle to several large European broadcast stations. Recent tests in this country on an experimental 150-watt 530-mc television transmitter indicate the feasibility of 50-kilowatt uhf television transmitters utilizing presently known techniques, including such tubes as the resnatron.

System Operation

A phase-to-amplitude a-m transmitter is in reality two identical phase-modulated transmitters driven from the same crystal oscillator, and fed into a common antenna. For the peaks of the amplitude modulation cycle the two channels are arranged to be in phase and a maximum amount of r-f power is delivered to the antenna. During the modulation troughs the two channels are swung out of phase so that the outputs effectively cancel.

Figure 1 shows the vector relations encountered at the antenna at three successive instants during a sinusoidal modulation cycle. If equal output currents \( I_1 \) and \( I_2 \) are caused to vary in phase so that phase shift in one channel is always accompanied by an equal but oppositely directed phase shift in the other channel, it can be seen that the vector sum of these two currents will vary in amplitude but not in phase, as a function of the relative phase angle \( \theta \). This resultant current is the one which is fed to the antenna.

The use of this principle permits building amplitude-modulated transmitters in which all amplification is done at relatively high efficiency in saturated class-C amplifiers, and which require no modulation transformers or other high-level modulation equipment. For a large standard broadcast transmitter the elimination of the massive modulation transformer and reactor alone results in a very large saving in physical size and initial cost of equipment.

Suitability for Television

The elimination of the modulation transformer permits a phase-to-amplitude modulated transmitter to be fully modulated down to zero frequency, if necessary, and to an upper frequency limit determined only by the r-f bandwidth of the power amplifiers. This feature makes the system appear quite attractive for obtaining high-power television signals. The video modulation can be inserted at low level, on the order of a few watts, yet the succeeding r-f amplifiers do not have the critical biasing requirements of the linear amplifiers which are usually associated with low-level modulation systems.

During the past year an experimental uhf television transmitter utilizing this system has been built for the Pacific Video Pioneers in...
For UHF-TV Transmitters

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Long Beach, California. This transmitter is now on the air in Long Beach on a carrier frequency of 530 mc. The peak power output of the unit is 150 watts. Although at present it is being used at this power level, just as in the case of f-m transmitters, all of the modulation equipment necessary for operation at any power level is present, and it is hoped soon to use the present unit merely as an exciter for succeeding r-f power amplifier stages.

The choice of tubes which can be used to go on to higher power is made easier by the fact that there is no amplitude linearity requirement placed on these amplifiers. High-power traveling-wave tubes, klystrons, resonatrons, and other similar devices which are difficult to modulate by any other method, should be ideally suited for use in a phase-to-amplitude modulated television transmitter.

Figure 2 is a block diagram of the present 150-watt UHF transmitter. The crystal oscillator output is multiplied up to a power level of about four watts at 265 mc. There it divides to go through the two halves of a twin-channel phase modulator, each side of which is capable of linear modulation up to ±22.5 degrees. The two-watt output of each phase modulator is then doubled in frequency and amplified to 75 watts power level in two 4X150A coaxial cavity stages. These two 75-watt 530-mc signals, which are constant in amplitude but varying in phase, are then fed into the common antenna. There they combine to produce a resultant 150-watt output wave which is constant in phase but modulated in amplitude. The function of the dummy load shown on this diagram will be discussed later.

A phase-to-amplitude transmitter can be functionally divided into three major sections: a twin-channel phase modulator, a radio-frequency power amplifier section, and an output combining network. The operation of the transmitter is easier to visualize by starting at the output end and working back to the crystal.

Output Combining Network

As one might suspect, the full story on the power-combining process is not quite as simple as the basic vector addition discussed earlier. There is a troublesome reactive component introduced by the relative phase of the drive voltages and the common load current.

Consider a phase-to-amplitude transmitter in which the final stages of the two-phase-modulated channels are connected in series in order to feed the common load resistance by means of the link coupling arrangement shown in Fig. 3A. The two channel voltages \( E_1 \) and \( E_2 \) add vectorially to produce a resultant voltage \( E_\text{r} \) which is effective in driving current through the load \( R_L \). It can be seen that

\[
E_\text{r} = 2E_1 \cos \theta/2 \tag{1}
\]

where \( \theta \) is the relative phase angle between the two channel voltages.

Since \( R_L \) is resistive, the common load current \( I_L \) circulating in the series circuit will be in phase with \( E_\text{r} \). Channel No. 1 is then putting out a voltage of \( E_1 \) but has a current of \( I_L \) flowing through its link coil. Since \( E_1 \) leads \( I_L \) in phase, this channel sees an inductive load. Channel No. 2 on the other hand, puts out a voltage of \( E_2 \) but has a load current of \( I_L \) and thus sees a capacitive load impedance. These reactive components effectively de-
tune the final tank circuits and if left uncompensated would reduce the plate-circuit efficiency of the final amplifiers in approximate proportion to the power factor of the load. This power-factor angle varies over the modulation cycle so that no static correction can be made which will be effective at all times.

It is possible judiciously to detune the final tank circuits, one to the inductive side and the other to the capacitive side in order to compensate completely for the reactive power somewhere near the middle of the modulation cycle. This is the procedure normally followed in low-frequency transmitters. With such an adjustment the power factor, and consequently the efficiency, will be found to remain high over the peak half of the modulation cycle.

The load power factor will then become very poor near the modulation troughs, but there the total power being handled is low and the actual power loss is small. Because of interaction of the two final circuit adjustments the actual detuning procedure is in practice rather critical and has not yet been attempted at uhf.

There is one further complication. The foregoing discussion has assumed that the output of each final amplifier remains constant in amplitude while varying in phase. Since the power drawn out of these constant voltage output stages varies over the modulation cycle it can be seen that with such an output connection the phase-to-amplitude system is in reality a load impedance modulation system. It is very much the same as if one had a frictionless and inertialess link-coupling device between the transmitter and its load. Amplitude modulation could then be accomplished by swinging the link back and forth, a process which would require no modulator power.

When confronted with such a widely varying load impedance the output voltage regulation of a normal class-C amplifier is quite poor. This is especially true near the no-load condition where the peak r-f plate voltage can rise to several times the applied d-c voltage. The result is a curvature of the modulation characteristic and danger from high-voltage breakdown unless steps are taken to regulate the final tank voltages.

**Dummy Load**

At the cost of somewhat reduced overall efficiency there is a simple way of completely overcoming both the reactive detuning problem and the voltage regulation problem. In Fig. 3B another output winding has been added to each final tank coil. These two new windings are connected in series and feed power to a dummy load resistor in such a manner that when $E_1$ and $E_2$ are series aiding, $E'_1$ and $E'_2$ are in series opposition. The vector diagram shows the resultant voltage across the dummy load to be a sinusoidal function of $\theta / 2$.

$$E'_{\text{RL}} = 2E_1 \sin \theta / 2$$

(2)

From Eq. 1 the power into the useful load at any time is

$$P = \frac{4E_1^2 \cos^2 \theta / 2}{R_L}$$

(3)

Similarly, the power into the dummy load is

$$P' = \frac{4E_1^2 \sin^2 \theta / 2}{R_D}$$

(4)

If $R_L = R_D = R$, then the total power drawn from both final amplifiers is the sum of 3 and 4;

$$P_{\text{total}} = \frac{4E_1^2}{R} (\sin^2 \theta / 2 + \cos^2 \theta / 2)$$

$$= \frac{4E_1^2}{R}$$

(5)

Equation 5 states that the total power drawn from the final amplifiers with the circuit arrangement shown in Fig. 3B is constant. The power is smoothly shifted back and forth between the antenna and the dummy load in accordance with the relative phase between channels which is determined earlier in the transmitter. Further analysis shows that the inductive component introduced by one load is exactly compensated by the capacitive component of the other load so that each looks into a load impedance which is resistive and constant during all parts of the modulation cycle.

The series voltage addition which has been discussed thus far is rather difficult to handle physically with coaxial lines, so that in the actual transmitter, instead of adding two constant-voltage generators in series, use is made of the quarter-wave transmission line property that such a line when fed with a constant-voltage generator at one end looks like a constant-current generator at the other end. These constant-current generators can then be combined parallel.

Figure 4 shows the actual configuration used in the present uhf transmitter. The constant voltage outputs from the two final stages are fed into terminals A and C. The top two $\lambda / 4$ lines transform these into constant-current generators which are combined in shunt to feed current to the antenna. The other half of the network takes the place of the second windings shown in Fig. 3B. Two more $\lambda / 4$ lines provide the constant-current generators and an extra $\lambda / 2$ added to one of the lines gives the necessary 180-
degree phase reversal.

The network shown in Fig. 4 then has the useful property of converting phase modulation to amplitude modulation. Its input impedances are resistive and constant regardless of the relative phase angle between the two input voltages. The input resistances equal the load resistances when the Z1 of all the lines in the network is \( \sqrt{2} R \).

Figure 5 shows the modulation linearity to be expected from the phase-to-amplitude system. It has already been pointed out that this curve of volts to the useful load versus the relative channel phase angle is cosineoidal. For speech or sine-wave modulation all operation must be restricted to the linear portion of this curve. Television video waveforms offer less of a problem, for although the transfer characteristic is quite curved near the top part, it departs from a straight line by less than 4 percent over the first 75 percent of its total amplitude. Thus, for television the full swing of a phase-to-amplitude transmitter, from completely out-of-phase to completely in-phase operation, can be utilized. The picture information which occupies the lower 75 percent of the composite video waveform falls on the more linear portion of the transfer characteristic and a simple sync-stretching operation at the video input to the modulator insures the required sync pulse height at the transmitter output.

It should be noted that when using the constant-impedance output network none of the high-power stages works any harder at the sync peaks than at any other part of the cycle so that sync compression from the usual causes is not present.

**Power Considerations**

For television waveforms the power diverted into the dummy load is less than half the total power because of the one-sided nature of the television signal. This loss is not so serious as might first be imagined because of two reasons: first, at the present stage of the uhf transmitter art the primary emphasis is not so much on what final stage efficiency can be obtained as it is on how much modulated power can be produced with available tubes. The power loss may be regarded as the price paid for using high-power tubes which are difficult or impossible to modulate by other means; second, the power loss is little more than one would expect to expend in high-level video equipment even if the modulation could be accomplished by other means.

If we make the simplifying assumption that the average plate efficiency of a uhf tube is roughly the same when operating near the peak power level, whether it be operated with grid modulation, as a class-B linear amplifier or as a saturated class-C amplifier, we can draw the following conclusions about the loss suffered by throwing away a portion of the power in a dummy resistor in order to obtain a simplified outphasing system. When a television transmitter is radiating sync pulses and a completely black picture, its average power output is very nearly 60 percent of the peak synchronizing pulse power. Thus, a tube which could produce 100 watts continuously without exceeding its ratings would be capable of producing 100/0.60 = 166 watts peak power when running with a black-level picture, still staying within its power dissipation ratings.

When the same tube is used in a phase - to - amplitude transmitter utilizing the constant-impedance output network, it is required to deliver continuously to the network an amount of power equal to the peak synchronizing pulse power. This would mean peak power per tube of 100 watts for the tube of this example when used in outphasing service as compared with 166 watts for the same tube in a grid-modulated transmitter.

This represents a 2.2-db penalty in the peak r-f power available caused by use of the dummy load resistor and represents the worst possible case. It is a pessimistic figure since the average plate efficiency of the saturated class-C stage will usually be somewhat higher than that of the other two systems at black level instead of equal to it as was assumed. Also, the foregoing comparison was based on the useful power obtained from a single tube. An outphasing system has two final stages whose power outputs add at the antenna, while no additional video power is required as would be the case if a grid-modulated transmitter were operated with multiple tubes in the final amplifier.

It should be pointed out, moreover, that the phase-to-amplitude system when operated without this dummy resistor is a high-efficiency system with overall efficiencies surpassing even that of plate modulation when losses in the modulator are taken into account. After becoming more familiar with the actual operating characteristics of the completed 150-watt transmitter, it may be possible to dispense with the dummy load resistor and the network arms leading to it, and to operate the final amplifier stages at higher efficiency by purposely detuning them, one to a higher frequency and the other to a lower one, just as is done in low-frequency transmitters. One very preliminary and partially successful attempt at this has already been made. Whether the more complicated tuning procedure can be held to a practical operating routine is something that only continued tests can determine.

**Radio-Frequency Amplifiers**

The second major division of a phase-to-amplitude system is the r-f power amplifier section. The amplifiers used in this television transmitter are of the conventional coaxial cavity type. Each channel utilizes one 4X150A tube as a straight-through amplifier on 265 mc followed by another 4X150A operating as a frequency doubler to 530 mc. Since both of the p-m sidebands must be amplified special attention was paid to the circuit load-
ing and to the interstage coupling networks to maintain the required 9-mc bandwidth.

The final and driver stages of this particular transmitter are located on a separate frame from the rest of the equipment and can be remotely mounted on top of the tower close to the antenna in order to minimize the 530-mc transmission line loss. At the present transmitter location the antenna is on top of a sturdy oil derrick which makes such an installation possible.

The third major component, the phase modulator unit, is really the heart of this type of transmitter.

**Phase Modulator**

Constructing a stable linear phase modulator which will work reliably at carrier frequencies of several hundred megacycles is quite a problem in itself. The prime requirements are simplicity and ease of adjustment, since the operating frequency makes it impractical to use a monitoring oscilloscope during tune-up. Several types of phase modulators have been built for this transmitter and tried with varying degrees of success.

The one in use at present makes use of a network similar to the one used at the output of the transmitter to convert p-m into a-m. Since this network is a linear, bilateral device it can be used equally well for converting a-m to p-m. It is only necessary to feed two nonadjacent terminals of the network with amplitude-modulated signals having the proper r-f and video phase relationships. From the other two terminals one can then obtain two signals of substantially constant amplitude, but phase modulated in opposite directions by equal amounts. This is exactly the result desired, and it comes about when the two amplitude-modulated input voltages are 90 degrees out of r-f phase and 180 degrees out of video phase with each other. The total linear modulation range of this arrangement is about 50 degrees, so that in order to obtain a 530 mc phase-shift versus video-voltage curve linear over the necessary ± 45-degree range, it is necessary to operate the phase modulator at half the final frequency, or at 265 mc.

Figure 6 is a block diagram of this 265-mc twin-channel phase modulator.

**Special Modulator Tube**

To obtain in practice the precise phase relationships required at the input to the network of the phase modulator just described, a rather involved tuning procedure must be used. In order to obtain a still simpler modulator, a special twin-channel phase modulator tube has been developed which does the entire job in one tube and requires virtually no alignment.

Fig. 7 is a cross-sectional diagram of such a tube.

A fan-shaped electron beam of rectangular cross section falls on two diagonal collector plates which are separated by a ground plane. The beam is intensity modulated at the carrier frequency and is electrostatically deflected laterally by the video modulation. Sideways deflection of the beam causes the point of electron impingement on one collector plate to move forward, thus shortening the transit time. At the same time the point of electron impingement on the other plate moves backward, increasing the transit time to that plate. Two separate output circuits tuned to the carrier frequency are then connected to these two collector plates, and the two output signals are thus phase modulated in opposite directions by the video input. The modulation characteristic can be linear or curved, depending upon the configuration of the collector plates.

Several of these special phase-modulator tubes have been built and successfully demonstrated. However, the maximum r-f power output that has thus far been obtained from any of them has been in the milliwatt region, and they have not been used in the transmitter because of all the extra amplification involved. If such a tube can be built to deliver on the order of one to ten watts into each channel, the problem of a really simple phase modulator for phase-to-amplitude television transmitters should be completely solved.

**Overall Transmitter Operation**

The developmental 150-watt transmitter has been as stable in operation as any other type of uhf television transmitter and has given consistent service. The measured overall video response is flat within 1 db to 4.8 mc, the modulation linearity is good, and the horizontal resolution of the radiated picture is better than 400 lines.

The phase modulator is at present the weakest link in the chain, and requires about twenty minutes of warm-up time to completely settle down to drift-free operation. After this period, however, the transmitter will operate over a normal eight-hour day with only occasional monitoring.

The real value in the phase-to-amplitude modulation system lies in its ability to go to very high power levels. The added complexity of the system can hardly be justified at levels where modulation power can be easily obtained by conventional means. For broadcast transmitters the savings in physical size, overall efficiency, and initial cost do not ordinarily become evident below five or ten kilowatts. The 150-watt uhf phase-to-amplitude television transmitter on the other hand is about the same physical size and only slightly more complex than a conventional grid-modulated transmitter of the same power level. It would then appear that the system would have distinct advantages for use in uhf television transmitters above 500 to 1,000 watts.

The work described in this paper has been carried on at the Stanford Research Institute, Stanford, California, as a portion of a uhf television program sponsored by John H. Poole, owner of experimental station KM2XAZ in Long Beach, California.

**REFERENCES**


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**Fig. 7—Cross-sections of experimental phase-modulator tube**
Electronic Control of
ANESTHESIA

Brain potentials, which increase as anesthesia decreases, are integrated and amplified to fire thyratron that actuates one-stroke electric pump for feeding more anesthetic to patient to maintain desired degree of anesthesia during an operation

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Clinical model of servoanesthetizer, being used for administration of nitrous oxide-ether anesthesia to patient on operating table
increase in the concentration of the anesthetic drug, this stimulating effect changes to one of depression of the electrical output which continues until, in deep anesthesia, the brain may become electrically inactive. This will be understood by reference to Fig. 1, which shows the effects of two commonly employed anesthetic drugs, ether and pentothal, on the brain potentials (electroencephalogram) of the monkey. The patterns are similar to those seen in the human being.

Thus, the electrical output of the brain provides us with a simple index of depth of anesthesia which can replace the estimate resulting from the integration of rather complex clinical signs. Since this electrical activity can be recorded by relatively simple means (electrodes attached to the surface of the scalp) and can be quantitated by integration, that part of the human linkage in the servomechanism which is concerned with estimating depth of anesthesia can now be replaced by an electronic circuit.

The next problem, that of replacing the error-computing and anesthetic-administering side of the servomechanism, is relatively simple. If an electromechanical system is designed that will deliver the anesthetic agent to the patient at a rate proportional to the energy output of the cortex, a servoloop will be completed that will automatically maintain a given level of anesthesia. The system is illustrated diagrammatically in Fig. 2.

**Details of Apparatus**

The complete apparatus for the automatic production and maintenance of anesthesia is called the servoanesthetizer. It comprises essentially five separate units: (1) electrodes and leads, (2) amplifier, (3) integrator, (4) electromechanical transducer, and (5) anesthetic reservoir and piston feed (with vaporizer for ether).

The electrodes which pick up the potential variations from the scalp consist of either small silver disks held in contact with the scalp by conductive jelly or fine needles which pierce the scalp a small distance. Two active leads and a ground are employed, the former being placed in the frontal and occipital (back) parts of the head, while the ground usually is located intermediately.

The amplifier has five R-C coupled stages and is push-pull throughout. By the use of cathode degeneration on the first two stages, a high (50,000 to 1) in-phase rejection ratio can be obtained which assists in eliminating interference. Since the brain-wave frequencies which are of interest for the control of anesthesia fall between about 1 and 6 cycles per second, it is advantageous to eliminate most of the frequencies outside this range. The amplifier used is linear between 1 and 10 cps, with cutoff at 0.5 and 30 cps. The first two stages are battery-operated. The voltage amplification employed is about 100.

The output from the power stage is fed to an inkwriter which traces the brain potential onto paper traveling at a rate of 1.5 cm per second. The inkwriter is used for monitoring and, if necessary, for the permanent recording of the brain wave and heart tracings throughout anesthesia.

A second amplifier-inkwriter is used to register the electrocardiogram and is not directly concerned in the automatic production and maintenance of anesthesia.

The input to the integrator circuit (Fig. 3) is taken asymmetrically from the third stage of the push-pull amplifier. The signal passes through potentiometer $R_v$, which is the main regulator of depth of anesthesia, to the grid of integrator tube $V_i$. By adjustment of screen potential with $R_s$, this tube is biased to cutoff in the absence of an input signal. With the arrival of brain potentials, anode current flows in $V_i$ and $C$, charges until, at a critical voltage, it is rapidly discharged by the flip-flop circuit using $V_a$ and $V_v$. The repetition frequency of the discharge is proportional to the integrated potential output of the brain, which, it will be remembered, is the electronic measure of depth of anesthesia. This relationship is illustrated well in Fig. 1, where the integrator pulses appear above the corresponding brain-wave tracing.

It remains to discharge to the patient appropriate amounts of anesthetic agent at each integrator pulse. This is done by use of the pulse to energize via thyratron $V_v$ a modified electromechanical stepping relay, the threaded shaft of which advances a metal block which is in contact with the piston of a syringe containing ether or barbiturate in solution. The syringe is connected, through a fine plastic tubing, to a vaporizer or a vein, according to the kind of anesthetic agent in use.

**Operation**

When this system is in operation, the anesthetic agent is fed to the

---

FIG. 1—Influence of pentothal sodium and ether anesthesia on electroencephalogram and integrated brain potential output of monkey brain. Pips of integrated tracing each produce one stroke of anesthetic pump.
animal or to the human patient at a rate which varies directly with the integrated potential output of the cortex. A point of equilibrium is reached at which the rate of infusion of the anesthetic drug balances the rate of removal or destruction by the tissues, as indicated in Fig. 2. The actual depth of anesthesia at which this equilibrium is attained is dependent on the proportionality settings between potential output of the cortex and dosage. This can be adjusted by gain control potentiometer $R_3$ (Fig. 3), which is calibrated in terms of depth of anesthesia.

The system is put into operation by injecting, initially, a small amount of anesthetic agent. On reaching the brain, the anesthetic stimulates the cortical neurones and increases their electrical output; this in turn will increase the rate of administration of the drug. In this phase the system will be seen to be selfaugmenting (positive feedback). As soon as the drug reaches the concentration at which suppression of cortical electrical activity commences, the system changes to a selflimiting (negative feedback) cycle. It is in this phase that the system settles into equilibrium and will maintain a depth of anesthesia which depends on the adjustment of $R_3$.

**Homeostatic Properties**

Because of its feedback cycle, the apparatus has some of the properties of a homeostatic system, and it tends to compensate for factors which disturb the equilibrium. For instance, if the anesthetic mixture is diluted or a leak develops in the intravenous tube, the machine automatically increases its rate of administration in an attempt to compensate for these changes. Complete compensation is not attained, since this is a droop variety of servomechanism (similar to the governor of a steam engine) in which a change in conditions results in a relatively slight shift of the system to a new equilibrium point. However, the fact that animals have been kept automatically anesthetized for periods up to two or three days without circuit readjustment suggests that compensation is adequate to deal with the disturbances encountered in normal anesthesia.

**Applications**

The servoanesthetizer is finding a number of different applications in both research and practical anesthesia. Its ability to hold a steady and known level of anesthesia is important in research work on brain function in the animal, since a variable which in the past has been difficult to control is eliminated. Research in human anesthesia, and more particularly investigations into the interaction of various anesthetic agents, will also be facilitated. The greatest interest, however, naturally attaches to the application of the servoanesthetizer to maintain clinical anesthesia. The control of the administration of ether by this method is now under trial, but early results indicate that smooth anesthesia from hunting can be maintained.

Although automatic anesthesia will relieve the anesthetist of much tedious work, it should be emphasized that he will always be required to initiate and probably to supervise the administration. Safety devices are now under development which will ensure that when an emergency arises, such as operative shock or failure of respiration, a warning signal is given and administration of the anesthetic agent is automatically discontinued. A further development is the provision of an adjustment for depth of anesthesia ($R_3$) which can be operated directly by the surgeon. This should ensure that the patient is always at a suitable level of anesthesia for any particular stage of the operation. A fuller discussion of the problems will be found in the original papers.

**REFERENCES**

PHOTOMETER
for Electron Microscope

Correct photographic exposure is determined by a simple attachment. A multiplier phototube views the fluorescent focusing screen and beam intensity is indicated by a microammeter. Special circuits protect the meter movement during exposure to strong light.

All electron microscopes incorporate a fluorescent screen located close to the photographic plate for the purpose of visualizing and focusing the electron image. To make an exposure, the screen is displaced and the electron beam is allowed to fall directly upon the photographic emulsion.

The usual method of determining the proper exposure has been to try to make an intelligent guess of the intensity by judging the brightness of the fluorescent image. In practice this procedure is not reliable and results in a considerable variation in the exposure of the plates. It was decided to try some type of photosensitive device to measure the light from the screen of the type EMU electron microscope in order to obtain more consistent results.

The light from the fluorescent screen at the intensity normally used for an exposure is weak and ordinary photocells are inadequate, unless a fairly sensitive galvanometer is used. The brightness of the screen will vary over a wide range during the exploration of a specimen, particularly in microscopes employing the biased gun. Because the pickup device might be exposed accidentally to strong artificial light or even daylight, it is possible for the output current from a phototube to rise to a value dangerous to a sensitive meter.

It was found that the type 931A multiplier phototube would give a satisfactory output when mounted externally in a position to receive light from the fluorescent screen. To avoid the use of a delicate meter, a self-limiting balanced vacuum-tube voltmeter output stage was added to the electron multiplier. The input circuit of this final stage includes a resistor in series with the anode of the phototube. A voltage is developed across this resistor when the phototube is illuminated, and the vacuum-tube voltmeter is used to measure this voltage. The circuit components are mounted in a small chassis, which was designed to fit into a space available inside the microscope cabinet.

Design Details

The 931A phototube requires a supply of some 1,250 volts. The power source is made in two sections: the first is a 1,000-volt pack to supply the dynode voltages, while the second is used to furnish the 250 volts between the final dynode and the anode. This last voltage source is also used to operate the vacuum-tube voltmeter, which consists of two 6J7 tubes operating with about 45 volts on the plates and about 2.5 volts negative grid bias. The grids are connected to the two ends of the resistor, which is in series with the plate of the 931A phototube. When current flows through this resistor, a voltage drop occurs and one of the 6J7 tubes draws less current, producing

FIG. 1—Circuit of the photometer used with the electron microscope

This paper is based on work performed under contract with the United States Atomic Energy Commission at The University of Rochester, Atomic Energy Project, Rochester, N. Y.

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an unbalance in the plate circuit. A 0–200 microampere meter between the plates measures this unbalance. When the signal approximates 3 volts, the 6J7 reaches cutoff, and beyond this point there is no increase in the meter deflection.

With no light on the phototube, and a rough balance obtained with \( R_t \), the meter is set to zero with \( R_c \). Then with 3 volts or more applied to resistor \( R_c \), the meter is set to full-scale deflection by means of the control \( R_c \). This completes the circuit adjustments.

The meter is mounted on the panel of the microscope just below the clock, and a pilot light is arranged with plastic conductors so that both the meter and the clock, which has a sweep second hand, are illuminated. This is a convenient arrangement because timing of the exposure is done by this clock. The control panel lights of the microscope are turned off during an exposure since a small amount of light from this source may reach the phototube. The room light switch on the panel of the microscope is wired so that only when the room lights are off is the photometer energized, making its operation more or less automatic.

The phototube is mounted externally on the microscope column at the top edge of the left-hand viewing window as shown in the photograph. It is protected by a brass tubing in which is milled a narrow slit oriented in such a way that it picks up light only from that portion of the fluorescent screen upon which the useful image falls. This arrangement insures accuracy at any magnification.

**Using the Instrument**

When the image of an opaque specimen covers a large part of the field, some judgment must be exercised in determining the proper exposure from the deflection of the meter but a few trials will calibrate the unit for almost any condition. For most of our work the light intensity is adjusted to a predetermined reading of the meter by means of the condenser lens control and a constant exposure time is used. If illumination from unwanted sources is excluded the phototube may be mounted in any convenient position and the light from the screen brought to it by means of a plastic rod.

The use of this attachment to the electron microscope has resulted in extremely uniform exposures. The elimination of guesswork in the exposure does away with the loss of otherwise useful plates and greatly simplifies the making of prints or enlargements from the negatives. The location of the phototube near the top of the window does not interfere with visual observation of the fluorescent screen from this side. Experience with the device for some two years has proved its practicability.
Microwave Diffraction Charts

The radius of the first Fresnel zone at various distances from the nearest terminal end of a microwave relay course can be determined from one nomogram. The adjusted distance required in Fresnel zone calculations is shown in the second alignment chart.

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MICROWAVE SIGNALS over line-of-sight courses are frequently observed to depart considerably from the free-space predictions.

Variations from free-space calculations are due to combinations of refraction and diffraction effects, as well as occasional absorption conditions due to rain, snow or fog. Of these factors, all but diffraction vary with weather conditions and combine to form the diurnal and seasonal variations noted in point-to-point relay services.

Although considerable information is available in the literature to enable the engineer to predict with fair accuracy the signal strength under given conditions of temperature and percentage of water vapor in the atmosphere, the usual practice is to allow certain empirical margins of safety or fading factors based on long-term observations of relay signals at various frequencies. Diffraction effects, unlike those associated with refraction, do not change with time and weather conditions but are determined by the choice of operating sites and the intervening terrain. As the course line clearance is readily determined, and frequently is a factor under the engineer's control, diffraction factors are of practical interest in most microwave relay installations.

Fresnel Zone

From diffraction theory, when a wave strikes an intervening object a spherical wavefront radiates from the edge of the obstruction. The field intensity at any point beyond the obstruction is thus dependent upon the vector sum of the direct and scattered wavefronts reaching the receiver. A Fresnel zone may be defined as a circular zone about the direct path at such a radius that the distance from a point on this circle to the receiving point has a path length that is some multiple of a half wavelength longer than the direct path. Hence, according to Fresnel's zone theory, all the even-numbered zones will send wavefronts to the receiver in opposite phase to all those from odd-numbered zones.

The effective field intensity at the receiver will rise and fall above and below the free-space value as the scattered waves alternately reinforce and cancel.

(continued on p 114)
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the direct wave. The energy reaching the receiver from a given zone is proportional to the area of that zone and inversely proportional to the distance from the receiver. As the width of the rings making up the zones decreases rapidly as the radius of the circles increases, the first few zones are the only ones of any practical importance in diffraction studies of radio waves. It has been stated  that a good optical path for microwave transmission is one with full first-Fresnel-zone clearance. With such an optimum path the signal strength at the receiver (excluding meteorological effects) is somewhat better than free space values due to the fact that the phase shift along a line from the transmitting antenna to the top of the obstruction and from there to the second antenna is about one-half wavelength greater than the phase shift of the direct path and some signal reinforcement is obtained.

Figure 1 indicates directly the radius of the first Fresnel zone as a function of distance and operating frequency. The construction shown assumes a plane wave (that the spherical wave has expanded to the point where the front is flat over the diameter of the diffraction zones).

The results given by this chart hold true only if the obstruction is very close to one end of the course. For accurate results at any point along the path, the setting on the distance scale should be adjusted in terms of the results given by Fig. 2. This enables the retardation on both parts of the circuit to be taken into account. Figure 2 is a simple reciprocal nomogram and, as the scales are linear, they may be multiplied by different decimal factors as required.

For example, to find the clearance required for a good microwave path, assume an operating frequency of 7,000 mc, a total course length of 11.5 miles and a principal obstruction 3 miles from the transmitter.

A line connecting 3 and 8.5 on the outside scales of Fig. 2 gives an adjusted distance of 2.2 miles. Connecting this point with 7,000 mc on Fig. 1 shows a required clearance of 40 feet at the point in question.

In addition to determining easily the requirements for a good optical path, these alignment charts permit making quantitative studies of signal intensity conditions under various diffraction conditions including grazing or even badly obstructed courses where the receiver may be in a shadow area.

The principal course obstruction should be plotted showing the projected area normal to the direct course between stations. The Fresnel zones should be drawn in as circles about the dot representing the course path, the radii being obtained from the charts. (While the nomograms show only the first zone radius, values for higher-order zones may be obtained by multiplying the indicated value by the square root of the number of the zone being considered.)

Having drawn the zone areas, with respect to the masking obstruction, the net field intensity may be obtained by integrating the area of the exposed zones. This can be accomplished graphically by means of the Cornu spiral. In this manner, the departure from free-space values may be accurately estimated for any course.

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TUBES AT WORK
Including INDUSTRIAL CONTROL
Edited by VIN ZELUFF

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Motor-Controlled Charger

By T. A. BENHAM
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FULLY-AUTOMATIC charging at a constant two amperes is provided for a bank of 50 two-volt storage cells by a circuit employing a W. L. 672 thyratron as rectifier and charger with a motor-driven rheostat for phasing control.

Figure 1 shows the means for deriving motor control. The charging current flows through R, developing a voltage proportional to the current. The wave shape varies from a quarter wave to something less than a half wave.

The average value of voltage is kept to 4 volts by the motor. The voltage is changed to steady d-c by $L_C$. The output of this filter is applied to the grids of two type 2050 thyratrons. The grid voltage for each tube is controlled by a potentiometer. The relays in the plate circuits of the 2050's operate the phasing motor.

When the charging current is too small, both relays are closed, the motor is energized and turns the phasing control rheostat to increase current. The grid voltage of $V_G$ is adjusted to extinguish the tube when the charging current is between 1.9 and 2 amp. When only $RE$, is energized, the motor is disconnected from the line voltage. As the charging current increases due to changes in battery voltage, $V_t$ extinguishes opening $RE$. This closes the motor circuit and the phasing control is turned to decrease current.

The wattage rating of $R$, must be high. When current flows for 90 degrees the power in $R$, is 39.5 watts.

When $S_1$ is pressed, $RE$, and $RE$, close. Relay $RE$, applies line voltage through one set of contacts and holds through the other. Relay $RE$, applies 115 volts to the primary of the plate transformer through the timer switch and holds. The five-minute timer, which starts when relay $RE$, closes, delays application of plate voltage to the W.L. 672 until the cathode attains operating temperature. When the timer switch closes, full plate voltage is applied to the thyratrons and $RE$, and $RE$, close with the motor in minimum charging current position.

The motor turns, increasing current to between 1.9 and 2 amperes. The system maintains 2 amp within 1/10 amp. To improve the sensitivity of the thyratron relay, a diode is connected across it. The diode reduces the cemf of the relay coil as thyratron plate current is decreasing. For increasing plate current, the diode is nonconducting.

As the battery voltage rises and the drop across the internal resistance decreases, the W. L. 672 conducts longer over the half cycle to maintain 2-ampere average current and the phasing rheostat decreases toward zero. Limit switch $S_4$ is placed so that the motor will close it when the batteries are fully charged. This switch, in series with the holding contacts of $RE$, releases the relay and removes the

Figure 1—Battery charger uses motor-driven rheostat to control current

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Semiautomatic Darkroom Timer

By MARLOWE W. IVIERSON
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The timer to be described and its associated enlarging machine were designed for use by photographic processing concerns. The majority of these desired one enlarging machine that could handle negative sizes from half 35 mm to 116 and magnifications from 1.3 to 5.0, so that the one machine could handle all of the oversize printing. A push-button timer embodies automatic correction for exposure time variation with negative magnification.

The circuit of the timer is shown in Fig. 1. A time key is depressed corresponding to the relative time of exposure desired by the operator. The selected time key sets the value of bias resistance in the cathode circuit of the 2050 thyratron. The initiating bar is then depressed, initiating relay K1, which in turn actuates the clutch solenoid.

The clutch and its associated mechanism then lowers the nohood and platen, energizes relay K4, and closes the print switch, which turns on the power circuit to the 1,000-watt printing lamp. Relay K3, then removes the short across the charging capacitor, C4, and connects the open end of the coil of relay K5 to the plate of the 2050.

Upon the removal of the short across the charging capacitor, C4, it is charged through the charging resistance R6. This resistance is a potentiometer, mechanically coupled to the paper carriage so that its resistance varies with the negative magnification in such a manner as to produce a time response which is a linear function of the magnification.

When the voltage across C4 rises to the point where its algebraic addition with the voltage across the bias resistance is sufficient to fire the thyratron, the thyratron fires, energizes relay K1, and the time is complete.

(The remainder of the text continues on p. 144.)

THE FRONT COVER

Metal loss due to corrosion or erosion in tanks, pipes, pressure vessels and other process equipment is determined by the Audigage. It replaces older methods of inspection, such as drilling a hole, calipering the wall thickness and rewelding.

The instrument, manufactured by Branson Instruments of Stamford, Conn., uses an X-cut quartz crystal to generate ultrasonic waves from 0.65 to 2.0 mc. The oscillator that drives the crystal is frequency-modulated over a small increment at an audio-frequency rate. When a thickness resonance is located within the modulated-frequency range, an audible indication is provided in headphones. Full details of the technique appeared in ELECTRONICS for January, 1948, page 88.
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SEAC performs seven basic operations: addition, subtraction, multiplication, division, comparison, logical transfer and input-output control. The comparison and logical transfer operations give the computer a degree of initiative and judgment. SEAC can modify its instruction, detect its own errors, determine when it has computed results to predetermined accuracy and refrain from printing incorrect answers.

The computer can add or subtract sets of eleven-digit numbers at the rate of 1,100 times per second. It multiplies and divides such numbers at the rate of 330 times per second. Instructions and numbers are sent in code at the rate of 1,000,000 pulses per second.

In any computer, the capacity and speed of its memory determine the limits of difficulty for the problems it can solve. The memory has a storage capacity of 512 words, achieved by use of 64 acoustic delay lines. A word is a sequence of 45 binary digits. The average time required for SEAC to refer to a word is 168 usec.

Conversion from the decimal system to the binary system is done automatically by the machine. The presence of a pulse is used to represent 1, while the absence of a pulse indicates 0.

Physical Description

The computer has four main sections: an input-output unit, a memory unit, a control unit, and an arithmetic unit. The input-output section receives instructions and prints the answers. The memory unit stores instructions and numbers, and the control unit directs the flow of information within the machine. The arithmetic unit performs the actual computations as directed by the control unit. When the arithmetic unit has arrived at a solution to a problem, the control unit orders the memory unit to send the answer to the output where it is printed out. The present input-output unit employs a manual keyboard and teleprinter for direct input.

Indirect operation is accomplished by use of punched tape. However, SEAC's design provides for later replacement of the teleprinter system by a faster magnetic wire system.

SEAC is housed in two consoles. One contains the acoustic memory, and the other contains the rest of the computer (including an additional memory, for future use, which consists of cathode-ray tubes). The memory cabinet is 60 inches wide, 31 inches deep and 84 inches high. The computer proper is shown in the photograph of the operator's position.

The principal components of the memory are the acoustic delay lines and associated electronic equipment. Each delay line has a capacity of 8 words. A word is stored as a series of sound waves travelling in a column of mercury. The waves are generated by a quartz crystal at one end of the tube and received by a
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similar crystal at the other. A special amplifier then transforms the sound energy into a pulse sequence, which is returned to the first crystal at its original strength. Thus a word is recirculated until called for by the control unit.

The memory unit contains 380 tubes used largely for reshaping and amplifying the pulses in the delay lines and for energizing the switches in the system. There are 3,500 germanium-diode switches.

The principal elements in the remainder of the computer are 9,300 germanium diodes and 495 tubes. In SEAC, the number of tubes is relatively small, a total of 875, in contrast to the 18,000 tubes in ENIAC. This reduces the number of tube failures.

The tubes in SEAC are used only for amplification of the signals and as sources of energy, not as part of the computing components proper. The use of 12,800 germanium diodes in the equipment has reduced the number of tubes used in contrast to previous computers. Standardized tube-and-transformer combinations simplify maintenance. The transformer method provides high-frequency coupling with a minimum of crosstalk between circuits.

**Optimum Dimensions for Parasitic Arrays**

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At the present time theoretical results for calculating the performance of parasitic arrays having three or more elements are not available. This led to setting up an experimental unit* which could be used either as a two-element or a three-element array to determine the effects of spacing and tuning on forward gain and input impedance. Figure 1 shows the arrangement of equipment used.

Verification of experimental techniques was accomplished by measuring gain and impedance versus spacing for two-element arrays. The results compare favorably with theoretical results obtained by Brown.

For the three-element array each parasitic element was tuned, in turn, for maximum gain at each spacing combination. Results are shown in Fig. 2. In all cases the driven element was fixed at its self-resonant length and maintained at constant power input.

Data on array input resistance $R_i$ and array input reactance $X_i$ are included in Fig. 2A and 2B respectively. These data are useful in obtaining the relative input impedance only, since the impedance of any other array would depend chiefly upon its height above ground.

Corrected Curves

The curves of Fig. 2C are slightly in error because of attenuation in the coaxial line to the array. Therefore the maximum points of the curves of Fig 2C were corrected for known errors and presented in Fig. 2D. Thus Fig. 2D summarizes the

*This work was done in part under Project No. 11, Engineering Experiment Station, Utah State Agricultural College, Logan, Utah.

(Continued on p 184)

**BEVATRON BUILDING TAKES FORM AT UNIVERSITY OF CALIFORNIA**

Expected to be completed early in 1953, the University of California Bevatron Building is shown here under construction. Steel fabrication is being handled by Consolidated Western Steel Corp., a U. S. Steel subsidiary. Visible at left is U. C. Cyclotron Building. When completed, bevatron is expected to accelerate protons to 8 billion electron volts
PHOTOGRAPHY measures the
"DEAD-TIME" of a G-M TUBE

How long does it take a Geiger-Mueller tube to recover full sensitivity after a pulse? That’s its time-resolution, and you may need to know it with considerable accuracy.

If you’ve formed the habit of teaming the camera with the oscillograph, you know how to handle this measurement—or many others that may be closer to your interests. For records you can examine over and over again of action occurring in very short time—circuit behavior, or any kind of phenomena translatable into electronic signals—there’s nothing to match photography.

Recording cameras are available at reasonable cost. The Kodak Linagraph Pan Film they use is stocked by your Kodak Industrial Dealer. (Also Kodak Linagraph Ortho Film for depressed sensitivity to red light.) Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

PHOTORECORDING
...an important function of photography
NEW PRODUCTS
Edited by WILLIAM P. O'BRIEN

TV Visual Demodulator
GENERAL ELECTRIC Co., Syracuse, N. Y. Type TV-21 television visual demodulator allows the transmitter operator to measure accurately the transmitted signal. The new unit feeds both picture and waveform monitors simultaneously and is easily installed in a standard equipment rack. It is crystal controlled, eliminating the need for tuning, and is practically impervious to stray r-f fields. Besides its primary use as a transmitter monitor it can be used as a double sideband detector or a transient demodulator.

Electronic Timer
GENERAL ELECTRIC Co., Schenectady 5, N. Y., has announced a new compact electronic timer which provides automatic control of operation, limit and sequence timing for industrial processes. It is available in three time ranges: 0.06 to 1.2 sec, 0.6 to 12 sec, and 6 to 120 sec. Controlled load requirements are: in-rush—15 amperes, carry—10 amperes, and break—5 amperes.

Specialized Tube Tester
MULTI-PRODUCTS Co., 559 E. Ten Mile Rd., Hazel Park, Michigan. The portable tube tester illustrated is designed for servicing controls employing a limited number and specific type of tubes as specified by the manufacturers of various types of electronic control equipment. The unit, which checks tube condition and internal shorts, measures only 4 in. x 6 in. x 8 in. and weighs only 6 pounds. It is fuse protected, operating on 115 volts 60 cycles.

Oscillograph Camera
FAIRCILD CAMERA AND INSTRUMENT CORP., Jamaica, N. Y. The F-284 Polaroid oscillograph camera was designed for photographing the screen of any standard 5-in. c-rscope and producing a print for engineering study within one minute without the need for darkroom processing. Writing speeds up to 1 in. per μsec have been recorded with an accelerating potential of 3,000 volts. Print size is 3½ x 4½ in. with the two recorded images reduced by a ratio of only 2 to 1 from the original trace.

H-V TV Test Probe
INSULINE CORP. OF AMERICA, 3602 35th Ave., Long Island City 1, N. Y. The 100X Hilvolter is a new heavy-duty probe that multiplies the existing ranges of any standard 10- or 11-megohm vtvm by a factor of one hundred. Measuring 8½ in. long and fitted with a clear Lucite nose piece and red barrier insulator, the probe is designed especially for testing h-v circuits in tv receivers. It is furnished with a 5-ft coax cord and a separate grounding lead. The cord terminates in a standard single-contact microphone connection. An adapter plug is also available for using the connector with v-t meters having phone jacks instead of microphone fittings.

C-R Oscilloscope
SYLVANIA ELECTRIC PRODUCTS INC., 1740 Broadway, New York 19, N. Y. Type 400 high-gain, wide-band c-r oscilloscope, designed particularly for tv circuit, laboratory and industrial applications, provides a vertical sensitivity of 10 mv per in. and a vertical response which is useful up to 4 mc. It also features an internal 60-cycle sine wave sweep.

September, 1950 — ELECTRONICS
**Pulse Type Magnetrons**

Tunable or fixed frequency — 1,000 to 25,000 megacycles — power range from a few watts to several megawatts.

**CW Magnetrons**

Fixed frequency, tunable and frequency modulated tunable — 1,000 to 10,000 megacycles — power range from a few watts to several kilowatts.

**Klystrons**

Integral and external cavity, low power — frequency range, 500 to 50,000 megacycles.

**Special Purpose Tubes**

Cold-cathode, gas-filled rectifier tubes — ruggedized diodes, triodes and pentodes for aircraft, industrial and military service — voltage regulator, voltage reference and radiation counter (Geiger-Mueller) tubes — germanium crystal diodes.

**Subminiatures**

Filamentary and cathode type tubes; fit standard sockets or may be soldered or welded into the circuit. Over 40 types—over half a million in stock—available through 310 Raytheon Tube Distributors.

For detailed information, get in touch with

**RAYTHEON MANUFACTURING COMPANY**

Power Tube Division  *Receiving Tube Division*

WALTHAM 54, MASS.  NEWTON 58, MASS.

ELECTRONICS — September, 1950
which eliminates one set of leads during tv alignment operations. The oscilloscope provides linear sweeps ranging from 10 cycles to 50 kc; and 5 megohm, 26-μf input impedance for negligible circuit loading which is suitable for any crystal, direct or special probe or with supplied lead.

Precision Potentiometers

TECHNOLOGY INSTRUMENT CORP., 1058 Main St., Waltham 54, Mass. Types RV3-8 (8 watts) and RV3-12 (12 watts) are improved precision potentiometers. Their new features include: (1) bronze bushings for the rotor shaft; (2) tapped mounting inserts; (3) rotor take-off slip ring constructed of silver-overlaid brass and mounted concentric to the shaft; (4) molded parts of low-loss mica-filled Bakelite to withstand high humidity and electrolysis.

Diode Modulator

GENERAL RADIO CO., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1000-P6 crystal diode modulator converts an oscillator, standard-signal generator or other r-f source into a test-signal generator for tv receiver testing. Range of modulating frequencies is 0 to 5 mc and carrier-frequency range is 20 to 1,000 mc, covering the proposed new uhf tv bands, as well as at currently used frequencies. Impedance is 50 ohms for r-f circuits, and coaxial 50-ohm attenuators and other accessories are available.

TV Power Control Unit

RADIO CORP. OF AMERICA, Camden, N. J. Illustrated above is the power control unit for mobile tv pickup equipment. It provides power consumption readings and permits regulation of both input and output voltages from a central point in the mobile unit, and can operate from any two-wire system providing input voltages between 100 and 120 volts, or 200 and 220 volts, 60 cycles at 5 kva. The unit is shock-mounted and designed for mounting in the television truck.

Industrial Power Amplifier

RADIO CORP OF AMERICA, Camden, N. J. Type MI-12188 two-stage bridging power amplifier features inverse feedback control and a voltage-regulated power supply. Frequency response is from 30 to 15,000 cycles with low distortion. The unit will supply 70 watts to any one of several load impedances when bridged across a line of 3.3 volts rms maximum. It operates from a 105 to 125-volt, 50 to 60-cycle power supply. Normal power consumption is 240 watts.

Gamma-Ray Detector

HALROSS INSTRUMENTS CORP., LTD., 171 Garry St., Winnipeg, Canada. Model 939 Scintillator employs the scintillation principle and provides a detection sensitivity over 100 times that obtained by conventional portable Geiger counters. It employs only high-vacuum tubes in conservatively designed circuits and will operate continuously between -20 and +110 F, with a relative humidity of 95 percent. A probe in the lower section of the case can be removed for lab research purposes.

VTVM

GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1803-A vacuum-tube voltmeter meets most a-c voltage measurement requirements of the electronics laboratory. Voltage range is from 0.1 to 150 v, covered

(Continued on page 212)
UNIFORMITY PLUS

that's what you get in every reel of

Audiotape

Unequalled uniformity of output volume is one of the outstanding advantages of Audiotape. This is especially important in professional work where shows are edited and assembled on tape. For even slight variations in output can become very objectionable when splicing brings high and low volume sections together.

Every 2500-foot reel of plastic-base Audiotape is guaranteed to have a volume deviation, at 1000 cps, of not more than ± 1/4 db within the entire length—and not more than ± 1/2 db from reel to reel. And these are outside limits, not averages. What's more, every 2500-foot reel is guaranteed to be entirely free from splices!

This extremely high uniformity is made possible by Audio's specially designed coating machines, which permit control of coating thickness to within five millionths of an inch. During the past 60 days, these machines have turned out more than 9,000 miles of plastic-base tape—with a volume deviation of not more than ± 1/2 db!

Remember—when you use Audiotape, you can be sure of the results every time. For every foot of Audiotape is monitored for output, distortion and uniformity—your assurance of the finest, professional quality recording tape obtainable.

Audio Devices, Inc.

444 Madison Ave., New York 22, N.Y.

Export Dept.: Rocke International, 13 East 40th St., New York 16, N.Y.

TEST IT—COMPARE IT

We will be glad to send you a free 200-foot sample reel of either plastic-base or paper-base Audiotape. It will speak for itself.
NEWS OF THE INDUSTRY

Edited by WILLIAM P. O'BRIEN

FCC Authorizes Complete Transcontinental Link

Completion of the American Telephone and Telegraph Company's proposed transcontinental microwave relay system was authorized in grants made recently by the Federal Communications Commission.

Chief among these are construction permits for 55 microwave relay stations to bridge the present gap between Omaha and San Francisco. This final link is scheduled to be completed by Jan. 1, 1952. It will provide four microwave channels, two of which will be used for television circuits, one in each direction. The other two channels will carry telephone traffic.

Construction of the New York-Chicago portion of the cross-country microwave route is virtually completed and is expected to be available for intercity tv network service in the near future. The Chicago-Omaha section, under construction, is planned to be ready for operation by April of 1951. As in the case of the coaxial cable, microwave relay can be used to augment tv network broadcast operation. The two facilities can be interconnected.

The estimated construction costs involved in the microwave relay grants total $20,400,000, of which amount $17,900,000 is for the Omaha-San Francisco link and $2,500,000 for additional equipment in the Chicago-Omaha section. This will bring the indicated cost of the completed transcontinental microwave system to $37,590,000.

NEC Technical Program

THIS YEAR'S National Electronics Conference will be held at the Edgewater Beach Hotel, Chicago, Ill., on September 25, 26 and 27. The advanced technical program is as follows:

**Mon., Sept. 25**

**10:00 A.M.**

**MICROWAVES AND ANTENNAS**


**MAGNETIC AMPLIFIERS**

Magnetic Amplifier Voltage Regulator, by J. L. Wolff of Westinghouse Electric Corp.

Noise Figure of the Magnetic Amplifier, by N. R. Castellini of Signal Corps Engineering Laboratories.

Magnetic Amplifiers with Orthonol Tape Cores, by W. A. Geyer of Naval Ordnance Laboratory.

**DIELECTRIC HEATING**

Dielectric Load Tuning in R-F Heating, by H. H. Hapgood of Westinghouse Electric Corp.

Measuring Dielectric Properties During R-F Heating, by E. Mittelman of Chicago, Ill.

**2:00 P.M.**

**TIME-POSITION MEASUREMENT**

The Electronic Umpire, by R. F. Shea of General Electric Co.

Thyratrons as Close-Differential Relays, by J. J. Baruch of MIT.

Micromechanical Relay Time Delay Unit, by J. F. Gordon of Bendix Radio Co.

**CIRCUITS**

Miniaturizing Pentode Amplifiers by Positive Feedback, by W. R. Asher of Naval Ordnance Laboratory.


Kernys of Twin-T Amplifiers, by L. G. Gitzendanner of General Electric Corp.


**TUBE TECHNOLOGY**

Electrolytic Tank Studies in Designing High-Vacuum Tubes, by J. E. Jacobs of General Electric X-Ray Corp.

A Beam-Type Tank That Multiplying, by A. Korn of Cleveland Northwestern U.


**10:00 A.M.**

**TELEVISION**

Television in Industrial Applications, by J. A. Good of Diamond Power Specialty Corp.


**INJECTION AND CONTROL**


Detection of Tramp Metal, by C. W. Clapp of General Electric Co.


**EXPLORATION AND NAVIGATION**

Recent Lunar Developments, by J. E. Hawkins of Seismograph Service Corp.

Flight Path Control, by D. L. Markussen of Minneapolis Honeywell Regulator Co.


**3:00 P.M.**

**RESEARCH INSTRUMENTATION**


Electronic Scanning Techniques for Low

RCA BEGINS TESTS ON NEW EMPIRE STATE ANTENNA

New television antenna, one of five designed for multiple video and fm antenna system on the Empire State Building, is shown on revolving turret during recent tests by RCA engineers at a site near Camden. N. J. L. J. Wolf, of RCA, extreme left; Frank J. Kear, consulting engineer of Kear and Kennedy, and C. W. Lyon, Jr., executive vice-president of Empire State, Inc., look on while R. S. Grimm, RCA engineer, monitors the test equipment. Group of interested onlookers at right includes; H. E. Ghieng and David Rain, both of RCA, and Thomas Howard, chief engineer of tv station WPIX, New York.

September, 1950 — ELECTRONICS
The Very High Frequency Omnidirectional Radio Range System, more simply known as VHF Omni Range (or VOR), has been standardized by international agreement as the most desirable method of short range aircraft navigation. A multiplicity of courses, theoretically infinite, is provided instead of the usual four courses obtained from the conventional Aural A-N system. The advantages of this are immediately apparent. Tangential courses are practical, as well as the conventional 'head-on' approach. By means of 'fixes' on two Omni stations, absolute position may quickly be determined, and by presetting the aircraft receiver, a pilot may maintain any angle of approach.

This Omnidirectional Radio Range System was DEVELOPED-DESIGNED-PRODUCED by LAVOIE LABORATORIES, Inc. We have both the experience and the facilities for the precise mass production of ELECTRONIC SYSTEMS at low unit cost.

If you will address us on your letterhead we shall be glad to send you a detailed description of the LAVOIE Omnidirectional Radio Range System.

Lavoie Laboratories, Inc.
RADIO ENGINEERS AND MANUFACTURERS
MORGANVILLE, N. J.

Specialists in the Development and Manufacture of UHF Equipment

A multipurpose D-C Amplifier with Reduced Zero Offset, by W. McAdam, R. E. Tandy, and A. J. Williams, Jr. of Leeds and Northrup.

Computers
Rosetti Principal Strain Computer, by C. M. Hathaway and R. E. Eddy of Hathaway Instrument Co.
A Versatile Small Scale Analog Computer, by J. T. Carlston of Westinghouse Electric Corp.
An Electrical Analog for Indeterminate Mechanical Structures, by J. P. Corbett and J. F. Calvert of Northwestern U.

Electroacoustics
Recent Design Developments on Electroacoustic Tone Generators, by W. L. Krauss and C. Tennes of G. O. Conn, Ltd. Design of Loudspeaker Enclosures, by L. L. Barnak of MIT.

Oscillography
A Portable Projection Oscilloscope, by V. V. Pool of Bell Electric Corp.

Control Instrumentation
Non-linear Techniques for Improving Servo Performance, by D. McDonald of Cook Research Laboratories.
Automatic Control of Inaccessible Terminal Voltages, by R. Cocorff and E. H. Gamble of Curtiss Wright Corp.

Nucleonics
Corona Voltage Regulator Tubes for Nucleonics, by D. Collins of Victory Instrument Co.

2:00 P.M.

Industrial Control
Electroacoustic Methods, Control Design Practices, by E. H. Vedder of Westinghouse Electric Corp.
Electronics in Electric Power Central Stations, by A. J. Ward of Sargent and Lundy.
An Indirect Method of Process Control by H. G. Durlam of Westinghouse Electric Corp.

Signal Generators and Analyzers
A 100- to 1,000 Mc Sweep Oscillator, by J. E. Ebert and H. A. Finke of Polytechnics, Inc.

Nucleonics
Radioactive Snow Gags with Telemetering, by A. D. Doreanus of Motorola, Inc.

Television Begins in Mexico

Mexico's first television station began its trial telecasting recently and three other stations were hurried to get under way. Licenses for operation have been issued to all four—three in Mexico City and one in Tijuana on the U.S. border.

The latter station, proposing to use channel six which would conflict with a nearby U.S. station in San Diego, has resulted in the U.S. and Mexico beginning exploratory talks toward a U.S.-Mexican television channel agreement.

At the same time, RCA-Victor has sent down the first mobile television unit ever to cross into Latin-America. This unit will be used in connection with the opening of XHTV, the television station of the Mexico City newspaper Novedades.

The first station to begin telecasting, XHTV, has its studios and transmitters located in the National Lottery Building, the highest in the Mexican capital. From the new tower, which is equivalent to the 23rd floor of the building, the beams can cover every home in the Mexico City area.

A second station, to be opened by the owner of Mexico's largest broadcasting and theater chain, Emilio Azarraga, is under construction and will start three-hour nightly telecasts in September.

All of the equipment for these two stations has come from the U.S., but a third station has been practically built in Mexico by an electronic engineer from imported parts and it was the first to get going with test shows (started last year).

This man, Ing. J. Camerer, hopes to start not only a telecasting but a television manufacturing plant in Mexico.

Industry Mobilization Committee

An ELECTRONICS industry mobilization committee to plan, coordinate and advise government agencies in war conversion and production was named in Chicago recently by James M. Blacklidge, chairman of the Association of Electronic Parts and Equipment Manufacturers.

The committee will work with manufacturers, distributors and government agencies to expedite production of war material and to consider problems of allocation and procurement.

James P. Quam, of Quam Nichols Co., Chicago, was named chairman of the mobilization committee, which includes: William J. Haligan, Hallicrafters Co.; Jerome J. Kahn, Standard Transformer Corp.; John H. Cashman, Radio Craftsmen, Inc.; S. N. Shure, Shure

(Continued on page 250)
It takes Experience to make a Leader

That's why SYLVANIA leads in Picture Tubes!

A look at Sylvania's past tells why it pays to insist on Sylvania Picture Tubes.

Radio. For more than 25 years, Sylvania tubes have been noted for their fine performance and long life. Out of this experience has come a knowledge of electron behavior . . . clearer picture reception and Sylvania's famous ion trap now licensed to other leading picture tube makers.

Electronics. Sylvania's electronics background includes the designing of cathode-ray tubes, radar and other precision equipment for wartime use. From this has developed many of the modern advances in high-frequency techniques necessary for best TV reception.

Phosphors. In the development of phosphors for the "Finest in Fluorescent Lamps," Sylvania has been an acknowledged leader for almost 20 years. This specialized experience is a basic reason for the smoothness and uniformity of Sylvania TV screens.

Lighting. Over half a century of experience lies behind Sylvania's lighting leadership. This includes years of research in filamentary wire, coiling and coating processes . . . further important reasons for the clarity and long life of Sylvania TV Picture Tubes.

For illustrated catalog giving ratings and engineering data concerning all Sylvania TV Picture Tubes, address: Sylvania Electric Products Inc., Dept. R-2109, Emporium, Pa.
NEW BOOKS

An Introduction to Luminescence of Solids

This book is an amazingly complete compilation of information on inorganic phosphors in their chemical, crystallographic and physical aspects, and also an excellent review of the modern physics of atoms and radiation.

The treatment is predominantly theoretical, but no practical aspect is neglected. There are actually six pages of cook-book recipes for making the more commonly useful phosphors, but especially the accompanying sage advice on the making of phosphors should be very carefully considered by beginners.

The author struggles valiantly to bring the theory of luminescence into a coherent whole. His obtention and interpretation (p 102) is thorough, but the subject seems to be like the biological field in that every explanation of the phenomena requires two more postulates to justify the first explanation so that the field continually expands instead of closing in.

The behavior of electrons in solids here described is so complicated and uncertain that to a radio engineer, accustomed to having electrons follow relatively simple rules in circuits, the picture of their behavior in nonmetallic solids given here may seem hopelessly confusing.

The luminescence of natural organic materials and synthetic dyes is fortunately largely ignored, which allows the book to remain in one volume and restricts the treatment to the prime purpose of the use of phosphors in cathode-ray tubes in general and television tubes in particular.

In spite of the large number of complex and elaborate symbols used, it is practically impossible to find a misprint. However, some of the figures are not completely self-explanatory.

The book is thoroughly indexed for authors, subjects and chemical formulas of phosphors as well as 750 references to modern articles pertinent to the subject material.

In the "Vorwort" to the 1930 edition of Leverenz on luminescence (privately published), the author states "This work is later to be revised, enlarged and then maintained as complete as the writer's"

(Continued from p 133)

RELEASED THIS MONTH


BACKTALK

This Department is Operated as an Open Forum Where Readers May Discuss Problems of the Electronics Industry or Comment Upon Articles that ELECTRONICS has Published

Television Servicing

DEAR SIRS:

SINCE ONE of the functions of Delta Electronics is the servicing of television receivers, your article "Why Television Receivers Fail in Service" was particularly appealing to us.

Your charts (Table I and II) are in agreement with our statistics, due to the fact that there is only one station in our area, however, we have a deficit of tuner calls and antenna troubles, but this is counteracted by unnecessary service calls that would be eliminated by trying another station.

As an independent, we are definitely against manufacturers and distributors getting up their own service agencies, as they are in direct competition with their own customers. We have nothing against retailers doing their own repairing, however.

We would be willing to go on record as approving of a system of standards among manufacturers as to policies, such as one year guarantee on all parts including the picture tube, or 90 days on all parts and one year on all tubes, provided such is done at no cost to the retailer, service organization, or customer. This should be incorporated in the original price of the television set.

We are also severely against the present trend (here) of salesmanship in which the customer is told the built-in antenna will work anywhere. This places the serviceman at a decided disadvantage when he is confronted with severe ghosts, snow, or other obvious reception difficulties.

A national manufacturer advertises that his built-in aerial will work in 8 out of 10 places of good signal. The customer takes this to mean the set will work in his home, period, and the salesman is the first person to agree. A few well scheduled advertisements by the manufacturer could easily change this unfortunate situation.

Perhaps we are lucky, but your average of 5 to 6 calls per year per set is high. Our yearly average is around four. This may not seem strange except for the fact that we are one of the organizations using low priced labor for service calls, pulling all sets to the shop for other than tube replacements. We count-

(Continued on p 260)

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time will permit,” which promise has been here most successfully fulfilled.—D. T. Wilbur, Allen B. DuMont Laboratories, Inc.

Wave Filters

THE AUTHOR has “aimed at providing an account of the properties of electric wave filters adequate for the needs of the student of physics and radio”. He has attempted to “strike a desirable mean” between the extended treatises on wave filters and the single chapters of general radio texts devoted to such filters. The book actually gives only a brief review of the elements of wave filters. Although Jackson attempted to provide “an adequate account of the subject, neither too brief nor too full of technical detail,” it is this reviewer’s opinion that the account is too brief to accomplish its object. The section in Terman’s Radio Engineers Handbook on “Network Theory, Filters and Equalizers” is as complete as this monograph.—MATTHEW LEBENBAUM, Airborne Instruments Laboratory.

Matrix Analysis of Electric Networks

This little book is an attempt to present the essential portions of Gabriel Kron’s method of network analysis in the simplest manner possible. As originally presented by Kron in “Tensor Analysis of Networks” (Wiley), stationary networks were considered as a special case of the broader and more difficult field of rotating machinery. Prof. Le Corbeiller contends this has prevented wide acceptance of Kron’s techniques in the simpler application.

The central idea of Kron’s original work is to consider a complex interconnected network as a

ELECTRONICS—September, 1950
TECHNICAL BOOKS

3 NEW books

... containing more factual information, more practical data, more clearly presented than anywhere else. You can't afford to be without them! Order NOW!

TV and OTHER RECEIVING ANTENNAS
(Theory and Practice)
Armsby E. Bailey
An outstanding book that explains and teaches. Clear and thorough. It can be used as a daily work reference. Complete coverage. All the latest type receiving antennas, short chimney-attached most faster 8%. This book means more profitable

TV reception antennas.

This book means more profitable

TV installation techniques.

by Samuel L. Marshall

A completely practical "how to do it" book, giving the answers to just about every TV antenna installation problem. Transmission lines, receiver adjustments and mechanical requirements whether for short chimney-attached-most or, even 80-ft. towers, including foundation. This book means more profitable installations — fewer return calls — faster installations—dollars in your pocket! Approx. 300 pages, 262 Illustrations. 8 1/2" x 5 1/2". Cloth Bound — $13.00

ENCYCLOPEDIA ON CATHODE-RAY OSCILLOSCOPES AND THEIR USES

by Rider and Uslan

This is undoubtedly the greatest and most complete reference book ever written on the cathode-ray tube. It is a practical encyclopedia which teaches how to use an oscilloscope, and how to get the most out of the device you now own. It assures your money's worth from your scope. It helps you select the proper equipment. The book begins with basic theory of cathode-ray tubes and proceeds through application in scopes and TV receivers... with full and clear explanations for uses in every field and research activity where a cathode-ray oscillograph. All scopes produced and sold during the last 20 years, more than 70 different models, are described completely with schematic wiring diagrams. Almost 500,000 words and about 3,000 illustrations are incorporated in more than 900 pages. Invaluable for engineers, servicemen, teachers, students, Armed Forces, radio amateurs, research laboratories, etc. 22 chapters. $9.00

NEW BOOKS (continued)

Incorporated tensor transformation of a primitive network in which all the branches are short-circuited on themselves. The problem of setting up the mesh or node equations is then reduced to one of setting down two tensors, one representing the circuit values and one representing the interconnections. The transformation is then merely a matter of routine manipulation. Although the minimum amount of computation necessary to arrive at a numerical solution is not reduced by the tensor analysis, it is organized in such a way that the procedure is largely routine and the chance for error, especially an error in the sign of a mutual impedance term, is greatly minimized.

In the book under review, the presentation has been greatly simplified by avoiding any mention of tensors or tensor concepts. As implied by the title, the material is presented purely in terms of matrix algebra. Actually, in the case under discussion, it makes little difference whether we call the quantities tensors or matrices. The distinction becomes significant only in applications, such as the study of rotating machinery, in which the network is varying. In avoiding discussion of the more difficult concepts commonly associated with tensor analysis nothing is lost, but simplification is achieved.

The author has indeed succeeded in presenting his material in simple form. The book is quite suitable for undergraduate students who have had no more than a standard course in a-c networks or for practicing engineers who have had no previous experience with matrices. The first chapter presents the fundamentals of matrix algebra in such a simple and clear fashion as to make it an excellent medium for the student's first introduction to the subject. The other three chapters take up respectively the mesh method, the node pair method, and the mixed method of network analysis all from the matrix point of view. Although the discussion is entirely in terms of steady-state analysis, the extension to include transient problems will follow immediately once the student has mastered the operational methods of transient analysis.

Although the book does succeed

TECHNICAL BOOKS

SOLVE ALL YOUR RADIO PROBLEMS

• more quickly
• easily
• accurately

HERE are quick answers to routine and special assignments in communications, broadcasting, aircraft radio, television, and related fields. With the substitution and addition of moduli in modern developments in the field 113 pages of carefully selected design data—charts, tables, circuits, diagrams, and formulas. Starting with a clear description of the physical, mathematical, psychological, and acoustical bases on which all electrical communication exists, the book covers covers completely from fundamental to specialized applications. The means of transmitting and utilizing energy in the very high frequency portions of the radio spectrum are also explored. Consult one or more of the 35 specialists who prepared it, whenever you need a fact or formula quickly — the answer to an ordinary or out-of-the-ordinary problem.

Radio Engineers Handbook

Keith Henney, Editor-in-Chief
Consulting Editor
SEE THIS BOOK 10 DAYS FREE

1197 pages, 6 x 9, 1038 illustrations, $10

THIS 4th Edition presents radio principles, standards, and practice for the designer, engineer, and radio technician. It brings the latest developments to the student's first introduction to the subject. The other three chapters take up respectively the mesh method, the node pair method, and the mixed method of network analysis all from the matrix point of view. Although the discussion is entirely in terms of steady-state analysis, the extension to include transient problems will follow immediately once the student has mastered the operational methods of transient analysis.

Although the book does succeed
Opportunities for Saving

CLEVELAND CONTAINER
LOW COST, SPIRALLY LAMINATED, PAPER BASE
PHENOLIC TUBING

Manufacturers of radio and television receivers know the outstanding advantages of Cleveland Cosmalite* on both performance and cost.

* * *

Designed to replace at a considerable saving the ordinary phenolic and fibre tubing... its properties include great strength, low moisture absorption, high dielectric strength, low loss and good machineability. Made in lengths up to 8½ ft. with types, diameters and thicknesses as desired. May be punched, notched, threaded and grooved to meet individual needs.


Send for samples today and investigate its low cost possibilities for you.

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO
PLANTS AND SALES OFFICES at Plymouth, Wis., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

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in presenting the material in clear and simple terms, it is to be regretted that the author has not included more examples and problems of a type that demonstrate the power of the method. Primarily because of the lack of such problems, the book is likely to leave the reader unenthused about the utility of the matrix method. Although the author says that he considers Kron's work to be the most significant advance since the introduction of impedance, he is not too successful in conveying this impression to the reader. If the book is used as an under-graduate text, it should definitely be supplemented with problems of analysis of complicated networks. Of course, for the practicing engineer who can supply problems from his own experience, this is not a serious problem.

In spite of the above criticism, the book does fill a very definite need. It is highly recommended to anyone wishing an introduction to the subject.—Warren D. White, Airborne Instruments Laboratory, Mineola, New York.

THUMBNAEL REVIEWS


ELECTROMAGNETIC THEORY. By Oliver Heaviside. Dover Publications Inc., New York, 1950, 356 pages, $7.50. Unabridged reprint edition containing all three volumes of this scientific classic, with critical and historical introduction by Ernest Weber. Though originally published between 1893 and 1912, the contents are still regarded as one of the most readable
DPi announces the new MCF-60 High Vacuum Pump for automatic tube exhaust machines... and answers these questions.

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The new MCF-60 3-Stage Fractionating Oil Diffusion Pump handles 60 liters per second in the range from $10^{-3}$ to $10^{-5}$ mm Hg and reaches an ultimate vacuum of $5 \times 10^{-7}$ mm Hg. Its powerful vapor jets can operate against a forepressure of 0.2 mm Hg or more. The jet assembly can easily be removed for cleaning.

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September, 1950 — ELECTRONICS
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Write for descriptive information on d-c capacitors, a-c capacitors, or ballast capacitors to Capacitors Sales Division, 42-304, General Electric Company, Pittsfield, Mass.

GENERAL ELECTRIC

ELECTRONICS — September, 1950

139
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NEW BOOKS (continued)

classics of science, brilliant in style and instilled with the author's dynamic personality. The closing predictions anticipated the atomic era with: "As the universe is boundless on one way, towards the great, so it is equally boundless the other way, towards the small; and important events may arise from what is going on inside of atoms, and again, the inside of electrons. There is no energetic difficulty. Large amounts of energy may be very condensed by reason of great forces at small distances."

INFRARED RADIATION THERAPY SOURCES AND THEIR ANALYSIS WITH SCANNER. By Leopold Ronner. Charles C. Thomas, Publisher, Springfield, Illinois, 1950, 34 pages, $1.00. Description of infrared scanner using bolometer with rotating shutter, a-c amplifier and recorder, and reproductions of coverage patterns obtained with various infrared sources.

GERMAN-ENGLISH TECHNICAL DICTIONARY. Edited by Kirt F. Leidecker. S. P. Vaeni, Publisher, 88 W. 12th St., New York, 1950, Vol. I—A-K now available, and Vol. II-L-Z out in fall 1950; both volumes $35.00. Based on data compiled by the U. S. Air Force for use in translating scientific terms in documents captured by the Allies after the fall of Germany. Its terminology has been adopted in official U. S. and British documents. Over 100,000 German terms are listed alphabetically, followed by English equivalents or definitions.

HYDROGEN IN CHEMICAL ATOMS. By W. M. Venable. Markowitz, Haas & Korenman, Pittsburgh 32, Pa., 1950, 354 pages, $4.00. Analysis of spectral levels from Li I to O VII, with 48 pages of tables showing how wave numbers of classification levels evaluated by usual methods are derived from wave numbers of true series levels by deductions of wave number differences contributed by hydrogen.


PRIMARY BATTERYBS. By George Wood Vinal, John Wiley & Sons, New York, 1950, 325 pages, $5.00. Elementary theory of cells, materials and production, operational characteristics, effect of temperature, standard cells, depolarized cells, copper and copper oxide cells, silver oxide and chloride cells, lead cells, mercury cells, and vanadium cells, and fused-electrolyte cells.

MODERN PLASTICS ENCYCLOPEDIA AND ENGINEER'S HANDBOOK. Breskin Publications, New York, 1950 edition, 1,200 pages, $3.00. All phases of plastics design and production, all types of plastics materials and new developments of past twelve months.

RADIO NOISE METER. ASA standard C93.1-1950. American Standards Association, 70 E. 42, New York, 16 pages, 65 cents. Proposed specifications for an instrument covering the range of 0.005 to 20,000, intended for general use in factories and in the field for measuring radio noise field intensities near electrical equipment and power lines as well as over lines for determining broadcast field intensities.


September, 1950 — ELECTRONICS

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September, 1950 — ELECTRONICS
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Westinghouse Rectifiers and Chargers for All Industries

ELECTRONICS — September, 1950
selected time key resistance is equal to the 2050 grid firing potential, the thyratron starts conducting. The 2050 plate circuit relay $K_2$ is then actuated, which breaks the holding circuit of relay $K_1$. Relay $K_2$ then de-energizes the clutch solenoid. The clutch and its associated mechanism then opens the print switch, de-energizes relay $K_2$, and raises the platen and hood.

In changing to its nonoperating position, $K_2$ opens the 2050 plate circuit, and grounds out the charging capacitor. Thus the printing cycle is completed, and the machine is ready for the next exposure.

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The diode in the charging circuit makes possible stable accurate timing. Reference is made to the charging circuit voltage curves of Fig. 2. The voltage across $C$, plotted as a function of time is not a continuous transient, but consists of a series of transients, each initiated at the beginning of a positive half-cycle input to the 6SN7.

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<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range mc</th>
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<tr>
<td>348</td>
<td>13,000-18,000</td>
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<tr>
<td>349</td>
<td>19,000-26,000</td>
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<tr>
<td>350</td>
<td>26,500-39,000</td>
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Absolute Accuracy

- Model 348: 1/1000
- Model 349: 1/1000
- Model 350: 1/1000

Approximate Loaded Q

- Model 348: 1000
- Model 349: 450
- Model 350: 1000

Fittings

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- Model 349: UG-419/U
- Model 350: UG-381/U

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- Division of the Sperry Corporation, Great Neck, New York • Cleveland • New Orleans • New York • Los Angeles • San Francisco • Seattle
- Electronics — September, 1950

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Featuring a Logarithmic Voltage Scale and Uniform Decibel Scale

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September, 1950—ELECTRONICS
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3. Speak up, wherever we are, against prejudice. Work for understanding.

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because the opposed windings are on a special flatted core

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By LAWRENCE FLEMING

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FULL-SCALE sensitivity of 10 millivolts is provided by the electronic voltmeter whose circuit is shown in Fig. 1 and 2.

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Figure 1 shows the basic circuit designed by Howard L. Daniels, of Engineering and Research Associates, Minneapolis, Minn. It differs from most a-c voltmeters in the proportioning of the circuit constants. The first stage, $V_1$ is a voltage amplifier designed to give maximum voltage gain in the required bandwidth. The second stage, $V_2$ is a current amplifier. Its load resistance is determined by the following considerations: it must be higher than the resistance of the rectifier and meter combination; it must be high enough to limit the overload current through the indicating instrument and low enough to permit a reasonable value of transconductance to be developed in the current amplifier.

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Springs, Wire Forms, Shimtings

September, 1950 — ELECTRONICS
When ever DC power is required at other than the supply voltage, Bendix® Specialized Dynamotors function as DC transformers. They can be wound for any input or output voltage between 5 and 1200 volts, and they can deliver power up to 500 watts. Multiple outputs can be supplied to correspond with several secondaries on transformers, and their output voltages can be regulated within close limits regardless of input voltage or load variations. Bendix Specialized Dynamotors are tailored to the exact requirements of each application by the design of the windings used in standardized frames. This reduces the cost, size and weight to an absolute minimum, consistent with the operational requirements. Compliance with Government specifications is assured by the choice and treatment of materials and the basic design. A complete description of your requirements will enable our engineers to make concrete recommendations . . . All orders are filled promptly and at moderate cost.

TUBES AT WORK (continued)

be employed in conjunction with a microammeter as shown; or a halfbridge may be used as in Fig. 2. The latter arrangement halves the sensitivity. Germanium diodes are used. The low-frequency limit of the instrument is determined by the ratio of $C_v$ to the plate resistance of $V_v$.

Since the actual load impedance of $V_v$ is low, this stage is inherently a wide-band device, and the high-frequency response of the circuit is that of the first stage. Because of this disparity in high-frequency response of the two stages, there is a wide margin of safety against high-frequency oscillation when feedback is applied. The low-frequency response is on a par with that of a conventional two-stage amplifier.

Average-Reading

The deflection of the indicating d-c meter is proportional to the full-wave average value of the a-c voltage applied to the input, since the signal can produce no change in the average charge on $C_v$.

In Fig. 1, the full-scale range of the circuit is measured by the ratio of meter current to input voltage:

$$I = \frac{A_1 g_{m1}}{e_i + 1 + R_e A_1 g_{m2}}$$

where $I$ = current in meter circuit, $e_i$ = input voltage to grid of $V_1$, $A_1$ = voltage gain of $V_1$, $g_{m1}$ = transconductance of tube $V_1$, and $R_e$ = feedback resistance common to input and output circuits. For the case of no feedback, this expression reduces to the product of the gain of the first stage and the transconductance of the second.

Practical Circuit

A practical embodiment of the Daniels principle is shown in Fig. 2;
VOLTAGE REGULATED POWER SUPPLIES
For Industrial and Research Use

MODEL 510
Model 510 features TWO COMPLETELY INDEPENDENT REGULATED POWER SUPPLIES.
OUTPUT DC FOR EACH SUPPLY: 200-500 volts, 200 Ma.
REGULATION: ±5% for both line and load variations.
RIPPLE: 5 millivolts.
OUTPUT IMPEDANCE: 2 ohms.
OUTPUT AC FOR EACH SUPPLY: 6.3 volts, 6 Amp., CT.
The supplies may be connected for series, parallel, or bucking operation.

MODEL 245
OUTPUT DC: 200-500 volts, 200 Ma.
REGULATION: ±5% for both line and load variations.
RIPPLE VOLTAGE: 5 millivolts.
OUTPUT IMPEDANCE: 2 ohms.
OUTPUT AC: 6.3 volts, 6 Amp., CT, unregulated.

MODEL 103, MULTIPLE POWER SUPPLY
TWO B SUPPLIES: 0-300 volts, 75 Ma. each, 150 Ma. when paralleled. Ripple 10 millivolts. Unregulated.
ONE C SUPPLY: Minus 50 volts to plus 50 volts, 5 Ma. Ripple 5 millivolts. Unregulated.
ONE FILAMENT SUPPLY: 6.3 volts AC, 5 Amp.

MODEL 515
B SUPPLY: 0-500 volts, 200 Ma.
REGULATION: ±5% for both line and load variations.
RIPPLE: 5 millivolts.
OUTPUT IMPEDANCE: 2 ohms.
C SUPPLY: 0-150 volts, 5 Ma.
REGULATION: 10 millivolts for line 105-125 volts. 
±5% for load at 150 volts.
RIPPLE: 5 millivolts.
FILAMENT SUPPLY: 6.3 volts AC, 10 Amp., CT,
This unit is available with a 300 Ma. B Supply, with or without C Supply.

MODEL 315
B SUPPLY: 0-300 volts, 150 Ma.
REGULATION: ±5% for both line and load variations.
RIPPLE: 5 millivolts.
OUTPUT IMPEDANCE: 2 ohms.
C SUPPLY: 0-150 volts, 5 Ma.
REGULATION: 10 millivolts for line 105-125 volts. 
±5% for load at 150 volts.
RIPPLE: 5 millivolts.
FILAMENT SUPPLY: 6.3 volts AC, 5 Amp., CT.

MODEL 600
Model 600 features TWO INDEPENDENT REGULATED POWER SUPPLIES.
OUTPUT DC FOR EACH SUPPLY: 0-500 volts, 200 Ma.
REGULATION: ±5% for both line and load variations.
RIPPLE: 5 millivolts.
OUTPUT IMPEDANCE: 2 ohms.
OUTPUT AC FOR EACH SUPPLY: 6.3 volts, 10 Amp., CT, unregulated.

Write for specifications on our complete line of power supplies
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ELECTRONICS — September, 1950
Webster Electric

Model "A" Cartridge

with Twist Mechanism

Kenyon Fits Your Production To A "T"

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840 Barry Street • New York 59, N.Y.
Insulate all these parts with tough Teflon tape

New Du Pont plastic offers unusual combination of electrical, mechanical and thermal properties for:

- Coil Separators
- Conductor Insulation for Armature or Field
- Slot Liners
- Coil Wrappers
- Taping of Mesh-Wound Coils
- Load Insulation

Look at these properties!

MECHANICAL. "Teflon" tetrafluoroethylene resin is extremely tough— withstands considerable abuse in assembly and in use. Doesn't deteriorate with time. In applying, it's easy to handle, smooth, conforms well to corners and odd shapes—is adaptable to automatic operations.

ELECTRICAL. Its electrical properties are excellent over wide ranges of temperatures and frequencies. Its power factor is less than 0.05% over the entire spectrum measured to date. Short-time dielectric strengths are high. "Teflon" has good arc-resistance, and doesn't carbonize under an arc discharge. It has zero water-absorption.

THERMAL. "Teflon" is capable of continuous service at 250°C (482°F.) without deterioration, exceeding the requirements of even Class II materials. In laboratory tests, molded bars kept at 250°C. for one month show only a 1% loss in tensile strength. "Teflon" also maintains good properties down to as low as -196°C. (-320°F.). Thus, an insulation of "Teflon" on a motor would not crack when motor is started in arctic temperatures.

CHEMICAL. "Teflon" has the highest degree of chemical inertness of any plastic. There is no known solvent for it. Thus, it is ideal for motors and generators operating under corrosive atmospheric conditions. "Teflon" is unaffected by outdoor weathering, as well. Samples exposed in Florida for over five years are completely unchanged.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Sales Offices: 350 Fifth Avenue, New York 1, N.Y.; 7 S. Dearborn St., Chicago 3, Ill.; 845 E. 60th St., Los Angeles, Calif.

Write today for free booklet on "Teflon" Tape.

ELECTRONICS — September, 1950
Need help with microwave transmission lines?...call TERPENING

The microwave mixer shown above was designed and produced on special order, in quantity, in our plant. Though made up from a number of different sections brazed together, special jigs, fixtures, and skilled techniques made it possible to hold tolerances between the outer flange center lines to ± .001".

Whether it's a special component, such as the mixer shown, or complete microwave transmission systems, we're set up to produce them with a high degree of precision from blueprints or performance specs. Although our engineering staff, laboratories, and fully equipped shop are usually busy on government contracts, our unusual facilities may permit us to work with you on special components for military or other microwave systems. We shall be happy to talk with you about your present and/or future needs.

L. H. TERPENING COMPANY
DESIGN • RESEARCH • PRODUCTION
Microwave Transmission Lines and Associated Components
16 West 61st St. - New York 23, N. Y. • Circle 6-4760

TUBES AT WORK
The full-scale sensitivity is 10 millivolts. The frequency range is 10 cps to 50 kc, within 3 percent. Five higher decade ranges are provided. The high-frequency limitation imposed by the first amplifier plate circuit coincides with the limitation imposed by the lack of capacitance compensation in the input step attenuator. Further extension of the high end implies extra complication. In this respect, the performance is narrower than in commercial meters.

The circuit employs 14-db feedback. At 26-db feedback, low-frequency oscillation appears, providing a 12-db margin of safety.

The device is extremely insensitive to tube and line voltage changes, and is not critical as to component placement or lead dress. Filtering and decoupling in the power supply is essential.

Circuits of lower sensitivity may be made using a triode for the first stage, and they are inherently more stable.

R-F Heats Combustion Furnace

CARBON and sulphur analysis of iron and steel by direct combustion is now being done by r-f induction heating.

The electronic combustion furnace comprises a class-C oscillator with suitable controls mounted in a metal enclosure. The frequency of operation is approximately 10 mc at a power output of 500 watts.

Loading and unloading of the sample to be analyzed is accomplished by means of a bolt-action mechanism centrally located on the panel, which provides an atmosphere seal in the same operation. The sample container is a small crucible or cupule manufactured from a special high-refractory mixture to withstand the high temperatures generated. The cupule is supported on a ceramic hearth mounted on an aluminum pedestal.

The combustion tube is a 10-inch section of high-silica tubing. The tube is fitted with a replaceable ceramic plug to diffuse the flow of oxygen immediately above the cupulet and to trap any particles thrown off during firing. A vitreous-
**CERAMIC DISK CAPACITORS**

Hi-Q Ceramic Disk Capacitors for by-passing, blocking, or coupling are being used by the millions by television receiver manufacturers who demand the utmost in performance.

Unit cost, time and labor may be saved by using several of the multiple capacity Hi-Q Disks where applicable in your television circuit. Multiple capacities having a common ground are available in standard units as shown in the chart below. Hi-Q Disks are coated with a non-hydroscopic phenolic to insure protection against moisture and high humidities. Hi-Q Disks like all other Hi-Q components assure you of the highest quality workmanship at the lowest possible cost.

Our Engineers are ready and willing to discuss the application of these highly efficient, dependable capacitors in your circuits. Write today for your FREE copy of the new Hi-Q Datalog.

<table>
<thead>
<tr>
<th>Type</th>
<th>A Diameter</th>
<th>B Lead Width</th>
<th>C Thickness</th>
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<tr>
<td>B.P.D. .00047</td>
<td>3/16&quot; max.</td>
<td>3/16&quot; + 3/16&quot;</td>
<td>3/16&quot; max.</td>
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<tr>
<td>B.P.D. .0008</td>
<td>1/16&quot; max.</td>
<td>1/16&quot; + 1/16&quot;</td>
<td>3/16&quot; max.</td>
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<td>B.P.D. .001</td>
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<td>3/16&quot; + 3/16&quot;</td>
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<td>B.P.D. .0015</td>
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<td>3/16&quot; + 3/16&quot;</td>
<td>3/16&quot; max.</td>
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<tr>
<td>B.P.D. .002</td>
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<td>3/16&quot; + 3/16&quot;</td>
<td>3/16&quot; max.</td>
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<tr>
<td>B.P.D. .004</td>
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<td>3/16&quot; + 3/16&quot;</td>
<td>3/16&quot; max.</td>
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<tr>
<td>B.P.D. .005</td>
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<td>3/16&quot; + 3/16&quot;</td>
<td>3/16&quot; max.</td>
</tr>
<tr>
<td>B.P.D. .01</td>
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<td>3/16&quot; + 3/16&quot;</td>
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<td>B.P.D. 2x.001</td>
<td>3/16&quot; max.</td>
<td>3/16&quot; + 3/16&quot;</td>
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<td>B.P.D. 2x.002</td>
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<td>B.P.D. 3x.0015</td>
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<td>3/16&quot; + 3/16&quot;</td>
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<td>B.P.D. 3x.002</td>
<td>3/16&quot; max.</td>
<td>3/16&quot; + 3/16&quot;</td>
<td>3/16&quot; max.</td>
</tr>
</tbody>
</table>

Insulation: Durez and Wax impregnated. Leads: 22 gauge pure tinned dead soft copper. Capacity: Guaranteed minimum as stamped. All capacitance measurements made at 25°C at 1 KC at a test voltage not over 5 volts RMS. Test Voltage: 1500 volts D.C. Insulation Resistance: 7500 megohms min. Power Factor: Max. 2.5% at 1 KC at not over 5 volts RMS. JOBBERS—ADDRESS: 740 Belleville Ave., New Bedford, Mass. ELECTRONICS—September, 1950

**Hi-Q COMPONENTS**

- Capacitors
- Trimmers • Choke Coils
- Wire Wound Resistors

**BETTER 4 WAYS**

- Uniformity
- Dependability
- Precision
- Miniaturization

ELECTRONICS - September, 1950

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in Curtiss Electric Propellers

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CHECK THESE ADVANTAGES

- Moisture-proof
- Radio Quiet
- Single-piece Inserts
- Vibration-proof
- Lightweight
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- Easy Assembly and Disassembly
- Fewer Parts than any other Connector
- No additional solder required

Unfailing dependability is the standard set by Curtiss propellers and American Air Lines in their selection of equipment.

Bendix-Scintilla is therefore the logical choice for the electrical connectors in the Curtiss Electric propellers on American Flagships.

In fact, wherever circuits must be arranged to connect and disconnect with ease and certainty Bendix-Scintilla is the choice.

Remember whenever there is no compromise with quality—it pays to specify Bendix-Scintilla electrical connectors—the finest money can buy.

Write our Sales Department for detailed information.

BENDIX SCINTILLA

SCINTILLA MAGNETO DIVISION

There's no compromise with quality—it pays to specify Bendix-Scintilla electrical connectors—the finest money can buy.
NEW!

THE HIGHEST GAIN COMMUNICATIONS ANTENNA EVER BUILT!

Actually delivers 6 db......
increases your power 4 times!

Now, for the first time, you can operate in areas previously far out of your reach. This vast extra service area is yours at no additional operating cost because the 6 db actually delivered by this new ANDREW antenna is equivalent to increasing your power 4 TIMES! Think of the economy! This tremendous extra power also fills in any dead spots.

It's another pace-setting ANDREW "first".

Uniformity of performance is assured regardless of supporting structure height through a NEW EXCLUSIVE ANDREW METHOD of electrically isolating the radiating elements from the support structure.

Lightning protection and quieter reception during electrical storms are achieved by a DC path which conducts static charges from the elements to ground.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>148-174 MC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE NO.</td>
<td>3000</td>
</tr>
<tr>
<td>Gain</td>
<td>6 dB</td>
</tr>
<tr>
<td>Height above top of tower</td>
<td>271/2 ft.</td>
</tr>
<tr>
<td>Length of support most extending into tower</td>
<td>5 ft.</td>
</tr>
<tr>
<td>Weight</td>
<td>625 lbs.</td>
</tr>
<tr>
<td>Moment of tower top*</td>
<td>9300 ft. lb.</td>
</tr>
</tbody>
</table>

*Based on 100 mph wind loading and 1/2" radial ice. Moments include loading added by 300 mm beacon for Type 3000 and double obstruction light for Type 3001.

Type 3000 is designed to support a 300 mm code beacon, and includes a suitable mounting plate. Type 3001 is designed to support a double obstruction light.

All models are designed for connection to ANDREW Type 737 transmission lines, and are provided with climbing steps.

All orders filled chronologically. Deliveries begin September 1. Write, wire or phone (ask for Mr. Bickel) today.

ANDREW CORPORATION
362 East 75th Street - Chicago 19

WORLD'S LARGEST ANTENNA EQUIPMENT SPECIALISTS

Transmission Lines for AM-FM-TV - Antennas - Directional Antenna Equipment - Antenna Tuning Units - Tower Lighting Equipment - Consulting Engineering Services

Work coil surrounds atmosphere-sealed tubing containing sample of iron being analyzed.

enameled work coil surrounds the combustion tube, and is supplied with r-f energy by the oscillator.

Integral piping for oxygen and combustion products is included, and flow is controlled by needle valves located in both lines. Oxygen is introduced through the top rear hose connector, flows through the top control valve and enters the combustion tube through the top breech opening. The products of combustion are led out through the bottom breech, through the bottom control valve and are conducted to the external train through the bottom rear hose connector.

When used for carbon determinations the oxygen flows from the top, over the heated sample, and the products of combustion are taken from the bottom of the combustion tube.

Flow of oxygen is indicated by the lowering of the level in the burette. The liquid level will come to a halt when about 1/4 of the liquid is expelled. This indicates that combustion and fusion are taking place. After the combustion is completed, (about 1 min) the flow of liquid resumes. When the level reaches the calibrated portion of the stem, the oxygen valve is closed, the plate current is turned off, and the loading mechanism lowered.

For sulphur determinations the
**Driver-Harris**

**perfection of new alloy for WESTINGHOUSE lamps**

**HERE WAS THE PROBLEM:**

How to obtain a strong, rigid assembly for conductors supporting the filaments of sealed beam automobile headlights and, at the same time, make a perfect seal between the conductors and the glass housing of the lamp, so that gas sealed within the lamp might not escape.

**AND HERE'S THE SOLUTION:**

The back wall of the lamp, cast from Pyrex-like glass, has three holes through which the conductors can be passed. The area around these holes is heated until the glass is near-molten. Over each hole, on the rear side of the lamp, is then placed a "thimble"—made of specially produced D-H alloy. These thimbles are pressed into the molten glass, which, upon cooling, holds them firmly in position. The conductors are then passed through the holes in the glass wall, and their free ends soldered to the base of each thimble respectively. Lugs soldered to the thimbles, outside, provide terminals for mounting the lamp in a socket. In this manner, a strong, stable, gas-tight assembly is obtained.

Westinghouse discussed its needs with Driver-Harris. Could the necessary type of thimble stock be obtained, and supplied in strip form, .009" thick, with negligible tolerances?

The answer is found on all Westinghouse sealed beam headlamps today. Driver-Harris not only produces an alloy with precisely the properties needed, but advanced D-H rolling techniques meet the exacting dimensional requirements specified.

**SPECIAL ALLOYS FOR SPECIAL PURPOSES** is an important phase of our business. If you have been unable to find the alloy you need, tell us about it. Our 50 years of development and manufacturing experience are at your service.

---

**The part played by the metal thimbles in solving the problem is vitally important:**

1. It is imperative that the thimbles be composed of a metal alloy with a coefficient of expansion closely approximating that of glass at all temperatures up to the melting point of glass. Any appreciable difference in the rates of expansion would result in the glass being fractured.

2. The thimble stock must be initially and entirely gas-free—to avoid the possibility of bubbles or strains being formed in the glass at the seal.

3. The stock must be held to extremely close tolerances when manufactured—to meet the requirements of meticulous, high-speed presses and dies specially developed to produce the thimbles.

**Driver-Harris Company**

**HARRISON, NEW JERSEY**

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

Manufactured and sold in Canada by

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Makers of world-famous Nichrome® and over 80 alloys for the electrical, electronic and heat-treating fields.

**ELECTRONICS — September, 1950**
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1309 Seventh Street, North Bergen, New Jersey

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Kahle Custom-Builds machines to make the exact tubes you require—from big 20-inchers to tiny sub-miniature—from laboratory types to those for high-speed production. Kahle puts each unit through exhaustive testing to assure trouble-free operation in your plant.

#1414 Button Stem Machine
For cathode ray tubes
Custom-built to individual requirements, turns out 400-500 TV stems per hr.—fine adjustment of speed, pressure, heat and sequence of operation—with labor-saving development for automatic tubulation flaring.

We specialize in cost-cutting production-boasting, labor-saving equipment for complete manufacture of cathode ray tubes, standard, miniature and sub-miniature radio tubes, sub-miniature tubes, fluorescent lamp, photocells, x-ray tubes, glass products.

Consultations invited. Send for our new catalog.

Only with CO-AX air-spaced articulated R.F. CABLES

THE LOWEST EVER CAPACITANCE OR ATTENUATION.

We are specially organized to handle direct enquiries from overseas and can give IMMEDIATE DELIVERIES FOR U.S.A.

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Bendix-Pacific telemetering facilities can provide you with any phase of a complete instrumentation service. These include:

- The standard AN/DKT-3 sub-miniature telemetering components which remotely measure and indicate acceleration, motion and position, pressure, strain, temperature, vibration, velocity, voltage and current. Transmitters up to 15 watts of power are available.
- Application engineering to adapt the Bendix-Pacific System to each specific problem.
- Installation and calibration services.
- Aircraft and missile antenna design and radiation analysis.
- Flight testing, providing all ground station facilities and reduction and analysis of data.

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Bendix-Pacific has developed for restricted use an exceptionally small, compact radar beacon for use in the common radar bands to facilitate vehicle tracking.

Inquiries from qualified companies and agencies for complete engineering data are invited.

Pacific Division
Bendix Aviation Corporation
North Hollywood, California

Eastern Engineering Office: 475 Fifth Ave., N.Y.
TO MEASURE—TO INDICATE—TO WARN AT A DISTANCE

September, 1950 — ELECTRONICS
Motorola—Precision-Engineered for
ADJACENT CHANNEL OPERATION

New "Uni-Channel"
Top performer in
low-cost 2 way radio

with the marvelous Sensicon circuit...

...for permanent selectivity—and 8 other Motorola improvements—Count on Uni-Channel through any routine or emergency to handle whole messages in heavy adjacent channel traffic

(±35 Kc. at 100 db. down, and ±15 Kc. at 6 db. down)—

your practical proof of superior Motorola equipment!

A marvel of mechanical convenience in one compact and accessible package. Just 4 screws install it in any vehicle. Or, as an emergency station, simply connect antenna and power.

Investigate Uni-Channel before buying.

Motorola

Communications Division 4545 Augusta Blvd., Chicago, In Canada: Rogers Majestic, Ltd., Toronto

Electronics — September, 1950

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If you have a fabricating or processing problem involving paper...if you require definite technical characteristics and, above all, dependable uniformity, it may be worthwhile for you and MOSINEE technicians to get together. MOSINEE is not interested so much in terms of volume production as in our ability to render helpful service to manufacturers in the field of electronics and in the electrical goods industry. Our "paperologists" are at your service for consultation. Please write Dept. E.

Circuit of high-frequency heating unit designed for carbon and sulphur determination

flow of oxygen is reversed, that is, the direction of oxygen flow should be from the bottom of combustion tube towards the top. Glass wool in the dome traps iron oxide.

The oscillator is of the tuned-plate type using a pair of 250-watt triodes in parallel. The oscillator components, with the exception of the tank coil, are mounted in the top section of the unit. The tank circuit comprising a 250-mfd vacuum capacitor and a 5-turn tank coil is coupled to the plate circuit through two ceramic capacitors mounted on the top coil terminal.

The tank coil also functions as the applicator and is located on the front panel inside the screened enclosure. This screen is designed to allow ventilation of the coil as well as physical protection to the operator. The equipment is manufactured by Lindberg Engineering Co. of Chicago.

Plug-In Amplifier Card

By W. H. Lyon
Service Manager
Soundscriber Corporation
New Haven, Connecticut

INCREASING USE of electronic circuits in equipment which had previously been considered as almost wholly mechanical, has posed a maintenance problem for many manufacturers. One company, a manufacturer of disc-type office equipment, has solved its service problem by designing its electronic circuits for easy replacement by a
Picture tube sizes for television have been paced by Du Mont for the past decade. And again it's Du Mont with the rectangular tube in the size the public wants — a rectangular with screen area (150 sq. in.) comparable with the round sixteen-inch tube. There is no need to sacrifice picture size to incorporate the advantages of the rectangular tube. This latest Teletron* features the exclusive Du Mont-designed Bent Gun for the sharpest focus and longest life free from ion spot blemishes. For that extra sales appeal, incorporate this newest Du Mont design in your receiver. Write for complete specifications.

**GENERAL SPECIFICATIONS**

- Overall length: 10 1/2".
- Greatest dimension of bulb: 16 1/4".
- Minimum useful screen diagonal: 15 1/2".
- Base: Duodecal 5 pin.
- Bulb contact: Recessed small cavity cap.
- Anode voltage: 12,000 volts DC.
- Grid No. 2 voltage: 300 volts DC.
- Focusing coil current: 115 approx. ma. DC.
- Grid No. 1 circuit resistance: 1.5 max. megohms.

*Trade-mark

ALLEN B. DU MONT LABORATORIES, INC. • TUBE DIVISION • CLIFTON, N. J.

ELECTRONICS — September, 1950
EXTREMELY COMPACT

Curtis
Type "M" and "MT"
TERMINAL BLOCKS
1 to 24 Terminals
Factory Assembled

These Curtis terminal blocks provide an economical, convenient way to simplify control wiring where space is limited. Terminals are held securely in a metal channel. A solid base provides ample insulation from the mounting channel and eliminates terminal screw grounding. Danger of damage or breakage is reduced to a minimum.

Send for
Bulletin
DS-119

Curtis Type "M" is without marking tags; Curtis Type "MT" is equipped with white fibre marking tags for both circuit identification and increased insulation. Both blocks have ample clearance and creepage distances for use in circuits carrying up to 300 volts, 15 amperes.

Curtis DEVELOPMENT & MFG. CO.
Terminal Block Sales—4025 West Madison St.
Chicago 24, Illinois
Factory—Milwaukee 16, Wisconsin

HEAT RESISTANT WIRES FOR EVERY APPLICATION...

So — you think this is HOT

Well for you or me it’s hot enough, but for Lewis heat resisting insulated wire it isn’t even a starter.

Toasters, waffle irons, stoves and on up to include jet engines—that’s where Lewis wire is doing its job day after day without complaint. Does your wire problem involve hot spots?

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.

FOR A TRIAL ORDER OR A CARLOAD consult

THE LEWIS ENGINEERING CO.
Wire Division
NAUGATUCK
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PAPER MACHINERY & RESEARCH, INC.
1014 OAK STREET
ROSELLE, NEW JERSEY

WIND more COILS faster
WITH YOUR PRESENT COIL-WINDING MACHINE!

HEATING UNITS
HEATING ELEMENT
RESISTANCE LINE CORD
THERMOCOUPLE WIRE
ASBESTOS LEAD & FIXTURE WIRE
INSULATED RESISTANCE WIRE
FIBERGLAS INSULATED WIRE
WIRE TO ANY SPECIFICATIONS

Installation of these inexpensive PAMARCO tensions lowers winding costs because each machine will accommodate more coils at higher winding speeds. In addition to increased production, PAMARCO tensions raise production quality. Free-running action practically eliminates wire breakage and shorted turns. Simple thumb screw setting quickly adjusts for any wire gauge. No tools or special skill are needed for operation. For complete data call or write.

LE WINDING COILS FASTER
An outstanding example of Raytheon creative electronic engineering in action. The new, improved Raytheon Electric Phonodrive features a "Cat's-Paw" tangent-contact drive resulting in unusually smooth, positive operation. Raytheon had one purpose in mind in developing this new line of phonodrives - to provide a reliable mechanism with the least possible background noise.

The high degree of perfection achieved in the Raytheon "Cat's-Paw" phonodrive is the mechanism that builders of de luxe phonograph equipment have been seeking. Yet, due to Raytheon mass production, manufacturing skill and the finest equipment, these Raytheon precision phonodrives are available at a remarkably low cost, to meet the demands of a competitive market.

Put them to the test. You'll discover why more and more manufacturers are standardizing on Raytheon— for trouble-free, low cost phonodrives.

**Model DTP De Luxe 3-Speed Turret Type**

- **Rim drive, 2-pole precision dynamically balanced motor incorporating Raytheon De Luxe Features: positive turret drive mechanism; shift lever control throws drive wheel into instant positive contact with motor shaft for desired speed; turntable shaft which revolves with turntable, grooved for "C" clip to secure table.** For trouble-free operation all models are equipped with oil impregnated bearings. Also available in 38 rpm 115 V a-c De Luxe (DSP) and Economy (ESP) models. Send for Bulletin 5000.

---

**RAYTHEON TYPE 350**

Shaded 2-Pole, 3000 rpm Motor.

**RAYTHEON TYPE 230-S**

4-Pole, 1/10 to 1/50 hp, 1550 rpm Motor.

**RAYTHEON TYPE 230**

Shaded 2-Pole, 1/20 to 1/150 hp at 3200 rpm.

"You can rely on Raytheon to run it!"
MODERN ELECTRONIC DESIGN MEANS PLUG-IN UNIT CONSTRUCTION

With basic elements as units—that is, plug-in, slide-in, lock-in, break away easily—so that electronic equipment is instantly accessible—ready for rapid checks, servicing, and unit replacement.

More and more engineers are finding that plug-in unit construction is the type of design that makes many of the new complex electronic projects feasible to operate and maintain. It's also recognized that plug-in, unit principles make present electronic equipment much more practical for wider general use.

Up to now there has been no one place where components specifically designed for plug-in, unit construction were available. To get this type of construction—it has been necessary for engineers to design and have parts custom made or improvise with standard components in make shift arrangements.

Here at Alden's we are designing and manufacturing components for plug-in unit construction. We are setting up to work with manufacturers on as many of these problems as possible. Very frankly, much of our work is still in the pilot run stage—but, in every instance—proven in use. If you don't see the answer to your problems here—let us work it out with you.

Back connected chassis—become instantly accessible. Half twist of handles brings chassis into place or ejects—no matter how heavy. Built for racks or as separate units—miniature and standard sizes.

Rugged color coded back connectors—make and break circuits—provide rapid circuit checks. Wide mating tolerances compensate for any chassis misalignment. Miniature and heavy duty sizes.

At last—a base specifically designed for plug-in units.

No more broken bosses, bent pins, "shorted" circuits.

More and more engineers have been uniting the basic elements of their circuits into compact, easily replaceable plug-in units. Since the conventional octal and tube socket bases have been the only component readily available, they have been constantly plagued by the broken bosses, bent pins, and "shorted" circuits caused by these bases.

This suggested an entirely new approach was necessary, so we went to work with some of these engineers. Out of this work the Alden-Noninterchangeable plug-in base was developed. Pins have been made strong and stubby—for long, rugged use. The boss is eliminated entirely. Slight lead of center pins and locating rings with marker in the socket allow quick lining up of plug-in units. Further, this base is supplied with 2 to 11 contacts—in variable pin patterns—so that even where the same number of contacts are used, the pin layout may be varied so only the correct unit will mount in its proper socket. Pin patterns can even be selected to isolate critical voltages or signals.

At the top operated clamps for tubes and plug-in units. Take minimum of space. Can be operated in cramped locations. Free floating clamps unit to socket without straining or bending pins.

Alden Cap Captive Convenience Screws—Hold miniature chassis, heavy plug-in cases or detachable mechanical units securely. Assemble easily in production by power tools—yet any tool or coin services in field.

Write for new booklet on "Components for Plug-in Unit Construction"

ALDEN PRODUCTS CO. 117 NORTH MAIN ST. BROCKTON 64, MASS.

TUBES AT WORK (continued)

All stages except the power amplifier are mounted on the pocket-size plug-in card mechanic or other nonelectronic serviceman.

The Soundscirber Tycoon model incorporates a three-stage amplifier of the plug-in card type. Included on the card is a miniature 25-ohm input transformer working into a 6BA5 pentode and two 6AD4 tubes. The output of the card amplifier directly drives an external push-pull power stage. The overall recording gain of the amplifier is 90 db.

All electrolytic filter capacitors are included on the card. The only parts of the complete amplifier that are not on the card are the 50C5 power tubes, the output transformer, the volume controls and the dry rectifier.

Service Exchange

Cards are replaced on an exchange basis. The customer pays a small fixed exchange price, and there is no interruption in the service from busy equipment for trouble-shooting.

The play-back amplifier card is similar to the recorder card, except it uses two 1S6 filament-type tubes for instant warm up.

The size and shape of the amplifier card permits a compact fit into a small compartment at the rear of the machine with the output tubes and rectifier. Natural ventilation of this compartment isolates the heat from the recording mechanism.

To promote long life for the power tubes, the plate current is substantially reduced during stand-
WHEN you remove excess weight from your television picture tubes, you take an important step toward cutting the cost of handling, packing, shipping and installing sets.

By using U·S·S Stainless Steel for the conical portion of the picture tube, manufacturers have found they can eliminate more than one-third of the weight of the tube. A special grade of U·S·S Stainless Steel—U·S·S 17-TV—has been developed for this application. Its thermal characteristics make possible fusing of the faceplate and neck to the metal cone with an airtight seal.

U·S·S 17-TV, like all other Stainless Steels, combines exceptional strength with its light weight. As a result, the picture tube can withstand extreme pressures... breakage hazards are reduced... there is less danger of implosion during manufacturing, installation and service.

In developing U·S·S 17-TV for the television industry, United States Steel engineers have assembled important facts on metal picture tube construction. Whether you manufacture or use cathode ray tubes, these facts are at your disposal.
FABRICATED SHEET METAL PRODUCTS
to your specifications...

COMPLETE facilities under one roof for quality mass production—including welding, baking and finishing. Whistler and Wiedermann equipment for short runs. Tool and die engineering and designing.

Large assortment of stock and special dies for the radio, television and electronic field. Production and engineering under the direction of a competent executive who has had over 36 years experience in sheet metal fabrication—backed up by a substantial organization and personnel.

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.

ART-LLOYD METAL PRODUCTS CORP.
2973 Cropsey Avenue Brooklyn 14, N. Y.
Telephone: ESplanade 3-2400

New Type 2A TAP SWITCHES
HAVE A CONSTANT CONTACT RESISTANCE OF
ONLY 1 or 2 MILLIOHMS!

These high quality switches with up to 24 contacts were specifically developed to meet the need for rugged precision instrument switches that have longer operating life and are economical components in competitively priced electronic instruments and military equipment.

Write for Technical Bulletin No. 28.

TECH LABORATORIES
PALSADIES PARK
NEW JERSEY
Cords

EXTRA for installation costs
EXTRA for rejections
EXTRA for come-back repairs
EXTRA for complaints
TOTAL $29.99

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READ
the FINE PRINT
...when you contract for Cheap Cords

With Belden Engineered Cords, there are no hidden costs. Engineered to your product, Belden Cords make for easy installation — eliminate costly extra assembly operations. Engineered for the service they encounter, Belden Cords give your product the chance to operate without cord failure and to maintain your customers' good will. Belden Engineered Cords are built far above minimum standards, complete with molded plugs, strain reliefs, or connectors, ready to attach. There are no extra costs. Investigate Belden Cords, today. Write Belden Manufacturing Company, 4625 W. Van Buren Street, Chicago 44, Illinois.

Belden
Corditis-Free
Cords

ELECTRONICS — September, 1950
Hard or soft worms, lead screws, etc., ground to your exact specifications in small lots or production runs. We invite you to submit your prints for quotation without obligation.

Beaver Gear Works Inc.
1021 Parmele Street, Rockford, Illinois

HIGHEST STABILITY in Quality Communications

In today's high-speed telegraph, teleprinter and multi-channel radio communication systems—more than ever before—ultimate stability is a vital need. Northern Radio's exclusive answer is the Type 105 Model 4 FREQUENCY SHIFT KEYER. Its highly stable oven has a temperature control of ±0.1°C at 60°, with heaters on 4 sides of the inner oven—giving this unit frequency stability unmatched in the industry. And, greatest ease of operation is assured by its completely direct-reading dials.

See the specifications on this outstanding model in the 1950 Electronics Buyer's Guide. For complete data on the precision-built Northern Radio line, write today for your free latest Catalog E-1.

Northern Radio Company, Inc.
143-145 West 22nd Street
New York 11, N.Y.

Boiler Combustion Control

CONTINUOUS CONTROL of small boilers and reliable operation at moderate cost are the advantages of the automatic combustion control system shown in the illustrations. Developed by James Hodgkinson of Manchester, England, the system employs a BTH photo-relay.

As shown in Fig. 1, a Bourdon tube indicator, calibrated to respond

FIG. 1—Single phototube responds to vane excursions

Filament-type tubes are used in the play-back unit for the stenographer by periods by removing the voltage from the screen grids.

Following the same replacement pattern, the recording and playback head assemblies are furnished as completely adjusted units ready for quick installation. One screw secures the units on accurately aligned dowels.

TUBES AT WORK

(continued)
How do users like General Electric's new all-purpose insulating varnish G-E 9574?

Here's a statement from J. L. Hughes, owner of the J. L. Hughes Electric Company, Columbus, Ohio.

"We have found from test and practical experience that General Electric general-purpose varnish 9574 is tops for our work."

Mr. Hughes knows what he is talking about. He has been in the business of motor repair and rewinding in Columbus for thirty-three years.

YES, G-E 9574 OFFERS YOU

One varnish you can depend on for ALL* jobs.

A Combination of electrical, chemical and mechanical properties formerly found only in special-purpose varnishes.

Easier Handling: Low baking temperature; deep penetration; simple thinning with petroleum spirits.

SEND FOR BULLETIN! If you haven't yet tried G-E 9574, get in touch with your local G-E Distributor, or write for our new bulletin to Section K1, Chemical Department, General Electric Company, Pittsfield, Massachusetts.

*G-E 9574 gives excellent results on all types of coils except extra-high-speed armatures. It is one of G. E.'s complete line of electrical insulating materials, including adhesives, wedges, cements, compounds, cords and twines, sleeving, wire enamels, mica, papers and fibers, permafils, tapes, tubing, varnished cloths, and varnishes.
Radio Engineers Use More Magneorders Than All Other Professional Tape Recorders Combined

GREATEST FLEXIBILITY
For delayed studio or network broadcasts, you can mount a Magneorder in a rack or console cabinet. For remotes, slip it into its really portable case.

You can add to your Magneorder equipment as you need it—for combination and carry Magneorders to suit every purpose.

HIGH FIDELITY, LOW COST
No other recorder offers such high fidelity at such a low price. Users are enthusiastic about the amazing tone quality and low distortion of Magneorderings. Magneorder frequency response 50-15 k - 2 db. Harmonic distortion less than 2%. Meets N.A.B. standards.

MORE FEATURES
Magneorder leads the field! Your Magneorder now has a 3 heads (separate erase, record, and playback) to permit monitoring from tape. Three speeds 15", 7½", and 3½" up to an hour on a 7" reel available on both PT6 and PT63 equipment. Dual track heads also available if desired.

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Send me latest catalog of Magneorder equipment

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Professional Tape Recorders for every purpose—every purse!

Congratulations to Harvey Radio Co. on its new sound demonstration room. Hear Magneorders now on display!

TUBES AT WORK
(continued)

to boiler pressures of 100 to 105 psi gage, is fitted with a pointer and vane system. Any excursion of the vane due to rising or falling boiler pressure will cause light to reach the phototube from either lamp 1 or 2.

The signal is amplified and used to energize the control relays of the electric motor. Action of dampers, fans speed, or stoker feed may then be controlled.

The camshaft rotates at one rpm and alternate contacts make simultaneously. One pair of contacts controls the lamps, while the other determines which direction relay (clockwise or counter-clockwise) shall be energized by the amplifier output voltage. Hence, only one phototube is required in this application.

Antihunt Control
A mechanical system provides antihunt control. Once the motor is started, the Bourdon gage is tilted to return the vane to normal position. Figure 2A shows the wide variations in boiler pressure experienced in manual operation while Fig. 2B was compiled over a similar period with electronic combustion control in use.

Video Yardstick
A TRANSPARENT RULER for measuring the duration and determining the frequency of video signals dis-
BE READY...

INSTRUMENTS for USE in the UHF and COLOR TV BANDS

THE CALIBRATED MEGA-SWEEP

CONTINUOUSLY TUNABLE WIDE BAND SWEEPING OSCILLATOR

For Displaying the Pass Band of all TV Amplifiers

- Single knob tuning of sweep frequency from 100 ke. to 900 mc.
- Approximate center frequency if sweep indicated on panel dial.
- Sweep bandwidth variable up to 50 mc. wide.
- Completely electronic saw-tooth sweep- no phasing or compensating.
- Micrometer head absorbs wavemaker for calibrating tuning system.
- Continuously variable output attenuator and "high", "low" output connectors provide output from approximately 200 microvolts to 100 millivolts.
- Internal impedance of output connectors approximately 50 ohms.

Price: $425.00

THE UHF MEGA-MATCH

DISPLAYS REFLECTION COEFFICIENT OF TERMINATIONS SIMULTANEOUSLY OVER WIDE FREQUENCY SWEET

- Displays reflection coefficient on standard oscilloscope over 34 mc. sweep anywhere between 10 and 1100 mc.
- Useful for rapidly designing broad band antennas, transformers, TV front ends, matching distribution systems and transmission line terminating impedances.
- Receives reflection coefficients down to 0.01 to 0.001 mc.
- With auxiliary signal generator and Mega-Chart (Smith Chart) can be used to determine phase of reflection coefficient and components of terminating impedance.

Price: $895.00

THE MEGA-NODE SR.

RANDOM NOISE SOURCE for the UHF and MICROWAVE RANGES

Memories the Noise Figure of TV Receivers in the UHF and Color Ranges.

- Employed a coaxial NOISE diode as a low-noise random noise over a frequency range of 400 ke. to 900 mc.
- Noise figure of test circuits (43 microvolts) between 0 and 30 do can be measured.
- Low VSWR at 30 ohm unmatched output. Smith chart provided with each instrument indicating actual amount of mismatch.
- Noise figures indicated on panel meter linear to db.
- Operates with diode temperature limited. Has regulated waveform supply.

Price: $895.00

THE MEGALYZER

SENSITIVE VISUAL VOLTMETER and SPECTRUM ANALYZER

- Displays VHF and UHF energy over sweep widths up to 30 Mc.
- Frequency Range 30 to 1000 mc.
- Frequency Resolution: Discriminates between Frequencies Separated by 100 kc.
- Input Signal Level: 100 to 10,000 microvolts (Useful above 10,000 microvolts with external pads.)
- Output vs. Input Linear for inputs above 100 microvolts.
- Determines Frequencies and Levels of RF Energy over Wide Frequency Range.

Price: $895.00

All prices F.O.B. Factory. 10% higher outside U.S.A. and Canada.

ELECTRONICS — September, 1950

ELECTRIC KAY COMPANY
25 Maple Avenue
Phone Caldwell 6-4000
Pine Brook, N. J.

179
played on a picture tube, the RCA Microstick measures microseconds and is useful in determining bandwidth of receivers, calibration of test-pattern wedges, frequency of beat interference and ringing, and many other measurements.

Ruler Divisions

It is based on the fact that the electron beam in the kinescope is deflected from the left-hand to the right-hand edge of the picture in approximately 53.3 microseconds during one horizontal scanning line.

To design a ruler for measuring millionths of a second in terms of horizontal distances across the picture, such a ruler would have a length equal to the width of the picture, and would be divided into approximately 53 equal divisions, each division representing one millionth of a second. With such a ruler, it is a simple matter to measure the duration, or elapsed time, from start to finish, of any signal that is present in the picture. Knowing the duration of the signal, or the number of cycles of signal that occur in a given time, it is easy to compute the frequency of the signal.

Application

One cycle of signal consists of a positive half-cycle and a negative half-cycle which, when applied to the kinescope grid, produce a bright spot and a dark spot on the scanning line. One bright spot and one dark spot, therefore, represent one cycle. Normally, the eye does not distinguish the individual spots in each scanning line, but, if the signal is repeated in each line in such a way that the spots become vertically aligned, the spots will appear as vertical lines. One dark and one light vertical line is equivalent to one cycle of signal on each scanning line. The frequency of the signal can be determined by counting the number of cycles in any desired number of microseconds, using the RCA Microstick to measure the number of microseconds.

Frequency in megacycles =

Number of cycles

Number of microseconds

If a fairly large number of cycles is to be counted, it is sufficiently
Through this portal pass the nation’s top stars

• You may not recognize the object pictured above. It is the first grid cylinder for a cathode ray tube gun structure, photographed from an unusual angle. The hole is only .040" in diameter—and the grid itself is deep drawn in one piece to save unnecessary welding and assembly operations by TV tube manufacturers.

This is tubing technology in operation. It is an example of Superior’s superiority in electronic research, production know-how and facilities, and metallurgy. It is one product of hundreds pioneered for the electronic industry by Superior.

You may already be one of our valued customers and friends—nearly all electronic manufacturers are. If small Seamless or Weldrawn tubing can help anywhere in your product Superior can help you. To find out how, write Superior Tube Company, 2500 Germantown Avenue, Norristown, Pennsylvania.

Which Is The Better For Your Product...

SEAMLESS... ? The finest tubes that can be made. Standard production is .010" to .121" O.D. inclusive, with wall thicknesses of .0015" to .005". Cathodes with larger diameters and heavier walls will be produced to customer specification.

*TRADMARK—SUPERIOR TUBE COMPANY
*MD. UNDER U. S. PATS. SUPERIOR TUBE COMPANY

Or LOCKSEAM... ? Produced directly from thin nickel alloy strip stock, .040" to .100" O.D. in standard length range of 11.5 mm to 42 mm. Round, rectangular or oval, cut to specified lengths, beaded or plain.

Electronic Products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800

All in a Day’s Work—Chemical Laboratory continually samples raw materials; checks and controls quality from suppliers.

Sized and Shaped for TV—Hundreds of tubular parts are produced by Superior from Weldrawn Type 305 (18-12) stainless steel.

Space and Time—188,000 square feet—over 4 acres—for developing, producing, and testing small tubing...plenty of space... and people who take time to give you a good product and good service.

Electronics — September, 1950

www.americanradiohistory.com
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Because

- They're precision-mixed, precision-made, precision-controlled for every electronic use
- Only our own exclusive formulas are used
- Our engineers are specialists in every iron core application
- Specially designed powder-mixing equipment assures uniformity and dependability
- Improved production, test and inspection facilities guarantee high quality performance

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Garden City, N. Y.
Cordoba 1472

Buenos Aires

TUBES AT WORK

accurate to count only the dark vertical lines, and use this figure as the number of cycles.

Community TV Antenna System

Surrounded by mountains, the town of Franklin, Pa. receives television programs from Pittsburgh, 65 miles away, over a wire service established in the town. Signals are received on multibay antennas installed on nearby mountain tops and fed along a five-mile line to the town.

The installation is owned and maintained by Haren Corp. of Franklin. It serves over 40 outlets in homes and places of business. Householders pay $9.25 a month, clubs and taverns pay $5.00 per month extra for each outlet when using more than one receiver, and retailers, who demonstrate television receivers, pay a flat $25 per month.

Signal strength at the antenna towers from the one station in Pittsburgh varies from 300 to 1,000 microvolts. Amplifiers in the line maintain a 3,500-microvolt level to the outlets. Both coaxial and flat line are used, but 300-ohm flat line is favored.

Results

Many communities have local ordinances governing the installation of wires around the town and over streets. Franklin has no such regulations and the line runs from house to house wherever permission can be obtained. This has necessitated running a line around a block to avoid certain properties whose owners refuse to cooperate.

Reception is reported good to excellent by observers but some difficulty is experienced on the extremes of the feed lines on rainy days. If the rain is followed by freezing conditions, however, the signal comes up to dry-day amplitude.

An example of the improvement the installation has offered is evidenced at the local Moose Club. Here, an investment of $1,500 in a 140-foot tower, antenna, booster amplifiers and rotators produced no usable pictures. Connection to the community line resulted in good reception on four sets in the club.
Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.

**Outstanding Features:**

- Continuous tuning.
- One tuning control.
- 5 KC resolution at all frequencies.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1 per cent.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment above 1000 MCS.
- Frequency marker for measuring frequency differences 0-25 MCS.
- Only three tuning units required to cover entire range.
- Microwave components use latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

**The equipment consists of the following units:**

Model LTU-1 R. F. Tuning Unit—10 to 1000 MCS.
Model LTU-2 R. F. Tuning Unit—940 to 4500 MCS.
Model LTU-3 R. F. Tuning Unit—4460 to 16,520 MCS.

Model LDU-1 Spectrum Display Unit.
Model LKU-1 Klystron Power Unit.
Model LPU-1 Power Unit.

**Where Used:**

Polarad's Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency distribution of energy in an r.f. signal in the range 10 to 16,520 MCS.

Other uses are:

1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measures noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.
final results of gain versus spacing and shows that maximum forward gain is obtained with the reflector spaced approximately 0.15 wavelength and the director spaced 0.3 wavelength.

The corrected gain of this array with conventional spacings (reflector spaced 0.15 wavelength and director spaced 0.1 wavelength) was found to be 6.74 db. Reference to Fig. 2D shows that the same array using a reflector spaced 0.15 wavelength and a director spaced 0.3 wavelength had a corrected gain of 8.6 db. Thus greater gain may be obtained by using the wider spacings. However, these spacings give higher input reactance (see Fig. 2B); so impedance matching may be necessary. Figure 2A shows that array input resistance increases with
Sorry, we can’t show you more . . .

... but the fact is that some of our business is labeled “Restricted.”

We mention this only because we want you to know that our plant and personnel are
U. S. Armed Forces Certified — approved to produce the precision work
required by exacting government specifications.

Our commercial work — for television, and electronic manufacturers, and
for many others requiring expert sheet metal fabrication and finishing — meets
the same high standards of precision.

The Donnelly staff and plant are experienced in working all types of sheet
metal to close tolerances and in producing
every type of metal finish.

DONNELLY ELECTRIC & MFG. CO.
DIVISION OF JOHN DONNELLY & SONS
3050 WASHINGTON ST., BOSTON, MASS

PRECISION SHEET METAL & PRESSED WOOD FABRICATION
Bigness in itself is no virtue... good products just as surely issue from small concerns as well as large—as during the years from 1915 to 1940 before Cannon Electric emerged as a "large company." Constantly adding to its products, today Cannon Electric ranks at the top of its particular industrial field, producing electric connectors, signal equipment, light specialties, automobile parts, etc. Still, the policy of its management is the same as during the "early days"—quality of product and conscientious service to its numerous direct customers and to thousands more who buy through radio parts jobbers and electrical wholesalers. These principles guide the company toward maintenance of good relations.


SINCE 191$

CANNON ELECTRIC

THE ELECTRON ART (continued)

spacing. This is an additional advantage of wider spacings, if the antenna is to be used over a range of frequencies.

REFERENCE


Electrodynamic Ammeter for VHF

In establishing standards for electrical circuits in the very-high-frequency region now so widely used by radio and television services it is important to extend the direct measurement techniques used at lower frequencies as far as possible. Up to 300 mc, the current flowing in a circuit whose physical dimensions are small with respect to wavelength is essentially a uniform quantity, and the electrical characteristics of small circuit elements may be determined directly in terms of voltage and current. This fact makes possible the establishment of a standard electrodynamic ammeter for the vhf range. Basically the method depends on a torque measurement on a conducting ring immersed in a field which does not change with frequency. This technique provides an absolute, broad-band measurement of high-frequency current, but several factors are critical in any actual design.

For minimum distributed capacitance and uniform current the short-circuited ring must be only a single turn, and the ring diameter must be small with respect to wavelength. For accurate inductance calculations the ring conductor should have a small cross section, but re-

Experimental model of the vhf electrodynamic ammeter. Deflection of a short-circuited ring in a section of coax tells amount of current flowing.

September, 1950 — ELECTRONICS
Mounting Bell’s new microwave lens in a horn-lens antenna. Other blocks will complete the lens.

**A focus on better, low-cost telephone service**

In the new microwave radio relay system between New York and Chicago, giant lenses shape and aim the wave energy as a searchlight aims a light beam.

Reasoning from the action of molecules in a glass lens which focuses light waves, Bell Laboratories scientists focus a broad band of microwaves by means of an array of metal strips. To support the strips these scientists embedded them in foam plastic which is virtually transparent to microwaves. Rigid and light in weight, the plastic is easily mounted on relay towers.

This unique lens receives waves from a wave guide at the back of the horn. As they pass across the strips, the waves are bent inward, or focused to form a beam like a spotlight. A similar antenna at the next relay station receives the waves and directs them into a wave guide for transmission to amplifiers.

This new lens will help to carry still more television and telephone service over longer distances by microwaves. It’s another example of the Bell Telephone Laboratories research which makes your telephone service grow bigger in value while the cost stays low.

**BELL TELEPHONE LABORATORIES**

*Working continually to keep your telephone service big in value and low in cost.*

*Laboratory model of the new lens. A similar arrangement of metal strips is concealed in the foam plastic blocks in the large picture.*

www.americanradiohistory.com
you get MORE PERFORMANCE for LESS MONEY with the NEW Browning OSCILLOSYNCHROSCOPE

For only $485.00

this new five-inch Browning 'scope gives you the basic laboratory equipment for pulse work — in a single, compact unit with:

- Triggered sweep rate continuously variable from 1.0 to 25,000 microseconds per inch.
- Sawtooth sweep rate 10 cycles to 100 Kc.
- Sweep calibration (triggered and sawtooth) in microseconds per screen division accurate to ±10%.
- Vertical amplifier flat within 3 db. from 5 cycles to 5 megacycles.
- Sensitivity 0.075 volts RMS per inch.
- Horizontal amplifier d.c. to 500 Kc, sensitivity 2 volts per inch.
- Self-calibrating on both X and Y axis.
- Readily portable ... weighs but 50 pounds.

plus these ELECTRICAL and MECHANICAL features

- SUP1 cathode-ray tube operates at accelerating potential of 2600 volts
- Sweep starting time is approximately 0.1 microsecond
- Sweep may be triggered or synchronized by positive or negative sine-wave or pulse signals of 0.5 volts (external) or 0.75 inches deflection (from vertical amplifier)
- Three-step attenuator — 100:1, 10:1, and 1, plus continuous adjustability over entire range
- Peak-to-peak vertical calibration voltages of 0.2-20-200 at accuracy of ±10% Cathode connection, brought out to front panel, allows external blanking and marker connection
- All deflection plates are available for direct connection
- Steel cabinet finished in black wrinkle
- Steel panel finished in black leathertite
- Copper-plated steel chassis with lacquer finish
- Controls grouped by function for operating convenience
- Free-view screen has graduated X- and Y-axis scales
- Size: 10" wide, 14½" high, 16¾" deep
- Instrument draws 180 volt-amperes at 115 volts 60 cycles.

NET PRICE, F.O.B. Winchester, Mass. ........... $485.00

FREE BULLETIN gives further data on this new, low-cost, versatile oscillosynchroscope. Ask for data sheet ON-34E.

THE ELECTRON ART (continued)

End view of electrodynamic ammeter shows calibration thermocouple

sistance then limits the current. A ring 1 cm in diameter of No. 20 copper wire is a practical size. When the ring current is small, the torque is also small, and the ring must be suspended on a delicate quartz fiber for accurate torque measurements.

The coaxial line, acting as the primary current-carrying element for the electrodynamic ammeter, has several advantages over other forms of conductor. Its electromagnetic field can be calculated in a straightforward manner, and the line may be readily modified for calibration work with different types of r-f ammeters.

Calibration may be accomplished directly and absolutely. A section of the coaxial transmission line, one wavelength long at 300 mc, is arranged with short-circuited ends to form a resonant cavity, and the torque ring is placed midway along the section.

A known value of 300-mc power is fed into an input loop at one end of the cavity. Under these conditions the torque ring will be at a current maximum and a voltage minimum, and the measured torque on the ring will be due almost entirely to the magnetic component of the cavity field. The measurement is then repeated at 150 mc where the current and voltage relations are reversed and the torque is due only to the electric component.

One further measurement is needed for absolute calibration of the ammeter. The cavity resonance frequency is measured at both 300 and 150 mc with and without the torque ring in place. The resulting changes in frequency are then a measure of the field discontinuity
Center, on black background, are the eight standard sizes of Arnold Tape-Wound Toroids. Around them are a number of other cores of special nature produced for individual needs.

ARNOLD TAPE-WOUND TOROIDAL CORES

APPLICATIONS
MAGNETIC AMPLIFIERS
PULSE TRANSFORMERS
NON-LINEAR RETARD COILS
and TRANSFORMERS
PEAKING STRIPS, and many other specialized applications.

RANGE OF SIZES
Arnold Tape-Wound Toroids are available in eight sizes of standard cores—all furnished encaised in molded nylon containers, and ranging in size from 1/2" to 2 1/2" I.D., 3/4" to 3" O.D., and 1/4" to 1/2" high.

RANGE OF TYPES
These standard core sizes are available in each of the three magnetic materials named, made from either .004", .002" or .001" tape, as required.

of DELTAMAX
4-79 MO-PERMALLOY
SUPERMALLOY*

In addition to the standard toroids described at left, Arnold Tape-Wound Cores are available in special sizes manufactured to meet your requirements—toroidal, rectangular or square. Toroidal cores are supplied in protective cases.

*Manufactured under licensing arrangements with Western Electric Company.

THE ARNOLD ENGINEERING COMPANY
SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
General Office & Plant: Marengo, Illinois
Wind Coils

FASTER!

Toroidal or Sector

WITH THE

NEW

Micafil Toroidal

Coil Winder

MODEL RW WITH COIL SUPPORT FOR CONTINUOUS WINDING

This machine, fitted with Coil Supports, automatically winds toroidal coils continuously around 360° or sector coils up to 270°. Winds in either direction. Permits stepless adjustments of feed speeds during operation.

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Dimension limits</th>
<th>Type RW-1</th>
<th>Type RW-11</th>
<th>Type RW-111</th>
</tr>
</thead>
<tbody>
<tr>
<td>for finished coil:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. O.D.</td>
<td>3 1/2&quot;</td>
<td>6&quot;</td>
<td>8&quot;</td>
</tr>
<tr>
<td>Min. O.D.</td>
<td>1 1/4&quot;</td>
<td>1 1/4&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>Min. O.D. Circular</td>
<td>9/16&quot;</td>
<td>9/16&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>Max. Hgt. (Section Coils)</td>
<td>2&quot;</td>
<td>2&quot;</td>
<td>4 1/2&quot;</td>
</tr>
<tr>
<td>Min. Hgt. (Section Coils)</td>
<td>13/16&quot;</td>
<td>1 1/4&quot;</td>
<td>1 1/2&quot;</td>
</tr>
<tr>
<td>Wire sizes:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single wire</td>
<td>23-38 AWG</td>
<td>18-32 AWG</td>
<td>10-28 AWG</td>
</tr>
<tr>
<td>Double or stranded wire, max.</td>
<td>2x26 AWG</td>
<td>2x23 AWG</td>
<td>2x18 AWG</td>
</tr>
<tr>
<td>Max. shuttle speed:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>While winding</td>
<td>200 RPM</td>
<td>200 RPM</td>
<td>150 RPM</td>
</tr>
<tr>
<td>While storing</td>
<td>400 RPM</td>
<td>400 RPM</td>
<td>300 RPM</td>
</tr>
<tr>
<td>Shuttle capacity:</td>
<td>1 1/4 oz.</td>
<td>1 1/4 oz.</td>
<td>4 1/2 lbs.</td>
</tr>
</tbody>
</table>

Investigate the many advantages of these moderately priced Toroidal Winders. Send today, for Bulletin M-3247-A.

There's a Micafil Winder for ANY Coil Winding Application

---

THE ELECTRON ART

(continued)

introduced by the presence of the ring. After the torque and discontinuity measurements are completed the instrument can be used as a standard to calibrate other ammeters at very high frequencies.

The electrodynamic vhf ammeter was developed at the National Bureau of Standards.

**Matching Loads on a Magic Tee**

**BY A. C. MACPHERSON AND D. M. KERNS**

_National Bureau of Standards Washington, D.C._

A MAGIC TEE (Fig. 1) is often used to match a variable load to an arbitrary fixed load. The arbitrary load and the variable load, of reflection coefficients $S_1 = |S_1| e^{i\theta_1}$ and $S_2 = |S_2| e^{i\theta_2}$ respectively, are placed on arms 1 and 2, respectively of the magic tee. A signal generator feeds power to arm 4, and $S_i$ is tuned until a null is indicated by a detector in arm 3. If the power delivered to the detector is less than the minimum power the detector can indicate, the null is only apparent and will be observed for a range of values of $S_i$ in the neighborhood of $S$. There follows a method of evaluating the limits of this range.

Assume that the generator and the detector are reflectionless. Then it can be shown that for a symmetrical lossless magic tee $4P_r/P_i = [|S_1|^2 + |S_2|^2 - 2|S_1||S_2|\cos(\theta_1 - \theta_2)]$, where $P_r$ is the power delivered to the detector in arm 3, and $P_i$ is the power fed into arm 4. Power $P_i$ is related to the power that the generator would deliver to a matched load, $P_m$, by $P_i = P_m(1 - |S|^2)$.

Assume that there is some defi-
By an entirely new process our engineers have produced this new high voltage rectifier cell with remarkably improved characteristics.

**HIGHER OUTPUT—INITIALLY** This cell gives you higher output when it is new because it has the lowest initial forward resistance of any similarly rated cell which we have tested.

**HIGHER OUTPUT—LONGER** This cell gives you higher output longer. Its forward resistance increases far less with age than any cell which we have tested. At the end of 10,000 hours of operation G-E cells showed an average increase in forward resistance of less than 6%.

**COOLER OPERATION** This cell is very cool running. Its low forward resistance results in lower temperature rise and higher efficiency.

**SPACE SAVING** These 26-volt RMS cells can now be used wherever you have previously used 18-volt cells. This will give you stacks that are smaller, lighter—more compact.

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**GET THE FACTS** Dollar for dollar, we believe that these cells are the best selenium rectifier buy on the market today.

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Apparatus Department, General Electric Company, Schenectady 5, N. Y.
THE THRIFTY TURNER TWENTY

Widely popular as an outstanding hand-held crystal microphone, the Turner Twenty is now available in a choice of crystal, dynamic, or carbon circuits. Various switching arrangements provide even more versatility to meet a wide range of applications. All 3 Models are typically Turner—brilliantly engineered and ruggedly constructed for "Sound Performance". The die cast metal case provides stability and ample shielding. The cable is securely anchored and Turner guarantees it will not pull out. For top value in the low-cost hand-held microphone field switch to the Turner Twenty.

CRYSTAL
Model 20X ........ $12.85
Model S20X With push-to-talk switch having slide lock feature. Switch connected in microphone circuit, normally open ........ $14.85
Model SR-20X With push-to-talk switch having slide lock feature. Switch, normally open, connected to two cable conductor independent of microphone circuit for relay control ........ $17.85

DYNAMIC CARBON
Model 20D ....... $16.85 Model 20R ....... $12.85
Model S20D ....... $18.85 Model S20R ....... $14.85
Model SR-20D ....... $21.85 Model SR-20R ....... $17.85

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IN CANADA: Canadian Marconi Co., Montreal P. Q.
and Branches
EXPORT: Ad. Auriema, Inc., 89 Broad Street, New York 4, N. Y.

Wien-Bridge Network Modifications

By R. ZUDHOF
The Hague, Holland

To determine the influence of the stray capacitance in shunt with the series resistor in a Wien-bridge network such as used in a-c bridges, resistance-capacitance oscillators and selective amplifiers, an attempt was made to find an expression for the frequency and the ratio of the impedances with an extra capacitance \( C_s \) placed in the circuit. Eight modifications of the Wien network were derived. Three of them showing interesting properties appear in Fig. 1.

From Fig. 2 the influence of the capacitance \( C_s \) on the frequency can
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ELECTRIC MANUFACTURING CO.
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Don't wait for the darkroom...
SNAP THE SHUTTER — SEE THE RESULTS IN ONE MINUTE!

Fairchild-Polaroid Oscilloscope Camera

There's no longer any need to wait for darkroom processing before evaluating newly exposed photographic "stills" of oscilloscope images.

With the new Fairchild-Polaroid Oscilloscope Camera you don't even bother with focusing—just snap the shutter, and remove the print from the back of the camera a minute later. The camera can be set up within two minutes; removed within a few seconds. Think of it—accurate photographic records in almost as little time as it would take to make sketches from memory.

Each 3¼ x 4½ print records two traces to make comparisons easy and to cut film costs in half.

The complete Fairchild-Polaroid Oscilloscope Camera consists of scope adapter for any five-inch oscilloscope, light-tight hood with viewing port, and Polaroid-Land Camera body with special lens and two-position shift device.


Specifications

Lens — Special 75 mm. f/2.8 Wollensak Opticon-anastigmat.
Shutter — Wollensak Alphax; speeds 1/25 sec. to 1/100 sec., "time," and "bulb."
Focus — Fixed (approx. 8 in.).
Picture Size — 3¼ x 4½ in. (2 images per print; 16 exposures per roll of film).
Image Size — One-half reduction of scope image.
Writing Speed — to 1 in./µsec at 3000V accelerating potential; higher speeds at higher voltages.
Dimensions — Camera, 10½ x 5½ x 6¼ in.; hood, 11 in. length, 7½ in. dia.; adapter, 2 in. width, 6¼ in. max. dia.
Weight — Complete, 7½ lb.

be determined when \( C_1 \) equals \( C_2 = C \). However, \( C_2 \) also has some influence on the impedance ratio. When in an R-C oscillator tuning is done by means of a variable capacitor, the stray capacitance \( C_s \) may have a harmful effect when the variable capacitor has its minimum value. Both frequency and impedance ratio will be affected if the value of \( C_s \) forms an appreciable part of the value of the variable capacitor in its minimum position.

In a resistor-switching oscillator with three or more ranges, the stray capacitance will probably not be the same on all ranges. Therefore at the high-frequency end the scales will not properly coincide.

The effect of \( C_s \) on the impedance ratio manifests itself in the output voltage, which will not remain constant. By means of a second capacitance \( C_2 \) in shunt with \( C_1 \), however, this ratio can be made constant. When \( C_1 \) is made \( C + C_s \), \( C_2 = C \) and \( R_1 \) equals \( R_2 = R \), the impedance ratio becomes

\[
Z_s = \frac{(C + C_2) R + CR + C_2 R}{(C + C_0) R - \frac{1}{2} \text{ constant}}
\]

The formula for the frequency now becomes

\[
f = \frac{1}{2\pi R \sqrt{C - C_s^2}}
\]

As can be seen, \( C_s \) has an opposite effect on the frequency from \( C \) and this property can be used to extend the frequency range.

When on all ranges trimmers \( C_s \) are placed over \( R \) and \( C_2 \), the oscillator can be completely trimmed, so that the scales properly coincide and...
Ready to Solve Your Design Problems

“326” MONEL

non-magnetic
rustless
strong

“326”® Monel is substantially non-magnetic at and above room temperatures. The approximate permeability at 68°F. is 1.025 and at 14°F. is 1.1. Neither hot nor cold working appreciably affect its magnetic properties.

“326” Monel is rust-proof and highly resistant to most commonly-encountered corrosives.

“326” Monel possesses high physical properties similar to those of Monel — strength, toughness, and resistance to abrasion.

In addition to these valuable physical characteristics, “326” Monel is a thoroughly practical metal ... economical to buy; easy to use; readily workable. There is less die wear than with materials that work-harden rapidly. Firing temperatures for vacuum tube use are lower (approximately 1500°F.) and “326” Monel can be fired in line hydrogen; dry hydrogen is not needed.

“326” Monel can be welded, brazed, or soldered ... can be readily machined, formed, drawn, or forged. It is available in standard mill forms. As strip, its most widely used form in the electrical field, “326” Monel is available in standard widths up to 12 inches, in thicknesses of 0.005 in. and heavier. In narrower widths, it is rolled to a thinness of 0.001 in.

Next time you are faced with a problem that demands a tough, non-magnetic, corrosion-resistant alloy ... specify “326” Monel.

Meanwhile, write for your copy of “Inco Nickel Alloys for Electronic Uses.” This valuable 26-page booklet gives the composition, characteristics, and typical applications of 18 helpful Inco Nickel Alloys.

Where Can You Use This Unusual Inco Alloy?

Typical Uses
- Cathode ray tube gun structures
- Structural parts of special vacuum tubes
- Mass spectrometer parts
- High voltage cable shielding tape, for use in wet, corrosive, abusive conditions.
- Good for voltages up to 50,000

Availability

<table>
<thead>
<tr>
<th>Material Type</th>
<th>“326” Monel Limiting Composition %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rods and bars</td>
<td>Ni + Co: 58-61</td>
</tr>
<tr>
<td></td>
<td>Fe: 2.50 max.</td>
</tr>
<tr>
<td></td>
<td>Mn: 2.00 max.</td>
</tr>
<tr>
<td></td>
<td>C: 0.30 max.</td>
</tr>
<tr>
<td></td>
<td>Si: 0.50 max.</td>
</tr>
<tr>
<td></td>
<td>S: 0.02 max.</td>
</tr>
<tr>
<td></td>
<td>Cu: remainder</td>
</tr>
</tbody>
</table>

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street, New York 5, N. Y.
Frequency range

V.L.F.-V.H.F.

Push button attenuator

Accurate V.H.F. Attenuation at Medium Cost!

Fully patented constructional features include an ingenious switching circuit, special high-stability resistors, effective internal screening and a precise assembly of components. These factors all combine to reduce internal couplings and the effect of residual reactances to a minimum.

Two Models Available. Ready for building into your own equipment.

Type 74600 A: 0-9 db in 1 db steps
Type 74600 B: 0-90 db in 10 db steps.

Both have a 75-ohm characteristic impedance and will handle inputs up to 0.25 watts. They may be used in tandem.

Performance

A. Guaranteed Accuracy of D.C. Adjustment

0-9 db Model—The insertion loss error will not exceed ±0.05 db for any setting.

0-90 db Model—The insertion loss error for the 90 db setting will not exceed ±0.3 db. For other settings this limit falls linearly to a value of ±0.06 db at the 10 db setting.

B. Guaranteed High Frequency Performance (including D.C. errors)

0-9 db Model—At 50 Mc/s, the insertion loss error for the 9 db setting will not exceed ±0.15 db. For other settings this limit falls linearly to a value of ±0.05 db for the 1 db setting.

0-90 db Model—At 50 Mc/s, the insertion loss error will not exceed ±0.1 db per step.

N.B. All insertion losses are relative to zero db setting.

Individual calibration charts for frequencies up to 100 Mc/s for the 0-9 db model and 60 Mc/s for the 0-90 db model can be supplied from the Standard Transmission Laboratories.

Standard Telephones and Cables Limited

(An I. T. & T. Associate)

TRANSMISSION DIVISION, NORTH WOOLWICH, LONDON, ENGLAND

even the phase shift in the amplifier on the higher frequencies can be compensated.

The output voltage can also be made constant over the whole range by means of the trimmers. Of course the resistors of all ranges must have the proper ratio and also the ganging of the variable capacitor has to be correct.

Fig. 3A presents the most general form of the first modification. It can be shown that for a constant impedance ratio $x$ must be equal to $y/z$ and when this condition has been fulfilled, $Z_1/Z_2$ will have the constant value $y + 1/z$.

When a Wien-bridge network is designed for optimum frequency stability, this property will be useful.

Trimming can also be done according to the modification shown in Fig. 1B. If $R_1$ and $R_2$ are both made equal to $R$, $C_1 = C$ and $C_2 = C + 2C_1$, the impedance ratio $Z_1/Z_2$ becomes

$$f = \frac{1}{2 \pi RC}$$

which is the formula of the original Wien bridge. The factor $2C_1$ may consist of the amplifier-input capacitance only and the trimmer $C_2$ must then be half of this capacitance.

Figure 1C shows an interesting property. The values of the components can be chosen such that tuning can be accomplished by variation of one circuit element only. When $C_1$ and $C_2$ are both made $C$, $R_1 = R - R_2$ and $R_2 = R$; the impedance ratio becomes

$$\frac{Z_1}{Z_2} = \frac{C (R - R_2) + CR + CR_2}{2CR}$$

thus $Z_1/Z_2$ is a constant, and
FOR THE MOST EXACTING INSULATING REQUIREMENTS

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No insulating material compares with MYCALEX 410 for today's exacting requirements — where advanced circuits and higher frequencies demand a combination of these properties:

- Extremely low loss factor (low as .015 at 1 MC)
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- High arc resistance, close dimensional tolerances...
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- Ability to mold in metal inserts with a tight, rigid bond...
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Remember, you no longer have to "design around" the problem of cost. New low MYCALEX 410 prices compare favorably with lesser insulators such as bakelite and phenolics. Specify MYCALEX custom-molded parts for the most critical insulating needs. Whatever your problems, our engineers will cooperate in the solution.

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SQUARE WAVES

PRECISION GENERATORS
by TEKTRONIX

Leading manufacturers now recognize that frequency and transient response measurements are most easily made by square wave testing techniques. This method is widely used on production line testing and adjusting of wideband amplifier, filter and attenuator circuits.

LABORATORY UTILITY

- FREQUENCY RANGE:
  25 cps—1 mc continuously variable.
- FREQUENCY METER:
  Direct reading, accurate to 3% of full scale.
- RISE TIME:
  .02 usec. for 93 ohm load.
- OUTPUT AMPLITUDE:
  15v across 93 ohm external load.
  160 ma maximum available for external load.
- SYNC INPUT AND OUTPUT CONNECTIONS.
- WEIGHT: 35 lbs.

ASSEMBLY LINE EFFICIENCY

- FOUR FIXED FREQUENCIES:
  LF—50 cps, 1 kc.
  HF—100 kc, 1 mc.
- RISE TIME:
  LF—.03 usec.
  HF—.02 usec.
- OUTPUT AMPLITUDE:
  LF—0 to 50v, continuously variable
  in 9 ranges. Accuracy 2% of full scale Useful as a voltage calibrator.
  HF—0 to 5v.
- WEIGHT: 21 lbs.

Both of these instruments feature coaxial outputs, fully regulated DC power supplies, electrically welded aluminum alloy construction and many other characteristics by which Tektronix has become known and accepted throughout the world.

TEKTRONIX, INC.

712 S.E. Hawthorne Blvd. Portland 14, Ore.

TYPE 105 SQUARE WAVE GENERATOR $395.00

TYPE 104A SQUARE WAVE GENERATOR $195.00

Prices f.o.b. Portland, Ore.

REFERENCES

(2) W. Noel Eldred, Generator for A-F Measurements, F-M and Television, p 31, June 1945.

THEATRE TELEVISION PROJECTON ON FULL-SIZE SCREENS

AN ELECTROMECHANICAL accumulation process has shown promise for direct projection theater television on full-size screens. This method has been developed at the Polytechnical Institute of Zurich, Switzerland and has been demonstrated successfully in experimental form.

The principle of the system is shown in Fig. 1. Light from an arc is projected through a thin layer of viscous liquid deposited on a thin metallic electrode which is transparent to the light beam. This surface, called the eidophor, is mechanically deformed by the charge accumulating from an electron beam impinging on its surface. The charge produces electrostatic forces...
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Crime prevention aided by Telechron Timing Motors

Most bank robbers take no chances on a vault that can screech a warning of their presence.

In fact, official records of the Diebold Corporation — makers of Bank Vault Burglar Alarm Systems — show that robbers who have attempted such an attack were so panic-stricken by the alarm, they left their tools behind them, thus leading to their own identification and arrest! These same records also show that nearly 2000 successful bank robberies on unprotected vaults were committed between 1903 and 1948. During the same period, only 57 attacks were made on Diebold-protected vaults — none of them successful.

Because the Diebold Alarm System must perform unfailingly at all times, the Telechron Timing Motor is specified. It is instantly, constantly synchronous...gives accurate performance.

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- [ ] Air Conditioning & Heating Controls

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ELECTRONICS — September, 1950
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2. Superior Staking Qualities
   ...ends will roll without splitting
3. Better for Molded Parts
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We invite your inquiry to the Waterbury Brass Goods Branch of The American Brass Company, Waterbury 20, Connecticut.

FOR QUALITY BRASS GOODS—ANAConDA

FIG. 1—Eidophor is control element in theater tv projection system

which cause the mechanical deformation.

Between the light source and the eidophor is a slit system (or Schlieren optics system), and a second slit system is positioned between the eidophor and the screen. The light passing to the screen may thus be controlled by applying appropriate mechanical deformation to the eidophor surface.

The method of modulating the

FIG. 2—Electromechanical deformation of eidophor surface controls light flux

September, 1950 — ELECTRONICS
BLAW-KNOX builds ANOTHER RINGSIDE SEAT to the Events of the World

For its ultra-modern station in the heart of down-town Louisville, WHAS engineers specified a Blaw-Knox Heavy Duty Type H-40 Tower 526 ft. high to support safely its 10,000 lb., 12 bay high gain TV antenna.

Telecasting top-flight national and regional programs, WHAS will open up a new market for TV sets and provide ringside seats for appreciative thousands in the populous and progressive Louisville area.

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY 2077 Farmers Bank Bldg., Pittsburgh, Pa.
COTO-COIL

PRODUCTION METHODS

Meet Price Requirements

Coto-Coil's highly specialized equipment and skilled operators, backed by engineering know-how, produce better windings at lowest costs and assure correct coil function.

COTO-COIL WINDING IN MULTIPLE GROUPS

Nine coils are shown being wound simultaneously at high speed with .0007" cellulose film interleaved between layers of wire. The machines are automatic and versatile. They will handle wire from #18 to #42, and acetate film or paper insulation from .0007" to .005" thick... at high speed.

We welcome the hard to satisfy. Let us figure on your particular requirements.

Air-Core Betatron

McGraw-Hill World News

A NEW BETATRON constructed by the Philips Laboratory for Scientific Research at Eindhoven, Holland, is considerably lighter in weight than existing models because it has no closed iron yoke for producing the required magnetic field. Instead,
THIS D.C. POWER SUPPLY INSTALLATION SUPPLIES CURRENT TO THE ARC LAMP WHICH PROVIDES A BEAM OF 800,000,000 CANDLE POWER. RECTIFIER RATING 85 V, 150 AMPS.

SELETRON power stacks are dependable and easily assembled to meet a wide range of special current and voltage conditions. Your own problems in rectification can no doubt be solved speedily by SELETRON'S engineering department. Write us now concerning them—or ask for our rectifier bulletin No. ES-31.

SELETRON DIVISION
RADIO RECEPTOR COMPANY, Inc.
Sales Department: 251 West 19th St., New York 11, N. Y.
Factory: 84 North 9th St., Brooklyn 11, N. Y.
Now PRECISION BALLS of Synthetic Sapphire

Now... the wear, corrosion, and heat resistance of synthetic sapphire in balls polished to within 20 micro-inches of sphericity.

These unicrystalline spheres resist corrosion or erosion by many acids and alkalis... possess a higher dielectric strength than glass or mica... have a low coefficient of friction and superior hardness. In many applications, they need not be lubricated.

Linde synthetic sapphire balls are available in 1mm, \( \frac{3}{8} \) inch, \( \frac{1}{8} \) inch, and \( \frac{1}{4} \) inch sizes. Three surface finishes are available: super-finished, semi-finished, and rough-ground blanks.

CALL or WRITE any Linde office for information on these balls, or the other forms of Linde synthetic sapphire.

### PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>( \text{Al}_2\text{O}_3 )</td>
</tr>
<tr>
<td>Coefficient of Friction</td>
<td>0.140</td>
</tr>
<tr>
<td>Hardness (Knoop)</td>
<td>1,525-2,000</td>
</tr>
<tr>
<td>Modulus of Elasticity in Flexure</td>
<td>50-56 ( \times 10^6 ) psi</td>
</tr>
<tr>
<td>Dielectric Constant</td>
<td>7.5-10</td>
</tr>
<tr>
<td>Modulus of Rigidity</td>
<td>21.5-27.5 ( \times 10^6 ) psi</td>
</tr>
<tr>
<td>Thermal Coefficient of Expansion up to 50°C</td>
<td>5.0-6.7 (per °C ( \times 10^{-6} ) )</td>
</tr>
<tr>
<td>Chemical Resistance</td>
<td>Unaffected by acids, dilute alkali.</td>
</tr>
</tbody>
</table>

**THE LINDE AIR PRODUCTS COMPANY**

Unit of Union Carbide and Carbon Corporation

30 East 42nd St., New York 17, N. Y.  
In Canada: THE DOMINION OXYGEN COMPANY, LIMITED, Toronto

The term “Linde” is a trade-mark of The Linde Air Products Company

---

Air core betatron offers possibility for portable x-ray units

---

A three-million-volt cathode rays, similar to x-rays but vastly more penetrating, are utilized in an electronic irradiating process developed

Sterilizing Pharmaceuticals

Packages to be sterilized pass beneath high-energy x-ray source

---

THE ELECTRON ART (continued)
ANNOUNCING... **2 New Units**

**Ideal for use wherever a voltage proportional to speed is required**

**Making Available a Wider Choice of ARMA Induction Generators**

Designed specifically for high performance in servomechanisms and electromechanical computing systems.

**Typical Specifications**

<table>
<thead>
<tr>
<th>Type</th>
<th>Dwg. No.</th>
<th>Freq.</th>
<th>Volts</th>
<th>Amps</th>
<th>Watts</th>
<th>Volts per 100 R.P.M.</th>
<th>Phase</th>
<th>Residual at 0 Speed</th>
<th>Rotar</th>
<th>Inertia</th>
<th>Dens. in.</th>
<th>Weight (lbs.)</th>
<th>Alloc. Max. Static Fric. Or in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A60</td>
<td>213409-1</td>
<td>60</td>
<td>24</td>
<td>0.18</td>
<td>2.0</td>
<td>2.0</td>
<td>0.33±5%</td>
<td>900 0°±1.5°</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>0.22</td>
<td>1.5</td>
</tr>
<tr>
<td>5E</td>
<td>213315-1</td>
<td>60</td>
<td>90</td>
<td>0.15</td>
<td>5.0</td>
<td>1.0 ±1%</td>
<td>600 0°±0.5°</td>
<td>5 5 15</td>
<td>2.60 6.3</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A400*</td>
<td>213480-2</td>
<td>400</td>
<td>115</td>
<td>0.100</td>
<td>8.0</td>
<td>8.0</td>
<td>0.20 Nom.</td>
<td>Note 1 Note 2</td>
<td>10</td>
<td>20</td>
<td>20</td>
<td>0.57</td>
<td>2.0</td>
</tr>
<tr>
<td>1B400*</td>
<td>213480-1</td>
<td>400</td>
<td>115</td>
<td>0.100</td>
<td>8.0</td>
<td>8.0</td>
<td>0.20 Nom.</td>
<td>Note 4</td>
<td>3 3 10</td>
<td>0.57</td>
<td>2.0</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>03ADC</td>
<td>715772-1</td>
<td>DC</td>
<td>24</td>
<td>0.15</td>
<td>3.5</td>
<td>3.5</td>
<td>0.070 V.D.C.</td>
<td>(approx.) for an accel. of 1400 Radians/Sec</td>
<td>0.019</td>
<td>0.54</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>213151-1</td>
<td>DC</td>
<td>38-46</td>
<td>0.12</td>
<td>5</td>
<td>5</td>
<td>0.1 V.D.C.</td>
<td>(approx.) for an accel. of 1400 Radians/Sec</td>
<td>0.25</td>
<td>3.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Types 1A400 and 1B400 are furnished with an external auxiliary unit which is considered in the statement of characteristics and in all quotations.*

**Features**

- Rugged construction
- High mechanical accuracy
- Characteristics stable with time and handling
- Low shaft runout
- Low friction and inertia
- High output to inertia ratio
- Precision output

**Types 1A400 and 1B400**

(they look alike) and Resistor Unit

ARMA CORPORATION

254 36th STREET, BROOKLYN 32, N.Y.

SUBSIDIARY OF AMERICAN BOSCH CORPORATION

ARMA ELECTRICAL RESOLVERS® - ARMA SYNCHROS - ARMA INDUCTION MOTORS - ARMA INDUCTION GENERATORS - ARMA MECHANICAL DIFFERENTIALS - ARMA ALTERNATING VOLTAGE COMPARATOR

**Induction Generator Booklet**

JUST PRINTED GIVES COMPLETE DETAILS

ASK FOR A COPY

ARMA PRODUCTS RELEASED FOR PRIVATE INDUSTRY

*Licensed for use under Arma patents Nos. 2,465,624 and 2,467,646. License information available.*

ELECTRONICS — September, 1950
HERE'S A COMPACT SLOWPOKE

Designers and manufacturers concerned with the excessive space requirements and high cost of external reduction gearing will welcome this new slow speed timing motor. The series 4400 requires minimum space and provides, at comparatively low costs, speeds from 6 hours to 7 days per revolution. The careful design, expert engineering and precision manufacture, are advantages common to all Haydon motors.

SUPERIORITY FEATURES

DEPENDABILITY: Slow 450 rpm rotor speed means less reduction gearing and fewer fast wheels, providing quieter operation and longer life.

SMALL SIZE: Smallest available of this type.

TOTAL ENCLOSURE: A basic feature of sound design.

CONTROLLED LUBRICATION: Separate rotor and reduction gearing lubricating systems permit selection of best methods and lubricants, control circulation, insure against leakage.

OPERATING POSITION: Operates continuously in any position.

SIMPLE, SECURE ASSEMBLY: Entire face of motor can be supported securely against mounting surface. Motor leads standard for quick, inexpensive wiring.

STANDARD INTERCHANGEABLE DESIGNS: Speed from 300 rpm to 1 revolution per week in only 2 interchangeable motor series.

For complete design and engineering specifications, write for catalog: Timing Motors No. 322 - Timers No. 323 - Clock Movements No. 324. Yours without obligation.

---

Lowering hood over 3,000,000-volt electrostatic generator used with MIT sterilizing equipment

at Massachusetts Institute of Technology for sterilizing a wide variety of pharmaceuticals after their final packaging. Penicillin, streptomycin, surgical sutures, anticoagulents such as heparin, and many other substances can be sterilized in their final sealed glass containers without detectable adverse effect on their potency or other properties.

The amount of cathode-ray energy that will completely destroy all bacterial and virus contaminants raises the temperature of the pharmaceutical less than 8 degrees. As a result, sterility of many heat-sensitive pharmaceutical products can now be achieved on a practical and economic basis by irradiation with such high-energy x-rays.

 Ultrasonic Vibration Accelerates Polymerization

EMULSION polymerization reactions used in the production of synthetic rubber have been speeded up by ultrasonic vibration. Both a magnetostriction oscillator operating at 15 kc and a 500-kc piezoelectric oscillator were used in tests con-
Gives You Proper Focus Under a Wider Range of Conditions

With the I-T-E Adjustable Shunt PM-EM Focus Coil you can adjust PM strength over a wide range, compensating for most tube and set variations. This feature virtually eliminates assembly line rejects caused by out-of-tolerance PM strength. Flexibility of the adjustable shunt makes it possible for you to use one focus coil design to focus several types and sizes of tubes.

Design features greatly reduce magnetic interference with ion magnet on new short neck tubes. Among the many other advantages of I-T-E Adjustable Shunt PM-EM Focus Coils is their low operating temperature — gained through lower focus current requirements. I-T-E Adjustable Shunt PM-EM Focus Coils retain proper focusing over a wide range of line voltage variations.

I-T-E makes Adjustable Shunt PM-EM Focus Coils for use with 10", 12", 14", 16", and 19" picture tubes. They are available in a variety of standard or special mountings, and any special mounting can be furnished upon request. Information needed to manufacture: Type of tube; second anode voltage; focusing current desired; special considerations for mountings and leads.

I-T-E’s design engineers will be glad to work with you on your applications or requirements — consult them without obligation. For complete information of I-T-E Adjustable Shunt PM-EM Focus Coils — or any other I-T-E wire-wound products — write, wire, or call, specifying your needs.

FOCUS COILS
RESISTOR DIVISION, I-T-E CIRCUIT BREAKER COMPANY
19th & Hamilton Streets, Philadelphia 30, Pa.

I-T-E Wire-Wound Products: FOCUS COILS • DEFLECTION YOKES • RESISTORS
Types
DO-81
DO-82
DO-83

LONG-SCALE INSTRUMENTS

In conventional panel instruments, limitations of instrument size often result in crowded, hard-to-read scales. But not in G-E long-scale instruments! Although the diameter of the instrument is only 3½ inches, the scale is almost 5 inches long. Large numerals and tapered pointer help make for quick, easy reading.

Cases are attractively designed, molded of sturdy Textolite. They'll improve the appearance—and sales appeal—of your panel. Round or square fronts are available. The Type DO-81 long-scale line is mechanically interchangeable with conventional 3½-inch designs now listed.

NO SHIELDING REQUIRED

Self-shielding is provided by the concentric construction of the magnet. The instruments may be used on either steel or non-magnetic panels without special calibration. Several instruments can be mounted side-by-side, free from the effect of one instrument on another.

INDICATE NONELECTRICAL QUANTITIES

Long-scale instrument scales can be marked for electrical quantities, or for nonelectrical quantities which can be measured electrically. Get in touch with your nearest G-E representative for complete information, or write for bulletin GEC-579. Apparatus Dept., General Electric Co., Schenectady 5, New York.

*Reg. Trademark General Electric Company

FIG. 3—Power concentration determines reaction time

FIG. 2—Ultrasonic vibration eliminates induction period

ducted by the Goodyear Tire and Rubber Co.

The special reaction cell shown in Fig. 1 uses an X-cut quartz crystal as the source of 500-kc energy. Drive is supplied by a 300-watt oscillator. An efficiency of 50 percent has been realized. Since the reaction chamber limits the charge to 200 cc, a 10-liter thermostated reservoir is used together with a circulating diaphragm pump.

In the magnetostriction method, a water-cooled coil is fed by a 1,000-watt vacuum-tube oscillator. A d-c
Since Carbogoy Company, Inc., pioneered cemented carbides in 1928, research and development have continued to occupy a major role in the Carboloy program. We welcome the challenge of new fields provided by latest additions to the Carboloy Company family of special metals.

LOOK to CARBOLOY CO., INC.
for the finest in special metals

CARBIDES • ALNICO • HEVIMET
polarizing current of 20 amp at 400 volts is impressed upon the coil and the coil-and-bar assembly immersed in the emulsion to be treated. The process is carried on at atmospheric pressure under a stream of nitrogen.

The principal effect at 50 C (Fig. 2A) is elimination of the induction period with only a slight increase in the rate of reaction. At 40 C (Fig. 2B) the effect of irradiation is more pronounced. To show that the reaction was not due to heating of the nickel bar by hysteresis and eddy-current loss, a hot aluminum control bar was introduced. The nickel bar furnished 50 watts of acoustic power for a 1,000-watt input to the amplifier.

Curves indicating the effect of power concentration on reaction time are shown in Fig. 3.

SURVEY OF NEW TECHNIQUES

ANALYSIS of water and gas pipeline systems has been carried out by use of an electric network analogy. Cornell University researchers announce that the device permits pressures and rates of flow to be represented easily by proportional electrical quantities. Each pipeline is represented by a fluistor, a special resistor consisting of a tungsten filament enclosed in an evacuated glass tube. Heavily loaded lines are indicated by bright fluistor filaments whereas underloaded lines fail to glow.

SEQUENTIALLY ARRANGED dots of red, blue and green-emitting fluorescent material form the basis of a direct-view color television tube for which a patent was recently issued to Allen B. Du Mont Laboratories, Inc. The single electron beam of the tube sweeps over the color dots of each line in synchronism with the beam of the camera tube at the transmitter, the screen of which has correspondingly colored and spaced photoelectric dots, each sensitive to one of the three colors. The tube is still under development even though the patent was applied for almost five years ago.
The new Sangamo Type FM "ARROWHEAD" tubular electrolytic capacitor is equipped with flexible, insulated wire leads and stud terminals to make installation easier by eliminating the problem of crossed wires and the need for insulating sleeves. Sangamo Arrowheads are much smaller than wax end filled types with insulated leads—smaller than any other type with dual leads!

These capacitors are housed in round aluminum containers which are encased in heavy insulating sleeves with mounting strap attached, and they are especially designed for the rugged television requirements where 85°C operating temperatures are encountered.

A trial of these new dry electrolytic capacitors will convince you. See your Jobber, or write for Catalog No. 800, which gives full information on the Arrowhead and the rest of the Sangamo Tribe.
BULLETIN 5008
Just off the press!

Flexible shafts—the very latest information and engineering data on power drive and remote control flexible shafts and casings, brought up to date to include latest developments.

It also tells you how to select shafts and casings for specific applications and how to work out the necessary details.

Write for a free copy today.

NEW PRODUCTS
(continued from p 126)

in 5 steps (1.5, 5, 15, 50 and 150 v, full scale). Accuracy is ± 3 percent. Frequency error is 10 percent at 120 mc, and correction curves are supplied by means of which rated accuracy can be obtained up to 200 mc.

Ultrasensitive Relay

SERVO-TEK PRODUCTS Co., 4 Godwin Ave., Paterson 1, N. J., has developed a new electronic relay system to provide supersensitivity in industrial control applications. The miniature unit illustrated operates from the 115-volt 50 or 60-cycle line and uses no filament to draw standby power with the relay circuit energized. Maximum current flow through the initiating resistance is in the order of microamperes.

Decade Inductors

THE HYCOR Co., 7116 Laurel Canyon Blvd., North Hollywood, Calif. The 700 series decade-inductor units are used for design and experimentation work on audio filters, equalizers and tuned circuits. Units may be connected in series to obtain
STANDARD RI-FI* METERS

14 kc to 1000 mc!

DEVELOPED BY STODDART FOR THE ARMED FORCES.

AVAILABLE COMMERCIALLY.

VHF!
15 MC
to
400 MC

VLF!
14 KC
to
250 KC

Commercial equivalent of AN/URM-5.
Sensitivity as two-terminal voltmeter, (95 ohms balanced)
2 microvolts 15-125 MC; 5 microvolts 88-400 MC. Field
Intensity measurements using calibrated dipole. Frequency
range includes FM and TV Bands.

HF!
150 KC
to
25 MC

Commercial equivalent of AN/PRM-1.
Self-contained batteries. A.C. supply optional. Sensitivity as
two-terminal voltmeter, 1 microvolt. Field intensity with 1/2
meter rod antenna, 2 microvolts-per-meter; rotatable loop
supplied. Includes standard broadcast band, radio range,
WWV, and communications frequencies.

UHF!
375 MC
to
1000 MC

Commercial equivalent of AN/URM-17.
Sensitivity as two-terminal voltmeter, (50-ohm coaxial input)
10 microvolts. Field intensity measurements using calibrated
dipole. Frequency range includes Citizens Band and UHF
color TV Band.

The rugged and reliable instruments illustrated above serve
equally well in field or laboratory. Individually calibrated
for consistent results using internal standard of reference.
Meter scales marked in microvolts and dB above one microvolt.
Function selector enables measurement of sinusoidal or complex
waveforms, giving average, peak or quasi-peak values.
Accessories provide means for measuring either conducted
or radiated r.f. voltages. Graphic recorder available.

*Radio Interference and Field Intensity.

Precision Attenuation for UHF!
Less than 1.2 VSWR to 3000 MC.
Turret Attenuators:
0, 10, 20, 30, 40, 50 DB.
Accuracy ± .5 DB.
Patents applied for.

STODDART AIRCRAFT RADIO CO.
6644 SANTA MONICA BLVD., HOLLYWOOD 38, CALIF.
Hillside 9294

ELECTRONICS — September, 1950
PRESTO... most carefully made recording discs in the world

Through 15 years of experience in manufacturing fine recording discs, Presto has learned that the choice of lacquer, how it is stored, tested and maintained, how it is applied to the aluminum base are among the most important considerations.

Specifications for recording lacquer have been carefully worked out after many laboratory and turntable tests. Compounded from a well-guarded formula, Presto lacquer is stored in constantly agitated tanks to insure even flowing.

In the Presto coating room, polished aluminum blanks are fed into the processing "tunnel" where liquid lacquer is automatically flowed on their surfaces to just the right thickness. After completing their 1½ hour trip through this 550 foot tunnel, the coated discs are carefully placed in racks for "curing."

Whenever you see the Presto label on a disc, it is your assurance of the most carefully manufactured, best performing and most permanent disc anywhere.

Cardioid Microphone

THE ASTATIC CORP., Conneaut, Ohio. Model DR-10 Sinabar microphone is a unidirectional cardioid crystal type which uses a special sintered metal to cancel out 15 db front to back. Frequency range, from 50 to 10,000 cps, is enhanced by a response selector switch which provides choice of ideal pickup characteristics for either crisp voice or general voice and music. A high-impedance microphone, its output level is -54 db.

Tape Recording Head

SHURE BROTHERS INC., 225 W. Huron St., Chicago, Ill. Model TR5 tape recording head combines the functions of record, playback and...
Announcing

RCA WV-97A

Senior VoltOhmyst*
reading peak-to-peak voltages

ONLY $62.50  Suggested User Price
Includes direct probe and cable, dc probe, ohms lead, and ground lead

TEN WAYS BETTER!

1. Directly measures complex waves from 0.2 volt to 5000 volts, peak-to-peak.
2. Has an over-all accuracy for ac measurement of ±3% of full scale.
3. Measures dc voltages from 0.02 volt to 1500 volts.
4. Measures rms values of sine-wave voltages from 0.1 volt to 1200 volts.
5. Has 7 non-skip ranges for both resistance and voltage.
6. At full-scale voltage points increase in a uniform '3:1' ratio.
7. Frequency response flat from 30 cps to approximately 3 Mc.
8. Negative-feedback circuit provides better over-all stability.
10. More convenient to use because of smaller size and new slip-on probes.

The WV-97A has a range of usefulness extending beyond that of any other instrument in the field. Its quality, dependability, and accuracy make it a true laboratory instrument; it is exactly what is needed for television in the design laboratory, factory, and service shop.

The new Senior VoltOhmyst measures dc voltages in high-impedance circuits, even with ac present. It reads the rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of dc. Its electronic ohmmeter has a range of ten billion to one.

Like all RCA VoltOhmysts, it features high input resistance, electronic protection from meter burn-out, zero-center scale for discriminator alignment, molded-plastic meter case, a 1-megohm isolating resistor in the dc probe, and sturdy metal case for good rf shielding.

An outstanding feature is its usefulness as a television signal tracer. . . made possible by its high input resistance, wide frequency range, and direct reading of peak-to-peak voltages.

For complete information on the new RCA WV-97A Senior VoltOhmyst, see your RCA Test Equipment Distributor, or write RCA, Commercial Engineering, Section 142Y, Harrison, New Jersey.

Available from your RCA Test Equipment Distributor

RADIO CORPORATION of AMERICA
TEST EQUIPMENT
HARRISON, N.J.

ELECTRONICS — September, 1950

SPECIFICATIONS

DC Voltmeter: 0 to 1, 5, 15, 50, 150, 500, 1500 volts

Input resistance (including 1-megohm dc probe): 1 megohm

Sensitivity for the 1.5-volt range: 7.3 megohms per volt

Over-all accuracy: ±3% of full scale

AC Voltmeter — Fourteen continuous ranges:

Peak-to-peak ranges: 0 to 1, 4, 14, 40, 140, 4000 volts

Maximum peak-to-peak input voltage: 1400, 4000 volts

RMS ranges (for sine waves): 0 to 1, 5, 15, 50, 150, 500, 1500 volts

Maximum rms input voltage: 1200 volts

Input resistance and capacitance with WG-218 Direct Probe and Cable:

1.5, 5, 15, 50, 150-ohm ranges: 0.83 megohms shunted by 85 μF

500-ohm range: 1.3 megohms shunted by 85 μF

1500-ohm range: 1.5 megohms shunted by 85 μF

Frequency response with WG-218 Direct Probe and Cable:

1.5, 5, 15, 50, 150, 500 ranges from 20 cps to 3 Mc for voltage source having 100-ohm impedance.

Overall accuracy:

1.5, 5, 15, 50, 150, 500, 1500-ohm ranges: ±5% of full scale

0.5-ohm range: ±10% of full scale

Ohmmeter:

Seven continuous ranges: 0.2 ohm to 1000 megohms

Center scale values: 0.1, 1, 10 megohms

Dimensions: 7½” high; 5½” wide; 3¾” deep

Available Accessories:

WG-264 Crystal Diode Probe: Extends range to 250 Mc

WG-289 High Voltage Probe and WG-206 Resistor to extend range to 50,000 volts ($7.75 suggested user price)

WG-289 High Voltage Probe and WG-206 Resistor to extend range to 50,000 volts ($9.95 suggested user price)

*RCA Patent Off.

www.americanradiohistory.com
Cars keep rolling off line when parts "fly" to the job

Increased production at a West Coast assembly line caused a parts shortage. Shipment in transit was located at St. Louis in late afternoon and AirExpressed to coast. Delivered 5 A.M. next morning. Speed like this keeps production rolling, lets you meet every delivery date. Shipping charge for 50-lb. carton: $24.56.

You get door-to-door service included in the low rate. This makes the world's fastest transportation method convenient and easy to use. Specify it regularly to keep customer service high—and high-cost inventories low.

Shipments go on all Scheduled Airline flights. Speeds up to 5 miles a minute—dependable service, experienced handling. For fastest shipping action, phone Air Express Division, Railway Express Agency. (Many low commodity rates in effect. Investigate.)

Air Express gives you all these advantages:
- World's fastest transportation method.
- Special door-to-door service at no extra cost.
- One-carrier responsibility all the way.
- 1150 cities served direct by air; air-rail to 22,000 off-airline points.
- Experienced Air Express has handled over 25 million shipments.

Radio Cue System
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N.Y. Model AB radio cue system, for use in directing personnel via a radio link, has found applications in television studios whereby personnel on the studio floor may move about freely without trailing communication wires. Illustrated above is the transmitter which operates on a low r-f frequency into a loop antenna—the transmitted information thus being restricted to a closely confined area. The pocket receivers are small and lightweight. Several r-f channels are available, should simultaneous transmission for separate activities be desired.

Industrial Tubes
Sylvania Electric Products Inc., 500 Fifth Ave., New York 18, N.Y., has made available three new elec-
Here are some of the many reasons why there are more Simpson 260 high sensitivity volt-ohm-milliammeters in use today than all others combined. The Simpson 260 has earned world-wide acceptance because it was the first tester of its kind with all these "Firsts":

**Simpson 260 SET TESTER**

WORLD FAMOUS FOR ALL THESE "FIRSTS"

- First high sensitivity instrument to use a metal armature frame.
- First to use fully enclosed dust proof rotary switch with all contacts molded in place accurately and firmly.
- First to do away with harness wiring.
- First to provide separate molded recesses for resistors, batteries, etc.
- First to cover all resistors to prevent shorts and accidental damage and to protect against dust and dirt.
- First with a sturdy movement adapted to the rugged requirements of a wide range of service work or laboratory testing.
- First to provide easy means of replacing batteries.
- First to use all bakelite case and panels in volt-ohm-milliammeters.
- First volt-ohm-milliammeter at 20,000 ohms per volt with large 4½" meter supplied in compact case (size 5½"x 7"x 3½").
- First and only one available with Simpson patented Roll Top Case.
- First to provide convenient compartment for test leads (Roll Top case).
- First to offer choice of colors.

The Model 260 also is available in the famous patented Roll Top safety case with built-in lead compartment. This sturdy, molded, bakelite case with Roll Top provides maximum protection for your 260 when used for servicing in the field or shop.

25,000 volt DC Probe for television servicing, complete, for use with 260, $12.85

**RANGES**

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Volts DC, Ohms AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000</td>
<td>1,000 Ohms per Volt</td>
</tr>
<tr>
<td>0-2,000</td>
<td>10, 50, 250, 1,000, 5,000</td>
</tr>
<tr>
<td>0-200,000</td>
<td>1000</td>
</tr>
<tr>
<td>0-20,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

**OHMS:**

<table>
<thead>
<tr>
<th>Ranges</th>
<th>0-2,000</th>
<th>0-200,000</th>
<th>0-20,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2,000</td>
<td>2,000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 meg Ohms (120,000 ohms center)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECIBELS:**

5 ranges -12 to +55 DB

**Prices:**

$38.95 dealers net; Roll Top $45.95 dealers net.

**Simpson Electric Company**

5200-18 W. Kinzie St., Chicago 44, Ill. • In Canada: Bach-Simpson, Ltd., London, Ontario

Electronics — September, 1950
Little lamps flash warnings—prevent accidents

WHEN you can show a customer that your product is safer to use than your competitor’s, you’ve got a big head start toward clinching the sale.

General Electric miniature lamps can add extra safety to your product. As indicator lights, they can be used to signal that a machine is running, to tell whether current is on or off, to flash a warning of high temperature or voltage. Used as dial lights, they make it easier for operators to read dials and gauges quickly, help spot trouble before it happens.

Plan now to design greater safety into your product with General Electric miniature lamps. They’re available in both filament and neon glow, in an almost limitless variety of types and sizes. You’re sure of long, dependable service from G-E miniature lamps because General Electric Lamp research is always at work to make G-E lamps Stay Brighter Longer. Lamp Department, General Electric Company, Nela Park, Cleveland 12, Ohio.

You can put your confidence in—

GENERAL ELECTRIC

tron tubes suitable for a wide range of industrial services where dependable operation and a service life up to 10,000 hours is required. Type 5691 is a high-mu twin triode recommended for voltage amplifier use and supplied with series-unit heaters; type 5692, a medium-mu twin triode, suitable for balanced d-c amplifier, multivibrator, blocking oscillator and resistance-coupled amplifier applications; and the 5693, a sharp-cutoff pentode designed particularly for high-gain resistance coupled amplifier service.

Diffusion Pump

EITEL-McCULLOUGH, INC., San Bruno, Calif. The HV-1 oil diffusion-type vacuum pump features: speeds up to 67 liters per second attainable vacuum of $4 \times 10^{-7}$ mm Hg, glass barrel, no liquid cooling, no charcoal trap, no mechanical wear, and simplicity of mounting and maintenance.

R-F VTVM

MILLIVAC INSTRUMENTS, P.O. Box 3027, New Haven, Conn. The MV-18b h-f v-t millivoltmeter measures frequencies from 1 me to 200 me flat with direct calibration and higher frequencies up to 2,500 me with calibration charts. The instrument contains a new carrier-type d-c amplifier having heavy negative feedback to insure accuracy and stability. Germanium crystal probes are used to rectify weak r-f signals with minimum cir-
BUILDERS OF COMMUNICATIONS EQUIPMENT, MEASURING INSTRUMENTS FOR COMMERCIAL AND INDUSTRIAL USE, AND OTHER ELECTRONIC DEVICES—PRODUCTS WHERE PRECISION PERFORMANCE LARGELY DEPENDS UPON TIME AS A FACTOR OF CONTROL—KNOW THEY CAN RELY ON Cramer DESIGN QUALITY ACCURACY

RUNNING TIME METERS
Synchronous motor driven. Register automatically and cumulatively total operating or idle time on circuits, machines, systems.

TIME DELAY RELAYS
Provide adjustable or fixed time delay between operation of a control circuit and subsequent opening or closing of a load circuit.

SYNCHRONOUS MOTORS
Permanent magnet type for applications requiring a constant speed at a given frequency. Small size. 30" ounce torque. Twenty-eight speeds from 60 rpm to 1/24 rph.

Philamon Laboratories manufactures a complete line of tuning fork resonators to meet your frequency control requirements. Temperature-compensated and hermetically sealed, the resonators are available in accuracies from 1 part in 3,000 to 1 part in 100,000, for operation over wide temperature ranges. The resonators may be obtained individually—as a part of compact sub-assemblies—or in completely engineered equipment.

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5717 Third Avenue, Brooklyn 20, N.Y.

SYNTHESIS IS A HIGH CLASS WORD FOR DESIGNING SERVO MECHANISMS

...SERVOSCOPE IS A HIGH CLASS INSTRUMENT FOR SERVO SYNTHESIS!

MEASURES
amplitude & phase vs. frequency
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accepted, 50 to 800 cps
MODULATES
chosen carrier, 0.1 to 20 cps
ANALYZES
D.C. or A.C. automatic controls
SUB-AUDIO
sine generator, 0.1 to 20 cps
SQUARE WAVE
generator, 0.1 to 20 cps
PHASE READING
to 1° accuracy, 2 methods
LINEAR SWEEP
for external use, 0.1 to 20 cps

SERVO CORP. OF AMERICA
NEW HYDE PARK, N.Y.
Double-Triode Subminiature
Sylvania Electric Products Inc., 500 Fifth Ave., New York 18, N. Y.
A new double-triode subminiature tube has been designed for applications in tv receivers, industrial electronics, servomechanisms and radio communications receivers. Available with pigtail leads as type 6BF7, and with short pins for socketing as type 6BG7, it is supplied in a T-3 bulb measuring only 0.400 in. in diameter and 1 1/2 in. long. Transconductance is 4,800 μmhos. Amplification factor per triode section is 35 when 100 volts are used on plates. Input capacitance per plate is 2.0 μμf; output capacitance, 1.0 μμf.

UHF Tetrode
Eitel-McCullough, Inc., 252 San Mateo Ave., San Bruno, Calif. The 4X150G uhf tetrode can be operated as either a conventional r-f amplifier or oscillator over a wide range of plate voltages at frequencies up to 1,000 mc. In pulse service efficient performance is obtained to above 1,500 mc. Typical performance in amplifier service at 750 mc is 100 watts output power per tube with a stage power gain of 11. In similar service at 1,000 mc output circuit loading. The new probes are designed to have 1.0-μμf input capacitance with a ± 25-percent tolerance.

The No. 74001 Tunable Coil Form
Another new Milen "Designed for Application" product is the No. 74001 permeability tuned, shielded plug-in coil form. Standard octal base of low-loss mica-filled Bakelite, polystyrene 1/8" diameter coil form, heavy aluminum shield, iron tuning slug of high frequency type, suitable for use up to 35 mc. Adjusting screw protrudes through center hole of standard octal socket. Special extension terminals facilitate connection to base pins.

JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY MALDEN MASSACHUSETTS

www.americanradiohistory.com
power is reduced to 50 watts with a stage power gain of 5.

Crystal Calibrator

Measurements Corp., Boonton, N. J. Model 111 crystal calibrator was designed for the frequency calibration of signal generators, transmitters, receivers, grid-dip meters and other equipment in the 250 kc to 1,000-mc range. Frequency accuracy is ±0.001 percent. The dual-purpose calibrator provides a test signal of crystal-controlled frequency and has a self-contained receiver with a 2-µw sensitivity. A new circuit arrangement uses the cross-modulation products of three separate oscillators operating.

YACHTSMEN with big boats and matching pocketbooks will be interested in this small new radar unit that detects headlands and other large objects up to 20 miles, picks up buoys at 75 yds. Radiomarine Corp. of America, 75 Var-

ick St., New York 13, N. Y.
High Sensitivity . . Logarithmic
AC VOLTMETER
40 MICROVOLTS TO 500 VOLTS
MODEL 47 VOLTMETER

SELF-CONTAINED
ALL AC OPERATED UNIT
An extremely sensitive amplifer type instrument
that serves simultaneously as a voltmeter and high gain
amplifier.

- Accuracy ±2% from 15 cycles to 30 kc.
- Input impedance 1 meg-ohm plus 15 uuf shunt
capacity.
- Amplifier Gain 40000

Also MODEL 45
WIDE BAND
VOLTMETER
.0005 to 500 Volts!
5 Cycles 1600 kc.

A few of the many uses:
- Output indicator for microphones of all
types.
- Low level phonograph pickups.
- Acceleration and other vibration measuring
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- Sound level measurements.

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45-17 Glenwood Street
LITTLE NECK, L. I., N. Y.

E-1 HERMETIC
SEALING
COMPONENTS
Easy to Install — High Dielectric
GASKET TYPE BUSHINGS

For heavier equipment requiring
larger terminals, E-1 Gasket
Type Bushings are recommended.
They offer high dielectric strength,
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sealing, easy installation. Specially
processed gland penetrates deeply
into the L-5 Steatite insulator,
seals against the mounting
surface, resists oil and
pitch and is unaffected by
high heat. Hot-tinned brass
studs provide excellent
electrical conductivity.

E-1 Bushings
meet all government
specifications for sealed
transformers and condensers
(\text{Jan T-27}, \text{Jan C-23})

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-65\text{°C} to +227\text{°F}
Hycar (-90\text{°C} to +350\text{°F})
Silastic (-100\text{°C} to +500\text{°F})

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Bulletin 831 for complete details
and specifications — no obligation.

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photo record!

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useful with every 'scope. Puts pattern
on paper for accurate tracing, all in
just a few seconds!

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log, semi-log, decrement, etc.
- Compare traces by super-position.
- Detect small, slow pattern
changes.
- Measure amplitude and wave
forms accurately.

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optical instrument that superimposes
the cathode-ray image on a sheet of
paper or right in your lab note book.
Uses a newly developed, double-
coated lens — high-reflection upper
surface, high-transmission lower sur-
face. Heavy, cast base contains lamp
to light record paper.

This useful accessory to every
'scope costs only $19.50. The first
cost is the last cost.

ORDER TODAY from
Robert A. Waters, Inc.
4 Gordon Street, Waltham 54, Mass.
at the fundamental frequencies of 0.25, 1.0 and 10 mc. Power supply is 117 v, 50 or 60 cycles.

Frequency Generator

VARO MFG. CO., INC., Box 638, Garland, Texas. Model 622B frequency generator operates from conventional 28-volt d-c aircraft power supply and delivers a 15-volt sinusoidal voltage to a 1-megohm load. It is hermetically sealed. Frequency is 400 cps ± 0.1 percent from −55 to +110 C. Measurements are 3¼ in. high, 1⅜ in. wide and 32 in. long, and weight is 11 ounces.

Screen Process Printer

MECH-TRONICS EQUIPMENT CO., Box 510, Silver Spring, Md., announces availability of the model 20 screen process printer, a machine that automatically applies wiring and capacitors to cylinders up to 1¼ in. in diameter. Screen sizes can be accommodated up to the dimen-
BURGESS BATTERY COMPANY

Burgess Battery Company lists hundreds of battery types developed by Burgess Engineers to meet new requirements. If the specific battery you need is not among them, the complete Burgess facilities, design, production, and engineering will be placed at your disposal to build the battery you need in any quantity — large or small!

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(Dept. E1) Freeport, Illinois

FOR DEPENDABLE SERVICE

JOHNSON

MULTIPLE WIRE CONNECTORS

Provide quick, positive connection of multiple wire cables in electronic applications. Available in 7 and 12 contact self-aligning, polarized types, JOHNSON connectors are well suited for both semi-permanent connections or for numerous operations during the life of equipment.

MOLDED BLACK PHENOLIC BODIES
Connector bodies are molded black phenolic material, capable of withstanding rough service. Either panel mounting or cable attachment is provided. Cable type shells are heavy gauge brass, dull finished and lined with fibre insulation. Bodies screw into the shells eliminating the possibility of damage in assembly or disassembly. Panel type connectors secured by a threaded retaining ring.

AVAILABLE WITH MOUNTING YOKE
In addition to their use as cable or panel types, JOHNSON connectors can be equipped with a mounting yoke to fit standard switch boxes and cover plates. The 12 contact male connector is also available assembled on a phenolic plate, bracket mounted, for special applications.

SILVER PLATED CONTACTS
All connectors have full floating silver plated contacts for maximum conductivity. Integral solder terminals permit fast trouble-free assembly. Will accept conductors up to AWG #14 solid. #16 stranded.

Could these connectors be used to advantage on your equipment? A request for samples will not obligate you in any way. Write:

JOHNSON
a famous name in radio
E. F. JOHNSON Co. Waseca, Minn.
sions of the 5 in. x 9 in. frame. Additional information can be had by writing for bulletin No. 21.

Miniature Potentiometer

GENERAL RESEARCH ASSOCIATES, 99 Grandview Ave., White Plains, N. Y. Model GR-2 is a small, lightweight potentiometer designed to be used for setting the zero or null in aircraft instruments of the self-balancing bridge type. It is 3 in. in diameter and projects 8 in. back of the mounting surface. It weighs approximately 10 grams and is available in overall resistance values from 50 to 5,000 ohms. It is provided with stops which limit the rotation to 330 deg.

VHF Impedance Bridge

GENERAL RADIO Co., 275 Massachusetts Ave., Cambridge 39, Mass. Type 1601-A impedance bridge extends the frequency range of conventional bridge techniques up to 165 mc. Similar in basic circuit to the type 916-A r-f bridge, the new instrument measures the impedance of antennas, lines, networks and components between the frequencies of 10 and 165 mc. Overall
Engineers who "talk test"... pick PEERLESS

The transformer proved definitely superior in the competitive...

SQUARE WAVE TEST

Claims and counterclaims of quality are easy to make... but to the engineer, tests really talk. And indisputable evidence of Peerless Transformer superiority is found in the Square Wave Test... which reveals the slightest flaw in design and performance. Tests conducted by impartial engineers prove Peerless components have better power characteristics, flatter response curves, less intermodulation distortion and lower insertion losses. Send for the complete Peerless Catalog... giving full details on transformers that are really "best by test."

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General Ceramics low loss insulators function efficiently in all frequency ranges and are capable of withstanding most all conditions of shock or vibration. Specification of standard shapes offers an opportunity to effect production economies. For unusual designs or mechanical specifications consult General Ceramics engineers. Estimates without obligation.

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2656 West North Avenue, Chicago 47, Illinois

Depend on Lewis Spring Engineers to keep abreast of the latest developments in television coil design and application. New and improved types including double coils with four leads, units with ceramic resistors and other choke, contact, band-tuning and channel coils such as shown above are being mass-produced by Lewis for leading TV manufacturers.

Take advantage of the up-to-the-minute know-how, experience and facilities of Lewis to help design and produce television coils to your specifications. You'll appreciate the efficiency, prompt delivery and economy in which Lewis will satisfy your demands.

There is a Lewis Engineer near you who will welcome the opportunity to check your requirements and quote delivery and price. Call or write us today without obligation.
accuracy is ± 2 percent for resistance and ± 5 percent for reactance. Terminals are type 874 coaxial connectors.

Timing Motor
HAYDON MFG CO., INC., Torrington, Conn. The 4400 series timing motor is an extra-slow-speed motor available in standard speeds of 6, 8, 12 hours, 1 day and 1 week per revolution. Nonstandard speeds are available on quantity orders in the ranges of 5, 9, 10, 15, 16, 30, 32 and 36 hours, and 2, 4, 10 and 30 days per revolution. Typical applications are in day-night thermostats, daily program timers and refrigerator defrosting mechanisms. Overall depth of the unit is 1 1/8 in.

Tiny Photoelectric Unit
SYLVANIA ELECTRIC PRODUCTS INC., Bayside, N. Y., has developed a tiny photocell which uses the photosensitivity of germanium. The units are expected to find wide use in such applications as decoding punched tape, electronic computing and sort-
opens new fields for space-saving Printed Electronic Circuits

This new development utilizing Low-Loss XXXP Phenolite, Laminated Plastic clad with copper foil—tightly bonded to both surfaces—is punched to the desired shape. The copper surfaces are printed with the required coil design, then etched, leaving a compact copper coil permanently imbedded in the insulating material.

Better TV Reception! A typical application of Copper Clad Phenolite Printed Electronic Circuits is used in this new, high-efficiency tuner manufactured by Variable Condenser Corp., Brooklyn, N. Y. It is being used in leading Television receivers for stronger, clearer pictures—less interference and "snow."

This new high-quality insulating material with low electrical loss is important because it is economical, space-saving and lowers labor costs. Write for samples and full information today.

Half-Octave Filter
GERSCH PRODUCTS, INC., 11846 Mississippi Ave., Los Angeles 25, Calif. Model SA-3 ultrasonic one-half octave filter has a range of 10 to 160 kc in half-octave steps and attenuation rate is 80 db per half octave. Minimum rejection outside the pass band is 40 db. It utilizes a passive network, without vacuum tubes, is not subject to overload and has the lowest possible distortion with excellent transient response.

Miniature Seismograph
SOUTHWESTERN INDUSTRIAL ELECTRONIC Co., 2831 Post Oak Road, September, 1950 — ELECTRONICS
"Wow-Meter"

Newly developed direct-reading instrument simplifies measurements of wow and flutter in speed of phonograph turntables, wire recorders, motion picture projectors and similar recording or reproducing mechanisms. It is the only meter in existence giving direct steady indication of meter pointer on scale.

The Furst Model 115-R "Wow-Meter" is suitable for both laboratory and production application and eliminates complex test setups. A switch on the front of the panel permits selection of low frequency cut-off and corresponding meter damping for use on slow speed turntables.

Frequency Response: 1/2 to 120 cycles or 10 to 120 cycles

Inquiries Invited on our line of Regulated Power Supplies

FURST ELECTRONICS
10 S. Jefferson St., Chicago 6, Ill.

See the New Precision Coil Bobbins

—with Anchored Flanges that can’t come loose!

Flanges are securely locked in place on a plastic-coated core to assure coils wound to closer tolerances and fewer rejects. Flange cannot slide to allow crowding of turns, and wire cannot slip off coil form. Insulation is improved. Bobbins made any shape—round, square, rectangular—any size, of finest dielectric Kraft, fish paper, cellulose acetate, or combinations. Low die costs cut unit prices surprisingly

If complicated USAF Specs or other Government Test Specifications have got you stymied, Bowser can put you in trim. Bowser Chambers for testing equipment under simulated environmental conditions meet all Govt. Test Specs, and some Bowser Units, like the Laboratory Units, provide facilities for testing under several conditions such as High or Low Temperature, High Altitude, Relative Humidity, etc. Bowser Units are custom built to meet individual testing, storage and processing requirements.

Why don’t you capitalize on Bowser’s experience in building Testing equipment of all kinds? Write NOW.

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Here, in a versatile instrument of advanced design, are all the things you need for complete oscillographic recording. The Hathaway Type S-8 Oscillograph, which has long been the standard of oscillographic recording, has been improved to meet the rapidly expanding demands of modern research. Whether your measurement problems are simple or complex, the NEW Type S-8 Oscillograph has the inherent capabilities necessary to measure vibration, pressure, acceleration, and strain with new ease and accuracy.

The newest features include:

- QUICK-CHANGE TRANSMISSION fully enclosed with gears running in oil to provide instantaneous selection of 16 record speeds over the range of 120
- CHART TRAVEL INDICATOR provides continuous indication of chart motion. Operator knows instantly by flashing lamp if anything should happen to interfere with chart motion
- FULL-RESILIENT MOUNTING FOR MOTOR AND TRANSMISSION isolates all possible vibration and makes possible the use of modern super-sensitive galvanometers
- NEW GALVANOMETER STAGE accommodates all Hathaway galvanometer for recording milliamperes, microamperes, or watts
- NEW RECORD-LENGTH CONTROL AND NUMBERING SYSTEM designed for long, trouble-free service under all kinds of ambient conditions
- All the other valuable features are retained, such as PRECISION TUNING-FORK-CONTROLLED TIMING SYSTEM produces either 1/10-second or 1/100-second time lines across sheet
- WIDE RANGE OF GALVANOMETER TYPES AND CHARACTERISTICS provide for almost any recording requirements. Natural frequencies to 10,000 cps. Sensitivities to 50,000 mm per ma, single and polyphase watts
- DAYLIGHT LOADING AND UNLOADING RECORDS TO 200 FT. IN LENGTH, width to 10 inches
- SIMULTANEOUS VIEWING AND RECORDING AUTOMATIC BRILLIANCE CONTROL
- 12 TO 92 ELEMENTS

Whatever your needs may be, investigate the NEW Type S-8 Oscillograph and its 170 types of galvanometers—the most versatile equipment in existence for general-purpose applications.

WRITE FOR BULLETIN 281-A-G

Houston 19, Texas. Type PSU-11 miniature seismograph unit contains twelve type GA-11 amplifiers plus a control unit. Amplifiers gain is 120 db. It features a 2-section L-C filter for 1-f rejection and a 1-section L-C filter for h-f rejection. Oscillograph specifications are: 25 traces; 6-in. paper; barrel-type electromagnetically-damped galvanometers; viewing screen; built-in timing system; built-in paper knife; removable take-up magazine and governor-controlled cranking motor.

Test-Point Jack

ALDEN PRODUCTS Co., 117 N. Main St., Brockton 64, Mass. Model 110BCS miniature test-point jack was designed for bringing out circuit leads for instantaneous check of any critical voltage in circuit while equipment is in operation. It measures 3 in. in diameter x 1 in. overall length, provides 100-percent insulation to a beryllium copper spring contact and will pass the fungus and salt-spray test.

Electronic Inverter

VARO MFG. Co., INC., BOX 638, Garland, Texas. Model 421 electronic inverter transforms 28 volts d-c to 400 cps ±0.1 percent, 115 ±1.0 percent single phase and/or 115 v ±3.0 percent three phase. Features are exceptional frequency and voltage stability over extreme conditions.
Cold heading was the only logical way to make this special part.

This refrigerator lid screw might have been made by other methods. With cold heading, however, in the hands of Scovill engineers, toolmakers and operators, this special part is produced in one piece, to close tolerances, with a better finish and greater strength, at lower cost.

Cold heading may open new possibilities for you to save money, speed production and improve your product. It's worth a try. Send your sample or blueprint for further information.

"Guide to the Profitable Use of Cold Heading"
—Bulletin No. 2 describes the advantages and limitations of this process for the designer. It's free for the asking.

**SCOVILL FASTENERS AND SPECIAL PARTS**

Industrial Fastener Sales. Waterville Division. Scovill Manufacturing Co., Waterville, Conn. Montclair, N. J. • Detroit • Wheaton, Ill. Los Angeles • Cleveland • San Francisco

**ELECTRONICS — September, 1950**
Model 389
Thyac

Beta Gamma Survey Meter

For exacting use in the laboratory or field service—where the application places a premium on accuracy and light weight with durability, the new 389 Thyac beta gamma survey meter is the answer to reliable performance.

Check the built-in features of this new instrument:

- A long life, low power vibrator power supply regulated to eliminate instrument drift, reduce calibration time, and substantially reduce battery costs.
- Waterproof construction—light weight (5 lb.).
- Probe assembly also permits use of the 1B106 mica window counter tube, 1B124 gamma counter tube, and the 1B126 cosmic ray tube.
- Fingertip range control affords ease of operation during survey periods.
- The use of quality parts lowers maintenance costs.

Victoreen is also a leader in supplying the finest in radiation instrument components. Our sub-miniature electrometer tubes, hi-megohm resistors, and extensive line of counter tubes are used and acclaimed by laboratories and manufacturers who are interested only in producing top quality radiation instrumentation.

Write for specifications and data sheets.

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NEW PRODUCTS (continued)

ranges of temperature and altitude, load and input ranges, and complete absence of moving parts. Output is 100 va, power factor 0.4 to 0.8 lag.

F-M Relay Receiver

Radio Engineering Laboratories, 36-40 37th St., L. I. C., N. Y., are in production on a new f-m relay receiver model 722 for the 88 to 108-mc band. It is a rack-mounted single-frequency crystal-controlled double i-f superhet unit. Distortion is less than 0.5 percent from 50 to 15,000 cycles; sensitivity noise factor, better than 6 db; and sputter point, less than 2 µv.

Decade Inductors

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. Available in single-decade units for building into other equipment and in three- and four-decade cabinet assemblies for laboratory use, the decade inductor illustrated provides
COILS and COIL FORMS

COILS. AR-2 and AR-5 h.f. coils are high-Q permeability-tuned RF coils on low-loss molded bakelite forms. AR-2 coil tunes from 75 mc. to 220 mc. with capacities from 100 to 10 mmfd. AR-5 coil tunes from 37 mc. to 110 mc. with capacities from 100 to 10 mmfd. Other windings may be substituted to modify range.

COIL FORMS. Molded of mica-filled bakelite permitting grooving and drilling. XR-50 (1/2" long, 1/2" dia. form; 1/2" long, 3/8" dia. iron slug) may be wound as desired to provide a permeability-tuned h.f. coil. XR-4 (1 1/2" long, 1" dia.) is standard four-prong form. XR-6 (2 1/2" long, 1 1/2" dia.) is six-prong form for use with special National XC-6C socket. Other types include XR-1 with four prongs, XR-2 and XR-3 without prongs.

Address export inquiries to Exp. Div., Dept. E-950

ELECTRONICS — September, 1950
Type 310-A Z-Angle Meter — Measures impedance directly in polar coordinates as an impedance magnitude in ohms and phase angle in degrees $Z \angle \theta$. Measures, with equal ease, pure resistance, inductance, capacitance or complex impedances comprised of most any RLC combinations. Range: Impedance ($Z$), 0.5 to 100,000 ohms; Phase Angle ($\theta$) +90° ($X_L$) through $0^\circ$ ($R$) to $-90^\circ$ ($X_C$). Accuracy: Within ±1% for impedance and $\pm 2^\circ$ for phase angle. Price: $445.00.

Type 311-A R-F Z-Angle Meter for radio frequencies — 100 kc to 2 mc. Simplifies laboratory and field impedance and phase angle measurements. Ideal for checking impedance of coils, transformers, coupling networks, lines, filters, antennas, etc. Direct-reading Impedance Range: 10 to 3,000 ohms up to 200 kc, and 10 to 1,000 ohms at 1 mc. Phase Angle: $+90^\circ$ ($X_L$) through $0^\circ$ ($R$) to $-90^\circ$ ($X_C$). Accuracy: Impedance to within ±3%, and phase angle $\pm 4^\circ$. Price: $530.00.

Type 410-A R-F Oscillator — 100 kc to 10 mc. (Special models 46.5 kc to 4.65 mc available.) Power oscillator for use as bridge driver and general laboratory measurements. Features: High stability, high output (approximate 30 volts, 30-60 f output impedance, expanded frequency scale, direct reading output voltmeter, compact design. Price: $350.00.

Type 320-A Phase Meter — frequency range 20 cycles to 100 kc. The first commercially available all-electronic instrument that directly measures the phase angle between two voltages in a simple operation. Ideally suited to applications in such fields as audio facilities, ultrasonics, servomechanisms, geophysics, vibrations, acoustics and many others. Phase angle readings made directly without balancing — stable at frequencies as low as 2 to 3 cycles. Voltage range: 1 to 100 peak volts. Terminals for recorder or choice of relay-rack or cabinet mounting. Price $475.00. Cabinet $20.00.

Type 110 Slide-Wire Resistance Box Convenient combination consisting of precision decade resistor and continuously adjustable slide-wire which provides smooth, continuous variation of resistance between decade steps (permits adjustment of resistance to one part in 10,000). For most applications, eliminates need for more elaborate multi-decade boxes. Ideal for student and general laboratory use. Decade resistance cards adjusted to within ±0.1% of nominal values, and slide-wire resistors direct-reading to within 3% of their maximum values. Cast aluminum cabinet. All resistance elements completely enclosed. Suitable for use at audio and ultrasonic frequencies. Type 110-A, range 0-1,000 ohms: $42.50. Type 110-B, range 0-110,000 ohms: $46.00.

See us at Booth 101 at the Show

Technical Catalog — yours for the asking. Contains detailed information on all TIC Instruments, Potentiometers and other equipment. Get your copy without obligation — write today.

TECHNOLOGY INSTRUMENT CORP.
1058 Main Street, Waltham 54, Massachusetts

NEW PRODUCTS (continued)

precise decade steps of inductance from one mh to one henry per step. Temperature coefficient of inductance is —24 parts per million per deg C over the normal range of room temperatures, and maximum storage factor, Q, is between 200 and 330. Accuracies range from 2 percent for the 1-mh steps to 0.25 percent for the 1-henry steps.

Driver Unit
RACON ELECTRIC CO., INC., 52 E. 19th St., New York 3, N. Y. Model PM-708th all-purpose driver unit for speech and music features a built-in 25-watt vacuum-impregnated line matching transformer. Available impedances are 15, 500, 1,000, 1,500 and 2,000 ohms. The voice coil is wound with aluminum wire for greatest efficiency and coil terminals are welded instead of soldered. Overload capacity is 75 to 100 percent; list price, $37.50.

New Germanium Diodes
GENERAL ELECTRIC Co., Syracuse, N. Y., has added five new types to
ECONOMICAL
MODERN
DESIGN
PRODUCTION
ENHANCING

EISLER's Electronic Equipment is especially Designed and Built to your exact requirements. From 5" to huge 24" Television Tube.

EISLER specializes in GLASS WORKING MACHINERY for the manufacture of: Cathode Ray; Radio Tubes (Standard, Miniature, Sub Miniature); Fluorescent Lamps; Glass Ampoules; Vials; Incandescent Lamps.

No. 102-VID
No. 57-VID

* Consultation without any obligation on your part is cordially invited.

EISLER ENGINEERING CO., INC.
751 SOUTH 13th ST. • NEWARK 3, NEW JERSEY

EISLER TRANSFORMERS
STANDARD • SPECIAL
Air, Oil or Water Cooled
Sizes From 1/4 to 300 KVA

INSULATION
FORMVAR • FORMEX • ENAMEL
STRIPED CLEAN IN SECONDS
with X-VAR

IN
OUT
WIPE

1. DIP WIRE in X-VAR for 3 seconds.
2. WITHDRAW and watch coating disintegrate.
3. WIPE CLEAN, Operation completed in seconds.

X-VAR is non-corrosive, non-creeping—leaves wire ready for soldering. Now in use by leading manufacturers of electrical products. Write for FREE SAMPLE for testing.

FIDELITY CHEMICAL PRODUCTS CORP.
472 Frelinghuysen Avenue, Newark 5, New Jersey

Peak Attenuation Efficiency

Cover the entire Radio Frequency Spectrum

Tests and evaluations of present-day electronic equipment call for reducing the area background level of radio interference to a far greater extent than is possible with any ordinary screen room or shielded enclosure. Specialists in this exacting field since the early days of World War II, ACE offers both the know how and the production facilities. Attenuations of 140db.—and higher—at frequencies as low as 0.15 and as high as 10,000 mc. are readily obtainable in our custom-built Rooms. Put your screening problem up to ACE. Write, wire or 'phone for details.

STANDARD "CELL TYPE" SCREEN ROOMS
Nine out of ten laboratory or production shielding problems can be solved fast and economically by ACE pre-built "cell-type" screen rooms. Minimum attenuations as high as 150 db. are obtained from 0.15 to 1000 mc. Easy to erect, enlarge or move. Fully proved. Low in price. Write for data bulletin.

ACE ENGINEERING & MACHINE CO., Inc.
3644 N. Lawrence Street
PHILADELPHIA 40, PA. REGENT 9-1010
NEW PRODUCTS (continued)

Sr,

Guessed that you found they couldn't do the job—or you couldn't keep up with them. Fixing your eyes on two screens at the same time is no mean trick. Consequently, you may have tried using a single channel scope with an electronic switch. And if you did, you soon found that when it comes to observing high speed phenomena, too many signals were being missed—signals, which in a medical application, mean the difference between a person being normal or not. An optical system, of course, would be too cumbersome as well as expensive beyond justification. If this problem is yours, the only economically sound answer is the Dual Channel Oscilloscope—Model H-21. Containing two separate and complete electron guns in a single 5" tube, this scope beats many single channel scopes in weight, size, and cost. Its sensitivity is better than 0.085 Vdc/in. (30 MV rms/in.), with individual controls for each channel. Adaptable to photographic recording, it offers engineers and scientists everywhere a valuable tool for research. Find out how the Model H-21 can help you by writing for our free bulletin today.

H-21 DUAL CHANNEL SCOPE
- Wide band, high gain DC amplifiers
- Frequency response: DC to 200KC
- Triggered and continuous sweeps
- Differential or single-ended input

everal new types of germanium diodes and transistors have been introduced by several manufacturers. Types SX-4A and Z-2 transistors use a metal case with two silver-plated phosphor bronze connecting pins. Each type SX-4A is checked for power gain of between 13 and 20 dB with 0.1 volt input at 5 kc. The Z-2 units are checked for characteristics suitable for trigger circuits. Types 1N60 and 1N70 germanium diodes are built to JAN specifications. Type G-9 Quad is a combination of specially selected germanium diodes with matched characteristics. The diodes are hermetically sealed in a metal radio tube shell with standard octal base.

Miniature Insulated Terminals
CAMBRIDGE THERMIonic CORP., 437 Concord Ave., Cambridge 38, Mass. The miniature insulated terminals illustrated are available in three lengths of dielectric and with voltage breakdown ratings up to 5,800 volts. The X1980XA is the smallest terminal, having an overall height of only 1 in. including terminal. Insulators are grade L-5 ceramic, silicone impregnated for maximum resistance to moisture and fungi.

Dry Disc Rectifiers
ELECTRONIC RECTIFIERS, INC., 2104 Spann Ave., Indianapolis, Ind., has introduced three new sizes in mag-
Years ago, the frequency measuring equipments made by Marconi's were for their own use, because nowhere else were sufficiently accurate instruments obtainable... and even to-day nothing compares with this latest stroboscopic equipment. Boasting a long and distinguished pedigree, it is precision built to a unique specification and can be rapidly installed anywhere in the world. Its rated stability of 1 part in 10^7 can be maintained indefinitely and direct readings of frequency obtained to a fraction of a cycle.

Full particulars are available from any of the addresses below.

MARCONI INSTRUMENTS LTD.
U.S.A. Sales and Service: 23-25 Beaver Street, NEW YORK, 4
CANADA: CANADIAN MARCONI LTD., Marconi Building, St. Sacramento Street, MONTREAL
ENGLAND (Head Office and Works): ST. ALBANS, HERTFORDSHIRE

Working with Inert Gases?

**Linde** HELIUM · NEON
ARGON · KRYPTON · XENON

Now available in commercial-size cylinders in addition to glass bulbs. Write for information on sizes, prices, rigid purity tolerances, special rare gas mixtures...

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street NEW YORK 17, N.Y.
In Canada: Dominion Oxygen Company, Limited, Toronto

The term "Linde" is a registered trade-mark of The Linde Air Products Company.

SELENIUM RECTIFIERS

**MINIATURE TYPE**

- 65 to 1,000 ma.
- To 160 v. R.M.S.
- In half wave or doubler circuits.

FOR ELECTRONIC APPLICATIONS.
Ask for Bulletins IS-1249, RN-749

**HIGH VOLTAGE TYPE**

- RATINGS TO 100 KV.
- In Phenolic, Glass or Hermetically Sealed Assemblies.

**POWER TYPE**

- RATINGS TO 250 KW.

- EFFICIENCY TO 87%

Ask for Bulletins C-349, C-848.
YOUR INQUIRY IS INVITED.

INTERNATIONAL RECTIFIER CORP.
6809 S. Victoria Ave.
LOS ANGELES 43, CALIFORNIA

AIR COOLING BY ROTRON FOR

- RADAR
- RADIO BEACONS
- COMMUNICATIONS
- NUCLEONIC DEVICES

Units available with 28-volt D.C. 115-volt COMMUTATOR and 115/230-volt INDUCTION Type MOTORS
at
Frequencies of 50-60, 400 & 380-950
with
Teflon, Class "A", "B", & "H" Insulation and
Silicone-Greased Ball Bearings
All to Army-Navy Specifications

2.5" Impeller, 120 cfm Max, 3" water
New Axial-Expansion Bakelite Housing

3" Impeller, 120 cfm Max, 3" water
Altitude Blower, Inlet & Outlet Duct Adapter

3" to 4.5" Impeller, 2.25" Motor, 120 cfm Max
Spider, Bellmouth, Motor Mountings

2" Impeller, 20 cfm Max, 0.25" water

ROTRON catalog covers complete Line of Units Rated from 6 to 2000 cfm

ROTRON Manufacturing Company
Engineering Sales Office
Woodstock New York
TEC'S ELECTRONIC BLACKBOARD

Here's the exact duplicate of the TEC Projection Oscilloscope developed for the U.S. Navy for mass electronics training. Makes waveforms brilliantly clear to groups as large as 750 persons! No more students hunching round a tiny image! No more mistaking what you mean!

External Screen: 8" x 10" or larger. Integral Screen: 18" x 25" for smaller groups. SKP-2 tube, brightness: 130 l.c., 20 KV acceleration. B & L 1/1.9 coated lens.

Y-AXIS: c-c gain 1 mv/cm/m d-c gain 2.5 v/in. Response: ± 1 db 2 cps. ± 10 db 7.5 kc. ± 3 db 825 kc. Input 2 megohms, 30 µf. Attenuator 1, 10, 100X.

X-AXIS: c-c gain 60 mv/m/cm. Also 2-axis input.

SWEEP CIRCUITS: Recurrent: 1 cps to 50 kc, auto, retrace blanking. Driven: 20 µs to 100 µs, auto, brightness.

INTERNAL SIGNAL CALIBRATOR: Input: 105-130 v., 50-60 cps, 600 watts. SIZE: 37" L x 26" W x 66" H—350 lbs.

Med. Gain Wide-Band Units available on special order.

Write TODAY for full data and prices.

TEC PRESENTS A NEW 12 MC OSCILLOSCOPE MODEL T-601-A

- 17 TUBES INCLUDING 5" CRT.
- 10 MILIVOLT SENSITIVITY
- 12 MEGACYCLE BANDWIDTH
- DEFORMATION PLATES AVAILABLE ON TERMINAL BOARD
- CONTINUOUSLY VARIABLE CALIBRATOR
- SWEEP MAGNIFICATION 5 TIMES SCREEN SIZE
- GOOD TRANSIENT RESPONSE
- TRIED AND PROVEN CIRCUITS
- CRT CALIBRATION GRID

WRITE FOR SPECIFICATION DATA SHEET

$349 50 LIST

Complete with low capacity probe

TELEVISION EQUIPMENT CORP.
238 WILLIAM ST., NEW YORK 7, N.Y.
IN CANADA, THE AHEARN & SOPER CO. LTD. OTTAWA

SEE YOU AT THE NEDA SHOW—BOOTH NUMBER 128

NEW PRODUCTS (continued)

nesium-copper sulphide dry disc rectifiers. New models include the H-12, a rectifier of four to two amperes capacity, the FT-12 with six to four amperes capacity, and the FS-12 with ten to six amperes capacity. Designed for use in small battery chargers and trickle chargers, in addition to other low-voltage d-c power supply applications, the rectifiers have instant operation from temperatures as low as -40 to +284°F.

Miniature Switch

Tynswich Electronic Sales Co., 8 West St., Meriden, Conn. The snap-action miniature switch illustrated has pure silver contacts. It features a new spring structure, operation at high speed, bounceless closure and maximum load rating for a given operating pressure. It is currently obtainable in either normally open or normally closed, single-pole, single-throw action.

D-C Power Supply

Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill. The BJ Junior unit illustrated supplies 1 to 12.5 amperes, 6 volts, continuous duty, with an intermittent rating up to 25 amperes. It supplies 3 to 9 volts at other ratings, operating from

September, 1950 — ELECTRONICS
In Only 1 SECOND!

COMPLETE AUDIO WAVEFORM ANALYSIS with the AP-1 PANORAMIC SONIC ANALYZER

Provides the very utmost in speed, simplicity and directness of complex waveform analysis. In only one second the AP-1 automatically separates and measures the frequency and amplitude of wave components between 40 and 20,000 cps. Optimum frequency resolution is maintained throughout the entire frequency range. Measures amplitude of components down to 0.1%.

- Direct Reading
- Logarithmic Frequency Scale
- Linear and Two Decade Log Voltage Scales
- Input voltage range 10,000,000:1

AP-1 is THE answer for practical investigations of waveforms which vary in a random manner or while operating or design constants are changed. If your problem is measurement of harmonics, high frequency vibration, noise, intermodulation, acoustics or other sonic phenomena, investigate the overall advantages offered by AP-1.

Write NOW for complete specifications, price and delivery.

BOOTH 428
National Instrument Conference and Exhibit, Buffalo, N. Y.
September 18-22, 1950

ELECTRONICS — September, 1950
**RCA Transducer Tube for Measurement of Vibrations up to 12,000 cycles**

When the call is for tubes... call your RCA Tube Distributor

A phone call to your local RCA Tube Distributor is a quick and sure way of getting prompt answers to your electron tube problems... or immediate delivery of the tube types you need. RCA Tube Distributors maintain stocks of RCA tubes to meet virtually every industrial and laboratory requirement.

---

**NEW PRODUCTS**

(continued)

115 volts, 50 or 60-cycle power source. The unit features new heavy-duty selenium rectifiers, an 8-position tap switch, a 0 to 10-volt meter with 5-percent accuracy and a 2,000-uf filter capacitor.

---

**Latch-Type Relay**

LEACH RELAY Co., 5915 Avalon Blvd., Los Angeles 3, Calif. Type 9061 relay is used where current is to be applied to the coil momentarily, the mechanical latch holding the armature closed until the latching coil is energized. Upon energizing the latching coil the mechanical latch is released, allowing the armature to open. Contacts are % in. diameter, rated 8 amperes 115 volts a-c, or 10 amperes 24 volts d-c, noninductive. Arrangement of contacts is dpdt.

---

**Heavy-Duty Chopper**

AIRPAX PRODUCTS Co., 1024 Greenmount Ave., Baltimore 2, Md. The A586 60-cycle chopper is a rugged unit designed for amplification of low-level d-c signals. It is supplied hermetically sealed to plug into an octal header. Contacts are spdt. Maximum coil voltage is 26 v at 60 cycles, standard 6.3 v. Contacts lag a driving sine wave by 45 deg. Life is in excess of 1,000 hours.

---

**Portable Instruments**

WESTINGHOUSE ELECTRIC Corp., P.O. Box 2099, Pittsburgh 30, Pa. Type P-12 portable instruments, in the 2-percent accuracy class, use both moving-iron and permanent-magnet moving-coil mechanisms in
TWIN BEAMS
THE RIGHT ANSWER . . .

for simple, accurate and convenient measurements. Simultaneous error-free comparison of voltages, currents, phases, frequencies, waveshapes.

THE COSSOR MODEL 1035
Twin Beam Oscilloscope
$650 f.o.b. New York
$465 f.o.b. Halifax

DIRECT READING calibrated time and voltage measurement controls. Continuously variable driven and recurrent sweeps from 150 millisecond to 5 microseconds, blanked flyback.

Independent Y axis AC amplifiers for each beam + or - sync.

Flat face 4" twin beam CRT, green, blue or long afterglow screens all available from stock.

Write for complete specifications and data on Model 1049
DC amplifier scope, Model 1428
Camera and film drives.

AGENTS THROUGHOUT U. S. & CANADA

COSSOR (CANADA) LIMITED
Windsor St., Halifax, Nova Scotia

BEAM INSTRUMENTS CORP.
Room 907, 511 Fifth Ave.,
New York 17, N. Y.

ANNOUNCING NEW, MODEL 1401
Plays 10 1/2" Reels!

$345.00

Complete, for console installation with single or dual track heads.

THE professional quality tape recorder you have been waiting for!
NAB standards; triodes throughout; 40-15000 cycles at 15", 40-8000 cycles at 7 1/2". Three motors; flutter less than 0.1%; signal-to-noise better than 50 db. Three heads for simultaneous erase, record, playback. Quick change from single to dual track. Write for booklet.

FISHER RADIO CORPORATION • Distributors • 37 E. 47th St., N. Y.

CORRECTION
RE: SEALS, HERMETIC

Your attention is called to the correct page number of the full page advertisement of:

HERMETIC SEAL PRODUCTS CO.
29-37 South 6th Street, Newark 7, N. J.

in the 1950 Mid-June Electronics Buyers' Guide

The above mentioned advertisement appears on page 87

Please make this correction on page D-100 of the Directory section of your Buyers' Guide issue.
TWO NEW WAVEGUIDE-OUTPUT REFLEX KLYSTRONS
Varian engineered to tune over the frequency range from 8,100 to 17,500 megacycles. These tubes are designed for transmitter service, for use as local oscillators and bench oscillators and as a power source for measurements. The tubes are small, light, and sturdily built. Flanges with mica windows bolt directly to the waveguide with a lapped surface to avoid reflections and leakage. Special grid techniques increase efficiency, reduce microphonics. A single screw tuner covers the entire broad tuning range.

Electrical Characteristics

<table>
<thead>
<tr>
<th>X-13</th>
<th>8,100-12,400</th>
<th>X-12</th>
<th>12,400-17,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Voltage</td>
<td>500 volts, max</td>
<td>600 volts, max</td>
<td></td>
</tr>
<tr>
<td>Beam Current</td>
<td>60 ma, max</td>
<td>60 ma, max</td>
<td></td>
</tr>
<tr>
<td>Heater Voltage</td>
<td>6.3 volts</td>
<td>6.3 volts</td>
<td></td>
</tr>
<tr>
<td>Heater Current</td>
<td>1.1 amp</td>
<td>1.1 amp</td>
<td></td>
</tr>
<tr>
<td>Reflector Voltage</td>
<td>0 to -1000 volts</td>
<td>0 to -1000 volts</td>
<td></td>
</tr>
<tr>
<td>Tuning Range</td>
<td>8,100-12,400 mc/min</td>
<td>12,400-17,500 mc/min</td>
<td></td>
</tr>
<tr>
<td>Power Output</td>
<td>100 milliwatts, min with transformer</td>
<td>10 to 100 milliwatts</td>
<td></td>
</tr>
</tbody>
</table>

Mechanical Specifications

<table>
<thead>
<tr>
<th>X-13</th>
<th>8,100-12,400</th>
<th>X-12</th>
<th>12,400-17,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode</td>
<td>Oxide coated, unipotential</td>
<td>Oxide coated, unipotential</td>
<td></td>
</tr>
<tr>
<td>Clearance dimensions</td>
<td>4 1/2 x 2 1/2 x 2 1/2 in.</td>
<td>4 1/2 x 2 1/2 x 2 1/2 in.</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>6 ounces</td>
<td>5 ounces</td>
<td></td>
</tr>
<tr>
<td>Output Flange</td>
<td>Mates with standard flange for 1 x 1/2 x 0.050 in. waveguide</td>
<td>Mates with standard flange for 0.702 x 0.312 x 0.040 in. waveguide</td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>Forced air cooling required for beam power inputs exceeding 10 watts</td>
<td>Forced air cooling required for beam power inputs exceeding 10 watts</td>
<td></td>
</tr>
<tr>
<td>Mounting position</td>
<td>Any</td>
<td>Any</td>
<td></td>
</tr>
</tbody>
</table>

Typical Operation

| Frequency | 10,000 mc | 16,000 mc |
| Beam Voltage | 400 volts | 600 volts |
| Beam Current | 48 ma | 50 ma |
| Reflector Voltage | 575 volts | 280 volts |
| Power Output | 250 milliwatts | 25 milliwatts |
| Load VSWR | Less than 1.1 | Less than 1.1 |
| Modulation Bandwidth | 30 mc | 50 mc |
| Temperature coefficient | Under 0.25 mc per degree C | Under 0.25 mc per degree C |

Not illustrated, X-21 klystron. Two- to five-watt two-cavity oscillator for operation between 5900 and 11,000 mc. Weight approximately 4 1/2 ounces. Specifications upon request.

Literature

Time Delay. Cook Electric Co., 2700 North Southport Ave., Chicago 14, Ill. Issue No. 14 of the Newsletter covers the new 2-cubic inch time delay incorporating a take-over relay. The unit described can be set to operate in a range from 3 to 15 seconds ± 10 percent and is factory adjusted. Its current carrying capacity is 5 amperes d-c inductive.


D-C Power Supplies. The Superior Electric Co., Hannon Ave., Bristol, Conn., has available a four-page folder on its new Varicell d-c power supplies, an instrument that pro-
The UNBRAKO Flat Head Socket Cap Screw

Maximum head contact, flush surface finish and non-slip internal wrenching make these screws ideal for assembly of thin-section materials. Available in National Coarse and National Fine Threads. Sizes from #4 to 3/4".

ULTRA-SENSITIVE D. C. AMPLIFIER

0-10 cycles response

The Model 53 Breaker-type D.C. Amplifier was developed for the measurement of d.c. and low frequency a.c. voltage in the microvolt and fractional microvolt region. It is compact, portable, and makes an excellent replacement for the suspension galvanometer. The output of the amplifier is sufficient to operate standard meters and recording devices directly.

It has been employed for the amplification of infrared detectors, thermocouples, voltaic photocells, and the like, both in research and industrial applications.

CHARACTERISTICS:

1. Noise level that approaches the theoretical limit imposed by Johnson noise.
2. Extremely low zero drift (less than .005 uV after warmup.)
3. Freedom from the effects of vibration such as found in moving vehicles.
4. Response characteristics permitting overall amplification flat from 0 to 10 cycles per seconds.

THE PERKIN-ELMER CORPORATION

LEADING MANUFACTURERS OF INFRARED SPECTROMETERS, CONTINUOUS INFRARED ANALYZER, UNIVERSAL MONOCHROMATOR, FLAME PHOTOMETER, Tiselius Electrophoresis Apparatus, D.C. AMPLIFIERS, AND OTHER ELECTRO-OPTICAL INSTRUMENTS FOR ANALYSIS AND RESEARCH.

FOR AC CURRENT ANYWHERE . . . .
NO MAGIC just use ATR
INVERTERS

For Inverting D. C. to A. C.

NEW MODELS  NEW DESIGNS NEW LITERATURE

ATR STANDARDS AND HEAVY DUTY INVERTERS

For Inverting D. C. to A. C.

AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL I. MINNESOTA-U.S.A
NEW PRODUCTS (continued)

Wide-Band D-C Amplifier. Furst Electronics, 12 S. Jefferson St., Chicago 6, Ill. Model 120 wide-band d-c amplifier is fully described in a recent catalog sheet. The instrument was especially designed to serve as a stable preamplifier, extending the range of c-r oscilloscopes, v-t voltmeters and other measuring instruments for a-c and d-c. It can also be used in connection with paper strip recorders to increase their sensitivity.

High-Fidelity Audio Equipment. Stephens Mfg. Corp., Culver City, Calif., has released an 8-page booklet giving installation instructions and suggested uses for a line of high-fidelity audio equipment. Included are wiring diagrams for the speaker systems and suggestions for most efficient wiring of speaker systems in general.

Germanium Diode. Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y. A recent catalog sheet describes and illustrates the type 1N60 germanium diode, a point contact rectifier designed for service as a video detector diode for tv receivers. Electrical and mechanical features and specifications are included.

Air System Socket. Eitel-McCullough, Inc., San Bruno, Calif., has available a catalog sheet covering the 4X150A/4000 air system socket which was developed in order to provide adequate air cooling of the 4X150A tetrode. The air system socket also makes possible improved circuit arrangements in high-frequency applications.

TV Replacement Guide. Standard Transformer Corp., 3580 Elston
TUNGSTEN and MOLYBDENUM GRID WIRE

Made to meet your specifications for gold content, diameter and other requirements.

Write for details and list of products.

Sigmund Cohn Corp.
44 Gold St., New York

MEASURE CONVERSION LOSS AND NOISE TEMPERATURE OF SILICON MIXER CRYSTALS

This portable self-contained instrument will indicate directly the conversion loss of all mixer crystals intended for use at or below 10,000 Mc. Above 10,000 Mc the readings are relative (crystals may be selected in the order of their quality). The instrument also indicates 30 Mc noise temperature. Conversion loss mean deviation - 1/2 db; noise temperature mean deviation - 1/2.

PRODUCTION TESTING
INCOMING INSPECTION
FIELD TESTING

Order All Type 390 $55.00 net
FOB Mineola, N.Y.

DEPENDABLE • HIGH QUALITY • DURABLE

MICROPHONES by ALTEC

639* 633*

Now Available... The famous 639 type adjustable directional microphone, long recognized as the standard microphone of this type. Unequalled for many professional uses. • The popular 633 "Saltshaker," still the world's finest dynamic microphone, famous for its rugged dependability and smooth response. • These two indispensable mikes are again available for delivery. Each represents the finest in design, in construction and in performance. Compare their price... and their quality.
Models 611 and 612 are popular instruments in research and design laboratories, vacuum tube plants, transmitter manufacturing plants, and in fixed and mobile communication services. They are ruggedly built for portable use, and are as simple to use as a D.C. voltmeter. The power absorbing load resistor is non-radiating, thus preventing transmission of unwanted signals which interfere with message traffic in communication services.

Frequency range: 30 to 500 MC (30 to 1,000 MC by special calibration)
Impedance: 51.5 OHMS—VSWR less than 1.1
Accuracy: Within 5% of full scale
Input connector: Female "N" which mates with "N-21" or "N-218.
Adapter UG-146/U is supplied to mate with VHF plug, PL259.

Special scale Model "61s" are available as low as ½ watt full scale, and other models as high as 5 KW full scale.

Catalog Furnished on Request

NEW PRODUCTS (continued)

Ave., Chicago 18, Ill. The seventh edition of the company's television catalog and replacement guide, form 338, is now available. The 26-page booklet gives complete specifications and list prices for a line of transformers and related components for TV replacement or conversion, indexed for use in 618 TV chassis and receiver models made by 64 manufacturers.

Variable Transformers. The Superior Electric Co., Hannon Ave., Bristol, Conn., has announced availability of a folder describing the newly redesigned Powerstat variable transformer types 116 and 216. The bulletin illustrates in detail the new features offered by the redesigned assemblies. It discusses the new brush assembly, fusing arrangement, cast-aluminum terminal box, coil and core design and polarity identification.

Photoelectric Amplifiers. De-Tectronic Laboratories, Inc., 1227 N. Clark St., Chicago 10, Ill., has published an 8-page folder describing and illustrating a line of photoelectric amplifiers for smoke control, fire detection, counting, production line control, inspection, burglar alarms, warning devices and many other industrial applications.


Hermetically-Sealed Relays. Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago 12, Ill. Catalog 5-H covers a line of her-
S.S. White Resistors are used in high voltage "HIPOT" couplers

S.S. White resistors are connected in series to permit a current to ground, when the "HIPOT" Coupler is used to measure or to synchronize voltage of high voltage lines.

Canadian Line Materials, Ltd.—maker of "HIPOT" Couplers and other transmission, distribution and lighting equipment—says: "We have always found S.S. White resistors of the highest quality". This checks with the experience of the many other producers of electrical and electronic equipment who use S.S. White resistors.

WRITE FOR BULLETIN 4906
It gives details of S.S. White Resistors including construction, characteristics, dimensions, etc. Copy with price list on request.

S.S. WHITE
THE S. S. WHITE DENTAL MFG. CO. INC.
10 EAST 40TH ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS AND ACCESSORIES
MOLDED PLASTICS PRODUCTS—MOLDED RESISTORS
One of America's AAAAA Industrial Enterprises

"The Standard by which Others Are Judged, and Failed."

"HIPOT" COUPLERS
When you use the Audax Polyphase... One single unit plays all your records superbly... and at less than the cost of ordinary magnetic pick-ups.

AUDAX COMPANY
500 5th Ave., New York 18
Fine Music Reproducers Since 1915

RADIO SHACK 1951 CATALOG JUST ISSUED!

WRITE TODAY for your FREE copy of the giant new 117-page Radio Shack Catalog—America's most complete, lowest-price electronics line. Latest post-Korean war releases of new equipment. One of the few all-new catalogs that will appear this year!

The RADIO SHACK Corp.
167 Washington St., BOSTON, MASS.

RADIO SHACK EQUIPMENT FOR RECORDING
TELEMETERING SIGNALS
(up to 40 kc.)

Almost overnight Ampex Magnetic Tape Recorders revolutionized radio network broadcasting. Ampex succeeded in this most critical service because of simplicity and dependable operation, plus a tone quality that is unequalled. Ampex is now available in several models for a wide range of requirements. Inquiries for special instrumentation and industrial control application promptly answered.

AMPEX MAGNETIC TAPE RECORDER

Get FREE BOOKLET today!
Radio Shack BOSTON 8, MASS.
Without obligation please send 10-page illustrated booklet containing technical specifications of Ampex Magnetic Tape Recorders.

Model 20C $1250
50 METER PANEL (L3154)

MODEL 20C C1775
40 METER PANEL (O3154)

AMPEX
BOSTON 8, MASS.

35 FEET UP on an Emergency Truck
Here's the ideal Antenna for emergency stations such as fire, police, water and other services. Fully collapsible and adjustable, they may be had in extended lengths up to 25 feet, collapsing to 6 feet. In use by municipalities, government and military services.

Ask Your Radio Jobber
PREMAX PRODUCTS
DIVISION CHISHOLM-RYDER CO., INC.
5001 Highland Ave., Niagara Falls, N. Y.
Check "Proof of Performance" with these PROVED B&W PERFORMERS

For those "proof-of-performance" tests required by the FCC, here's a combination that will enable you to comply with the least amount of time ... trouble ... and money!

Audio Oscillator
Model 200 . . . . $115
Provides a low distortion source of audio frequencies between 30 and 30,000 cycles. Self-contained power supply. Calibration accuracy ±3% of scale reading. Stability 1% or better. Frequency output flat within 1 db, 30 to 15,000 cycles.

Distortion Meter
Model 400 . . . . $140
For fundamentals from 30 to 15,000 cycles measuring harmonics to 45,000 cycles; as a volt and db meter from 30 to 45,000 cycles. Min. input for noise and distortion measurements 3 volts. Calibration: distortion measurements ±5 db, voltage measurements ±5% of full scale at 1000 cycles.

Linear Detector
Model 404 . . . . $85
Provides combined RF detector and bridging transformer unit for use with any distortion meter. RF operating range: 400 kc to 30 mc. Single ended input impedance: 10,000 ohms. Bridging impedance 6000 ohms with 1 db insertion loss. Frequency is flat from 30 to 50,000 cycles.

Sine Wave Clipper
Model 250 . . . . $10
Speeds accurate analysis of audio circuits by providing a test signal for examining transient and frequency response ... at a fraction of the cost of a square wave generator. Designed to be driven by an audio oscillator.

See your dealer or write today for covering literature. Dept. EL-90.

Barker & Williamson, Inc.
237 Fairfield Avenue
Upper Darby, Pennsylvania

New Products (continued)

Humidity-Proof Capacitors. Cornell-Dubilier Electric Corp., South Plainfield, N. J. Bulletin RT349 describes and illustrates the Royal Tiger paper tubular capacitors which use Polykane, a solid synthetic thermosetting compound. The humidity-proof capacitors can be used at ambient temperatures from -35 to +100 °C, and are available in ratings at 100, 200, 400, 600 and 1,000 volts d-c. Insulation resistance of the units described exceeds 10,000 megohms per unit or 2,000 megohms per µf at 25°C.

Broad-Band Amplifier. Electro-Mechanical Research, Inc., Ridgefield, Conn. Two sides of a sheet recently issued give a description of the model 36B amplifier, a versatile broad-band instrument designed for operation in the frequency range from d-c to 1,000,000 cycles. An illustration of the unit, quantitative data on performance and applications are included.

Electronic Stop-Watch. American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y. A recent 4-page publication treats of the electronic stop-watch which indicates time intervals from 10 µsec to 3 seconds. Operating principle, methods of measurement and time ranges of models 100 and 110 chronoscopes are shown. Also included are discussions of accessories known as the model 211 input adapter and model 301 photoelectric adapter. Prices and specifications for the four units are given.
No Time to Develop Film

**TIPSS**

FEATHER SOLDERING PENCILS

**ELECTRONICS**

42 Riverside Avenue

BROCKTON, MASS.

NOW:

**PRECISION POTENTIOMETERS**

Various types of potentiometers custom wound to specifications are available. They feature extremely close limits in electrical characteristics and mechanical construction, low electrical noise, low torque, and long life.

All types will operate within specified limits of performance at temperatures —55° C. to +55° C., 95% relative humidity at altitudes up to 50,000 feet. Corrosion resistant materials are used throughout and all insulating parts are fungicided. Our potentiometers meet AN-E-19 specifications.

We invite your inquiries and specifications.

Write for Bulletin F-68.

**THE GAMEWELL COMPANY**

Newton Upper Falls 64, Massachusetts

A minor modification of the standard sinusoidal potentiometer type RL-11-C (as illustrated) permits operation up to 1800 RPM. After a test of 28 million cycles at 1800 RPM, one of these units showed negligible wear.

**NOW!**

**SPEED UP ALL SOLDERING WITH**

**UNGAR**

FEATHER-LIGHT SOLDERING PENCILS WITH

**HI-HEAT**

INCREASED WATTAGE

**TIPS**

For use with No. 776 Handy & Cord Set

Stop wrestling with big iron. New HI-HEAT TIPS in your Ungar Electric Soldering Pencil produce a really versatile tool that’ll work on a pair with the big, bulky 100-150 watt irons. If you can’t get immediate delivery, please be patient; for production hasn’t yet caught up with demand. Ask your supplier for No. 1236 Pyramid or No. 1239 Chisel. List price, $1.25 each.

**E = 5 x 0.5 min**

**E** = Breakdown voltage

**e** = Rated d.c. working voltage

INDUSTRIAL CAPACITORS are unvaryingly held to this formula.

Designed for maximum safety and the smallest possible volume, INDUSTRIAL CAPACITORS are the most widely used capacitors in industrial applications.

WRITE TODAY FOR DETAILED CATALOG

**INDUSTRIAL CONDENSER CORP.**

**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 1/4 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.
New Miniature Insulated Terminals to help your miniaturization program

Featuring extremely small size combined with excellent dielectric properties, three new miniature insulated terminals are now available from CTC.

Designed to meet the requirements of the miniaturization programs now being carried out by manufacturers of electrical and electronic equipment, the terminals come in three lengths of dielectric and with voltage breakdown ratings up to 5800 volts. In addition, they have an extremely low capacitance to ground.

The X1980XA is the smallest terminal, having an over-all height of only three-eighths of an inch including lug. Insulators are grade L-5 ceramic, silicone impregnated for maximum resistance to moisture and fungi.

All terminals have hex-type mounting studs with 3/48 thread or .141" OD rivet style mounting. Mounting studs are cadmium plated, terminals are of bright-alloy plated brass.

Write for additional data.

NEWS OF THE INDUSTRY
(continued from page 130)


Mobile Radio Serves as Game Warden

Equipment for the largest two-way mobile radio communication system to be established by any fish and game commission in the United States will be supplied by the RCA Engineering Products Department to the Arkansas State Fish and Game Commission.

Under terms of a contract recently awarded to RCA, six 250-watt Fleetfone main station equipments, twelve 30- to 50-mc station receivers, one hundred and twenty-five 60-watt mobile Fleetfone units, two complete microwave relay stations, and remote control units and test equipment are being supplied to the fish and game authorities.

The Arkansas State Fish and Game Commission plans to operate a microwave relay station, station receiver, and remote control unit from headquarters in the State Capitol at Little Rock. The other microwave station, as well as station receiver and transmitter units, will be situated at Shinnall Mountain, Ark. Six communication stations, located at Star City, Hope, Magazine Mountain, Iron Mountain, and Forest City, Arkansas, will be provided with 30- to 50-mc station receiving, transmitting, and remote control units.

Tower installations for the two-way radio communication system have already been started by the Arkansas authorities. Double Yagi antennas for the RCA type CWTR-5A microwave relay links and dielectric whip antennas for the commission's mobile equipment fleet are scheduled to be installed soon.

Frequencies assigned to the fish and game commission provide for 957- and 959-mc operation of the microwave relay equipments. The mobile transmitter units will operate on 46.74 mc and 46.82 mc, and

THE NEWEST
SMALLEST
SWITCHES

FOR ONE-HOLE MOUNTING

FOR STANDARD MOUNTING CENTERS

The new Type MCT-1 telephone-type switch — the smallest made — mounts in a single round hole — eliminates need for slitting panel and drilling and tapping four small holes — provides versatile switching action in addition to its standard features.

"Universal" Type MCT-4 Mounting plate has two sets of four, tapped, mounting holes to fit all standard mounting centers. BOTH MODELS FEATURE

Electrostatic shielding between two sets of contact sections reduces coupling between circuits; grounding tab, integral with frame, is included in terminal assembly. Versatile lever action provides either locking on both sides, non-lock on both sides, non-lock on one side, lock on one side.

Contact builders permit all popular as well as special circuit arrangements. Cam-spring mechanism is especially designed for quiet operation and to reduce contact bounce to a new minimum.

MCT Ratings
Palladium contacts rated at 1 amp. at 115 volts, 60 cycles, non-inductive load. Request Catalog Sheet and B/P #315-100 giving details of contact arrangements, dimensions, and prices.

GENERAL CONTROL COMPANY
1202 SOLDIERS FIELD ROAD
BOSTON 34, MASSACHUSETTS

September, 1950 — ELECTRONICS
BIRTSCHER
STAINLESS STEEL - LOCKING TYPE
TUBE CLAMPS

Stainless Steel
Corrosion Proof

83 VARIATIONS
Where vibration is a problem, Birschler Locking TUBE CLAMPS offer a foolproof, practical solution. Recommended for all types of tubes and similar plug-in components.

More than three million of these clamps in use.

FREE CATALOG
Send for samples of Birschler stainless steel tube clamps and our standard catalog listing tube base types, recommended clamp designs, and price list.

THE BIRTSCHLER CORPORATION
5878 HUNTINGTON DR.
LOS ANGELES 22

DANO MEANS MORE COIL QUALITY

Whether you require untreated coil windings or specially treated vacuum impregnated coils with wax or varnish, Dano is always ready to furnish you with quality coils.

EVERY COIL MADE TO YOUR EXACT SPECIFICATIONS

- Form Wound
- Paper Section
- Bakelite Bobbin
- Molded Coils
- Bakelite Bobbin
- Cotton Inter-weave
- Coils for High Temperature Applications

Also Transformers Made to Order

THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

ELECTRONICS — September, 1950
LATEST DEVELOPMENT
IN LOW DRIFT CRYSTAL UNITS—100 TO 200 K.C.

STABILITY LESS THAN
.005% FROM —40° TO +70°C
FREQ.-TEMP. CHARACTERISTICS OF AN AVERAGE SC/10A CRYSTAL UNIT

TYPE, SC-10A

2"

STD. OCTAL BASE


VHF-ADF Installation Planned

The CAA has announced a contract award to Bendix Aviation Corporation for 44 "Very High Frequency Aircraft Direction Finders" (VHF-ADF). They are to be installed at airports now equipped or to be equipped with surveillance radar equipment. These devices will enable air traffic controllers to identify aircraft within range of their surveillance radar screen during communication with that aircraft.

The ADF operation is linked with the scope of surveillance radar and the mobile receivers on 46.74 mc. The fixed station 250-watt transmitters will transmit on 46.74 mc, while the fixed station receiver units will operate on both 46.74 mc and 46.82 mc.

The complete membership of the RTMA Television Committee, together with their company affiliations, is as follows:

HF and UHF power leakage positively and economically controlled by new gasket material

The unique combination of controlled resiliency, stability and conductivity found in Metex "Electronic Weather Stripping" makes it particularly effective as a shielding material for such electronic applications as radar equipment, high frequency heating, television broadcasting and high frequency communication.

It is available in strips or in die-formed gaskets of the shape, size and volume required by the particular application. Economical in cost, the use of this material permits further savings in assembly time and eliminates much costly machining of closure surfaces that would normally be required.

"Electronic Weather Stripping"

The base material is a knitted—not woven—wire mesh which is made from any metal that can be drawn into wire. Knitting produces a mesh consisting of a multiplicity of interlaced loops which increase the normal resiliency of the wire and, by their hinge-like action, permit freedom of motion without loss of stability.

These characteristics are retained even when multiple layers of this mesh are compressed to form gaskets or strips. The result is a compressible, resilient, cohesive, conducting material with a large internal surface area. Where hermetic sealing is also required, these gaskets are made in combination with neoprene or similar materials.

Applications

Among the varied applications where Metex "Electronic Weather Stripping" has already proved its effectiveness and economy are: Air craft pulse modulator shields, waveguide choke-flange gaskets, shielding metal housings, replacing beryllium-copper fingers and springs on TR or ATR tubes, and ignition shielding to prevent radio noise interference. The facilities of our engineering department are available at any time to assist you in determining the possible adaptability of "Electronic Weather Stripping" to your specific requirements. A letter, addressed to Mr. R. L. Hartwell, Executive Vice President, and outlining briefly your particular problem will receive immediate attention.

Metal Textile Corporation
641 East First Ave.  Roselle, N. J.

September, 1950 — ELECTRONICS
**TRY REMLER FOR SERVICE-TESTED "HARD-TO-GET" COMPONENTS**

**TOUGH IS THE WORD...**

most descriptive of this new REMLER microphone. Waterproof and shock resistant, it withstands rough handling, yet sensitivity and fidelity are comparable with conventional units. As shown, equipped with press-to-talk switch, 6 foot cord and PL68 plug. It is also available in chest units and handsets. The answer to high microphone mortality.

Ideal for marine, aircraft and mobile service. Write for complete specifications and prices.

---

**MACDONALD ELECTRONIC MICROAMMETER**

This instrument is designed to replace high-sensitivity galvanometers in many applications. Due to its ruggedness, freedom from burnout, and relative insensitivity to shock, it is an ideal instrument for use in balancing resistance bridges measuring crystal rectifier output, photo-cell, strain-gage, thermocouple, and lead-sulphide cell current, etc. The instrument may also be used as a DC pre-amplifier for recorders. When used in this manner, current amplification of 1,000 is available.

**SPECIFICATIONS:**

- Sensitivity: 1 microampere full scale
- Accuracy: ±3% full scale
- Time constant: About 6 seconds
- Power supply: 115 V, 60 C.P.S.
- Dimensions: 7 x 2 1/4 x 9 1/2".

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**REMLER COMPANY LTD.**

2901 Bryant St. San Francisco 10, Calif. Phone Valencia 4-3435

**REMLER**

Since 1918 Pioneers in Electronics and Plastics

We manufacture

- **Coil Winding Equipment**
  - Universal
  - Universal Progressive
  - Bank Wound
  - Bobbin
  - Transformer
  - Solenoid

**COIL WINDING EQUIPMENT CO.**

(Formerly Production Equipment Co.)

37 W. Main St., Oyster Bay, N. Y. Tel. OYster Bay 6-1285

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- Power supply: 115 V, 60 C.P.S.
- Dimensions: 7 x 2 1/4 x 9 1/2".
LECTROHM

"Rib-on-edge" RESISTORS

LECTROHM "Rib-on-edge" resistors are constructed of edge mounted resistance alloy ribbon of corrugated nature. Herein lies the secret of the larger than average heat dissipating area and, therefore, greatest efficiency in limited space. Vitreous enamel coating covers and anchors the ribbon to the refractory tube providing an integral and solid unit.

- Request sample—giving resistance, maximum current, voltage drop required and space available.
- Ask for catalog.

LECTROHM INcORPORATED

3603 Archer Avenue Chicago 38, Illinois

Division of NATIONAL LOCK WASHER CO., NEWARK, N. J.

SAPPHIRE and GLASS JEWEL BEARINGS

Performance proved for precision and long life by world's leading makers of electrical, aircraft and timing instruments; compasses; weather recorders; all testing, indicating and recording apparatus.

Unset or set in screws or bushings to suit requirements. Write for brochure.

Serving industry with fine jewels since 1913

Richard H. Bird & Co., Inc.
3 Spruce Street, Waltham, Mass.

If You Are Having Difficulty Maintaining Your Mailing Lists...

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled change in industrial personnel. McGraw-Hill Mailing Lists cover most major industries. They are compiled from exclusive sources, and are based on hundreds of thousands of mail questionnaires and the reports of a nation-wide field staff. All names are guaranteed accurate within 2%.

When planning your direct mail advertising and sales promotion, consider this unique and economical service in relation to your product. Details on request.

DIRECT MAIL DIVISION
330 West 42nd Street New York, 18, New York

ELECTRONICALLY REGULATED
LABORATORY POWER SUPPLIES

RACK MODEL 32

- STABLE & DEPENDABLE
- MODERATELY PRICED
- STANDARc RACK MOUNTING PANEL SIZE: 10½" X 19½" DEPTH: 9" WEIGHT 28 LBS

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 VDC at 300 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 5A unregulated
- OUTPUT #3: 6.3 Volts AC CT at 5A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

For complete information write for Bulletin E-2

LAMBDA ELECTRONICS CORPORATION
CORONA NEW YORK

September, 1950 — ELECTRONICS
actuated by the VHF radio impulses from the aircraft being contacted. A line of light is drawn on the screen from the aircraft pips to the center of the scope which enables the airport traffic controller talking to the aircraft to be certain which of the pips on his screen represents the plane with which he is in communication. He is, thus, able to give the pilot directions for entering the landing pattern. These installations require no additional equipment aboard the aircraft.

**BUSINESS NEWS**

**TECHNICAL PRODUCTS & SERVICES** Co., Santee, Calif., was recently formed to manufacture and distribute a comprehensive line of radio, electronic and nucleonic products or services for schools and laboratories.

**STATION WPIX** recently bought $160,000 worth of new equipment from RCA for television transmitter installation on the Empire State Building, N.Y.C. Full time broadcasting from the new site is expected to start early in December.

**SYMPHONIC RADIO & ELECTRONIC** Corp., Cambridge, Mass., recently moved its entire plant and facilities to a larger building at 160 Washington St. North, Boston, Mass., to increase production of radios and record players.

**SPRAGUE ELECTRIC** Co., North Adams, Mass., and Philips Industries, Inc., Hartford, Conn., have formed a new corporation, the Ferroxcube Corp. of America, to be located at 50 E. 41st St., N.Y.C. The new corporation will manufacture...
Coil Insurance
FOR FAMOUS PRODUCTS

PARAMOUNT Spiral Wound PAPER TUBES
Protect Coil Accuracy and Stability
in Countless Applications

Years of specialized "know-how" easily enable PARAMOUNT to provide exactly the shape and size tubes you need for coil forms and other uses. Hi-Dielectric, Hi-Strength Kraft, Fish Paper, Red Rope or any combination wound on automatic machines. Wide range of stock arbors. Special tubes made to your specifications or engineered for you.

NEW! Moisture-Resistant Shellac-Bond Kraft Paper Tubing. Heated shellac forms a bond which prevents delaminating under moisture conditions.

WRITE ON COMPANY LETTERHEAD FOR STOCK ARBOR LIST OF OVER 1000 SIZES

PARAMOUNT PAPER TUBE CORP.
616 LAFAYETTE ST., FORT WAYNE, IND.
Manufacturers of Paper Tubing for the Electrical Industry

SPECIALTY BATTERY COMPANY
Ray-O-Vac Subsidiary

WRITE FOR NEW FREE CATALOG

LAB-BILT DRY BATTERIES
Here are complete descriptions of 78 Lab-Bilt Batteries of industrial and hard-to-get types. Specification Sheet enables you to order batteries especially designed to your own requirements. No order is too small. Specialty makes and ships FRESH Lab-Bilt Batteries without delay. Get this new catalog today.

WHITNEY METAL TOOL COMPANY
41 YEARS EXPERIENCE

WHITNEY-JENSEN
No. 247 PRESS BRAKE
Production shops turning out quantities of small forgings in large presses and job shops requiring a small brake, will find the No. 247 a cost reducing, space-saving piece of equipment. Capacity of the machine is 14 ga. mild steel over 90° 90° V die or 4½ V. Strokes per minute - 47
Throat height - 11-1/2"
Throat depth - 6-1/4"

WHITNEY METAL TOOL CO.
150 FORBES ST., ROCKFORD, ILL.

JOHNSON TOWER LIGHTING FILTERS

* High Impedance To RF!
Low Impedance To 60 Cycle Current!

Using JOHNSON Lighting Filters, antenna radiation resistance is changed less than 1% in compliance with FCC regulations. Filters also serve as a static drain device when used with grounded AC circuits. Variable tuning capacitor for maximum RF reactance. Can be adjusted for high impedance over the standard broadcast band.

JOHNSON...a famous name in Radio!
E. F. JOHNSON CO., WASECA, MINN.

CAPITOL RADIO ENGINEERING INSTITUTE
An Accredited Technical Institute

ADVANCED HOME STUDY AND RESIDENCE COURSES IN PRACTICAL RADIO-ELECTRONICS AND TELEVISION ENGINEERING
Request your free home study or resident school catalog by writing to:
DEPT. 2898
16th and PARK ROAD, N. W.
WASHINGTON, D. C.
Approved for Veteran Training

JOHNSTON INSTITUTE FOR TECHNOLOGY

September, 1950 — ELECTRONICS
NEWS OF THE INDUSTRY  (continued)

a ferromagnetic ferrite that is particularly useful as a core material in high-frequency coils and transformers.

ARMOUR RESEARCH FOUNDATION of Illinois Institute of Technology recently organized a nuclear science section in the physics department. The new section will apply radioactive tracer techniques to research problems.

THE EQUIPMENT & SERVICE Co., Dallas, Texas, is a recently established organization devoted to industrial electronic, broadcast and electrical engineering problems. It has manufacturing facilities for the building of small electrical equipments.

THE BERKELEY SCIENTIFIC Co., manufacturer of high-speed electronic counting devices, has moved to a new 15,000-sq ft building in Richmond, Calif.

CONSOLIDATED ENGINEERING CORP., Pasadena, Calif., manufacturers of electronic analysis instruments, have begun construction of a new 66,000-sq ft plant scheduled for completion Jan. 1, 1961.

PERSONNEL

A. W. PARKES, Jr., vice-president in charge of field engineering and sales for the Aircraft Radio Corp., Boonton, N. J., has been elected chairman of the Northern New Jersey unit of the IRE for the 1950-51 season.

JOHN R. DUNNING, scientific director of Columbia’s new cyclotron, has been appointed dean of the school of engineering, Columbia University, New York City.

RICHARD G. LEITNER, for the past four years chief engineer of the Lear, Inc., California division, has resigned to take a similar post with the U. S. Electronics Corp., Los Angeles, Calif., manufacturers of sound specialties.

ERIC WALKER, on leave of absence from Penn State, where he directs the Ordnance Research Laboratory and heads the electrical engineering
U-Bolts or Centered Eyes

rapidly duplicated with diacro

HYDRA-POWER BENDER

At last—a PRODUCTION BENDER that "BENDS THEM ALL"—tubing—angle-channel—extrusions—moulding—strip stock—bus bars—and of course, all types of solid materials. U-Bolts and Eye-Bolts are just two examples of the shapes that can be rapidly produced in one operation with this hydraulic power bender.

The DI-ACRO HYDRA-POWER BENDER can be easily set up in your own plant for a great variety of forming operations, or it can be delivered completelyTooled for speedy production of a specialized part. Investigate this universal machine before you buy any "single purpose" bender.

Send for 40-PAGE "DIE-LESS DUPLICATING" CATALOG
giving full information on all DI-ACRO Benders, Brakes, Shears, Rod Parters, Notchers, Punches—also our offer of free DI-ACRO Engineering Service.

DI-ACRO is pronounced "DIE-AK-RO"

DI-ACRO

321 8th Avenue, Lake City, Minnesota

NEWS OF THE INDUSTRY (continued)

Francis X. Rettenmeyer, for the past five years chief engineer for Federal Radio and Telegraph Co., has joined Philco Corp. as executive engineer to assist in the engineering administration of the company's government and industrial electronics program.

Samuel Freedman, formerly new developments engineer and in charge of sales engineering for the microwave firm of DeMornay Budd Inc. of New York and Calif., is now owner and manager of the recently organized firm of Technical Products & Services Co., Santee, Calif.

Donald E. Smith, formerly an engineer for the electronics division of Sylvania Electric Products Inc., Boston, Mass., has been transferred to the renewal tube sales department of the radio tube division.
HUNDREDS OF STANDARD
JONES
TERMINAL PANELS
Complete equipment for
SPECIALS
Send your
specifications
for prompt
quote.

ELECTRONICS
undisputed best..."Ears"or Instruments!

Several pages of Jones
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equipment enables us
to promptly produce prac-
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Send print or description
for prices, without obliga-
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panels also listed, Send for catalog with
engineering drawings and
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NEW MUSIC LOVERS
AMPLIFIER
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Exclusive feedback circuits. Model
200 PG offers frequency response of
±0.108, 10 to 50,000 cps. Distortion
at 20 watts is 0.2%—no phase shift
or transient oscillations of any kind.

Write today for free technical bulletin.

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in place, it is precision positioned
and moulded integrally with the
housing.

2. You get permanently accurate set-
ings, smooth action and low
uniform torque provided by the
stainless steel, precision ground,
double thread lock screw guiding the
moving contact.

3. You get precise positioning of the
moving contact because of the
two bearings supporting the rotor
assembly.

4. You get good rigid terminals be-
cause they are milled integrally
with the housing.

5. Terminals soldered to ends of re-
sistance element before moulding.

6. Entire resistance circuit is an in-
tegral part of the housing.

7. You get accurate setting and re-
setting due to anti-backlash spring
in contact guide.

8. You get a fine resolution because
of the 43½" length of resistance
wire in the spiral element.

LINEARITY
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Units for immediate shipment:
1,000 to 30,000 ohm range.
Special resistance values made to order.

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THE GEORGE W. BORG CORPORATION
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PRECISION MINIATURE SLIP RING ASSEMBLIES

and commutators for gyros, computers,
resolvers, motors, and selsyns

- Absolute minimum torque friction
- Diam. ranges .050–24.0 inches
- Minimum 1000 VAC hi-pot between circuits
- Fine silver rings are electroplated to assembly.
- Palladium and rhodium deposits to prevent
  tarnish and minimize friction
- Supplied to your specifications at competitive
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- Supplied to your specifications at competitive
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For Precision Washers...For Precision Stampings...

WHITEHEAD STAMPING CO.
A preferred source of precision-made WASHERS and STAMPINGS. 46 years of ex-
perience and up-to-the-minute facilities, assure highest quality and service.

WHITEHEAD STAMPING CO.
1691 W. Lafayette Blvd. Detroit 16, Michigan
The difference between the quality of music obtainable from the new PFANSTIEHL STRAIN-SENSITIVE PICKUP and that from ordinary pickups is as great as the difference between good FM radio and AM radio reception.

There is no doubt why the PFANSTIEHL STRAIN-SENSITIVE PICKUP brings out the brilliance of truly great voices and orchestras...the latest in technology on your records that other methods of reproduction leave untouched.

- The PFANSTIEHL STRAIN-SENSITIVE PICKUP is an amplitude transducer with a CONSTANT RESISTANCE of about 250,000 ohms.
- Signal output is at a practically CONSTANT IMPEDANCE level.
- Excellent transient response.
- NO DISTORTION, phase shift or evidence of parasitic modulation apparent.
- LINEAR RESPONSE free from peaks or resonances.

Cartridges for micro groove (.001 tip radius) and standard grooves (.0027 tip radius) are available along with a Quick Change Cartridge Holder.

Style A is tipped with famous PFANSTIEHL M47B Precious Metal Alloys which will wear down to less is a .003 flat in 100 playing hours. Strain-Sensitive Elements equipped with Diamond styli are also available. A special preamplifying circuit is necessary to operate this new pickup. Four styles of preamplifiers with and without power supply and continuous tone controls are available, and are engineered to provide the correct polarized output for the pickup element, and also to provide the first stages of signal gain.

Proof of the excellence of the PFANSTIEHL STRAIN-SENSITIVE PICKUP is apparent both in tests and in actual listening, when its wide range flat response is best demonstrated.

Ask your handyman...or try the handy coupon below to get complete FREE INFORMATION.

PFANSTIEHL CHEMICAL COMPANY

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For Only $650.

This compact induction heater saves space, yet performs with high efficiency. Operates from 220-volt line. Complete with foot switch and one heating coil made to customer’s requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only $650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following range of Power: 1-2-3½-5-7½-10-12½-15-18-25-40-60-80-100-250KW.

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Design engineers and manufacturers in the radio, electrical and electronic fields are finding in LAVITE the precise qualities called for in their specifications... high compressive and dielectric strength, low moisture absorption and resistance to rot, fungus acids, and high heat. The exceedingly low loss factor of LAVITE plus its excellent workability makes it ideal for all high frequency applications.

Complete details on request

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ELECTRONICS
September, 1950

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rectory seems to fit, you are up the proverbial creek; especially if the customer is a bit in a hurry and you can only get said part from a manufacturer who is either too busy or just hasn’t the common courtesy to answer a letter. I’d say for all manufacturers to use standard parts only, if they have no distributor (wholesaler) setup.

In closing let me state that television is a wonderful business, but it already needs a housecleaning. Not by New York City’s licensing proposal, however, but by all the manufacturers just getting together and setting up a system of standards. A survey by said manufacturers, or by ELECTRONICS, among the service agencies would bring to light some of their pet gripes and perhaps some good ideas. This letter contains some of my ideas, what are yours?

CHARLES R. MADYELL, JR.
Consulting Electronic Eng.
Delta Electronics, Inc.
New Orleans, La.

An Illuminating Question

Dear SIRS:

Your comments on the developments in electron tubes during the life of ELECTRONICS made very interesting reading.

The paragraphs on the 931A and 1P21, in particular, were appreciated by this group. However, I should like to inquire whether “a billionth” by ELECTRONICS standards is a thousandth of a millionth or a millionth of a millionth, when you say the 1P21 “goes down to half a billionth of a lumen.” I believe that on reflection you will find us even more conservative than you thought. Or have I missed a congressional redefinition of our billion to conceal the increase in the national debt?

ALAN M. GLOVER
Engineering Section
Tube Dept.
Radio Corporation of America
Lancaster, Pennsylvania

(EDITOR'S NOTE: As far as ELECTRONICS is concerned a billion is still one thousand million. We wonder, however, if the British definition might not come in handy if the current trend toward increased photosensitivities continues.)

September, 1950 — ELECTRONICS
HERE'S A PARADE
YOU WON'T WANT TO MISS...

Everybody loves a parade but here's one that's particularly interesting to YOU because it's packed with "pocket-book" appeal. It's a never-ending parade of products and services designed to help you do your job better, quicker and cheaper.

You're in the "reviewing stand" for this parade because it comes to you in the advertising pages of every issue of this magazine. Alert manufacturers use these advertising pages to get the news about their products and services to you...quickly and effectively.

To be well-informed about the latest development(s) in your industry...and to stay well-informed...read all the ads too.
Radar, Communications and Sonar Technicians WANTED
For Overseas Assignments

Technical Qualifications:
1. At least 3 years’ practical experience in installation and maintenance.
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Base pay, bonus, living allowance, vacation add up to $7,000.00 per year.
Permanent connection with company possible.

Apply by Writing to
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Men qualified in RADAR, COMMUNICATIONS or SONAR give complete history.
Interview will be arranged for successful applicants.

Physicists
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Physicists—Mathematicians—Engineers—Senior Engineers

- What do you want in a position?
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The W. L. Maxson Corporation offers special opportunities if you are heavily experienced in research and development of radar, computers and associated equipment. Please address your job requirements and resume to: A. Holtissem for individual attention.

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Several Engineers

Needed by contractor for work at Naval Air Missile Test Center, 50 miles northwest of Los Angeles. College degree and experience essential. Radar, digital computer or general pulse technique experience required.

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SENIOR ELECTRONIC CIRCUIT PHYSICISTS for Advanced Research and Development

MINIMUM REQUIREMENTS:
1. M.S. or Ph.D. in Physics or E.E.
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Hughes Aircraft Company
Attention: Mr. Jack Harwood
CULVER CITY, CALIFORNIA

ELECTRONIC ENGINEERS
BENDIX RADIO DIVISION
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PRODUCTION DESIGN RESEARCH
Bendix Radio Division, a leader in the field of high quality radio and communications equipment, has positions for engineers experienced in the design and development, for production, of radio and radar equipment or electronic research.

Positions are available at all salary levels.
Good advancement opportunities, air-conditioned plant in suburban location, excellently equipped laboratories, technical library, large experimental engineering model shop.

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Interviews will be held in Baltimore, Chicago and New York.
Please send resume of experience promptly to:
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Submit detailed resume. Personal interview will be arranged.

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Send resume of education and experience, salary requirements and photographs to:
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These requirements represent permanent expansion in RCA Victor's Engineering Division at Camden, which will provide excellent opportunities for men of high caliber with appropriate training and experience.

If you meet these specifications, and if you are looking for a career which will open wide the door to the complete expression of your talents in the fields of electronics, write, giving full details to:

National Recruiting Division
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WANTED
Distributor for our telephone-type interoffice communication equipment. Fully stereocommunication equipment. Privately owned company.

Appraising only first class, well established sales and installation organization need apply.

Please reply to
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RESISTORS OTHER MAKES ARE ALSO ACCEPTABLE
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900—Fixed Paper Capacitors
± 0.5 to 10% MF
Various Rated 8 Watt Wire WO: Dejur—
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Any Quantity:
SCR-284 & BC-375
A) Surplus, complete, brand new, unused.
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OFFERS: F.O.B. New York to be submitted with detailed description of condition & complete list of items composing each unit to . . .
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WESTERN ELECTRIC VACUUM TUBES
Types 101F, 102F, 272A, 274A or B, 316A
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WILL BUY
SUBSTANTIAL QUANTITY
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new or used but in good working order
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Take Advantage Of It
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September, 1950 — ELECTRONICS
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Receiving system. The projector. Magnetostrictive, permanent magnet polarization.

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Keypad and indicating system. Keypads are mechanical; keys in the indicator unit determine the pulse length and keying interval. Ranges are indicated by the flash of a neon lamp.

Complete sets available less host. Also stacks alone.

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Transmitting system. The receiver-dialer unit contains two telephone-like devices called a Communicating Transmitter. The projector is of the Rockwell tail crystal type with a single element used for both listening and ranging. The frequency is 30 kc 25 kc.

Transmitting system. The receiver-dialer unit contains two telephone-like devices called a Communicating Transmitter. The projector is of the Rockwell tail crystal type with a single element used for both listening and ranging. The frequency is 30 kc 25 kc.

Type QCU-1. ECHO RANGING AND LISTENING EQUIPMENT Use. All volunteer ships.

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Keypads of 1, 2, 5, 10, 100, 10,000 yards and manual. Transmitting system. The receiver-dialer unit contains two telephone-like devices called a Communicating Transmitter. The projector is of the Rockwell tail crystal type with a single element used for both listening and ranging. The frequency is 30 kc 25 kc.

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Transmitting system. The receiver-dialer unit contains two telephone-like devices called a Communicating Transmitter. The projector is of the Rockwell tail crystal type with a single element used for both listening and ranging. The frequency is 30 kc 25 kc.
A.C. MOTORS

5071930, Delco, 115 V., 60 cycle. 7000 r.p.m. Price $4.50 each net.

36938-2, Hayden Timing Motor, 110 V., 60 cycle, 2.2 w., 4/5 r.p.m. Price $3.00 ea. net.

Type 1600 Hayden Timing Motor—110 V., 60 cycle, 3.2 w., 4 r.p.m. with brake Price $4.00 each net.

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Type 1600 Hayden Timing Motor 110 V., 60 cycle, 2.3 w., 1 r.p.m. Price $2.70 each net.

Type 1600 Hayden Timing Motor 110 V., 60 cycle, 3.5 w., 1 r.p.m. With shift unit for automatic engaging and disengaging of gears. Price $3.30 each net.

Type 1600 Hayden Timing Motor, 110 V., 60 cycle, 2.2 w., 1 1/5 r.p.m. Price $3.00 each net.

Eastern Air Devices Type J3 Synchronous Motor 115 V., 400 cycle, 3 phase, 8,000 r.p.m. Price $8.50 each net.

Telecron Synchronous Motor, Type B3, 115 V., 60 cycle, 2 r.p.m. 4 w. Price $5.00 each net.

Barber-Colman Control Motor, Type AYL3 5091, reversible 24 volts D.C., 1 amp 1 R.P.M., Torque 500 in. lbs. Contains 2 adjustable limit switches with contacts for position indication. Ideal for use as a remote positioner or a beam or television antenna rotator, will operate an AC 60 cycle. Price $6.50 each net.

SERVO MOTORS

CK 1, Pioneer, 2 phase, 400 cycle. Price $10.00 each net.

10047-2-A Pioneer 2 phase, 400 cycle, with 40-1 reduction gear. Price $7.25 each net.

FPE-25-16 Diehl Low Inertia 20 V., 60 cycle, 2 phase, 1500 r.p.m. 150 amps. Price $10.00 each net.

CK2, Pioneer, 2 phase, 400 cycle, with 40:1 reduction gear. Price $6.50 each net.

CK5 Pioneer, 2 phase, 400 cycle. Price $2.00 ea. net.

MINNEAPOLIS-HONEYWELL TYPE B

Part No. G303AY, 115 V., 400 cycle, 2 phase, built-in gear reduction, 50 lbs. in torque. Price $8.50 each net.

Kollsman Type 776-01 400 cycle 2 phase drop-up type, fix phase voltage 29, variable phase 35V. maximum, frequency 400 cycle.

Price $10.50 each net.

REMOTE INDICATING MAGNESYN COMPASS SET

Pioneer Type ANS730-2 Indicator and ANS730-3 Transmitter 26 V., 400 cycle.

Price $40.00 per set new sealed boxes.

Kollsman Remote Indicating Compass Set Transmitter part No. 6890k-03, 26 V., 400 cycle.

Price $12.50 each net.

GYROS

Schwein Free & Rate Gyro type 45600. Consists of two 28 V. D.C. constant speed gyro. Size 8" x 4.25" x 4.25".

Price $10.00 ea. net.

Sperry A5 Directional Gyro, Part No. 656029, 115 volts, 3 phase.

Price $17.50 each net.

Sperry A5 Vertical Gyro, Part No. 644841, 115 V., 400 cycle, 3 phase.

Price $20.00 each net.

Sperry A5 Amplifier Back Pack Part No. 644890. Contains 1000. Frequency Meter. 350 to 450 cycle and 400 cycle, 0 to 130 volt milliamperes, 3 phase.

Price $10.00 each net.

Sperry A5 Control Unit Part No. 644836.

Price $7.50 each net.

Sperry A5 Azimuth Follow-Up Amplifier Part No. 656030. With tube.

Price $5.50 each net.


Price $9.50 ea. net.

Pioneer Type 12800-1-D Gyro Servo Unit. 115 V., 400 cycle, 3 phase.

Price $10.00 each net.

Norden Type M Vertical Gyro. 28 V., D.C.

Price $19.00 each net.

Allen Calculator, Type CI Bank and Turn Indicator, Part No. 21500, 28 V., D.C. Contains 28 V., D.C. constant speed gyro.

Price $10.00 each net.

Sperry A5 Gyro Flux Gate Amplifier, Type 12076-1-A

Price $17.50 ea. net, with tubes.

G.E. Servo Amplifier Type 2CVC1, 115 V. 400 cycle, in reduction gear. Price $9.00 each net.

Minneapolis Honeywell Amplifier Type G403, 115 V. 400 cycle.

Price $8.00 each net.

D.C. MOTORS

5069625, Delco Constant Speed, 27 V., 120 r.p.m. Built-in reduction gear and governor. Price $3.90 each net.


C-28P-1A, John Oster Series Motor, 27 V., 0.7 amps., 7000 r.p.m., 1/100 h.p. Price $3.75 each net.

Jaeger Watch Co. Type 44-K-2 Contact Motor, Operates on 3 to 4.5 volts D.C. Makes one contact per second. Price $2.00 each net.

General Electric Type SBA10AJ25C, 27 V., 0.65 amps., 14 oz. n. torque, 145 r.p.m. Shunt Wound, 4 lead reversible. Price $5.00 each net.

General Electric Type SBA10AI75C, 27 V.D.C., 0.5 amps., 8 oz., in. torque, 250 r.p.m. Shunt Wound, 4 leads reversible. Price $6.50 each net.

General Electric Type SBA10150D, 27 V., 0.7 amps. 110 R.P.M. 1 oz. ft. torque. Price $4.50 ea. net.

D.C. ALNICO FIELD MOTORS

S. S. FD-16, Diehl, 27 V., 10,000 r.p.m. Price $4.50 each net.

S. S. FD-18, Diehl, 27 V., 10,000 r.p.m. Price $4.50 each net.

S. S. FD-21, Diehl, 27 V., 10,000 r.p.m. Price $4.50 each net.

5069600, Delco 27.5 V., 250 R.P.M. Price $10.00 each net.

706343, Delco 27.5 V., 10,000 R.P.M., Shaft 0.5 in. long. Price $7.50 ea. net.

5068571, Delco 27.5 V., 10,000 R.P.M. with blower assembly. Price $10.00 ea. net.

5071895, Delco 27.5 V., 250 R.P.M. Price $10.00 ea. net.

5072400, Delco 27.5 V., 10,000 R.P.M. Shaft 0.5 in. long with worm gear. Price $6.75 ea. net.

GENERAL ELECTRIC D. C. SELSYNS

8TJ9-PDN Transmitter, 24 V. Price $3.75 each net.

8TJ9-PAB Transmitter 24V.

8DJ1-PCY Indicator, 24 V: Dial marked —10° to +65°.

8DJ1-PCY Indicator, 24 V: Dial marked 0 to 360°.

AMPLIFIER

Pioneer Gyro Flux Gate Amplifier, Type 12076-1-A

Price $17.50 ea. net, with tubes.

G.E. Servo Amplifier Type 2CVC1, 115 V. 400 cycle, in reduction gear. Price $9.00 each net.

Minneapolis Honeywell Amplifier Type G403, 115 V. 400 cycle.

Price $8.00 each net.

Write for Catalog NE100

U. S. Export License-2140

September, 1950 — ELECTRONICS
ELECTRONICS
INSTRUMENT ASSOCIATES
37 EAST BAYVIEW AVE., GREAT NECK, N. Y.
Telephone GReat Neck 4-1147

SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

INVERTERS
Wincharger Corp. Dynamo-Generator Unit, PE 101-C. Input 13, V.D.C. or 26 V.D.C. D.C. AT, 12.6 or 63 amps. Output 400 V.D.C. AT, 135 amps, 800 V.D.C. AT, 0.2amps, 9 V.A.C. 80 cycle at 1.12 amps. Price $10.00 each net.

153F, Holtzer Cabot. Input, 24 V.D.C. Output 115 V., 400 cycle, 3 phase, 750 V.A. and 26, 400 cycle, 1 phase, 250 V.A. Voltage and frequency regulated also built in radio filter. Price $115.00 each net.


12117, Pioneer. Input 12 V.D.C. Output 26 V., 400 cycle, 6 V.A. Price $22.50 each net.

12117-2 Pioneer. Input 24 V.D.C. Output 26 V. 400 cycle, 6 V.A. Price $20.00 each net.


PE 218, Ballantine. Input 28 V.D.C. at 90 amps. Output 115 V. 400 cycle at 1.5 K.V.A. Price $50.00 each net.

METERS
Weston Frequency Meter, Model 637, 350 to 450 cycles, 115 volts. Price $10.00 each net.


Weston Voltmeter. Model 666, Type 204 P, 0 to 30 volts D.C. Price $4.25 each net.

Weston Ammeter. Model 506, Type S-61209, 0 to 100 amps. D.C. Price $7.50 each net with ext. shunt.

Weston Ammeter. Type 51, Dwg. No. 116465, 0 to 150 amps. D.C. Price $6.00 each net. With ext. shunt $9.00 each net.

Westinghouse Ammeter. Type 1090, D-120, 120-0-120 amp. D.C. Price $4.50 each net.

Weston Model 545. Type 826P Indicator. Calibrated 0 to 3000 R.P.M. 234" size. Has built-in rectifier, 270 degree movement. Price $15.00 each net.

RECTIFIER POWER SUPPLY

PIioneer AUTOSYNs
AY1, 26 V., 400 cycle. Price $5.50 each net.
AY14D, 26 V., 400 cycle, new with calibration curve. Price $15.00 each net.
AY20, 26 V., 400 cycle. Price $7.50 each net.

PRECISION AUTOSYNs
AY101D, new with calibration curve. Price $5.00 each net.

WRITE—WRITE OR CALL FOR SPECIAL QUANTITY PRICES
AY101D, new with calibration curve. Price $5.00 each net.

PIioneer AUTOSYN POSITION INDICATORS
Type S907-17, Dial graduated 0 to 360°, 26 V., 400 cycle. Price $15.00 each net.

Type 6007-39, Dual, Dial graduated 0 to 360°, 26 V., 400 cycle. Price $30.00 each net.

PIioneer TORQUE UNIT
Type 12602-1-A. Price $40.00 each net.

Type 12606-1-A. Price $40.00 each net.

Type 12627-1-A. Price $50.00 each net.

TYPE 12627-1-A. Price $50.00 each net.

MAGNETIC AMPLIFIER ASSEMBLY
Pioneer Magnetic Amplifier Assembly. Saturable Reactor type output transformer. Designed to supply one phase of 400 cycle servo motor. Price $5.00 each.

TORQUE UNIT AMPLIFIER
Type 12073-1-A, 5 tube amplifier, Magnesyn input, 115 V., 400 cycle. Price $17.50 each net with tubes.

ALL PRICES, F. O. B. GREAT NECK, N. Y.

INSTRUMENT ASSOCIATES

IMMEDIATE DELIVERY

BLOWER ASSEMBLY
MX-215/AFG
John Oster, 28 V.D.C. 7000 r.p.m. $4.50 each net.
Westinghouse Type FL Blower, 115 V., 400 cycle, 6700 r.p.m., Airflow 17 C.F.M. $3.70 each net.

RATE GENERATORS

F16, Electric Indicator Co., two-phase, 22 V. per phase at 1800 r.p.m. $12.00 each net.
J36A, Eastern Air Devices, 02. V. per r.p.m. $9.00 each net.
B-68, Electric Indicator Co., Rotation Indicator, 110 V., 60 cycle, 1 phase. $14.00 each net.
PM-1-M Electric Indicator Co. Same as type B35, 2 V. per 100 R.P.M. Max. speed 5,000 R.P.M. Can be used D.C. motor, 1/77 H.P. 115 V. D.C. $9.75 ea. net.

SINE-COSINE GENERATORS
(Resolvers)
FPE 43-1, Diehl, 115 V., 400 cycle. $20.00 each net.

SYNCHROS

1F Special Repeater, 115 V., 400 cycle. Will operate on 60 cycle at reduced voltage. $15.00 each net.

7G Generator, 115 V., 60 cycle. $30.00 each net.

2JF3 Selsyn Generator, 115 volts, 400 cycle. $5.50 each net.

2J1M1 Control Transformer 105/63 V., 60 cycle. $20.00 each net.

2J1G1 Control Transformer 75/57 V., 400 cycle. $1.90 each net.

2J1H1 Selsyn Differential Generator, 57.5/57.5 V., 400 cycle. $3.25 each net.


5G Generator 115 volts, 60 cycle. $4.50 each net.

5SF Repeater, 115/90 V., 400 cycle. $5.00 each net.

Price $19.00 each net.

2JF1 Selsyn Generator, 115 V., 400 cycle. $3.50 each net.

5SD Differential Generator 90/90 V., 400 cycle. Price $12.00 each net.

1CT Control Transformer, 90/55 volts, 60 cycle. $4.00 each net.

POSITION TRANSMITTER
Pioneer Type 4550-2-A Position transmitter, 26 volts 400 cycle, gear ratio 2:1. $15.00 each net.

SEARCHLIGHT SECTION

Searchlight Section

All prices, F.O.B. Great Neck, N.Y.

Western Union address: WUX Great Neck, N.Y.

Write for Catalog NE100
TEST EQUIPMENT

30 MC I.F. STRIP, VIDEO, and AUDIO AMPLIFIER AND 110 Volt 60-2600 cps POWER SUPPLY, Bandwidth 10 mc, new, part of APR-5 Receiver .................................................. $65.00 less tubes


X Band Spectrum Analyzer 8500-9600 Mc., calibrated linear below cut-off attenuator, calibrated frequency meter, tuned mixer, 4 i.f. stages, 3 video stages overall gain 125 db, regulated power supply.

S Band Spectrum Analyzer 2700-3900 Mc., similar to above.

The above Spectrum Analyzer also available with S and X band tuning units.

K Band Test Load low power ............... $20.00


X Band Below Cut-Off Wave Guide Attenuator, with calibrated dial, type N input connector, output connects to 1/2" x 1/2" wave guide .......... $55.00

X Band Test Load, low power ............. $15.00

TS-62 X Band Echo Box with r.f. cable and pick-up antenna.


APR-1 or APR-4 Radar Search Receiver, 30 mc I.F., 2 mc wide.

TUN. IND. PROGRAM ADAPT DP
VIDEO AUDIO
PULSE STRIP ADAPT DP
BLANDARD INPUT OFF
AUDIO SIRK

Tuning Units For APR-1 or APR-4 Receivers (can be used with any 30 mc amplifier):

TN-19, range 1000-2000 mc, tuned mixer cavity ......................... $150.00

TN-54, range 2000-4000 mc, tuned mixer cavity ......................... $150.00

TS-110 5 Band Echo Box 2400-2700 mc, portable ......................... $110.00

TS-184 Echo Box and Attenuator for APS-13

TS-170 Test Oscillator for ARN-5

TS-226 Peak Power Meter for APS-13

TS-89 Voltage Generator for measuring high video pulses, ratios, 1:10 and 1:100, transmission flat within 2db 150 c.p.s. to 5 mc, with cable for attaching to scope.

Waveguide Below Cut-off Attenuator L-101-A U.H.F. Connectors at each end, calibration 30-100 db. ......................... $10.00

X Band Test Load, 50 watts, average power, 1/2" x 1/4" waveguide, Band load ........................................ $35.00

HI POWER X BAND TEST LOAD, dissipates 200 watts of average power for 1/2" x 1/4" waveguide, VSWR less than 1.15 between 7 and 10 KMC ... $150.00

TS-45A/APM-3 Signal Generator, 9200-9600 mc, 110 V, 60-800 cps.

TS-35/AP X Band Signal Generator, pulsed, calibrated power meter, frequency meter, 5700-9500 mc.

X Band VSWR Test Set TS-12/AP, complete with linear amplifier, direct reading VSWR meter, slotted waveguide with gear driven traveling probe, matched termination and various adapters, with carrying case, NEW UNITS I and II are available separately or together as a test set.

Standard Signal Generator Measurements 65B, 100 kc to 30 mc, 1,200,000 micro-volts, good working order. $400.00

S Band Crystal Mixer, Variable Oscillator Injection ........................ $12.50

S Band Mixers, tunable by means of slider type N connector for the R.F. and local oscillator input, U.H.F., connector for the I.F. output, variable oscillator injection ................... $30.00

Waveguide Below Cut-Off Attenuator, type N connectors, rack and pinion drive, attenuation variable 120 decibels, calibrated 20-120 db, frequency range 300-3000 mc. ......................... $35.00

ELECTRO IMPULSE LABORATORY

P. O. Box 250 Eatontown 3-0768 Red Bank, N. J.

September, 1950 — ELECTRONICS
SEARCHLIGHT SECTION

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

SELENIUM RECTIFIERS
FULL WAVE BRIDGE TYPE

<table>
<thead>
<tr>
<th>Input</th>
<th>0-20V AC</th>
<th>Current</th>
<th>Price</th>
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TRANSFORMERS—115V 60 CY
HI-VOLTAGE INSULATION

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CENTER TAPPED RECTIFIERS
Single Phase Full Wave Bridge

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TRANSFORMERS—220v 60 Cyc

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EQUIPMENT SPECIALS

SEARCHLIGHT SECTION

FILTER CHOKES HI V INS

PHONE DIGBY 7-0347
WRITE FOR FULL INFORMATION PRICES

RADIO HAM SHACK INC.
189 GREENWICH STREET, NEW YORK, N.Y.
BROWN TELEPLOTTER RECEIVER

Model 791X1R
115 volt 60 cycles

Contains a pen driven by two balancing motors which write on rear of a translucent chart. Pen arm position is in terms of two coordinates supplied by two amplifiers. Originally intended for recording plotted or written data from central plotting board. Writes at one half scale on 18 in. chart. Discriminator input circuit designed to operate unit as function of two varying R.F. frequencies varying about mean of approx. 400 Kc. Further data on request. (Shipping weight 435 lbs.)

Price $375.00

SAWTOOTH POTENTIOMETER
W.E. KS-15128
Type HL-R-R
100 ohms element
Non linear ring gives linear output with CRT deflection control load. Cont. rotation.
3 brushes 180 degrees opposed. 5 taps 180 degrees opposed.
Stock #22-181. Price $6.50 each.

400 Cycle Generators
Homelite SABA02B2S-1 400 cycle out at 1 phase 115 v. 30 amps. Also a d-c output of 28 v. and 10.5 amperes. Special at $175.00 each.


PRECISION AUTOSYN
Pioneer Type
AV-100 Control Autosyn Precision type 24 v. 400 cycle. Stock #2A-297.

A-5 Autopilot Indicator
Autosyn Type Pilot Indicator for A-5 Autopilot. 26 v. 400 cycles. Stock #2A-299. Price $12.50 each.

SYNCHROS

Cyl. 1F, 1CT, 6F, 6CT, 6DD, 6HT, 6DP, 6DSF, 6DFG, 6DG, 6DG, TG.

Prices on Request

ALSO IN STOCK

Subfractional Horsepower AC Motors
Haydon 36028—115 v. 60 cy. 1 rpm.
Eastern Air Devices A-726—115 v. 400 cy. 1/100 hp. Cont. duty. 1700 rpm.
E. A. D. J-3—115 v. 400 cy. 1/30 hp.
E. A. D. J-40B—115 v. 100 cy. 1/250 hp.
Dohi FFH-24—115 v. 100 cy. 1/250 hp.
Synchro 660—210 v. 60 cy. 1 rpm.
E. A. D. J-3—115 v. 400 cy. Int. duty.

400 CYCLE AC BLOWERS
E. A. D. 3-1—215 v. 400 cy. 25 c.f.m.
Westinghouse Type EF—115 v. 400 cy. 17 c.f.m.

DC MOTORS

Haydon 30091, 1 rpm. 25 v. d.c. 120 ma.
Dohi 300922—150 v. 250 cy. 2500 rpm. cont. duty.
W. E. KS-5080-1—2/300 hp. 4 hp. head shaft.
National Magnetic—50600. 1 hp. Int. duty.
Dohi FDE-53-5—3000 rpm. Gov. cont. 5A.
Holtzer—Cubot—22-220—1/2 hp. 27 v. cont.
Arma Tailgait Motor—515-30 (Stairstep).
Elmo B-24-1/65 hp, 3100 rpm. 27 v. d.c. armature. (Coil control).
John Oster—A-17—1/12—Split field series reversible, 2 x 4 rpm. 2 watts output.
General Electric S8560H1—8—Split field series rev. 60 v. 1 x 4, 3000 rpm.

AC SERVO MOTORS
Kollmoran—756-50—400 cy. 2 phi dog cup type.
Dohi FP—25-3—2 phi 60 cy. 28 v. 2.8 watts output.
Pioneer CK-2—2 phi 400 cy. 1.05 in./sec. stall.

AUTOSYN (Pioneer)
B-DA—Dial Oil Pressure Indicator ($99.75 ea.)
B-DA—Oil Pressure Transmitter ($145.00 ea.)
Pioneer Type—AV-1, AV-14, AV-54, 230v.
C-14—Fuel Pressure Transmitter, Pioneer 1-81A and 1-83A Compass Indicators.

MAGNESYN

Pioneer Type CM-1, 4 magnets.
Pioneer 1106-1E-B1 Indicator, AN-5762-1, General Electric Servo 2101D, 211F1, 2131H1, 2131J, 2131K1, 2131R, 2131R1, etc.
Army Ordnance Synchros 1V, X, 11, Y1, XV, XVIII, XXI, etc.
400 Cycle Synchros Kollmoran 755-01, 1F, General Electric KM-5060L-2D.
Aircraft Amps—General Electric SABA31J18A and SABA31J3A.

INVERTERS

Leland—1425E, PE-2111.
General Electric—PE-2111D, SABA31J11A, 18D5X, 5A, etc.

A-S AUTOPilot COMPONENTS

GENERAL ELECTRIC D C SELSYNS

MICROWAVE ANTENNA
AR-217-APQ 150, 12 cm dish and 10" inch Parabolason Weatherspoon, Taradale 16" dia. 34 v. DC generator motor for conic scan. Stock #2A-35. Shipping wt. 70 lbs.

Price $99.05 ea.

MINIATURE DC SELSYN INDICATOR


SLEEP GENERATOR CAPACITOR

Hi-speed bearings. Split stator. Silver-plated coaxial type. 5-10 muf.

Stock #22A-107. Price $8.75 each

OSTER PM MOTOR

Alino Field 27.5 v. d.c. Can also be used as rate generator. Stock #2A-281. Price $4.75 each.


12 V. D.C. MOTOR

John Oster B-9-2
1.4 amps.
5000 rpm.


FORD SERVO MOTOR

115 volt 60 cycle two phase low inertia motor. 15 watts output. BuOrd. 20727.

Stock #2A-293. Price $10.59 each.

ANTENNA TILT INDICATOR


SPECIALISTS IN FRACTIONAL HORSEPOWER MOTOR SPEED CONTROL
## COAXIAL CABLES

**GUARANTEED! NEW!**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Price per 1,000 ft.</th>
<th>Price per 5,000 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG-5/U</td>
<td>33.5</td>
<td>55.5</td>
</tr>
<tr>
<td>RG-6/U</td>
<td>97.6</td>
<td>165.0</td>
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<tr>
<td>RG-7/U</td>
<td>115.0</td>
<td>135.0</td>
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<td>RG-9/U</td>
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<td>165.0</td>
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<td>RG-11/U</td>
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<td>255.0</td>
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<tr>
<td>RG-13/U</td>
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<tr>
<td>RG-15/U</td>
<td>315.0</td>
<td>375.0</td>
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<tr>
<td>RG-17/U</td>
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<td>455.0</td>
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<tr>
<td>RG-19/U</td>
<td>455.0</td>
<td>545.0</td>
</tr>
</tbody>
</table>

*No min. order—others 25% min.*

Add 25% for orders less than 1,000 feet.

## SELLYSYS

**115 V. 60 Cycles**

<table>
<thead>
<tr>
<th>3¾&quot; dia. x 3¾&quot; long</th>
<th>57°/93 pair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting Brackets (Blanket) for sellysys, and differential in 3½&quot; pair</td>
<td></td>
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## CAPACITORS

**POSTAGE STAMP MICA**

<table>
<thead>
<tr>
<th>MFD</th>
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<tr>
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</table>

**SILVER MICA**

<table>
<thead>
<tr>
<th>MFD</th>
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</table>

## PRECISION CONTROL

<table>
<thead>
<tr>
<th>4 WATT</th>
<th>4 WATT</th>
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<tbody>
<tr>
<td>6,000</td>
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<td>6,000</td>
<td>6,000</td>
</tr>
</tbody>
</table>

## THROAT MIKE—MT 81-A

Two Microphone pickup capsules with 50 ohm card and PL-58 Brand New!

<table>
<thead>
<tr>
<th>Gear Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>$65.00</td>
</tr>
</tbody>
</table>

## 2J1G1 SELYSYS

**BRAND NEW**

Can be used on 2800 Hz or any 100 V.A.C.

<table>
<thead>
<tr>
<th>2AG FUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
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<tr>
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## OIL FILLED

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## METERS

**Brand New—Guaranteed**

<table>
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<tr>
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<td>V.D.C.</td>
<td>V.D.C.</td>
<td>V.D.C.</td>
<td>V.D.C.</td>
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## TRANSMITTING MICA SPECIALS

<table>
<thead>
<tr>
<th>3/16&quot; hole x 3/8&quot; O.D.</th>
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</thead>
<tbody>
<tr>
<td>Steel or Aluminum</td>
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</table>

## UNIVERSAL JOINT

<table>
<thead>
<tr>
<th>3/16&quot; hole x 3/8&quot; O.D.</th>
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</thead>
<tbody>
<tr>
<td>Steel or Aluminum</td>
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</tbody>
</table>

## JONES BARRIER STRIPS

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
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<tbody>
<tr>
<td>2-14 Y</td>
<td>9/10</td>
</tr>
<tr>
<td>2-14 W</td>
<td>11/10</td>
</tr>
<tr>
<td>2-14 V</td>
<td>11/10</td>
</tr>
<tr>
<td>2-14 X</td>
<td>11/10</td>
</tr>
</tbody>
</table>

## RELIANCE MERCHANTIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. Telephone Rittenhouse 6-4927
PEAK ELECTRONICS CO.

**SELECTED AND GUARANTEED SURPLUS AT A FRACTION OF ORIGINAL COST**

188 Washington St., New York, N.Y.

---

**POWER TRANSFORMER**
- 500 volts CT, 125 ma. @ 2 A. @ A. @ 125 volts \( \times \) 80. Full case packed...
  - $1.95 ea.

**POWER TRANSFORMER**
- 110 volts CT, 150 ma. @ 2 A. @ 125 volts \( \times \) 80. Full case packed...
  - $2.95 ea.

**POWER SUPPLY KIT**
- Uses the transformer described and illustrated plus (110) 1 ma. chokes (11) diodes (capacitor). (1) output. (1) A. $9.95 ea.

---

**REDUCTION BOX**
- High Voltage, 1/2 Meg 1/2 kv Price...
  - $9.95 ea.

---

**HIGH CURRENT MICAS**
- Type G4 Ceramic Core 3/4" High. 5/8" Diameter Tolerance 5% or Better.

---

**SCR 522 TRANSFORMER RECEIVER**
- Case and housed in separate Desconator Power Supply. Excellent radiation. 126.50 ea.

---

**MOTOR & GEAR BOX**
- Type R/L-14 case 2 VDC, 1/4 hp, 1 min. with Gear Reduction Unit...
  - $2.25 each

---

**NON INDUCTIVE RESISTORS**
- 250 Ohm 1/4 watt. $0.25 ea.
  - 500 Ohm 1/4 watt...
  - 1000 Ohm 1/4 watt...
  - 5000 Ohm 1/4 watt...

---

**MULTIPLIER CAPACITORS**
- 2 Meg 1/2 of 1% Case Enclosed 2 kv...
  - 1 Meg 1/2 of 1% Case Enclosed 2 kv...
  - 1/2 Meg 1/2 of 1% Case Enclosed 2 kv...

---

**1218 SHIMMERS**
- 12 units $1.00 ea.

---

**300 MICROAMP RELAY**
- Delicately insulated. S.P.D.T., 10,000 ohm coil resistance. Breaks at 600 millivolts quite adjustable for other currents. Terrible values at only...
  - $1.95 ea.

---

**FILAMENT TRANSFORMER**
- 6.3 volts at 13 ma. Primary 110 volts 60 cy. S-III: 6.3 volt 0.05 microfarad 3D. W. 3/4 lb. As illustrated. Worth $1.95. Only...
  - $1.60 ea.

---

**RATHEON SWINGING**
- 2 to 12 liters, 1 Amp to 100 ma. 15 Ohms DC fully and. High voltage installations, ceramic insulators. Very conservatively rated. Weight 80 lbs. 95.5 ea.

---

**THORDARSON PLATE TRANSFORMER**
- Chet, Model F159, 220 volt 60 cy, Primary 220 volts 0.0005, 2200 volts C.T. Secondary 0.025 watts. Weight 20 lbs...
  - $22.50 ea.

---

**30 WATT WIRE WOUND RESISTORS**
- Ohms: 100-250-35-450-500-1.5 k-
  - $0.98 ea.

---

**SLIDER ADJUSTABLE RESISTORS**
- 20 Watt: 1, 3. 5 Ohm...
  - 50 Watt: 100, 200, 300 Ohm...
  - 100 Watt: 200, 500, 75, 125, 250 Ohm...

---

**MIDGET VARIABLE CONDENSERS**
- (3 MNF (RF 75) 1 MFD (D)...
  - $0.65 ea.

---

**CERAMICOS**
- MFD: 1-33-3. 6. 10...2 22, 120, 500...
  - $0.65 ea.

---

**SILVER MICA CAPACITORS**
- MFD: 47. 500, 0.005...
  - $0.65 ea.

---

**OIL CONDENSERS**
- 86 mfd 800 volts 100 ma...
  - 4 mfd 600 volts 8 ma...
  - 10 mfd 400 volts 80 ma...
  - 6 mfd 200 volts 100 ma...
  - 0.15 mfd 600 volts 6 ma...
  - 0.1 mfd 500 volts 5 ma...
  - 0.05 mfd 300 volts 4 ma...

---

**H. V. SCOPE TRANSFORMER**
- 110Y 1/2 CV Pri., Case...
  - 2.25 ea.

---

**FILAMENT TRANSFORMER**
- 110V 1/2 CV, Hermetically Sealed...
  - $0.95 ea.

---

**MISCELLANEOUS BAGGERS**
- 2md 240 volts @ 0.040 a...
  - 0.002 mfd 600 volts 8 ma...
  - 0.003 mfd 600 volts 10 ma...
  - 0.004 mfd 600 volts 12 ma...
  - 0.01 mfd 2000 volts 0.005 a...
  - 0.1 mfd 7000 volts 0.008 a...

---

**H. V. SCOPE TRANSFORMER**
- 110Y 1/2 CV, Oil Cans...
  - $0.95 ea.

---

**FILAMENT TRANSFORMER**
- 110V 1/2 CV 50A, 25V, 6MA...
  - $0.95 ea.

---

**SPECS AND FIL. TRANSFORMERS**
- Pri. 115 volts, 60 cy. S-III: 6.3 volt 0.05 microfarad 3D, W. 3/4 lb. CT 3 amps, P.I. Ins. 15 kv.

---

**WESTINGHOUSE SILLION RECTIFIER**
- Hermetically sealed, Oil Immersed Full Wave Bridge, 2000 Volts AC...
  - $3.50 ea.

---

**ILA STANDARDS**
- 3000 ohms 25 watt with mount $1.49 each...

---

**WHY WOUND RESISTORS**
- 5 watt ohm: 3-5-25-250-2500...
  - $0.06 ea.

---

**DIRECTED TRANSFORMER**
- 100-250-35-450-500-1.5 k-
  - $0.98 ea.

---

**LIST OF MILLIMICROAMPS**
- Mfd: 47-50-0.005...
  - $0.65 ea.

---

**SILMEX 2000 MFD 50-300-750-3000-1.5 k-
  - $0.65 ea.

---

**FILAMENT TRANSFORMER**
- 110V 1/2 CV Pri. Case...
  - $2.75 ea.

---

**2000 MFD 50-75-125-250-
  - $0.75 ea.

---

**H. V. SCOPE TRANSFORMER**
- 110Y 1/2 CV, Hermetically Sealed...
  - $0.95 ea.

---

**MISCELLANEOUS BAGGERS**
- 2md 240 volts @ 0.040 a...
  - 0.002 mfd 600 volts 8 ma...
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  - 0.004 mfd 600 volts 12 ma...
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  - 0.1 mfd 7000 volts 0.008 a...

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**H. V. SCOPE TRANSFORMER**
- 110Y 1/2 CV, Oil Cans...
  - $0.95 ea.

---

**FILAMENT TRANSFORMER**
- 110V 1/2 CV, Hermetically Sealed...
  - $0.95 ea.
SEALIGHT SECTION

ELECTRONICS — September, 1950

ASB YAGI ANTENNA

ADJUSTABLE TUNING

SAME EXCEPT DOUBLE STACKED

FULL LINE OF APPLIED COAXIAL CABLES

COAXIAL CONNECTORS

GENERATORS

- Eclipse-Planner Type T60-3A (Navy Model N.E.A.

NAVY MODEL AIA ANNAIfAS

TEST EQUIPMENT

- Alfred W. Barber Labs., Inc. VM-25 TVM

PHILADELPHIA AREA

- General Radio Model P-500A Standard Signal

- Galvin Model CES-1 Standard Crystal Test Set

- HOLLAND INSTRUMENTS - 500-820 Test Set. Price...

- TS-18/1AP-1, Delco Test Set. Price...

- REL-W-115, W-220 MC. Price...

- CPR-18/1D Range Calibrator for A.E.G., A.S.E.

- CPR-18/1D Range Calibrator for A.E.G., A.S.E.

- General Radio Model 801-B Signal Generator...

- HP Model 200A, 200B, 200C Audible Oscillators

- C.O. Model 60-250, Series 1000. Price...

- All Items New Except Where Noted 

- Used and Refurbished. Price...

- W. E. MERCURY CONTACT RELAYS

- Glass insulated mercury switch H.P. contact assemblies.

- D-10687 high speed relay in stock. Supply your

- Types of relay specials...

- All shaft lengths beyond honing - BS (Screw slot)

- STANDARD BRANDS ONLY

- ASB YAGI ANTENNA

- ADJUSTABLE TUNING

- SAME EXCEPT DOUBLE STACKED

- FULL LINE OF APPLIED COAXIAL CABLES

- COAXIAL CONNECTORS

- GENERATORS

- Eclipse-Planner Type T60-3A (Navy Model N.E.A.

- NAVY MODEL AIA ANNAIfAS

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- ELECTRONIC RESEARCH LABORATORIES

- 1021-A, CALLOWHILL ST. PHILA: 23, PA

- Telephones - MARKET 7-6590 and 6591

- SELL FOR OUR COMPLETE TUBE LISTING

- www.americanradiohistory.com

- ELECTRONICS — September, 1950

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- Telephones - MARKET 7-6590 and 6591

- SELL FOR OUR COMPLETE TUBE LISTING

- www.americanradiohistory.com
TEST EQUIPMENT
1 125 Test Set
BC 771 Frequency
Meter
BC 221 Freq. Meter
BC 107 Scope
TS 12
TS 13/AP
TS 102A/AP

ARROW has the VALUES!

RADIO EQUIPMENT R. C.-100-B

This equipment made by General Electric was designed for ground use as an identification of friendly aircraft.


Primary requirements are 110 to 120 volts, 50 to 60 cycles for the entire unit and accessories.

Cabinet CH-118 is of the Standard 14 inch rack type structural steel frame with wicker angles for each of the units. A full length access door with safety interlocks forms the rear of the cabinet.

Transmitter BC-769 is designed to transmit RF pulsed signals at 470 megacycles with the use of two type 155 tubes operating in push-pull with resonant grid, plate and filament lines.

Keying unit BC-770 furnishes the pulse of the Transmitter. Receiver BC-768 was used to detect the 493.5 megacycle reply from the interrogated station and to sufficiently amplify these signals for oscilloscope observation.

Rectifier RA-32 produces the high voltage. Pn-015 kilovolt DC Motor connected across the output filter to maintain the voltage fed to transmitter BC-769, while a 0.20 milliammeter is connected to the ground return to measure the average current.

Antenna AN-22B consists of 24 vertically polarized, half wave reducing elements, a reflecting screen, open-wire transmission line sections and a concentricline terminating section or elevator.

Wave trap FL-25 is used to separate received and transmitted signals.

Transmission line MC-377 is of 3/4 inch air-dielectric, 70 ohm concentric line type and is assembled by means of solderless air tight connectors.

Control Box BC-773 contains necessary controls for operation.

Amplifier BC-783B is used to amplify the output of Receiver BC-768 for suitable oscilloscope presentation.

Air Compressor M-349
Together with 12 feet of 1/4 inch soft copper tubing and necessary hardware is used to fill and maintain transmission lines with dry air under pressure. Operation is direct from 110 V AC 60 Cycles.

Oven M-348
Is furnished for removal of moisture from the dehydrator and cylinders of the compressor. It too operates from 110 V AC 60 cycles.

Frequency Meter BC-771
Frequency Meter BC-771 is used for frequency checking and for tuning operations on Radio Receiver BC-769 and Radio Receiver BC-768. It is a separate unit mechanically and has its own power supply, which requires a 110 to 150 Volt, 50 to 60 cycle source.

The circuits consist of an r-f oscillator, a crystal oscillator, a 30,000 cycle oscillator and associated mixer, multiplier, and amplifier tubes. The crystal oscillator is used to set the r-f oscillator to exactly 94 or 93.7 megacycles.

For tuning Radio Transmitter BC-769 to 470 megacycles, the signal from the radio transmitter is mixed with the fifth harmonic of the r-f oscillator, operating at 362 megacycles, to produce an audio-beat frequency. For tuning Radio Receiver BC-768 to 493.5 megacycles, the fifth harmonic r-f oscillator, operating at 507 megacycles and modulated by the output of the 30,000 cycle oscillator, is fed into the radio receiver.

The entire RC 100 as described above—all brand new—complete.

Technical Manual TA-11-113B is furnished with the complete set.

Prices on individual components will be furnished on request.

ARROW SALES, Inc.
Dept. B
714-24 S. Michigan Ave., Chicago 16, Ill.
PHONE 4-7327

September, 1950 — ELECTRONICS
MOTOR GENERATORS DYNAMOTORS, INVERTERS, ETC.

2.5 KVA DYNAMOTOR Elec. Co.
138V DC to 120V AC, 60 cy, 1 Ph. Complete with Magneto Condenser, 2-Field Wires and Full Set of Remote Parts including Spare Armatures for Gen-set and Motor.
Full specs. and price on request. New.
2 KVA MG SET. Olds & Merrill.
115V DC to 120V AC, 60 cy, 2 Ph. Complete motor on 208V, 60 cy. Exposed rated 220 cy. $65.00
1.25 KVA MG SET. Allis-Chalmers.
115V DC to 180V AC, 60 cy, 1 Ph. Fully repaired. Suitable for 115V. $65.00
Same machine but for 208V, New. $65.00

RADAR COMPONENTS

card-2AC-10 MODULATOR Control Heats. New and complete with box. $15.00

MODEL AN/APA-10 PARAMOMIC ADAPTER

Provides 4 Types of Presentation:
(1) 198400X
(2) 198100X
(3) Oscillogram
(4) Oscilloscope

3 I98400X
1 198100X
5 Oscillogram
1 Oscilloscope

S. G. RADAR EQUIPMENT

Naval Yard Spares for Model 5G Radar
Consisting of the following:
- CH-208ABM Rectifier Power Units for mod.
- CH-208ABM Rectifier Power Units for mod.
- CH-208ABM Rectifier Power Units for mod.
- CH-208ABM Rectifier Power Units for mod.
- CH-208ABM Rectifier Power Units for mod.

LINE VOLTAGE STABILIZERS

RAYTHEON - New Type: CR-97087 Input: 25 - 135V 0.75/1.0/1.5 Output: 1500V, 5.5 Ohm. Weight 35 lbs. Overall size 14 x 18 x 9.6 inches. Equipped with remote control by wall mounting.

Brand New $49.50

RAYTHEON. In-put type 96-135V, 10 Watts. Volts 460/230/115 New.

400 CYCLE TRANSFORMERS

AUTO 1400 volts. 2A, 50/60 cycle.

FILAMENT 400/500 volts. Input 12/20/20/20/20.

1500/1500 volts. Output 2500/2500/2500/2500/2500 watts.

115V, 60 cycle. New. $15.00

PLATE WAVE, 1KVA. Input 208V, 60 cycle. 220/240 volt.
New.

SCOPE FL. & FIL. 400/220 volt. 115V, 60 cycle. New.

High Voltage Capacitors On Filled
- 25 MFD., 20 KV... $17.50
- 5 MFD., 20 KV... $17.50
- 10 MFD., 20 KV... $17.50
- 15 MFD., 20 KV... $17.50
- 20 MFD., 20 KV... $17.50

All brand new. Made by well known manufacturers.

MICROWAVE TUNING UNITS

Tuning Units for AP-1 and AP-4 LVS-16 (RX-230) in TX-180 (2300-10000 MC).

Three front ends may be used with any unit at 50 MC. IF amplifier or as converters in receivers tuned to 50 MC.

PRICE $250.00

SWEEP GENERATOR CAPACITOR

High speed sweep generator for use with various air craft radars. Brand new.

$1.00

PARABOLOIDS

Semicircular dish for test. 3" deep. Mounting base for elevation and azimuth control on 1.5" or 3.5" shafts L. A. 3.5 lbs. Width 8 lbs. Brand new pair price...

$6.75

All merchandise guaranteed. Immediate delivery, subject to prior sale.

All Prices Subject to Change Without Notice

www.americanradiohistory.com
### Latest WELLS Tube Price List

Many Types Are Now Scarce At These Low Prices. Check your requirements at once for your own protection. All tubes are standard brand, new in original cartons, and guaranteed by Wells. Order directly from this ad or through your local Parts Jobber.

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### PHOTO-TUBES

- **917/CE114-C**
  - **318/CE1**
  - **456/CE11**
- **922/CE22C**
- **252/CE22C**
- **990/CE80C**

### SPECIAL TUBES

- **45/CE242**
- **917/CE211**
- **917/CE212**
- **917/CE213**

Huge Display at Our LaSalle Street Show Rooms
MIDGET RELAYS
GUARDIAN 300 ohm SPDT 24VDC ceramic insul.
3 amp cont., #R100-39 ea.
ALLIED 300 ohm 24VDC
dpdt 1 amp cont., #R82-300 ea.
Minilax ind 1 amp cont., #R83-45 ea.
Clear 2000 ohms SPST N.O. 1 amp cont., #R48-30 ea.
Automatic 1300 ohm SPST N.O. 1 amp cont., #R100-30 ea.

RELAYS TELEPHONE TYPE
W. E. 9400 ohms 6MA SPDT 1 amp cont., #R92-17.25 ea.
CLARE 2000 ohms SPST N.O. 1 amp cont., #R48-30 ea.

ALLIED TYPE BO RELAYS
5 VDC SPDT. Operation on 12 VDC, 180VAC, intermittent for 10VAC for 45D. oper.
No. 100-105 310 DC, SPST N.O. 80 ea.

SAVE 50% AT UG.

ANTENNA SWITCHING RELAYS
110 VAC SPDT 10 amp classic manual relays. All solid. #R100-50 ea.
G. E. #3783-50 ohm swtchable isolation 10 amp cont., #R105-12.95 ea.
Clear 205 ohms SPDT N.O. 10 amp cont., #R100-95 ea.

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Over 200,000 in our stock all sizes wattages.

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LOW-LOSS FERRULE INSULATION
(picture actual mount—4 Thread) $15.00

SINE-COSINE SQUARE
MULTIVIBRATOR
W. E. CoE D565W100 for very low feedback circuits.
$7.50 ea.

S.S. WHITE DENTAL LAB RESISTORS
1K, 4K, 68K, 100K, 500K. All I watt
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SOLENOIDS
A-B type 85A
Air-cooled starting relay 24 VDC 150 amp coil "O" frame 800. #1105 $1.35 ea.
Others in stock—send us your needs for our price.

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SERVO OUTPUT XFMRs
PP66 to Servo mechanism with 10M ohm feedback winding. MJ metal core
$2.45 each

DUAL unit PP66 to Servo mechanism with 10M ohm feedback winding and 300 to Servo mechanism.
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KENWOOD RX100 XFR. 5V $3.50 ea.

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Universal general corp.
324 Canal St. N. Y. C. WA lker 5-9642

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EAST COAST RADIO COMPANY
811 Main St., Jacksonville, Fl.
Phone 51259

All Stock new or in good condition. We will
ship order. Nets and sight draft B/L attached.
Or, check with order. Inspection authorized
can be arranged.

RECEIVERS

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NEW YORK'S RADIO TUBE EXCHANGE

We have one of the largest stocks of
radio, klystrons, magnetrons, power and special tubes.
Contact us for your requirements. 

TUBES TUBES TUBES

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Prices quoted are net, FOB N.Y.C. our warehouse. Export packing extra, except where included in specifications.

**THEME**

- **60 BC-610 Transmitters with BC-614 Steep Amplifier.**
- **30 BC-102 Receivers with BC-101 Steep Amplifier.**
- **30 BC-202 Receivers with BC-201 Steep Amplifier.**
- **20 BC-302 Receivers with BC-301 Steep Amplifier.**
- **10 BC-402 Receivers with BC-401 Steep Amplifier.**
- **5 BC-502 Receivers with BC-501 Steep Amplifier.**
- **100 BC-152 Receivers with BC-151 Steep Amplifier.**
- **50 BC-252 Receivers with BC-251 Steep Amplifier.**
- **30 BC-352 Receivers with BC-351 Steep Amplifier.**
- **15 BC-452 Receivers with BC-451 Steep Amplifier.**
- **5 BC-552 Receivers with BC-551 Steep Amplifier.**

**Radio Receivers**

- **100 BC-152 Receivers with BC-151 Steep Amplifier.**
- **50 BC-252 Receivers with BC-251 Steep Amplifier.**
- **30 BC-352 Receivers with BC-351 Steep Amplifier.**
- **15 BC-452 Receivers with BC-451 Steep Amplifier.**
- **5 BC-552 Receivers with BC-551 Steep Amplifier.**

**Radio Amplifiers**

- **100 BC-152 Receivers with BC-151 Steep Amplifier.**
- **50 BC-252 Receivers with BC-251 Steep Amplifier.**
- **30 BC-352 Receivers with BC-351 Steep Amplifier.**
- **15 BC-452 Receivers with BC-451 Steep Amplifier.**
- **5 BC-552 Receivers with BC-551 Steep Amplifier.**

**Transistors**

- **100 BC-152 Receivers with BC-151 Steep Amplifier.**
- **50 BC-252 Receivers with BC-251 Steep Amplifier.**
- **30 BC-352 Receivers with BC-351 Steep Amplifier.**
- **15 BC-452 Receivers with BC-451 Steep Amplifier.**
- **5 BC-552 Receivers with BC-551 Steep Amplifier.**

**Electronic Equipment**

- **100 BC-152 Receivers with BC-151 Steep Amplifier.**
- **50 BC-252 Receivers with BC-251 Steep Amplifier.**
- **30 BC-352 Receivers with BC-351 Steep Amplifier.**
- **15 BC-452 Receivers with BC-451 Steep Amplifier.**
- **5 BC-552 Receivers with BC-551 Steep Amplifier.**

**Miscellaneous**

- **100 BC-152 Receivers with BC-151 Steep Amplifier.**
- **50 BC-252 Receivers with BC-251 Steep Amplifier.**
- **30 BC-352 Receivers with BC-351 Steep Amplifier.**
- **15 BC-452 Receivers with BC-451 Steep Amplifier.**
- **5 BC-552 Receivers with BC-551 Steep Amplifier.**

**Communication Devices Co.**

CABLE ADDRESS: TELEMARINE, N.Y.

540 W. 27th St., N. Y. 1. N. Y.
ARMY • AIR FORCE • NAVY
SURPLUS EQUIPMENT

BUY NOW . . . AND SAVE 50% TO 85%!

GENERATOR
Brand New
Eclipse-Pioneer Type
716-3A (Navy model NEA-3A) Output—115 Volts ac, 10.4 amps, 800 cycle, single phase; 28.6 Volts dc, 60 amps @ 2400 rpm, spline drive, self excited, weight 60 lbs, in original carton
$29.95

BC-605 INTERPHONE AMPLIFIER
Brand New . . . original carton; Can be easily converted to intercommunications set for office or home. It's a real buy for new equipment at this price
$4.49

BC-683 RECEIVER
With 12 or 24 volt dc supply
$39.50

BC-684 TRANSMITTER
With 12 or 24 volt dc supply
$39.50
Set of 80 CRYSTALS for BC-684
$15.95

BC-604 TRANSMITTER
With 12 or 24 volt dc supply
$29.50
RACKS—for BC-603-606 and 683-686
$7.95

VOLTAGE STABILIZER
Unit of FC/DF Equipment; input 225/450 volt ac; single phase; 60 cycle; 845 amp; output 117 volts; 25.6 amp; 85% PF. Used, Good—shipping wt. 150 lbs.
$100.00

CBM TRANSDUCER
Brand New, shipping wt. 460 lbs
$150.00
ASK-1 RACK MT-100/ASK-1
$4.95
ASK-0 RACK 620 RECORDER
Like New $79.50
BC 312 Brand new, in original cartons
$150.00

BLACK LIGHT KITS
Ultra-Violet Fluorescence
New . . . build your own black light lab equipment at a new low co. with these easy-to-assemble components. Kit contains: Ultra-Violet tube, brackets, ballast, starter, wire, plug and wiring diagram.
3-Watt Kit (1/2" tube) $3.00
6-Watt Kit (1/2"") tube) $4.00

HAYDON TIMING UNIT
An excellent automatic timing device for remote control of electrical equipment. Hundreds of uses. 110V . . . dc cycle, 2 watts, 1/10th rpm. Brand New
$1.95

TRANSCRIBER-REPRODUCTION UNIT
Navy Type PT-1, Mfg. by Mcmurray, Inc.; Brand New complete with approx. 1000—16" blank recording discs
$395.00

TELEGRAPH TRANSMITTER
(Radio Marine Corp.)
Power input: 460 Volts ac; Power output 200 watts; 3 phases; freq. range 350-500 kc. Used, Good
$150.00

RADIO TELEPHONE
(Radio Marine Corp.)
Mod. ET 8012-8, 110 volt dc power supply; 2100-2750 kc; 75 watt; Crystal control
Like New $395.00

PARALLAX COMPUTOR
For B-29 sighting station, Mod. 2CHLCS-R
Unused $98.00

CAMERA, RECORDING
(Mfg. Calumet Corp.)
Type 0-5, Single Frame
$269.00
RA-43 RECORDER
Used, Good $59.50
$75/AT-4
Used, Good $95.00

WRITE FOR PRICES AND INFORMATION ON THE FOLLOWING
We have partial and some complete units of equipment listed.

AIRBORNE UNITS
R50/AP5-6A 1D-33/APA6
R50-AP5-6A 1D-33/APA6
T-56/ART2 AM-33/ART
AP3 T28/APT-1
AP3 T28/APT-1
AP3-7 ART-RT/APN-7
AP3-7 ART-RT/APN-7
AN-AP5-26 AS-97/ART
AN-AP5-26 AS-97/ART
RS/AR7 BC 1148C
RS/AR7 BC 1148C
AP5-13
AP5-13

SHIPBOARD UNITS
BN-1 SQ
SL-1 SQ
S7-1 SN
QJA YL
DAB-3 SD-3
SJA SD-3 (Antenna)
YJ QC
BN AN-U1Q-2

POSTABLE BEACONMETER AMPLIFIERS and spare parts.
TEST SET (TS 104/APA)
TEST SET (TS 318/APA)
CW-60AMB

AUTOMATIC TELEPHONE (TYPE NK-25)
DIAL TELEPHONES (Mfg. NORTH ELECTRIC)
BD-75 SWIBoard
BD 100 SWIBoard

ALL EQUIPMENT F.O.B. PASADENA, CALIFORNIA
PLEASE ENCLOSE FULL AMOUNT WITH ORDER

C and H Sales Company
BOX 356-E EAST PASADENA STATION • PASADENA 8, CALIFORNIA

Brand New BLOWERS
115 Volt 60 cycle, approx. 100 cubic ft./min. 35 in. 34" Intake, 27 out. Motor size 3 1/2" x 3 1/2" x 3 1/2" HP. Complete with mounting bracket. Gov't surplus. Brand new and boxed.
Order No. $7.95
E-3984

GASOLINE ENGINE GENERATORS:
HOMELITE HRP-28 28.5 Volt DC, 2000 Watts
HOMELITE HD20-13 30 Volt DC, 1500 Watts
AIRCRAFT PORTABLE G-18 110 Volt DC, 3000 Watts
Gonk, Tested...
$55.50
$92.50
$125.00

DCEQ 7812 12 Volt DC, 750 Watts
$89.50

WRITE TODAY FOR QUOTATION ON YOUR DYNAMOTOR OR INVERTER NEEDS!

METERS
0-150 Volt 400 Cycle 5/8" Round...
0-5 Amp, AC 3" Id. 0-100 A. Scale...
0-150 Volt 400 Cycle, 200 Volt AC...
0-5 Milliamper DC 5/8" Square...
0-5 Volt 3/8" Rd. w/0-15 & 0-600 DC Volt Scale...
$2.95
$3.95
$3.95
$2.95
$3.95

SELENIUM RECTIFIER UNITS
HEAVY DUTY—30 Volt DC OUTPUT...
TYPE 143 w/Transformer & VR 100 amp...
TYPE 3FB-5 w/Transformer, VR & Blower 200 amp...
TYPE 32A-11 Rectifier only, Closed 200 amp...
TYPE A1 Rectifier only, Closed 300 amp...
TYPE RE-0 Rectifier only, Closed 600 amp...
$98.50
$98.50
$49.00
$59.50
$59.50
$59.50

HAMMETT RECTIFIER
MODEL SBR-100 12—Input 120 Volt AC 0 cycle 1 Phase 12 Amperes Output DC 15/30 Volts 150/200 Amperes Price—NEW...
$116.00

Write Dept. E • • • All Prices Arc F.O.B.
Lima, 0. 25% Deposit on C.O.D. Orders
FAIR RADIO SALES
132 S. Main St.
LIMA, OHIO

RADIO & RADAR EQUIPMENT
Prompt Shipment
BRAND NEW
2432 West 3rd St. Cleveland 13, Ohio

G.O.V.'S SURPLUS
Ceramicals, micas, bathubs, oils, sockets, trimmers, chokes, Xformers, pots, relays, synchros, Link Xmitters. EMPIRE ELECTRONICS
Box 102
LEFFERTS STATION, BROOKLYN 25, N. Y.

HIGH TENSION CABLE
Portable. Shielded. #10 AWG. Neoprene Jacket. Will bury 25,000 VAC or 35,000 VDC.
$364.00/1000-ft.
CUNNINGHAM ENGINEERING CO.
Beaumont, Texas
SELENIUM RECTIFIERS and ASSOCIATED COMPONENTS

SINGLE PHASE
Full Wave Bridge

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Current</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1-30</td>
<td>200 Ma</td>
<td>$4.95</td>
</tr>
<tr>
<td>B1-30</td>
<td>1.0 Amp</td>
<td>2.49</td>
</tr>
<tr>
<td>C1-10</td>
<td>100 Ma</td>
<td>6.95</td>
</tr>
<tr>
<td>C1-50</td>
<td>100 Ma</td>
<td>6.95</td>
</tr>
<tr>
<td>B1-10</td>
<td>0.5 Amp</td>
<td>4.95</td>
</tr>
<tr>
<td>B1-20</td>
<td>0.5 Amp</td>
<td>4.95</td>
</tr>
<tr>
<td>B1-30</td>
<td>0.5 Amp</td>
<td>4.95</td>
</tr>
<tr>
<td>B1-40</td>
<td>0.5 Amp</td>
<td>4.95</td>
</tr>
<tr>
<td>B1-50</td>
<td>0.5 Amp</td>
<td>4.95</td>
</tr>
<tr>
<td>B1-60</td>
<td>0.5 Amp</td>
<td>4.95</td>
</tr>
</tbody>
</table>

Input: 0-18 VAC  Output: 0-12 VDC

Power Supplies

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Current</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td>GP410</td>
<td>0-4 VDC</td>
<td>$49.50</td>
</tr>
<tr>
<td>GP510</td>
<td>0-12 VDC</td>
<td>$78.50</td>
</tr>
<tr>
<td>GP520</td>
<td>0-28 VDC</td>
<td>$85.00</td>
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Full Wave Center Tap

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Current</th>
<th>Price</th>
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<tbody>
<tr>
<td>C1-10</td>
<td>100 Amp</td>
<td>$6.95</td>
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<tr>
<td>C1-50</td>
<td>100 Amp</td>
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<td>B1-10</td>
<td>50 Amp</td>
<td>7.95</td>
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<td>B1-50</td>
<td>50 Amp</td>
<td>12.95</td>
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Three Phase

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Current</th>
<th>Price</th>
</tr>
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<tbody>
<tr>
<td>C1-30</td>
<td>150 Amp</td>
<td>$9.95</td>
</tr>
<tr>
<td>C1-60</td>
<td>150 Amp</td>
<td>18.95</td>
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</table>

Rectifier Capacitors

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Volts</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-10</td>
<td>15 VDC</td>
<td>$1.95</td>
</tr>
<tr>
<td>C1-30</td>
<td>30 VDC</td>
<td>$3.95</td>
</tr>
<tr>
<td>C1-50</td>
<td>50 VDC</td>
<td>$7.95</td>
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Rectifier Transformers

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Volts</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-10</td>
<td>15 VDC</td>
<td>$1.95</td>
</tr>
<tr>
<td>C1-30</td>
<td>30 VDC</td>
<td>$3.95</td>
</tr>
<tr>
<td>C1-50</td>
<td>50 VDC</td>
<td>$7.95</td>
</tr>
</tbody>
</table>

Rectifier Mounting Brackets

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Current</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-10</td>
<td>100 Amp</td>
<td>$5.95</td>
</tr>
<tr>
<td>C1-50</td>
<td>100 Amp</td>
<td>10.95</td>
</tr>
</tbody>
</table>

Catalog

Write for our Catalog No. 738, which lists additional Selenium Rectifiers, associated transformers, condensers and filter choices.

WESTINGHOUSE HIPERSIL CORES

Over 40,000 units in 20 dimensions, several gauges: up to 16,000 units in some sizes. Available for immediate delivery. Send for list with complete descriptions.

RAYTHEON MFG. CO.
Surplus Sales Dept. Waltham, Mass.
Tel. Waltham 5-5860-Ext. 2

WHOLESALE ONLY
Electro-Nuclear Components Aircraft Equipment Hydraulics Radio & Electronic Supplies

13933-9 B3 Detroit 3, Mich.
Phone Townsend 2-3343

McColpin Christie RECTIFIERS
model MH 24-25 list price $215.00
SAVE OVER 75%
OUR PRICE $49.50

BRAND NEW — ORIGI
AL PACKAGING
input—230 volts, 3 phase, AC output—24-28 volts, 25 amps DC
Copper sulphide type, Heavy duty.
Produces 6 phase, full wave, smooth DC.
Less than 2% ripple, withstand shocks and momentary overloads. Size 13" x 13" x 19".
Weight 85 lbs.

LEO SAGAL CO.
437 CLOVERDALE AVE.
LOS ANGELES, 36, CALIFORNIA

NEW HOLTZER-CABOT TOTALLY ENCLOSED MOTORS
50 H.P.M. Reciprocating Single Phase
Capacitor-Run Type
115 Volts AC 60 cycle 0.3 Amp.
Torque 10 inch lbs.
Aluminum, shank 1/4" dia., 250 feet (16.10 cent.
SAMPLE $17.20

GRAIN OF WHEAT LAMPS

Gall for illuminating meters, compass dials, airplane instruments, etc. Bidding up in range from base to use in models, doll houses, miniature trains, etc. Prices: Mazda G.E. 323 Mazda G.E. 328 3V 8-28 $1.20 per dozen. Special prices...

MARKTIME 3 HOUR SWITCH
3 amp. time delay. Politer mountable to turn off after time elapses. Ideal for deactivating off radios and TV sets when you go on or off the job. Telechron supply especial price...

Is also available in 30 min. and 1 hr. at...

ISOLATION TRANSFORMER $1.95
Nat. Ironcore Mfrs. 50 volts 30 amp. 115 V. to 115 V. 60 cy. Ideal to prevent shocks from small radio and television and electronic devices.

Shipping Weight 5 lbs.

Kilowatt Demand Meter Totalizer containing three dials. totaling kilowatt hours and millions of watt hours, etc. Shipping weight 2 lbs...

Fractional H.P. Motor Brushes & Springs assorted Strom is full for any motor.

RUSSELL 1280 AC MOTORS...

GONIOMETERS

We are Authorized Wholesalers for Micro Switch Corp., and carry the largest stock of Allied Bradley Selenium, Parker & Brownfield Relays, Guardian Electric Co., Relays and Relais and Brownfield Clock motors in the state. Electric Coils.

EST. 1923
EST.
1923

BLANK NO.
Experimenters and Inventors Supplies
16 12 St., New York 7, N. Y.

If there is anything you want or something you don't want that readers can supply, write to...

Searchlight Section

September, 1950 — ELECTRONICS
TELEVISION CAMERA
350 line resolution. Easily converted to present RMA standards. Circuits available with complete, like new.

FLASH: 50 APN-9
LORAN RECEIVERS
WE ARE LOOKING FOR ALL TYPES OF RADAR AND AIRCRAFT RADIO EQUIPMENT
We want...

MIRROR - front surface aluminized on optical glass 1 3/16" diameter 3/16" thick...

PRECISION LEVEL - interior ground tube level with 4 adjusting screws. Overall length 1/4", diam 1/8". One end with square 1/4" diam 1/8".

DELCO BLOWER - strobe type D.C. Flange diameter 3.5-1/16". RPM @ 12 volts 2400 RPM @ 6 volts 1600. $1.95.

SELENIUM RECTIFIERS - G.E. model 9DA 525A maximum A.C. volts 56 D.C. amps. 5.100..............$1.00.

CIRCUIT BREAKER - 20 amp 30 volt D.C. O-H Cat. #57414..............$1.10.

GLASS YALI - to use as a permanent level on equipment..................$1.00.


Lamp Assembly C290. Geni. Made by Eastman Kodak with Iris Diaphragm 12 volt lamp.............$1.00.

WATTHOUR METER SINGLE PHASE - G.E. type 1-16 two wire 2 amp. 110 volt 50 cycle..................$5.75.

SEND FOR FREE BULLETIN

TELEPHONE DIRECTORY, 6-6843
ELECTRONIC MECHANICAL & ELECTRONIC COMPONENTS

ALL PRICES F.O.B. N. Y. CITY

CALLING ALL ENGINEERS!

TELEVISION CAMERAS

BATH TUB CONDS.

<table>
<thead>
<tr>
<th>Capacity</th>
<th>Voltage</th>
<th>Terminals</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 in</td>
<td>600 V</td>
<td>ST</td>
<td>2.25</td>
</tr>
<tr>
<td>30 in</td>
<td>600 V</td>
<td>ST</td>
<td>2.25</td>
</tr>
<tr>
<td>36 in</td>
<td>600 V</td>
<td>ST</td>
<td>2.25</td>
</tr>
<tr>
<td>42 in</td>
<td>600 V</td>
<td>ST</td>
<td>2.25</td>
</tr>
</tbody>
</table>

**NEW SILVER MICA CONDS.**

<table>
<thead>
<tr>
<th>Size</th>
<th>Voltage</th>
<th>Terminals</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>3000, 5000, 10,000, 20,000, 30,000, 50,000, 100,000, 200,000</td>
<td>ST</td>
<td>1.65</td>
</tr>
<tr>
<td>2000</td>
<td>3000, 5000, 10,000, 20,000, 30,000, 50,000, 100,000, 200,000</td>
<td>ST</td>
<td>1.65</td>
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**MOLDED PAPER CONDS.**

<table>
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<tr>
<th>Size</th>
<th>Voltage</th>
<th>Terminals</th>
<th>Price</th>
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<td>1.000</td>
<td>3000, 5000, 10,000, 20,000, 30,000, 50,000, 100,000, 200,000</td>
<td>ST</td>
<td>1.65</td>
</tr>
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</table>

**MICA POTTERY WITH MICA**

<table>
<thead>
<tr>
<th>Size</th>
<th>Voltage</th>
<th>Terminals</th>
<th>Price</th>
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<tbody>
<tr>
<td>3.000</td>
<td>3000, 5000, 10,000, 20,000, 30,000, 50,000, 100,000, 200,000</td>
<td>ST</td>
<td>1.65</td>
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**MICA PAPERS WITH MICA**

<table>
<thead>
<tr>
<th>Size</th>
<th>Voltage</th>
<th>Terminals</th>
<th>Price</th>
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<tbody>
<tr>
<td>3.000</td>
<td>3000, 5000, 10,000, 20,000, 30,000, 50,000, 100,000, 200,000</td>
<td>ST</td>
<td>1.65</td>
</tr>
</tbody>
</table>

**COAX CONNECTORS**

8-85P
8-85FN

**TEST & POWER EQUIP.**

Freq. Meter Type TS-6/0.09/100-2400 Dc/DC, 200 milliamp. $12.00.

**RADIO LABORATORIES**

**MONMOUTH**

**CONDNERS SPECIAL**

~5 atm 400V dfc Oil Cond.

**OIL CONDENSERS—New**

<table>
<thead>
<tr>
<th>Symbol Cap</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>000</td>
<td>150V</td>
</tr>
<tr>
<td>B.</td>
<td>000</td>
<td>180V</td>
</tr>
<tr>
<td>C.</td>
<td>000</td>
<td>200V</td>
</tr>
<tr>
<td>D.</td>
<td>000</td>
<td>250V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol Cap</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>200</td>
<td>200V</td>
</tr>
<tr>
<td>B.</td>
<td>200</td>
<td>250V</td>
</tr>
<tr>
<td>C.</td>
<td>200</td>
<td>300V</td>
</tr>
<tr>
<td>D.</td>
<td>200</td>
<td>350V</td>
</tr>
</tbody>
</table>

**PRICE $5.50—CARTON of 24 $4.50**

WATTHEAT METER SINGLE PHASE - G.E. type 1-16 two wire 2 amp. 110 volt 50 cycle..................$5.75.

MANUFACTURED BY

COLUMBIA ELECTRONICS LTD.
524 S. SAN PEDRO ST.
LOS ANGELES 13, CALIF.
Cable Address: COLELECT

ELECTRONICS — September, 1950
SEARCHLIGHT SECTION

GENERATOR: Generator 91-119 v. r. c. 75 W. 40% P.F. 1200 watt.
     single phase, 800 c, 48 2400 RPM.
     Output 25 x 28.5, 40 c.
     Res. 64% dia. 138% O.A. length incl. 25% split
     shaft 25° long. Flange mounting. Wt. 48 lbs. Rotation
     counter clockwise viewed from drive end. Generators are
     self excited. Brand new in original boxes. Mfr. by
     Bendix. Retail Price $57.50 ea. 2 for $90.00.
RECEIVERS
Copper Subbase, F.W.V. 35 v. r. c. In. 1.8 v. d. c. @ 1
     amp. out. (Five 90 12, r. c. filament). New, Brand
     $5.00 each, 10 for $45.00, 100 for $400.00.

TUBES:
Discount 29% on
orders over $50.00
1022 45-75 719A 6.50
1321 58 719A 9.48
2320 87 721A 7.50
3922 3.50 722A 7.50
3907 19.50 75418 1.85
3011 7.00 75419 1.95
3616 7.00 75419 1.95
701 A 3.50 772A 1.75
701 A 3.50 772A 1.75
701 A 2.75 770A 1.75
701 A 2.50 770A 1.50
701 A 2.00 745A 1.25
701 A 1.00 743A 0.75
701 B 12.50 751A 1.25
701 B 2.00 WE
701 A 2.75 203A 8.75
713A 4.25 204 8.75
714X 3.75 (REC) 12.50
714A 2.50
SPECIAL: Reciprocators, West-
     inghouse History Charge
     Tube, 6 amp. 65 c. Cat.
     34561 EL28A. New
     orig. box. $1.50 each, 4 for
     $5.00.
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     house, 31-in. surf., 4 heat-
     oil. 115, 200, 400, and
     600 watt. 118° to
     400°. Price each $17.25.
     (Two price $34.50 each.
     2 for $69.00.

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     Mfr. by Donald Equipment Co.
     Special rating 600 to 32,000 BPM.
     New blank lined tube with 3-amp.
     and
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     voltage test. New, original
     $65.00 ea. 2 for $110.00.

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RADIO TRANSMITTING TUBES

<table>
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<tr>
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<th>PRICE</th>
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<tr>
<td>807</td>
<td>$1.20</td>
<td>IN CARTONS</td>
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<tr>
<td>805</td>
<td>$4.75</td>
<td>&quot;</td>
</tr>
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<td>813</td>
<td>$7.50</td>
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<tr>
<td>1622</td>
<td>$1.35</td>
<td>&quot;</td>
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<tr>
<td>954</td>
<td>$0.10</td>
<td>IN BULK</td>
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**Note:** This is an index page from the September 1950 issue of *Electronics* magazine. It lists manufacturers and companies that produce various types of electrical components, including coils. The page is a part of the "Professional Services" section and includes a list of advertisers. The text is arranged in a table format, with each company listed on a separate line along with the page number where the company is located in the magazine. The index is designed to help readers quickly find information about specific companies or products. The page also includes a list of professional services and equipment for sale. The information is likely to be useful for engineers and technicians looking for specific components or companies in the electronics industry.
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