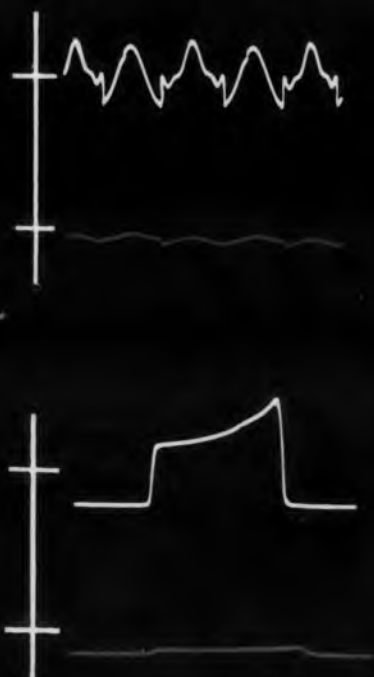


# ELECTRONIC

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**T**WENTY-FIVE new type subminiature high-output diodes can be mounted on a 1/4 sq in plate. Upper curves compare two conventional with two new diodes as to null voltage outputs in a balanced bridge rectifier circuit. Flatness of the red curve indicates extreme uniformity of the new units. Lower curves compare forward drop with a 100ma, one microsecond pulse applied.

**September 1954**

# FREED MAGNETIC AMPLIFIERS

## Series MAFS

*Designed for high-performance control systems*

### TWO CYCLE RESPONSE TIME — DRIFT-FREE

The Freed MAFS series of Magnetic Amplifiers is characterized by

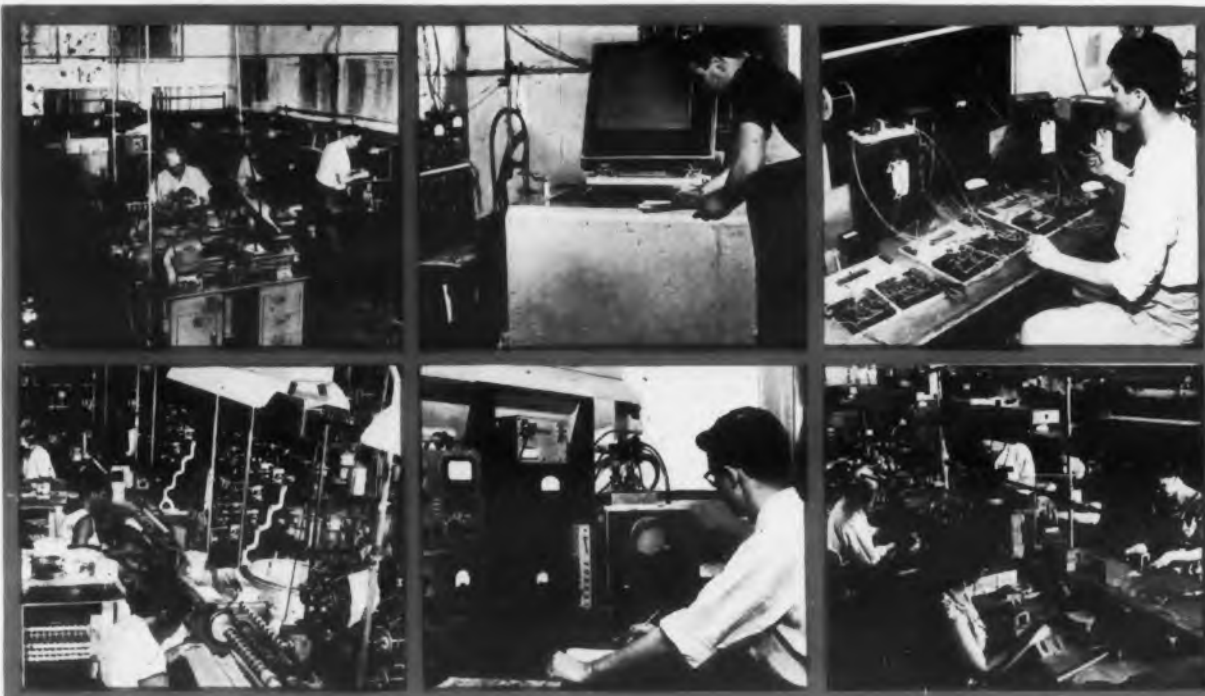
- **FAST RESPONSE** — 2 cycles of power frequency delay for 100% response to step input signal.
- **PHASE REVERSIBLE A.C. OUTPUT WITH ZERO DRIFT OF NULL POINT**

The MAFS series includes the units described below. Engineering and development facilities are available for the design and development of Magnetic Amplifiers having special performance characteristics.

FAST-RESPONSE MAGNETIC AMPLIFIERS — DRIFT-FREE								
Supply Voltage and Frequency	Full Power Output	Max. Voltage Output	Signal Req. for full output	Max. Power Gain	Mfr. and Type No.	Typical Motor Load Stall Torque	No Load Speed	FREED Type No.
115V., 60	15 watts	115V. AC phase reversible	.IV. AC (10,000 ohms input impedance)	$1.5 \times 10^7$	Diehl FPE 25-11	5.5 in-oz	3500 RPM	MAFS-1
115V., 400	5	57.5V. AC phase reversible	.IV. AC (10,000 ohms input impedance)	$5 \times 10^6$	Kearfott R 110-2	1.5	5300	MAFS-2
115V., 400	10	57.5V. AC phase reversible	.IV. AC (10,000 ohms input impedance)	$1 \times 10^7$	Kearfott R 111-2	2.4	5300	MAFS-3
115V., 400	50	115V. AC phase reversible	.IV. AC (10,000 ohms input impedance)	$5 \times 10^7$	Bendix CK-3000	14	3700	MAFS-4

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**FREED RESEARCH**, Engineering and Production Facilities Combine to Produce Transformers and Instruments of Top Performance.



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Freed Magnetic Amplifiers, Saturable Transformers and Reactors are designed for efficient operation and long life. They can be used wherever reliable, rugged and maintenance free systems are required.

The types of amplifiers listed are designed to control AC servomotors.

Development facilities are available for the design of magnetic amplifiers to meet specific requirements.

All standard units are hermetically sealed and meet MIL-T-27 Specifications.

**SATURABLE TRANSFORMERS** — Controlled with dual triode, plate supply can be either DC or AC; no rectifiers; AC or DC control signals.

**PUSH-PULL MAGNETIC AMPLIFIERS** — AC or DC control signals; high gain; may be used with magnetic or vacuum tube preamplifiers if needed.

**FAST-RESPONSE MAGNETIC AMPLIFIERS** — High gain; half-cycle per stage response time; AC or DC control signals; RC feedback networks for control system stabilization can be used directly; preamplifier not needed.

**HIGH TEMPERATURE MAGNETIC AMPLIFIERS** — Designed to operate in ambient temperatures as high as 200°C.; AC or DC control signals.

**DRIFT-FREE MAGNETIC AMPLIFIERS** — For rigid drift-free requirements of control systems; designed to meet specific requirements.

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- High Fidelity
- High Level Pulse
- High Q Toroids
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- Step-down
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- High Q Reactors
- High Temperature
- Miniature Audio
- Charging Reactors
- Sub-miniature
- Precision Reactors
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### Advertising Representatives

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 James S. Mulholland, Jr.,  
 Blair McClenachan  
 127 East 55th St.,  
 New York 22, N. Y.  
 PLaza 3-8677

**Chicago:** Thomas P. Kavooras  
 664 No. Michigan Ave.  
 Chicago 11, Ill.  
 SUperior 7-8054

**Los Angeles:** Robert E. Ahrensorf  
 1140 Wilshire Blvd.  
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# ELECTRONIC

*design*

Vol. 2

No. 9

September 1954

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**NBP**

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## Here's a low-cost solution to your high-precision timing problems

The New Potter Model 432 Interval Timer is a general-purpose instrument for timing relays, camera shutters, high-speed machine operations, and for calibrating electrical and mechanical timing devices. It is simple to operate—even an unskilled operator can make interval measurements to within 0.00001 second.

**Versatile Input Circuits** permit measurement of time between any combination of voltage changes, contact opening, or contact closure, thus accommodating a wide variety of timing problems.

**Timing Is Achieved by Electronically Counting** the number of pulses produced by a high-frequency crystal-controlled time-base oscillator during the unknown interval. Three time-base frequencies (1, 10, and 100 kc) are provided for making measurements in increments of 0.01, 0.1, and 1 millisecond. Results are displayed directly in milliseconds with an illuminated decimal point—misinterpretation of readings is virtually impossible.

**Maximum Timing Range** of the 432 is 1 second; this can be extended to 1,000,000 seconds by addition of a mechanical register (available as an optional feature). The 432 also serves as a totalizing counter (can be used to count relay contact bounces) and as a secondary frequency standard with outputs of 100 kc, 10 kc, 1 kc, 100 cps, 10 cps, and 1 cps for general laboratory use.

**Descriptive Literature Is Yours** for the asking. Write today and see how this compact, low-cost instrument can solve your timing problems with greater accuracy and convenience.

**Potter** POTTER INSTRUMENT COMPANY, INC.

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# HIGH SPEED SWITCHES

for High Power Pulsed Modulators

for High Power Electron Tube Protection

## Machlett Hydrogen Thyratrons

ML-5949/1907 • ML-5948/1754



Hydrogen Thyratrons answer the need for high speed switching of high peak power combined with simplified circuitry: zero bias . . . broad hold-off voltage range . . . extremely rapid change from non-conducting to conducting state . . . broad ambient temperature range.

### Typical Operation

	ML-5949 1907	ML-5948 1754	
Plate voltage, forward, epy . . . . .	25	25	KV max.
Plate voltage, inverse . . . . .	5	5	KV max.
Peak current, ib . . . . .	500	1000	amps max.
Pulse repetition rate, prr . . . . .	450	360	pps
Pulse duration (nominal) . . . . .	2.0	2.5	usec
epy × prr × ib* . . . . .	$6.25 \times 10^9$	$9.0 \times 10^9$	

\* epy × prr × ib is the product of maximum forward plate voltage by pulse repetition rate by maximum pulse current. The maximum limit is determined to hold average tube dissipation to a reasonable maximum value.

### Protective Circuits Described

Hydrogen thyratrons as high speed shunting switches are described in Cathode Press, Vol. 11, No. 1, 1954. Write for a copy.

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Springdale, Connecticut



Over 55 years of electron tube experience!

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## Editorial . . .

### The Quiet Revolution

For some time now, a slow steady change has been taking place in electronic devices as a result of two relatively recent developments in the field. One of these is a component and the other a production technique. Both are so basic that their adoption is causing a "quiet revolution" in the electronic industries. We are, of course, referring to the transistor and the use of printed circuit techniques.

Of these two developments, the transistor has produced the lesser impact as far as commercial applications are concerned. Cost, availability, limited frequency range, and lack of standardization are some of the reasons why many designers have been reluctant to use transistors. Through intensive research and development programs on the part of transistor manufacturers, all of these deterring factors are rapidly being corrected. Before too long we should see many new commercial applications of transistors on the market.

Printed circuit techniques, on the other hand, have gained a fair amount of acceptance among designers. Test instruments, small phonograph amplifiers, larger audio amplifiers, a-m/f-m receivers, computers, and TV receivers are some of the places where printed circuit techniques are being employed. One TV set manufacturer has designed his set using sectionalized printed circuits throughout, and a French TV receiver has been publicized that has the entire chassis printed on a single sheet of laminate material. All kinds of interesting schemes are being tried. The next several issues of ELECTRONIC DESIGN will cover some of these design ideas in detail.

This revolution, though quiet in the sense that not much publicity has been given the commercial applications of these developments, is none the less real. It is up to the designer to make his company aware of this trend and to lead management out of its interior by thoroughly investigating the possibilities of these developments for his particular product line.

ELECTRONIC DESIGN • September 1954

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# Engineering Review ...

**TV of the Future . . .** The television receiver of 1964 is envisioned as having a picture screen so thin that the complete unit could be hung on the living room wall like a painting. The circuitry would be built into the picture frame and would use printed wiring and miniaturized components. Controls would be located in a small box besides the viewer's chair.

For those who might prefer a table model, the thin picture screen would be mounted, like a vanity mirror, attached to slender arms extending upright from a small cabinet that would house the circuitry.

As explained by Dr. Lloyd T. DeVore, manager of the General Electric Company's Electronics Laboratory, the "picture on the wall" concept stems from a complex project to speed the plotting of aircraft in military filter centers. At present, this aircraft plotting is done manually. Plotting would be automatic with a thin-type screen. Development of speedier switching techniques and new fast-reacting phosphors are needed before the thin-type screen can be applied to TV sets.

**Scientist Honored . . .** For his invention of the zirconium concentrated-arc lamp, Mr. William D. Buckingham of the Western Union Telegraph Company has been awarded a John Price Wetherill Medal by the Franklin Institute, Philadelphia 3, Pa. The device produces a high-intensity, sharply defined, extremely small beam of light with modulation characteristics unobtainable at the time of its invention.

**Compact Airborne Radar . . .** A new airborne radar that can spot storms up to 150 miles ahead is being installed on Pan American-Grace Airways' new fleet of Douglas DC-7's. Designated the Type RDR-1, the equipment operates in the X-band (3.2cm).

Manufactured by Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md., the design of the radar is based on this firm's military weather radar. The five-unit system weighs 136-1/2 lb. Power output for a pulse width of 2.0  $\mu$ sec is 40kw peak. The repetition rate is 400pps. Beamwidth is 3.8°.

Sweep ranges available on the point position indi-

cator are 0-20, 0-50, and 0-150 miles, with range marks at 5, 10, and 25 miles. The nose-mounted 22" diam antenna is gyro-stabilized. While designed primarily for weather purposes and as a storm-warning device, the radar has provisions for ground beacon navigation and terrain radar mapping.

**Tri-Element Atomic Battery . . .** By adding a third element to an atomic battery, the Ohmart Corporation has produced a cell in which a varying signal applied to this control element results in a variation in current output of the cell. Acting very much like the grid of a vacuum tube, the added element converts the battery into a self-powered amplifier with wide application possibilities. A photograph of the unit and cross-section are shown below.

The radioactive source is strontium-90, a long-life

The tri-element atomic battery shown below can act as a self-powered amplifier. A cutaway diagram of the battery is given at the right.

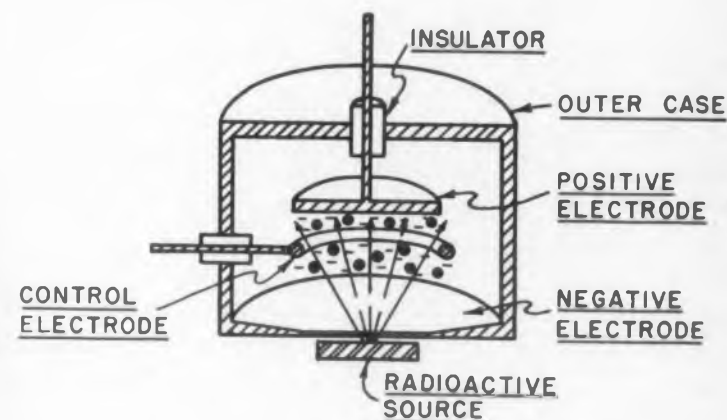


isotope. Although it is a waste product of atomic reactors, this atom source is very expensive at present. It is also employed in this firm's two-element atomic battery. The efficiency of utilization of the isotope is not very high and should be increased with further development.

In the first version of the tri-element type, the control element is in the form of a metallic ring and the enclosure is filled with argon gas as a separating medium. With a load resistor of  $10^{11}$  ohms, the amplification factor is 0.075 within the range of control element potential of -12 to zero volts and 0.28 when the potential is +2 to +10v. Argon is a more suitable separating medium than air, which has also been tested.

The amplification factor can be increased by making the control element in the form of a grid instead of a ring and by increasing the density of the separating medium. A semi-conductor could serve as the required separating medium.

The Ohmart Corporation, located at 2236 Bogen St., Cincinnati 14, Ohio, has developed some applications for the device. One, in which the cell serves as a transducer to match a low impedance to a high impedance, is in a small, all-electronic integrating device. The firm's two-element battery, which has an adjustable output, has already been widely applied in industry to furnish constant currents for reference purposes. One application is in a density gage for pipe lines to determine what fluid is flowing in the line. This gage is manufactured by Ohmart. The battery can also be used as a standard cell.



**Radio Research Laboratory . . .** A new multimillion dollar radio research laboratory is being established at Boulder, Colo. by the National Bureau of Standards, Washington 25, D. C. The NBS already maintains a number of transmitting antennas for research purposes in the same area.

The laboratory will continue efforts for more effective utilization of the available spectrum and compile information about the characteristics of radio energy under diverse conditions.



## Engineering Review . . .

**Millionth Transistor . . .** Raytheon Manufacturing Company has produced its one-millionth transistor. The great majority of the firm's output has gone into hearing aids, where field failures are running at the low rate of less than 2% per year. This compares with a failure rate of about 2% for subminiature tubes in the same service. The transistors were produced at Raytheon's Receiving Tube Div., 55 Chapel St., Newton 58, Mass.

**Electronic Air Traffic Control . . .** The latest development in air-ground communications receives messages on flight plans and the weather, answers them within minutes where necessary, and stores the information for future use—all without human intervention. Known as the "Message Storage and Processing System", it was recently installed at the Civil Aeronautics Authority Technical Development and Evaluation Center at Indianapolis, Indiana.

Developed by the Engineering Research Associates Div., Remington-Rand, Inc., 315 Fourth Ave., New York 10, N. Y., it is estimated that 12 to 15 such installations can service all the major aircraft traffic centers in the nation. The system automatically receives coded messages from several remote points by teletypewriters, examines these messages and performs clerical operations on them, files up to 2000 such messages on a magnetic drum reference, locates any desired message and causes it to be typed out at one or more remote points, and discards any message when notified that it is not needed.

Using a magnetic memory drum, information on departure times, fuel loads, destinations, routes, pay-loads, and other data is compared with other flight plans already recorded on the drum. Existing plans are then revised, cancelled, or brought up to date, according to the circumstances. The system will warn automatically of possible emergency situations when a position report has not been received within a specified time interval after a flight has been estimated over a fix.

**Electronic Farming . . .** In order to harvest crops at the optimum time, two-way radios are being employed by a large food processor to direct harvesting equipment. The system is applied to the harvesting of such delicate crops as beans and peas, which reach and remain at peak quality for only a few hours.

Gibbs Foods of Quarryville, Pa., has four vehicles equipped with communication gear supplied by Radio Division, Bendix Aviation Corp., Baltimore, Md.

## G. E.'s

## LATEST CONTRIBUTION TO



# STACKED

## CUSTOM BUILT TO PROVIDE 143 POWER COMBINATIONS!



- ★ **Smallest unit size yet developed!**
- ★ **Most reliable performance of any rectifier within this category!**
- ★ **Hermetically sealed for lifetime use!**

The following germanium rectifier stacks, each occupying a volume of only 1.62" x 2.5" x 6.00", are typical of the 143 standard stacks in G. E.'s new rectifier line.

CIRCUIT	D.C. OUTPUT (55°C Resistive Load)
Half Wave . . . . .	2 amps @ 280 volts or 3 amps @ 190 volts
Full Wave Center Tap . . . . .	2 amps @ 280 volts or 3 amps @ 190 volts
Full Wave Bridge . . . . .	1 amp @ 565 volts or 3 amps @ 210 volts
Three Phase Half Wave . . . . .	1.12 amps @ 420 volts or 4.5 amps @ 140 volts
Three Phase Bridge . . . . .	1.3 amps @ 575 volts or 2.6 amps @ 280 volts
Three Phase Star . . . . .	1.8 amps @ 280 volts or 3.6 amps @ 140 volts



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Designed and built to deliver new *power performance*, the G-E Stacked Rectifier is 75% less by volume and weight than any other comparable dry type rectifier. And, rectifier losses are reduced to one-third or less of those encountered with any other type of rectifier. You can count on extreme reliability... tested for compliance to 10,000-hour standards. Note also that there are no forming or aging effects.

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Electronics Park, Syracuse, New York



★ ★ ★ GENERAL  ELECTRIC

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**Instruments for Rent . . .** Small electronic manufacturers can now utilize expensive electronic instruments for laboratory or production use by renting them. Polarad Electronic Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y., will rent valuable instruments at a monthly rental that is only a small fraction of their price.

The plan is particularly useful when some instrument is only required for a short time. A purchase option is available with the rental plan. Under the separate option contract, most of the rental charge may be applied towards eventual purchase.

**Computer Clinic . . .** An Electronic Computer Clinic will be held in conjunction with the First International Automation Exposition at the 244th Regiment Armory, 14th St., New York City, from November 30 to December 2, 1954. The clinic is a lecture and demonstration course on both digital and analog computers.

The course is planned for personnel who contemplate using computers in the laboratory or plant. Advance registration is required. Attendance at the sessions will be restricted in size. Sessions will be repeated up to a maximum of nine times to accommodate registrants. The registration fee is \$5.00, payable in advance. Registration forms may be obtained from Richard Rimbach, Electronic Computer Clinic, 845 Ridge Ave., Pittsburgh 12, Pa.

**Eight-Hour Magnetic Tapes . . .** Magnetic recording tapes that run continuously for eight hours are now being offered to provide music in stores, factories, etc. The tapes are manufactured by Magne-Tronics, Inc., 122 E. 42nd St., New York 17, N. Y.

**Antenna Rating System . . .** A new antenna rating system known as the "Signal-to-Noise Figure of Merit Rating" has been proposed by Douglas Carpenter, Chief Antenna Engineer, JFD Manufacturing Company.

Five basic antenna functions, (1) horizontal polar pattern, (2) front-to-back and side ratio, (3) terminating impedance, (4) gain, and (5) vertical polar pattern, were selected to be considered in composite form to create the specific value designated "Signal-to-Noise Figure of Merit Rating". For each characteristic, an optimum level was established. A theoretically perfect antenna would be rated 100%, made up of a maximum of 20% for each of the factors.

A six-page brochure entitled "Signal-to-Noise Figure of Merit", is available from JFD Manufacturing Co., Form No. 287, 6101-16th Ave., Brooklyn 4, N. Y. It is complete with diagrams, charts, and an actual example of how this system can be applied.





### Taping "Gun"

Electrical harness wrapping is greatly accelerated by using this new "taping gun" to dispense plastic tape. Weighing less than 20 oz with a 36-yard roll of  $\frac{3}{8}$ " tape in the circular magazine, the gun enables an operator to bundle the wires and cut the tape in about one second. Once the tape is threaded around the bundle by the curved tip, it is cut by pressing a thumb button. This tool is marketed by Minnesota Mining and Manufacturing Co., St. Paul, Minn.



### Patch Panel

A removable patch panel for the analog computer at the Analog Computation Center operated by Electronic Associates, Inc., near Princeton, N. J. The Center's facilities are available to industry on a rental basis. Problems can be set up on this panel at the Center or at the client's laboratory while the computer is working on other problems.

## Engineering Review . . .

**Transatlantic Data Processing . . .** Statistical information has been transferred from one punched card to another across the Atlantic Ocean in a recent demonstration. The data was transmitted at the rate of 1000 characters a minute by radio.

The two-way experimental transmission was undertaken by the U. S. Air Force. It linked Port Lyautey, Morocco, and Washington, D. C. The punched cards were fed into a "data transceiver", a new machine developed by International Business Machines Corp., 590 Madison Ave., New York 22, N. Y., which converted the data into electrical signals.

If adopted, the system would eliminate steps in accounting procedures dealing with the deployment of military forces and the distribution of replacement equipment now maintained at Air Force bases. It would materially contribute to the speeding of procedures necessary to move replacement parts to overseas bases.

**High-Fidelity Sales Premium . . .** High fidelity components installed as original equipment in a home like a refrigerator are being used as a sales stimulant by a Dayton, Ohio contractor now developing a suburban residential area. In the model home, the sound equipment is installed in two mahogany panels that flank the fireplace. Behind one panel is the dual coaxial speaker and its enclosure. The amplifier, pre-amplifier, and record changer are located behind the opposite panel. Both panels are set flush in the wall at waist level. The record changer is mounted on a pull-out drawer.

The living room wall in which the equipment is installed divides the garage from the house. Easy

accessibility for servicing is provided by removing the backs of the panels on the garage side. The contractor, G. W. Leekrone & Sons, Inc., plans to equip each home in the development with the "Custom Music Ensemble" manufactured by General Electric Co., Syracuse, N. Y.

**F-M Military Radio . . .** Frequency-modulation radio equipment newly developed for the U. S. Army Signal Corps provides sending and receiving facilities in the frequency range of 100 to 400Mc for relaying a broadband signal of 250 to 68,000cy over a line-of-sight path. One link would require only one set at each end, but where multi-link coverage is desired, one set would be used at each end of the system and two sets would be used at each relay point connected "back to back".

Designated AN/TRC-24, the gear has a 45-ft antenna mast divided into nine easily assembled sections. The antenna consists of two half-wave dipoles, which may be polarized horizontally or vertically. Developed by the Bell Telephone Laboratories, the AN/TRC-24 is manufactured by Western Electric Co., Inc., 195 Broadway, New York 7, N. Y.

**Tiny TV Station . . .** Transmitting over a maximum of only three miles, a tiny 8w TV transmitter at the U. S. Air Force Base, Limestone, Me., provides 10 hours of major network programs daily for the base's 15,000 personnel.

Designed as a morale aid, the station broadcasts in an area not covered by commercial stations. A grant of \$34,000 from the Strategic Air Command's welfare fund paid for the installation, which was designed, built and erected at cost by the Radio Corporation of America. The equipment and studio are housed in a 10' x 13' shack atop the 4-story base hospital.

**Movie on Stamping . . .** A thorough tour of a modern metal stamping plant is shown in "Stampings For Electronics", a 20-minute 16mm color movie available for free showings to technical societies, industrial management, and other interested groups.

The design and construction of accurate progressive dies for subminiature and other sizes of stampings for electronic components is a feature of this filming of the John Volkert Metal Stampings, Inc., plant at 222-34 96th Ave., Queens Village 29, N. Y.

**Tiny Speaker . . .** No larger than a candy bar, the newly developed "Kilosphere" loudspeaker accurately reproduces frequencies in the treble range. The unit is a perforated metal oblong with about 1000 tiny rectangular apertures, encased in a metallized-plastic foil. One of the speakers is shown in the photograph below. It is 5" long by 2" wide by 3/8" thick.

Each of the 1/8" x 25/1000" apertures acts as a speaker when the covering foil is set into vibration by the output from the audio amplifier. Since electrostatic force is applied over the entire speaker instead of a single point, as in conventional cone speakers, the aperture speakers all operate in phase. Distortion due to variations in phase is thus eliminated, and excellent reproduction in the treble range is made possible.

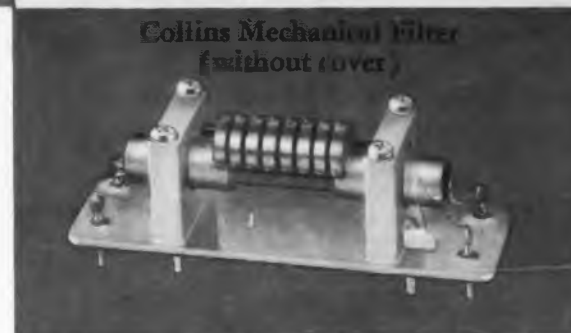
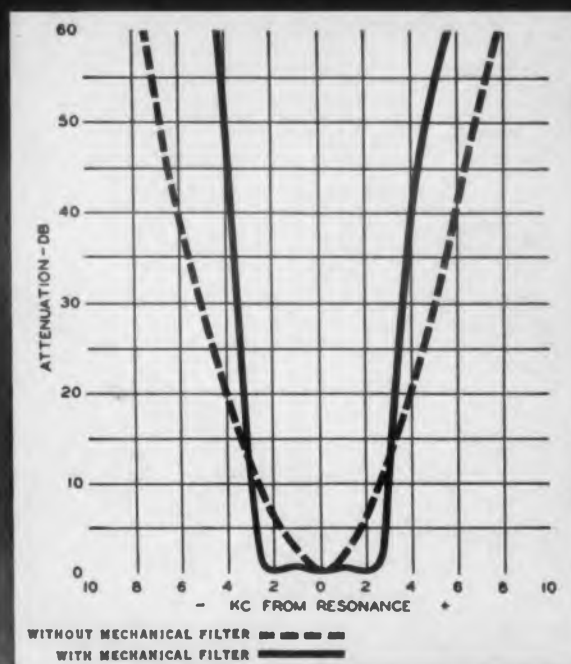
The Kilosphere produces an unusually smooth sound pressure curve in the range from 3000 to 20,000cy. In operation, it is driven from a band-pass filter that eliminates the lower frequencies, which



are reproduced by a conventional "bass" speaker. Developed by Columbia Records, Inc., 799 Seventh Ave., New York 19, N. Y., the new-type speaker is being incorporated in this firm's Type 360 phonograph and in a table-model tape recorder. Two of the Kilospheres and a pair of 6" speakers are mounted in the phonograph. These speakers will eventually be offered to other manufacturers.

For more information on developments described in "Engineering Review", send inquiries directly to the address given in the individual item.

# The Collins Mechanical Filter for MAXIMUM SELECTIVITY



Collins 18S-4  
Transmitter/Receiver



Today's expanded air-ground radio communications have greatly increased the problem of adjacent channel interference. It has become increasingly difficult to control sideband radiation and maintain good channel selectivity.

Collins has solved these problems by incorporating the Mechanical Filter in the Collins 18S-4A HF Transmitter/Receiver. The Mechanical Filter, recently developed by Collins, produces a better signal-to-noise ratio — greatly increases channel selectivity — practically eliminates adjacent channel interference. The effect of the Mechanical Filter on the 18S-4A's selectivity is clearly shown on the accompanying graph.

Collins 18S-4A provides both receiving and transmitting facilities — up to twenty crystal controlled frequencies assigned anywhere in the range of 2.0 to 18.5 mc. Transmitter output, nominally rated at 100 watts cw or voice, is sufficient to assure communication over very long distances. Full remote control is provided over a positive 26-wire system. The proven performance of the Collins 18S Transceivers coupled with the increased selectivity afforded by the Mechanical Filter in the 18S-4A offers aviation the most advanced transmitting-receiving equipment available today.

For additional information on the Collins 18S-3 or 18S-4 or the Collins Mechanical Filter line, now available to industry, contact your nearest Collins office. Technical brochures will be forwarded on request.

For complete information and technical details, contact the Collins office nearest you.

**COLLINS RADIO COMPANY** Cedar Rapids, Iowa

261 Madison Ave.  
NEW YORK 16

1930 Hi-Line Drive,  
DALLAS 2

2700 W. Olive Avenue,  
BURBANK

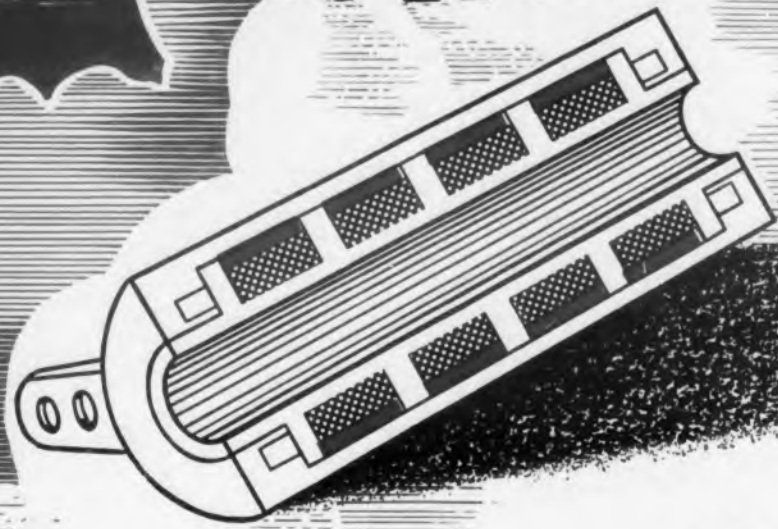
COLLINS RADIO COMPANY OF CANADA, LTD., 74 Sparks Street, OTTAWA, ONTARIO

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# DAVEN TURNS TO AIR



*in a completely new approach*

**to the production of Encapsulated Sealed-Ohm Wire Wound Resistors**

*Only DAVEN* turns to air to keep the molding material absolutely separated from the resistance wire in its new line of Super Davohm Encapsulated Sealed-Ohm Resistors. The wire is maintained in a slot filled with dry air . . . no external pressures are applied to it. These air pockets, between the wire and the plastic coating, guarantee absolute stability . . . eliminate shorted turns.

*Only DAVEN* matches the temperature coefficient of expansion of the molding compound with the ceramic bobbin, the resistance wire and the metal terminals. This removes the possibility of cracks or strains on the wire during cycling.

Because of the special construction used, Daven can furnish Encapsulated Wire Wound Resistors with temperature

coefficients below  $\pm 20$  P.P.M./ $^{\circ}$ C. when required, and with accuracies to  $\pm .05\%$ .

These exclusive Daven precision, wire wound resistors are completely hermetically sealed . . . yet are no larger than standard lug-type resistors.

In addition, these units are made in accordance with MIL-R-93A specifications, and are substantially more rugged than conventional resistors. They will withstand the JAN-R-93, characteristic A, salt-water immersion test, and, in addition, temperature cycling from  $-65^{\circ}$ C. to  $+125^{\circ}$ C. The strong molding material will resist pressures equivalent to 75,000 ft. altitude, and will not cold flow at temperatures up to  $150^{\circ}$ C.

Write for latest Resistor Brochure

THE **DAVEN** CO. 169 Central Ave.  
Newark 4, N. J.

## Engineering Review . . .

**TV-Phone Intercom . . .** A telephone user can see the person with whom he is speaking by using the newly developed TV-Telephone Intercom System. When the person making the call lifts his handset, his image appears on one-half of the 17" TV screen. As soon as the called person answers, his image appears on the other half of the screen.

Kalbfell Laboratories, Inc., P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif., developers of the system, envisage a number of applications. Purchasing agents can use the device for selecting merchandise at a considerable saving in time. Personnel identification and personnel interviews, inter-plant and inter-city conferences can be conducted by TV at considerable savings in time and money.

When the telephone is not being used for communication, the TV monitor can display regular TV broadcasts, closed-circuit transmissions, or subscription TV. For the latter purposes, the image covers the entire screen. The system features a vidicon pick-up tube with circuitry similar to this firm's standard TV camera, which has an 8Mc bandwidth and a horizontal resolution about twice that of standard TV receivers.

The pick-up tube is mounted over the screen and tilted to scan a person seated a few feet away. A simple adjustment enables either party to make the entire screen available. The handset is mounted to the right of the screen.

**Oscillograph Records 12 Parameters . . .** A new 12-element oscillograph for monitoring power lines will wait indefinitely with no parts in motion until a fault occurs, when it will start and come to full recording speed in 2millisee. After it has started, the instrument will continue to run until the fault is cleared. It will then stop, record the time, and reset itself in readiness for the next fault.

The device was described at the recent AIEE Summer and Pacific

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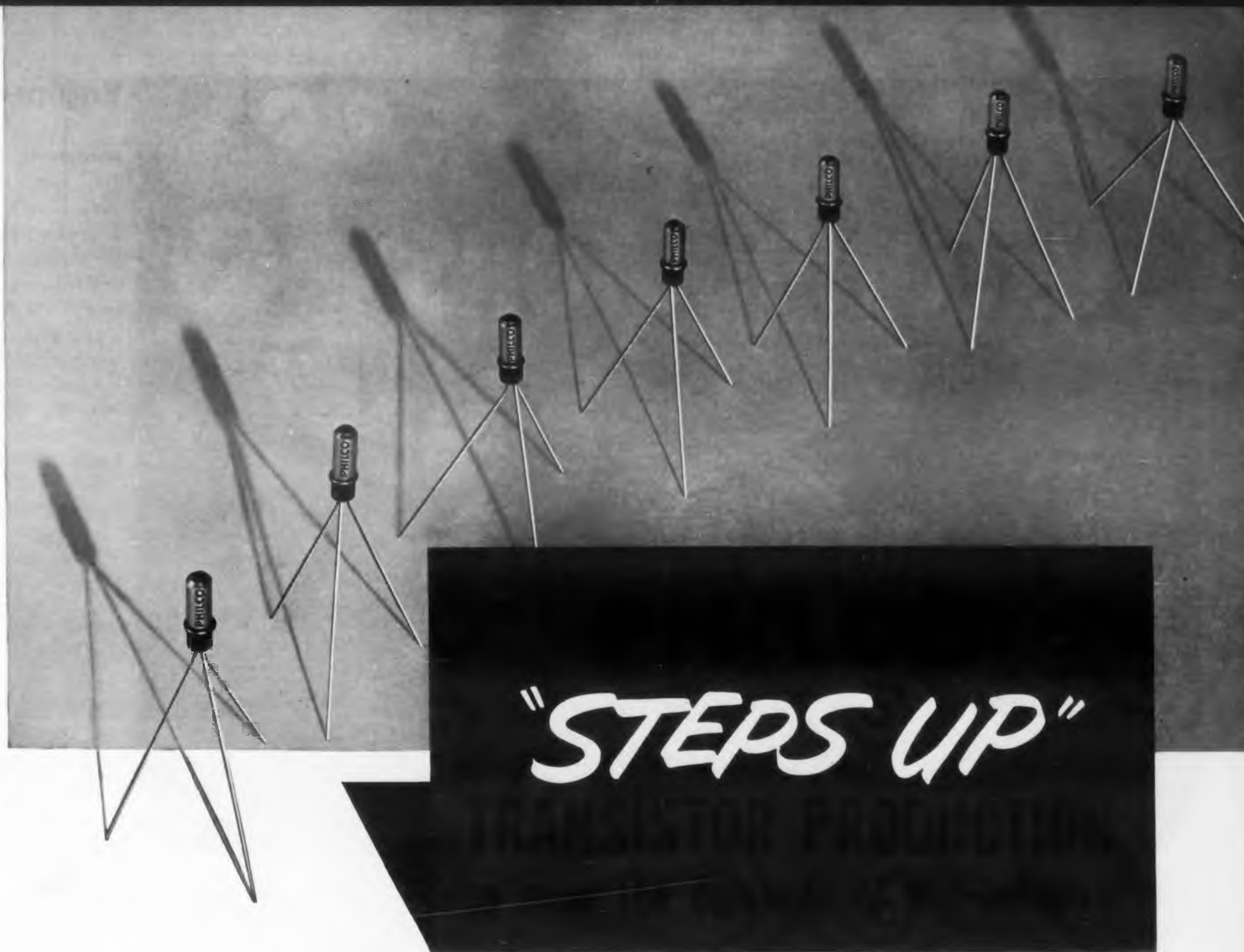
General Meeting, Los Angeles, in a paper entitled "A New 12-Element Automatic Oscillograph and Applications on the Bonneville Power Administration" by C. M. Hathaway and W. L. Davis, Hathaway Instrument Co., Portland, Oregon, and J. R. Curtain of the power administration. It automatically records 12 quantities of voltage, current, power, and the approximate location of faults, enabling engineers to take quick remedial action.

It can take as many as 100 consecutive records without any supervision, even if faults are days or weeks apart. Records are made on photosensitive paper. The recording paper travels at the rate of 12' per second.

**Rubber Dies for Tin . . .** The cost of tin-base die casting has been materially reduced with the development of rubber dies, which are used in conjunction with a simple centrifugal casting process, according to the August, 1954, issue of *Tin News*, published by the Malayan Tin Bureau, 1028 Connecticut Ave., Washington 6, D. C.

**Transistorized Engine Room . . .** A robot bearing temperature monitoring system that employs transistors has been developed for use in the engine rooms of U. S. Naval vessels. When one of the bearings reaches its critical temperature, an alarm sounds and a signal light glows to indicate the troubled area. By turning a switch, a miniaturized electronic indicator then gives the duty engineer a precise temperature reading.

Capable of steadily monitoring some 40 locations, usually in the turbine area, the system was developed by the Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa. A prototype system utilizes three transistors in each of 40 amplifiers. Thermistors imbedded in the bearings act as the sensing elements. Printed circuit techniques were employed in the amplifiers. The complete transistorized systems draws less than 30w input power.



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**SUPERIOR PERFORMANCE**

*makes Philco Transistors  
the recognized standard.*

*With Philco*

*Alloy Junction Transistors*

*you gain the advantages of*

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*and simplified circuitry to*

*improve your product.*

**RELIABILITY . . .** six years of Philco research and development in semi-conductors have established the quality, uniformity and production standards (from basic materials to tested transistors) required for large scale production.

**AVAILABILITY . . .** recognizing the potential transistor requirements of the electronic industry, Philco planning has resulted in production facilities which assure an unfailing supply of high quality transistors—now!

*Phone, write or wire Dept. ED today for descriptive literature and specifications on Philco transistors.*

**PHILCO TRANSISTORS FEATURE . . .**

- *Maximum reliability*
- *Uniform characteristics*
- *Hermetically-sealed resistance-welded case . . . leads fused in glass*
- *Minimum size*
- *Ruggedized construction*



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IN137A & IN138A

NARROW RANGE  
A5B and  
IN200 TO IN215  
17 TYPES IN  $\pm 10\%$   
VOLTAGE RANGES  
FROM 3 TO 180 VOLTS

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ZENER DIODES  
VOLTAGE REGULATORS  
HIGH BACK IMPEDANCE RECTIFIERS

AVAILABLE AS  
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## Engineering Review . . .

**Automatic Production of Printed Circuits . . .**  
Machinery that automatically inserts certain components into printed-wire boards has been developed. The experimental system is planned as the nucleus of a completely automatic method of producing printed-wire circuits using conventional components. One of the machines in the system is shown below.

Developed by the Research Div., United Shoe Machinery Corp., 140 Federal St., Boston, Mass., the equipment processes 5" x 8" boards at the rate of 9600 per 8-hr day. The experimental machine will only insert resistors, tubular and disc capacitors, jumper wires, and eyelets in pre-punched holes in the



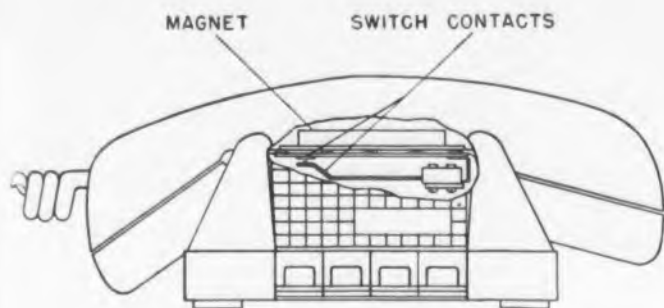
"Belted" resistors are running out of the spool at the top and being inserted into 5" x 8" printed-wired circuit boards by this United Shoe Machinery Corporation experimental machine.

board. Additional inserting heads for tube sockets, coils, and other components have not as yet been developed.

An important part of the system is the "belting" of pigtail components in order to secure the best feeding conditions. After their leads are automatically straightened, the components are secured by their leads to two parallel-running strips of tape like the ties on railroad track. The belted components are wrapped on spools. One machine has already been built for "belting" resistors.

The spools feed the resistors into the inserting





#### Permanent-Magnet Switch

The familiar "pop-up" button has been eliminated in this telephone by the use of a permanent magnet. The switch controlling the circuit is held open by the magnet until the handset is lifted off the base. Since the switch is completely enclosed, dust is kept out of the base. The unit was developed by the Connecticut Telephone & Electric Co., Meriden, Conn., using a magnet manufactured by Carboloy Dept., General Electric Co., Detroit, Mich.

heads, which automatically cut and form the wire leads and insert them through the pre-punched holes. At the same station, the lead ends protruding through the board are automatically clinched to hold each component in place until the board is dip soldered. To avoid damage to the bodies of the components, they are handled by their leads throughout the entire operation.

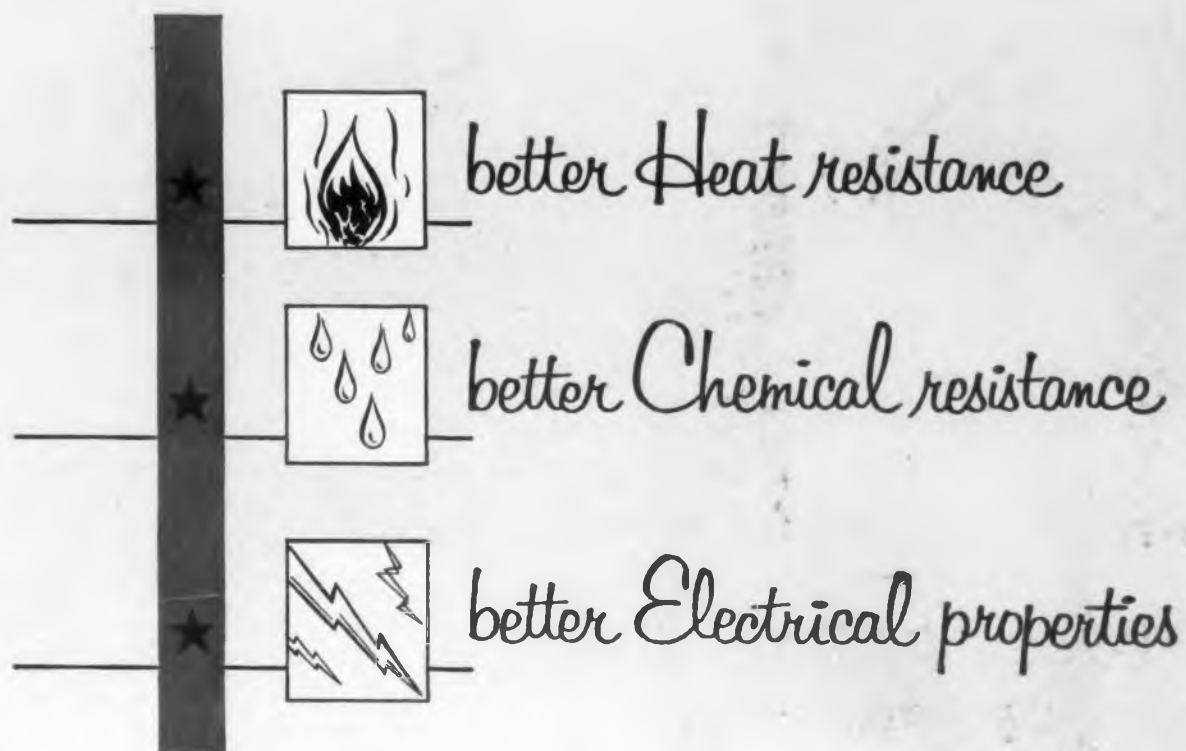
To insure uniformity in the completed product, there are several safeguards in the experimental machine. Included are provisions to stop the machine when a station is empty, when a component is missing or not correctly inserted, or when an inserting head does not complete its cycle. Another automatic system for producing printed-wire circuits is shown on pp. 32 and 33.

**TV "Booster" System . . .** A 23db improvement in field intensity in at least 50% of the reception areas resulted from a test of a TV "booster" in conjunction with regular station transmission. In effect, the "booster" equipment receives the original signal from the station's main transmitter, amplifies it, and then broadcasts the amplified signal throughout the local area where signals from the main station are weak.

The 10w booster gear was located some 37 miles from the 1000w main transmitter. The demonstration was conducted by the Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y., in cooperation with WJTV, Jackson, Miss., under a temporary FCC grant. A 70-page report entitled "An Experimental Investigation of the Engineering Aspects of a UHF Booster Installation" is available to interested persons.

*Important news!*

## *EPON<sup>®</sup> resin 828 with new Curing Agent CL gives*



**IF YOU** are among the many users of Epon resin 828 for casting, laminating or other structural applications—you will welcome this new development of Shell Chemical's continuing research program.

Curing Agent CL\* produces Epon resin polymers with improved mechanical and electrical properties at temperatures as high as 300° F. After three hours' immersion in boiling water or acetone, glass cloth laminates of

Epon resin 828 and Curing Agent CL retained more than 95% of their initial dry flexural strength. And with Curing Agent CL you can use the "B-stage," or pre-curing, process—permitting dry layups and specialized casting techniques.

Your request will bring you a sample of Epon resin 828 and Curing Agent CL for evaluation, as well as a copy of Technical Bulletin SC:54-10. Write for them—today.

*Curing Agent CL is Shell Chemical Corporation's name for metaphenylene diamine. We do not manufacture Curing Agent CL. It is available in commercial quantities from E. I. du Pont de Nemours & Company and National Aniline Division, Allied Chemical & Dye Corp.*

\*A development of Shell Chemical laboratories. Patent applied for.

### **SHELL CHEMICAL CORPORATION**

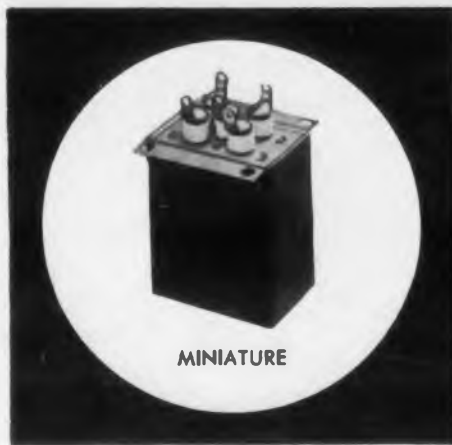
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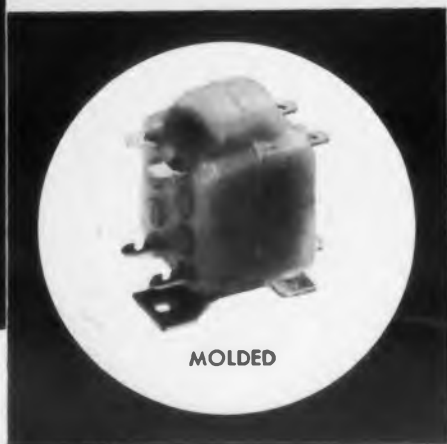
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MINIATURE



MOLDED



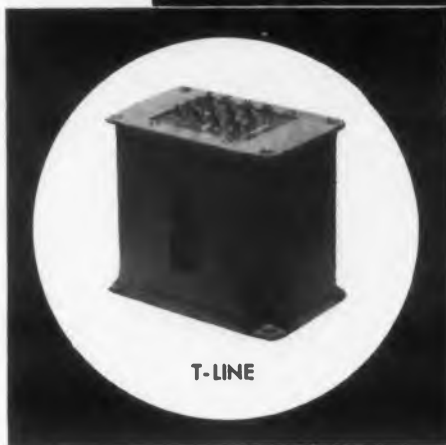
CASED



HERMETICALLY SEALED  
OIL-FILLED



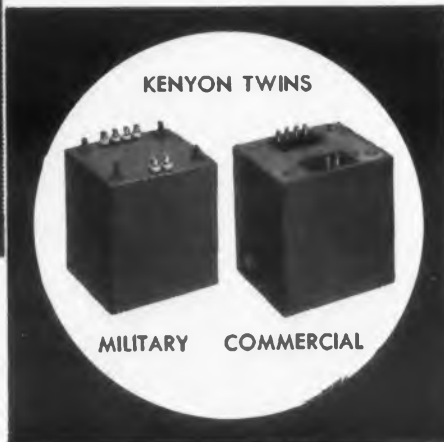
A-LINE



T-LINE



TOROIDS



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MILITARY COMMERCIAL

## KENYON TRANSFORMERS

*Engineered and Built to Meet the Most Rigid  
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Kenyon's engineering staff and production department have had more than fifteen years' experience in designing and building units which exactly meet the most rigid and unusual specifications. Your inquiries are invited.

Miniature—Molded—Cased—Hermetically Sealed Oil-Filled—A-Line—T-Line—Toroids—The Kenyon Twins, M-Line to meet all Mil-T-27 Requirements; C-Line for all commercial requirements.

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### Meetings

**September 13-24:** *First International Instrument Congress and Exposition*, Commercial Museum and Convention Hall, Philadelphia, Pa. For information, write to A. H. Peterson, Mellon Institute, Pittsburgh 13, Pa.

**September 15-17:** *Symposium on Information Theory*, Massachusetts Institute of Technology, Cambridge 39, Mass. Sponsored by the Professional Group on Information Theory, IRE, and others. For information, write to Dr. R. M. Fano, Research Laboratory of Electronics, M.I.T.

**September 16-18:** *Joint Electron Tube Engineering Council, General Conference*, Chalfonte-Haddon Hall, Atlantic City, N. J.

**September 29-30:** *Symposium on Industrial Electronics*, Mellon Institute, Pittsburgh, Pa. For information, write to Dr. J. B. Woodford, Jr., Electrical Engineering Dept., Carnegie Institute of Technology, Pittsburgh 13, Pa.

**October 4-6:** *Tenth Annual National Electronics Conference*, Hotel Sherman, Chicago, Ill. For information, write to R. E. Honacek, Illinois Bell Telephone Co., 208 W. Washington St., Chicago 6, Ill.

**October 4-13:** *International Telecommunication Union*, Geneva, Switzerland. For information, write to Secretariat, ITU, Palais Wilson, Geneva.

**October 11-15:** *AIEE Fall General Meeting*, Morrison Hotel, Chicago, Ill. Special emphasis will be on electrical aspects of air transportation, with eight sessions planned on this subject. For information, write to AIEE, 33 W. 39th St., New York 18, N. Y.

**October 12:** *Ferromagnetism Conference: Naval Ordnance Laboratory*, Silver Springs, Md. For information, write to L. R. Maxwell, U.S.N. Ordnance Laboratory, Silver Spring, Md.

**October 13-17:** *1954 Annual Convention, Audio Engineering Society*, Hotel New Yorker, New York, N. Y. For information, write to C. J. LeBel, P. O. Box 12, New York 11, N. Y.

**October 18-20:** *Radio Fall Meeting*, Hotel Syracuse, Syracuse, N. Y. For information, write to Radio-Electronics-Television Manufacturers Association, 777 14th St., Washington 5, D. C.

**October 18-20:** *Conference on Electrical Insulation*, Pocono Manor Inn, Pocono Manor, Pa. For information, write to D. A. McLean, National Academy of Science, 2101 Constitution Ave., Washington 25, D. C.

**October 26-28:** *National Conference on Tube Techniques*, Western Union Auditorium, 60 Hudson St., New York 13, N.Y. Sponsored by Working Group on

# DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

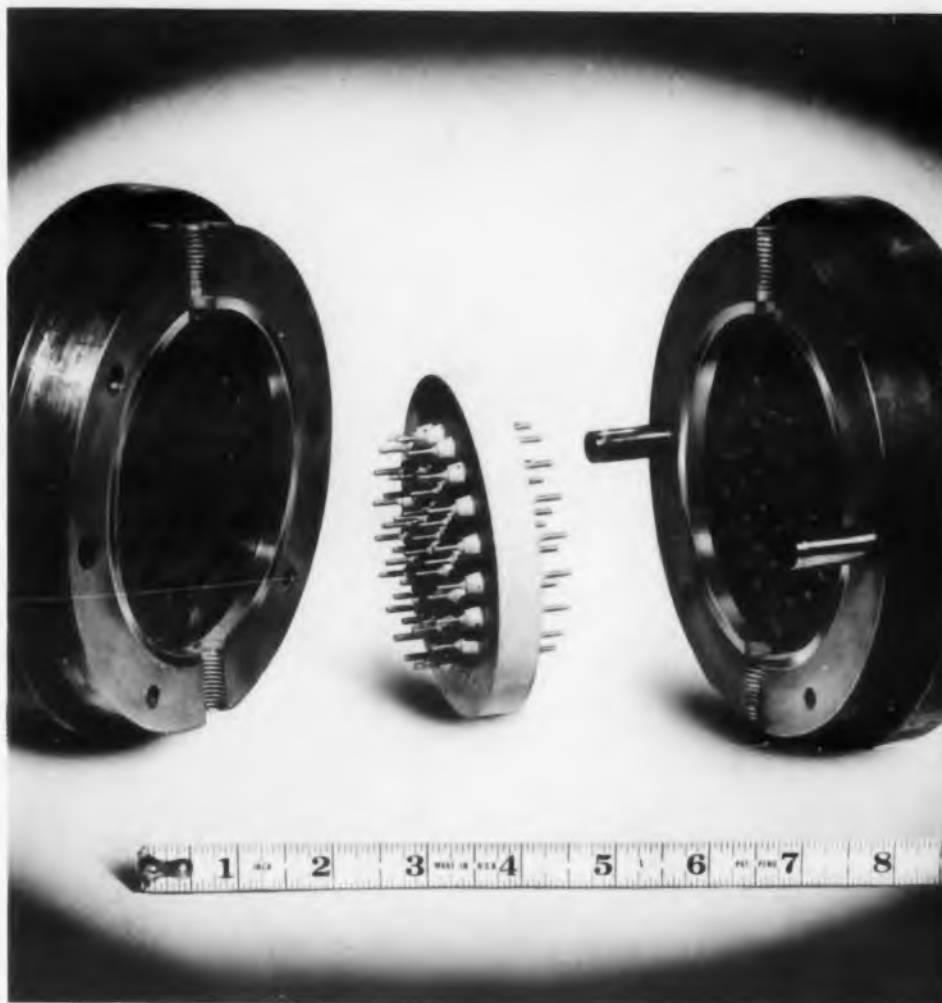
Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company

AUG.-SEPT. 1954

## Casting Molds of KEL-F® Polymer Replace Plated Metal Molds . . . Cut Costs, Finishing and Rejects!

Complex electrical terminal boards, made of an especially abrasive epoxy compound, are now cast in molds of KEL-F polymer, replacing former metal molds. Advantages include lower original mold costs, lower maintenance costs, fewer rejects and higher product precision without extensive machining.

Excellent wear characteristics of the new molds result in longer mold life despite high silica content of the casting resin. The non-hesive properties of KEL-F polymer prevent pitting by the resin, result in damage-free release of the product without special coatings. Penn-Plastics Manufacturing Company, Glenside, Pa., produce these intricate new molds by transfer methods. Molded of KEL-F polymer Grade 300, they are designed to hold 40 terminal pins and to impress forty  $\frac{1}{16}$ " numerals in both faces of the finished part. Terminal boards are manufactured by Penn-Plastics in conjunction with Woodmont Products, Inc., electronic parts manufacturers of Huntingdon Valley, Pa.



For further information ask for Application Report P-101



## Wafer-thin Insulator Mount of KEL-F® Polymer Increases Life of Miniature Switch to 5-Million Cycles!

A wafer of KEL-F polymer provides a tough, insulated mount for a contact bar, guards the performance of this sealed precision switch under severe thermal cycling. Currents up to 10 amps are handled for a life of from 1 to 5 million cycles.

This fluorocarbon plastic is molded directly to the beryllium-copper switch blade. It insulates the switch blade against arc-heat damage and its dimen-

sional stability guarantees positive contact position for service between minus 90°F and plus 200°F . . . without shorting. Haydon Switch, Inc., Waterbury, Conn., utilizes insulation molded of KEL-F polymer Grade 300 in single- and two-circuit snap switches for automatic equipment used in aircraft, marine and industrial applications.

For further information ask for Application Report E-123

KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

MOLDING  
POWDERS

KEL-F

FLUORO  
CHLORO  
CARBON  
PLASTIC

KEL-F

DISPERSION  
COATINGS

KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

OILS  
WAXES  
GREASES

(SEE REVERSE SIDE)

Registered trademark for The M. W. Kellogg Company's fluorocarbon polymers.

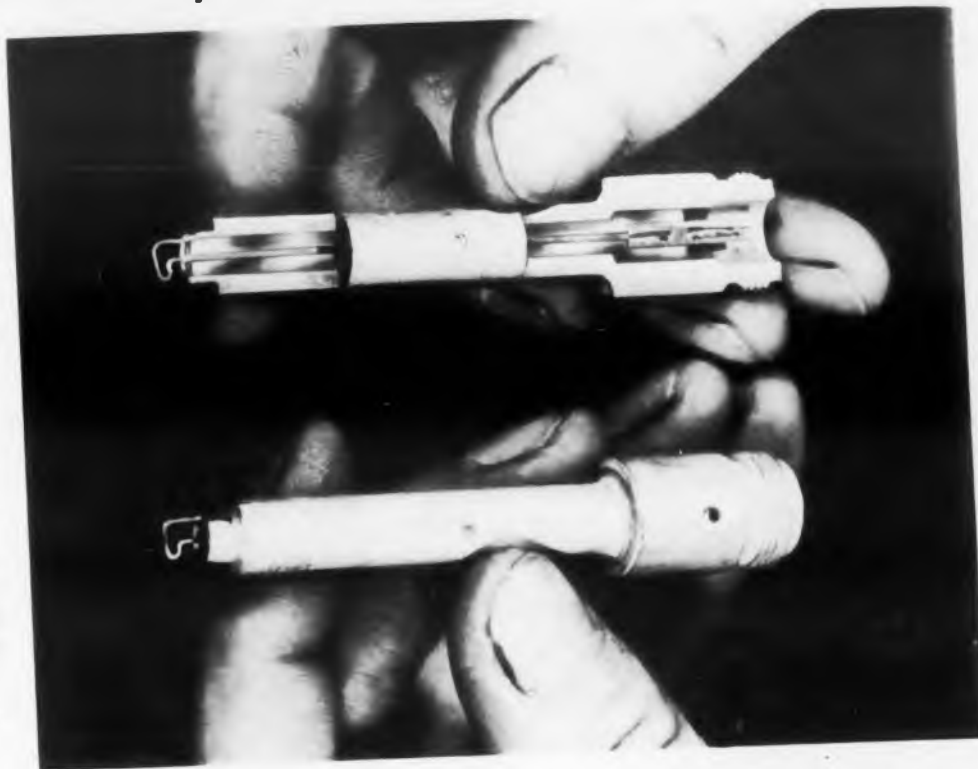


## Only One RF Signal Probe, Insulated with KEL-F Plastic, Now Needed for Entire 500 to 5,000 Mc Range

Specification of KEL-F polymer plastic as the insulation for this wave-meter probe resulted not only in a widened instrument range and accuracy, but increased efficiency and life as well.

This readily-molded fluorocarbon plastic permits complete, "tight" insulation of the vital filaments in a single operation. Excellent electrical properties of KEL-F polymer under high humidity and thermal cycling eliminate leakage and shorts. High strength and dimensional stability prevent insulation failure from cracking or shrinkage in service.

Thompson Products, Inc., Cleveland, Ohio, insulates the probe by injection molding, using KEL-F polymer Grade 300. It is used in the company's Model WIN6AA Wavemeter.



For further information ask for Application Report K-124

### Molders & Fabricators of the Month

Leading molders, extruders and fabricators specialize in the production of materials and parts made of "KEL-F" . . . each month this column will spotlight several of these companies with their principal services and products.

#### Consolidated Molded Products Corp.

Scranton, Pa.  
Compression & transfer molding  
Injection molding

#### Cortland Industries, Inc.

Chicago, Ill.  
Sealing of film  
Production machining

#### General Plastics Corporation

Paterson, N. J.  
Dispersion Coating

#### United States Gasket Company

Camden, N. J.  
Extrusion  
Forming & machining  
Injection, compression & transfer molding  
Rod, tube and sheet; tube sockets  
Gaskets, gauge glasses & tower packing

#### The William Brand and Company, Inc.

Willimantic, Conn.  
Insulated wire

### Recent Significant KEL-F Polymer Developments . . .

**Pyrex-to-steel** seal is effected in a new centrifugal pump with a resilient O ring of KEL-F plastic. Damage to the glass observation plate, leaks at high pressures have been eliminated.

**Electronic tubes** used at high altitudes are now hermetically sealed in new sockets made of fluorocarbon plastic. Consistent hermetic seal over a wide temperature range, low "arc-over" and shock damage are major features.

**Conductivity cell-valve** units for testing potable water use KEL-F polymer as a structural and electrical insulating member. Immersed continuously in water at temperatures up to 250°F, machined insulator maintains critical electrode gap.

**Pump vanes** of molded glass-filled polymer have been found to have the necessary strength as well as complete chemical inertness to stand up under hot, extremely corrosive chemicals in a new transfer pump.

OFF THE PRESS . . .  
Revised "BUYERS GUIDE"  
listing KEL-F polymer  
products, molders and fabricators.

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

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Tube Techniques, Dept. of Defense. Papers should be submitted to Dr. Harold Jacobs, Thermionics Branch, Evans Signal Laboratory, Belmar, N.J. For information, write to Harold J. Sullivan, Advisory Group on Electron Tubes, 346 B'way, N. Y. 13, N.Y.

**November 4-5:** *East Coast Conference on Airborne and Navigational Electronics.* Sheraton-Belvedere Hotel, Baltimore, Md. For information, write to IRE, 1 East 79th Street, New York, N.Y.

**November 8-10:** *Symposium on Modern Advances in Microwave Techniques,* Engineering Societies Bldg., 33 W. 39th St., New York 19, N. Y. For information, write to Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y.

**November 10-11:** *Conference on Electronic Instrumentation and Nucleonics in Medicine.* Morrison Hotel, Chicago, Ill. For information, write to AIEE, 33 West 39th Street, New York 19, N. Y.

**November 15-17:** *ASA Fifth National Conference on Standards.* Hotel Roosevelt, N.Y.C. For information, write to Public Relations Director, ASA, 70 E. 45th St., New York, N. Y.

**November 18-20:** *Symposium on Precision Electrical Measurements,* National Physical Laboratory, Teddington, England. For information, write to Director, NPL, Teddington, Middlesex, England.

**November 29-December 3:** *First International Automation Exposition,* 242nd Coast Artillery Armory, New York, N. Y. For information, write to First International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

**December 8-10:** *Eastern Computer Conference,* Bellevue-Stratford Hotel, Philadelphia, Pa. The theme of the Conference is, "Design and Application of Small Digital Computers". For information, write to Eastern Joint Computer Conference, P. O. Box 7825, Phila. 1, Pa.

**January 17-19:** *High Frequency Measurements Conference,* Hotel Statler, Washington, D. C. Sponsored by AIEE and IRE. One-hundred-word abstracts of papers to be submitted should be sent to the chairman of the appropriate session listed as follows: Frequency and Time Measurements, Dr. B. M. Oliver, Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.; Power and Attenuation Measurements, E. W. Houghton, Bell Telephone Laboratories, Murray Hill, N. J.; Impedance Measurements, Dr. D. D. King, Johns Hopkins Univ., Baltimore, Md.; and Measurements in Transmission and Reception, B. Parzen, Olympic Television and Radio Co., 34-01 38th Ave., Long Island City 1, N. Y. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

◀ CIRCLE ED-300 ON READER-SERVICE CARD

KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

MOLDING  
POWDERS

KEL-F

FLUORO  
CHLORO  
CARBON  
PLASTIC

KEL-F

DISPERSION  
COATINGS

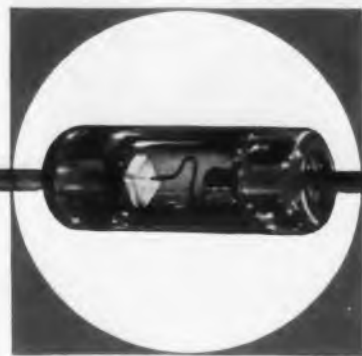
KEL-F

TRIFLUORO  
CHLORO  
ETHYLENE  
POLYMERS

KEL-F

OILS  
WAXES  
GREASES

# Hughes Fusion-Sealed Germanium Diodes



ACTUAL DIMENSIONS  
DIODE BODY:  
0.265 by 0.130 inches (maximum)  
SHUNT CAPACITANCE:  
0.5  $\mu$ f (maximum)  
AMBIENT OPERATING  
TEMPERATURE RANGE:  
-78°C to +90°C

Hughes Point-Contact Germanium Diodes are fusion-sealed in a one-piece, gas-tight glass envelope . . . impervious to moisture, fumes or other external contaminating agents. The flexible dumet leads are especially suitable for spot-welding; or they can be iron- or dip-soldered as close as 1/4 inch to the diode body—without special precautions.

The germanium crystal is permanently bonded to one lead, the cat whisker is welded to the other, and the point of the cat whisker is welded to the crystal. Hughes diodes are highly resistant to shock and vibration. Positive mechanical stability is achieved without risking contamination from fluxes, waxes or impregnants. And—each diode is thoroughly tested to ensure the stability of

its electrical and physical characteristics. All this means: sturdy, highly reliable diodes. TYPES—The Hughes line of diodes comprises standard RETMA, JAN, and many special types. Special types are produced according to customer specifications and are tested at high or low temperatures . . . for specific recovery time . . . for matching in pairs or quads.

## ELECTRICAL SPECIFICATIONS AT 25°C unless otherwise indicated

DESCRIPTION	RETMA or Hughes Type	Clip-in Hughes Type	Peak Inverse Voltage† (volts)	Absolute Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1V (mA)	Maximum Inverse Current		Other Characteristics
						@ -50V (mA)	Other (mA)	
HIGH PEAK	1N55B	HD 2052	190	150	5.0		0.500 @ 150V	
	1N68A	HD 2053	130	100	3.0		0.625 @ 100V	
1 MEG TYPES	1N67A	HD 2054	100	80	4.0	0.050	0.005 @ 5V	
	1N99	HD 2055	100	80	10.0	0.050	0.005 @ 5V	
	1N100	HD 2056	100	80	20.0	0.050	0.005 @ 5V	
500K TYPES	1N89	HD 2057	100	80	3.5	0.100	0.008 @ 5V	
	1N97	HD 2058	100	80	10.0	0.100	0.008 @ 5V	
	1N98	HD 2059	100	80	20.0	0.100	0.008 @ 5V	
	1N116	HD 2060	75	60	5.0	0.100		
	1N117	HD 2061	75	60	10.0	0.100		
GENERAL PURPOSE	1N90	HD 2063	75	60	5.0	0.500		
	1N95	HD 2064	75	60	10.0	0.500		
	1N96	HD 2065	75	60	20.0	0.500		
JAN TYPES	1N126*		75	60	5.0	0.850	0.050 @ 10V	Non-JAN equivalent, HD2070; clip-in, HD2066
	1N127**		125	100	3.0	0.300	0.025 @ 10V	Non-JAN equivalent, HD2071; clip-in, HD2067
	1N128***		50	40	3.0		0.010 @ 10V	Non-JAN equivalent, HD2072; clip-in, HD2068
	1N198		100	80	5.0	0.250	0.075 @ 10V	
						These values tested 100% at 75°C		
COMPUTER TYPES	1N191	HD 2077		§	5.0	400K $\Omega$ min. between -10 and -50V @ 55°C§		Back resistance recovers to 50K $\Omega$ and 400K $\Omega$ (200K $\Omega$ for 1N192) in 0.5 $\mu$ sec and 3.5 $\mu$ sec max., respectively.†
	1N192	HD 2078		§	5.0	200K $\Omega$ min. between -10 and -50V @ 55°C§		
	HD2013 HD2014				• 50 @ 1V & 1 @ 0.35V 50 @ 1V & 1 @ 0.35V	0.120 @ -3V 0.60 @ -6V	0.2 $\mu$ sec recovery time.° 0.2 $\mu$ sec recovery time.°	
UHF	HD2016A				UHF MIXER DIODE			
MISCELLANEOUS	HD2051		125	100	4.0	0.050		1N63 equivalent.

†That voltage at which dynamic resistance is zero when back voltage rises linearly at 90°/sec.

‡Back Recovery Time is measured with a forward pulse of 30mA, followed by a reverse pulse of 35 volts. Loop resistance of test circuit 2500  $\Omega$  max.

°Recovery time is that point at which the diode voltage reaches -1V after the initiation of a 6V back pulse through 20K  $\Omega$  from an initial 3 mA forward bias. Total shunt capacitance is 20  $\mu$ f.

§Tested at 55°C. Test voltage is a continuous 60 cps sine wave. Peak Reverse Voltage across the diode is 70V. Peak Forward Voltage not less than +2V or Peak Forward Current not less than 20 mA, whichever occurs first.

\*Formerly 1N69A.

\*\*Formerly 1N70A.

\*\*\*Formerly 1N81A.

Descriptive Bulletin SP2A is available on request.

## Hughes

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CIRCLE ED-13 ON READER-SERVICE CARD FOR MORE INFORMATION

**P**RINTED CIRCUIT techniques and more popular in electronic signers, aware of the many attractive inherent in these techniques, are eager to use printed circuits in their electronic designs. Much has been written on the fabrication techniques of printed circuits, but information, however, has appeared on a printed circuit.

It is the purpose of this series of articles to provide such information. We will begin with the more important basic design techniques for printed circuits. A designer can use these techniques for deciding whether or not to use printed circuits in a given piece of equipment. If he has decided to use printed circuits, these articles will help the designer so that he will avoid errors at the very outset.

Succeeding articles will cover the design of printed circuits in greater detail. In this way it is hoped that the confusion and mistaken notions about printed circuits may be dispelled, and that the engineers will be encouraged to take advantage of this relatively new technique, which holds promise for the future of the electronic industry.

### Advantages of Printed Circuits

Why should a designer consider printed circuits? Over the past three or four years, a number of answers to that question have evolved. In printed circuits, all the solder joints in an assembly may be made at one time by dipping the circuit card with its associated components into a solder bath. Where hand soldering is expensive, printed circuits affect considerable savings.

Table 1. Currents sufficient to cause component failure

Foil width (Inches)	Burnout Current (mA)	Copper foil thickness (Inches)
1/64	3	.0014"
1/32	5	
1/16	10	
1/8	15	
1/4	23	



# Printed Circuit Design

## I—Basic Design Factors

By George Maisch, Chief Electronic Engineer,  
Photocircuits Corp., Glen Cove, N. Y.

**P**RI NTED CIRCUIT techniques are becoming more and more popular in electronic applications. Designers, aware of the many attractive possibilities inherent in these techniques, are eager to incorporate printed circuits in their electronic devices. Although much has been written on the fabrication and production techniques of printed circuits, little or no information, however, has appeared on how to design a printed circuit.

It is the purpose of this series of articles to present such information. We will begin with a survey of some of the more important basic design factors involved in printed circuits. A designer can use these as a basis for deciding whether or not to use printed circuit techniques in a given piece of equipment. Having decided to use printed circuits, these factors can guide the designer so that he will avoid some basic design errors at the very outset.

Succeeding articles will cover these design factors in greater detail. In this way it is hoped that some of the confusion and mistaken notions surrounding printed circuits may be dispelled, and that electronic design engineers will be encouraged to take advantage of this relatively new technique, which holds so much promise for the future of the electronic industries.

### Advantages of Printed Circuitry

Why should a designer consider the use of printed circuits? Over the past three or four years, a number of answers to that question have evolved. With printed circuits, all the solder joints in an electronic assembly may be made at one time by dipping the printed-circuit card with its associated components in a solder bath. Where hand soldering is expensive, printed circuits affect considerable savings.

Table I. Currents sufficient to cause foil burnout.

Foil width (Inches)	Burnout current (amperes)	
	Copper foil .0014" thick	Copper foil .0028" thick
1/64	3	5
1/32	5	8
1/16	10	15
1/8	15	20
1/4	23	35

Automatic manufacturing methods are readily applied to printed circuits production. Most or all of the components can be machine inserted in a printed circuit card (see pages 12, 32 and 33 of this issue). This eliminates hand wiring errors as well as a large part of assembly labor costs.

Prototype designs can be adhered to on the production line. In the production of conventional electronic equipment, production engineers must often alter the prototype by changing component positions, lead dress, etc. Assemblers further affect these factors, leading to variations from the prototype as well as changes between production models. Unwanted effects such as instability of feedback loops, stray capacitances and inductances, etc., are easily introduced by these deviations from the prototype model. With printed circuits, the design engineer can freeze these variables and keep them under control. Performance

characteristics that are determined by conductor width and pattern layout, change very little from one assembly to another.

Another advantage of printed circuits is that this technique permits making many devices that are almost impossible to produce in any other way. Complex switches and code wheels are typical examples.

### Design Considerations

In order to realize these and other advantages of printed circuits, a number of very important factors must be kept in mind by the designer. Failure to do so will increase the cost of the assembly and create production problems that can easily nullify all of the advantages previously mentioned.

*Process Limitations*—As seen in Fig. 2, conductor patterns are produced by various methods. The steps

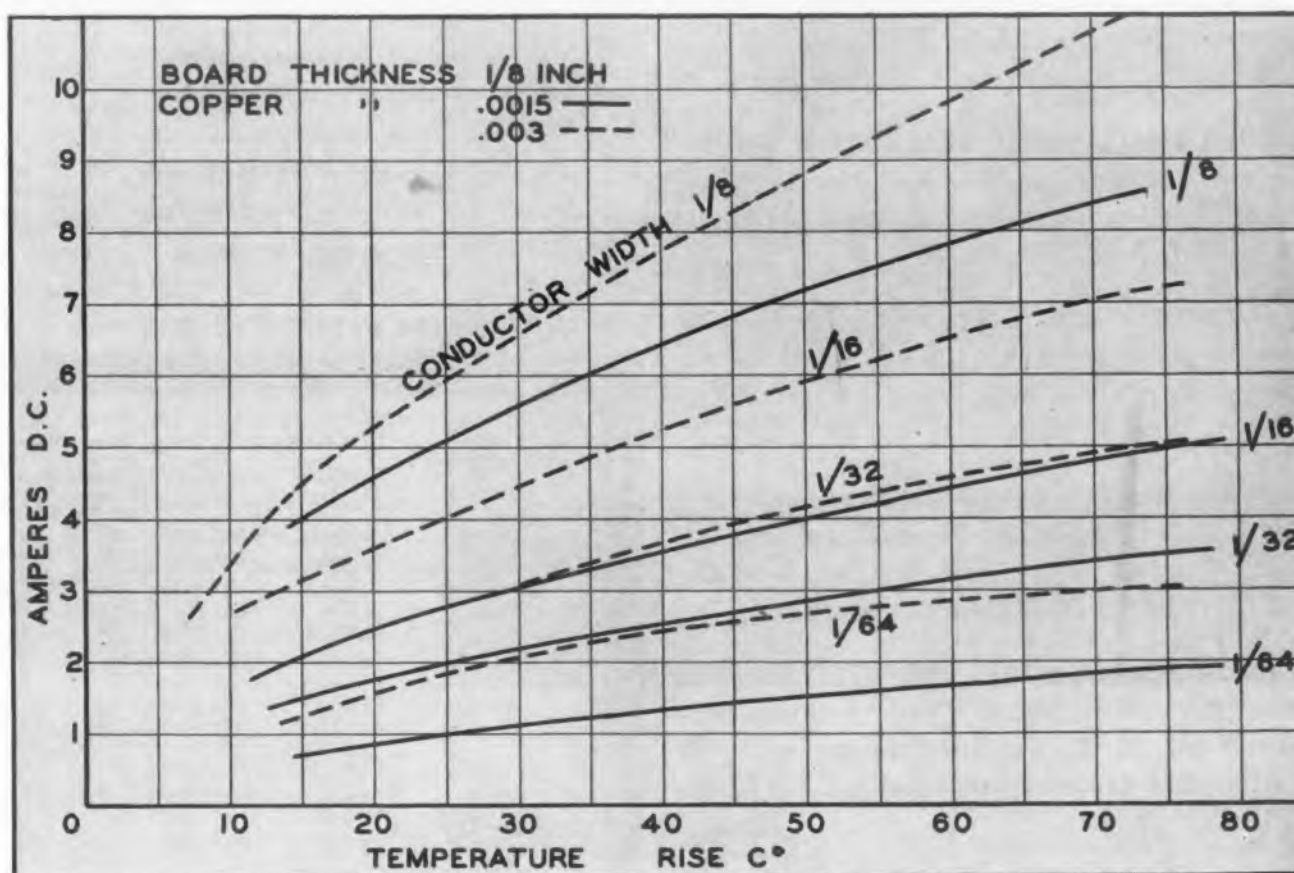


Fig. 1. Current carrying capacity vs temperature for various widths of copper foil.

in the making of plated-through holes are also illustrated. (This series will consider printed circuits produced by only one method—etched metal foil adhering to plastic sheets. However, portions may apply to other systems where techniques are similar.) There are inherent limitations in the process that limit a designer's freedom of effort in creating a pattern. The most important of these limitations involves considerations of line width, line spacing, and "undercut."

**Line Width**—Since no printing process is perfect, lines that are too narrow result in a high production reject rate because of nicks, pinholes, or other imperfections. Although etched patterns with line widths as narrow as 0.005" can be made, a practical minimum width for economical production is 0.020".

**Line Spacing**—Similarly, the use of narrow spaces between lines results in unetched copper or short circuits. Patterns have been produced with spacings as narrow as 0.005", but for economical production, a minimum spacing of 0.020" is recommended.

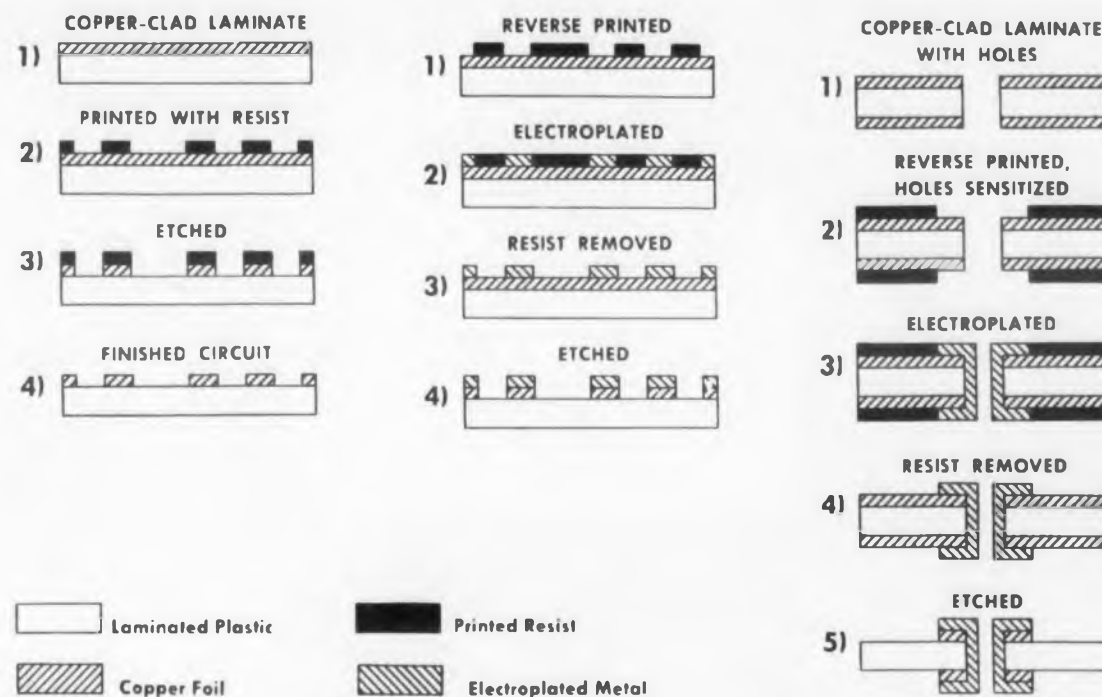
**Undercut**—For each unit of depth of metal removed by etching an approximately similar unit in width under the protective resist is also removed. Due to the small dimensions involved, this is generally ignored, but it must be said that the effect is to make thin lines thinner, narrow spaces wider, and small holes larger. The term used to describe this condition is "undercut". The designer can compensate for this condition by making lines wider on his master drawing. For example, in etching through copper 0.0027" thick, 0.002" to 0.003" will be lost from the edge of the line. If a line is to be 0.030" wide, the designer should make the line on the master drawing wide enough so that the printed resist line comes out 0.036" wide.

**Electrical Considerations**—Most of the electrical considerations relating to printed circuit design revolve about the fact that the conductor pattern is bonded to some kind of dielectric material. The surface and volume resistivity of this material, as well as its dielectric constant and dielectric loss factor place significant limitations on designs. Environmental conditions such as temperature and humidity also must be considered. The designer has to select his dielectric material with all these factors in mind. The physical layout of the circuit pattern will be influenced by the electrical properties of this material.

**Mechanical Considerations**—The insulating material also influences the mechanical considerations in printed circuit design. Resistance to shock and vibration, deformities due to temperature, abrasion resistance, and similar mechanical characteristics are governed by the choice of materials for the conductor pattern and the insulating support.

**Current-carrying Capacity**—The designer of a printed circuit must know something of the ability of an etched foil circuit to carry an electric current. It will generally be found that patterns of very narrow lines will conduct ample current for a typical electronic circuit.

Fig. 2. Printed-circuit fabrication. At the left are the steps in the etched-foil process. The plated-foil method is illustrated in the middle, and the steps in the making of plated-through holes can be seen at the right.



#### Methods of applying the resist ink

Method	Application	Technique
Photo-resist	Small lot runs; high degree of accuracy in fine details	Foil surface coated with light sensitive enamel. Portion exposed to light through transparent portions of negative becomes resistant to mordant
Screen printing	For large runs	Resist ink screened on surface of foil in typical silk screen operation
Offset printing	For large runs	Resist ink transferred to foil from inked offset plate

The major considerations remain those previously described under etching limitations as well as maintaining a line commensurate with the design under development. The table and curves shown on these pages present some basic data on the current-carrying characteristics of copper-foil. They can be used as a guide in setting up the original design. Note that for most electronic circuits, with the possible exception of heater circuits, the line dimensions may be quite narrow.

Conductors that may be required to carry current several times normal because of some abnormal condition must be made wider. Low impedance circuits,

such as the filament leads in a vacuum tube circuit, are typical examples. Plate circuits, although likely to develop short circuits, are usually protected by a series resistor or other means to prevent currents sufficient to burn out part of the foil conductor. Before laying out a printed wire pattern, the designer must determine approximately how wide each copper foil should be. **Circuit Markings**—A desirable feature, which may be included at no extra cost other than the time required in the initial drawing, is copper-foil markings on the base to identify nearby components, to indicate correct voltage readings at certain points, and to give





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any other information that will aid in the identification or service of an assembly. Again the same caution used in determining line width and other problems in etching must be observed. If small markings are used, small isolated areas in letters and numerals should be filled in to appear as a solid area. This will help hold the letter intact. Numerals and letters should be not less than 3/32" high.

**Mounting Considerations**—It is not good design practice to mount speakers, transformers, big capacitors, and similar parts on a printed circuit card. They are usually better mounted on an associated rigid metal chassis.

A means of mounting a printed assembly must be included in the layout of the pattern. This may be nothing more than provision for holes with adequate clearance for screw heads and other hardware.

Printed wiring ordinarily involves exposed wiring with the danger of electric shock. Suitable provisions must be made to avoid this possibility. For example, the printed circuit may be coated with an insulating plastic or it can be placed in a protecting container.

**Subassembly Techniques**—Ordinarily most radio and TV circuit assemblies are too large to be made as a single assembly even in hand-wired units. The subassembly system of design is necessary with printed wiring since assemblies should be made small enough for convenient dip soldering, fabrication, and handling in automatic equipment. This is very useful in servicing equipment. A small section of a circuit can be quickly replaced to effect a repair if it is a subassembly. Thus, a necessity becomes an advantage.

**Warpage**—It is difficult to obtain perfect flatness in printed circuit boards. Any design should be so arranged that a small amount of warpage will not result in an awkward assembly procedure or shorts to adjacent components or chassis. Standards deemed acceptable by plastic manufacturers allow for large deviations from flatness and apply to large sheets. Table 2 gives information on warpage allowed on the laminates. Warpage is reduced when the material is cut to circuit-board size, but is still apparent and should be considered. This difficulty arises most often when using laminated plastics with copper on one side only. Therefore, if a problem of insufficient clearance be-

Table 2. Maximum warp (in percent) based on 36" dimension. These values do not apply to cut pieces, but only to sheet sizes as manufactured.

Range of Thickness (Inches)	Copper on One Side		Copper on Two Sides Both Thicknesses
	0.0014"	0.0028"	
1/32 to 3/64	20	24	6
3/64 to 1/16	15	18	6
1/16 to 1/8	10	12	3
1/8 to 1/4	5	6	1.5

From National Electrical Manufacturers Assn. Bulletin LPI-7.04

cause of permissible warpage exists, a circuit with copper foil patterns on both sides of the laminate is desirable.

**Space Considerations**—Miniaturization has been mentioned as a major benefit in printed circuitry. Where subminiature components are used this is true, but in accepted radio and TV designs, miniaturization may not be achieved. In fact, the opposite, or an expanded circuit may result.

It has been standard practice in wired assemblies to bunch components about tube sockets in a manner that allows components to be mounted at random angles and stacked above each other in two or more layers. Such a means of assembly has been found convenient and efficient due to the shortness of leads and the use of the tube socket and its mounting as tie and ground points. In present printed wiring practice components are usually mounted in a single layer in relatively close contact with the plastic. This results in an expanded circuit that, due to the longer circuit leads, may prove less efficient, especially in high frequency applications. A means of assembling smaller circuit boards and then arranging in multiple or stacked layers is used to overcome this condition (see p. 33 for one example of "stacked" construction).

**Printed Circuit Costs**—The cost of a printed circuit depends primarily upon the type of laminate material selected; the size, shape, and thickness of the board; the thickness of the foil employed; the complexity of the fabrication required to produce the finished printed circuit; the quantities of items that will be produced; as well as the design costs involved in making the original layout of the wiring pattern. It is easy to see that because of the many variables that must be considered, no accurate general statement on cost can be made. In fact there are times when it may be economical to produce a single printed circuit for a certain application. On the other hand, printed circuit techniques may not prove economical at all for another use even though fairly large quantities are involved.

In the last analysis, the economic advantage of printed circuits does not depend upon the cost of the circuit itself, but on the relative cost of the circuit compared with its conventional equivalent produced by hand-wiring methods. The designer must weigh all the factors concerned to arrive at a workable and economically practical answer.

Making the transition from conventional hand-wired equipment to printed circuitry need not be difficult for the designer, regardless of the complexity of the equipment involved. By keeping in mind the various basic design factors previously mentioned, many costly mistakes can be avoided at the very beginning of a project. Following the rules that will be laid down in succeeding articles in this series will help the designer create a circuit that is readily fabricated and one that will give him the performance originally proposed for his design.

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# Easily-Installed Controls

**S**IGNIFICANT production-cost savings in the mounting of controls can be gained by use of the "Snap-Tite" control shown in the drawing. No tools, hardware, or twisting of tabs are required to mount them. As shown in the photograph, an operator can push two of these controls into place at one time.

Six spring clips on the control fit into the standard tab and bushing holes in chassis. No panel retooling or production line rearrangements are

required to accommodate them. The controls are primarily designed for fine-adjustment applications in TV and electronic equipment. The units have a short knurled and slotted shaft for fingertip or screwdriver adjustment. The shaft is molded of high-impact, blue-colored, polystyrene plastic for best electrical insulation and mechanical strength. It extends  $1/2''$  from the face of the mounting panel. The length of the  $1/4''$  diam shaft is  $31/64''$ . The unit is less than  $1''$  broad.

"Snap-Tite" Controls are quickly installed two at a time without tools. Clips hold them in place.



Available values and control is lab. Divi 900 East 1, Wis. 0.045" to 19 gage.

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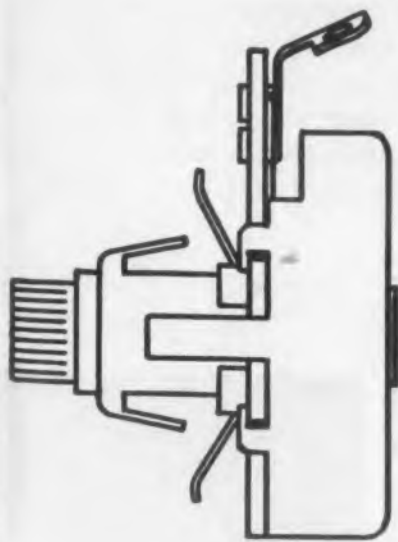
Sideview of the secur



Available in standard resistance values and tapers, the "Snap-Tite" control is manufactured by Centralab, Division of Globe-Union, Inc., 900 East Keefe Avenue, Milwaukee 1, Wis. They fit into panels of from 0.045" to 0.065" in thickness, 16 to 19 gage, respectively.

These controls can also be used to advantage for installation in inaccessible places, since they do not require tools. For more data, turn to Reader-Service Card and circle **ED-17**.

Sideview of the unit showing the securing spring clips.



## G.E. designs 400-cycle alternator to meet demanding guided-missile requirements

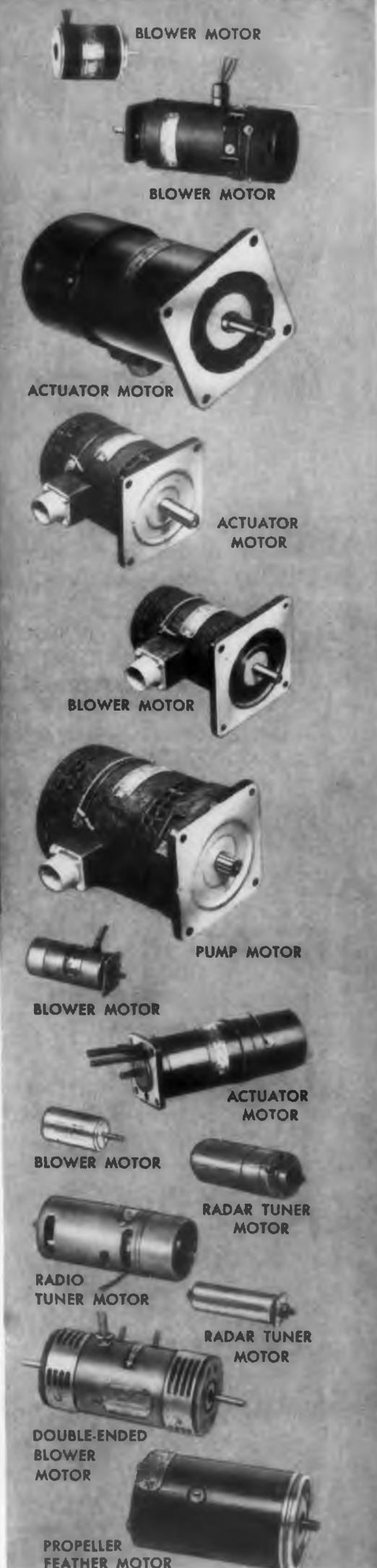
### Another example of G-E motors for aircraft

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A few of the hundreds of aircraft and armament motors designed and built by General Electric.

Fig. 1. The "whisker wire" in this 1/4" long, glass-encased diode is bonded to the semi-conductor forming a gold-germanium eutectic alloy at the junction.



## High-Output Subminiature Diodes

**F**ORWARD current ratings in the order of hundreds of milliamperes are characteristic of a new line of subminiature gold-bonded germanium diodes, one of which is shown in Fig. 1. Only 1/4" long x 0.1" diam, a number of the hermetically sealed units can be mounted in a small area (see cover). Produced with very uniform characteristics, the glass-encased diodes are rugged, stable, and can operate to 90°C. Divided into five classifications, the many types can



Fig. 2. The diodes are available in matched quads or pairs mounted in either octal bases (top) or 7-pin miniature bases (bottom).



be utilized in a variety of diode circuits, a few examples of which are given in Figs. 5 to 8.

Two outstanding characteristics of the diodes are demonstrated in the cathode-ray oscilloscope photos shown in Figs. 3 and 4 and on the cover. The lead wires are made of "Dumet", a composite metal with a temperature coefficient of expansion that matches that

of glass. Manufactured by Transitron Electronic Corp., 403 Main St., Melrose 76, Mass., they are also furnished in matched pairs and quads mounted on octal or 7-pin subminiature bases as shown in Fig. 2.

Each of the circuits illustrated utilizes the outstanding characteristics of the particular type or types of gold-bonded diodes employed. In the core-switching circuit shown in Fig. 6, the high pulse-current capacity of Types *T25G* and *T6G* is important. The core is alternately magnetized in opposite polarity by the input and clock pulses. When the clock pulse is applied, there will be an output pulse only if the core had previously been magnetized in the opposite polarity to that of the clock pulse.

The diodes are used to prevent the backward flow of pulses into the input circuits, to provide unidirectional clock pulses from a push-pull clock source, and to avoid loading of the inputs by the other windings. The resistors isolate the cores from the diodes. It is desirable to use high pulse currents in this application, for the rise time, driving requirements, and physical size are simplified if fewer turns may be used on a winding. Pulse currents commonly used are from 50 to 200ma. Operation of gold-bonded diodes in this application is practicable up to 20Mc.

In the diode-capacitor memory matrix shown in Fig. 7, the input diodes are used to charge up the capacitor if a signal pulse is applied to any one of them. The output diode is normally biased in the inverse direction and does not interfere with this action. When it is desired to read out the presence or lack of stored voltage, the output diode is returned to zero bias, providing an output pulse if the capacitor has previously received a signal. This also serves to discharge the capacitor and erase any previous signals in the memory.

The capacitor charge will slowly leak off because of the inverse currents,  $I_d$ , of the diodes. The holding time will depend on this parameter and the size of the capacitor. The time required to charge up the capacitor also depends on its size and the short cir-

cuit current,  $I_s$ , available from the signal source.

If the circuit is arranged so that the input pulse will charge the capacitor for one time constant, and holding time is defined as that time required for the capacitor voltage to drop to half or less of its initial storage voltage, it can be shown that:

$$\text{Holding Time/Charging Time} = 0.31 I_s/I_d$$

The diodes' forward drop during the charging cycle is important under these conditions, and should be small compared to the source voltage to prevent a loss of stored voltage. In addition, the diodes should be uniform in inverse current to prevent the output diode from charging up the capacitor. The saturated or constant current nature of the gold-bonded diodes discussed here is helpful, for it prevents the capacitor from charging up to much more than about  $1/2v$ .

When high-speed operation is desired, the inverse and forward pulse recovery characteristics may be important. Experiments with these units indicate that they are satisfactory in the range of  $0.5\mu\text{sec}$  input pulses or larger.

The diodes can be furnished with a high degree of balance at high power levels. This feature is important for the following types of equipment: balanced modulators; phase, frequency, and amplitude discriminators; magnetic and differential amplifiers; suppressed carrier modulators and demodulators; d-c to a-c converters; and harmonic generators. For more information on these gold-bonded, subminiature diodes, turn to the Reader-Service Card and circle **ED-20**.

Fig. 3. An oscilloscope comparison of null voltage output between conventional point-contact diodes (top) and Type *T18G* Diodes in a balanced bridge circuit. The new diodes are more easily matched over the entire forward current range.

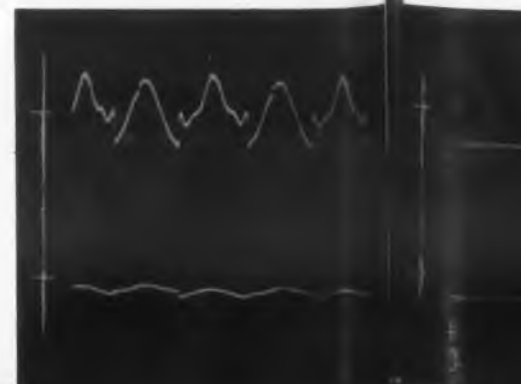




Fig. 5. A bridge rectifier circuit capable of delivering 7.3w at 140ma and 52v. Utilizing Type T5G Diodes, the component values are as follows: R = 350 ohms, L = 0.25h, and C = 10mfd. The input voltage,  $E_s$ , is 57v at 400cy.

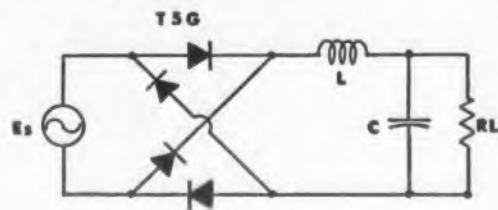


Fig. 6. This core-switching circuit can be used in shift registers, storage elements, delay lines, and as a pulse-shaper or gain stage.

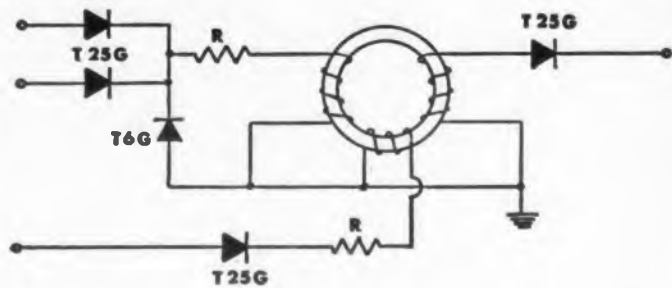


Fig. 7. A memory-matrix circuit.

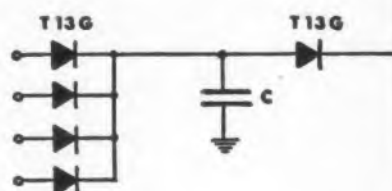


Fig. 8. A balanced rectifier circuit.

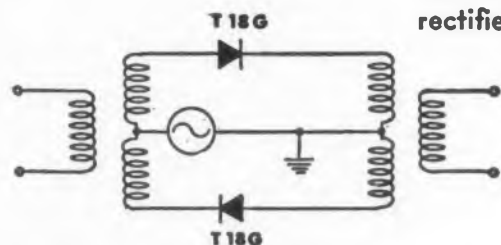


Fig. 4. The vertical scale is 8v/inch in this oscilloscope comparison of forward drop with a 100ma,  $\mu$ sec pulse applied to a conventional point-contact diode (top) and a Type T25G Diode.

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# Measurement of Cable-to-Rigid Line VSWR

By A. B. Giordano, Professor of Electrical Engineering  
Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

*Editor's Note: This article is an excerpt from the "Handbook of Microwave Measurements", edited by Moe Wind, Research Assistant Professor, and Harold Rapaport, Research Associate, Polytechnic Institute of Brooklyn. It is taken from the section on the measurement of standing wave ratio written by Dr. Giordano. The Handbook, recently published by the Institute, is available from the Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y. It is printed in two volumes and is priced at \$12.00.*

**T**WO OF THE FOUR methods of measuring one of the electrical characteristics of rigid-line cable connectors, the cable-to-rigid line VSWR, are described in this article. The rigid-line connector connects cables to rigid lines, as distinct from cable connectors, which join cables to cables.

The cable-to-rigid line VSWR includes the effects of the electrical reflections arising from the cable-clamping device in the connector, and from the difference in characteristic impedance between the cable and the cable connector. The cable-to-rigid line VSWR is defined, as shown in Fig. 1, as the VSWR seen looking into the rigid coaxial line with the cable terminated in a matched load. It is assumed that the characteristic impedance of the cable connector and the rigid coaxial line are equal.

Four methods of measurement are possible for measuring cable-to-rigid line VSWR. These are:

1. Single-slotted-section method with long terminating cable.
2. Two-slotted-section method with one slotted section built around the cable.
3. Frequency variation method.
4. Variable-short-circuit method.

The single-slotted-section method assumes that the cable-to-rigid line VSWR can be measured if the connector is terminated by a cable of sufficient length and attenuation such that the characteristic impedance is observed at the input. This method is not

reliable, however, because of the so called "periodicity effect" which may give rise to sudden changes in the input impedance of the cable, thus terminating the connector in a mismatched load. The two-slotted-section method can be used to measure the cable-to-rigid line VSWR provided one of the slotted sections is built having the cable as a core, hence a different slotted section is required for each different cable size. Cable slotted sections are ordinarily not available commercially and the accuracy and consistency of the results obtained with those that have been built are doubtful.

## Frequency Variation Method

Direct cable-to-rigid line VSWR measurements can be made without the use of special cable slotted sections and lengths of periodicity-free cable by using the frequency variation-of-VSWR measurement technique. This method uses the same equipment as the two-slotted-section method with an added length of cable (long in terms of wavelength) as part of the sample. The procedure consists of measuring the VSWR in the input slotted section as a function of a small variation in frequency and determining the cable-to-rigid line VSWR from a graphical analysis of this information.

The arrangement of equipment for this method is shown in Fig. 2 and except for the adapters, is the conventional type used for making VSWR measurements described in the *Handbook*. Adapters for some cable connectors and coaxial line sizes are reported in the literature<sup>1, 2</sup>; these must be reflection-free and specifically designed for the particular cable and cable connector under test.

## Measurement Procedure

1. Arrange equipment as shown in Fig. 2 and follow the general tuning and warm-up procedures indicated in Section 2.02, *Handbook*.
2. Adjust the signal source frequency to a value on one side of the nominal frequency of mea-

surement. (See Section I, *Handbook*, for detailed procedures on the measurement of frequency and wavelength.)

3. Measure the standing wave pattern of the termination in slotted section No. 2. If the load termination is not matched ( $VSWR \leq 1.02$ ) use a tuner to match the load. (See Appendix D, "Impedance Matching Techniques", *Handbook*, for detailed descriptions of tuning devices and matching procedures.)
4. Measure the input VSWR of the test sample (cable and connectors) in slotted section No. 1.
5. Vary the frequency of the signal source by a small amount and repeat steps 3 and 4. (The frequency increment is dependent upon the nominal frequency of measurement and the length of the cable between the two test connectors. For a sample length of cable 50 wavelengths long, a total frequency excursion of from 2 to 5% yields sufficient information for graphical analysis. Hence, if the nominal frequency of measurement is 3000Mc, then about ten points spaced 15Mc apart defining at least one maximum and one minimum are enough.)
6. Repeat step 5 for approximately 10 different frequencies about the nominal frequency (or a sufficient number of closely spaced points) so that the curve of input VSWR as a function of frequency can be plotted, as shown in Fig. 3.
7. From the plot of input VSWR versus frequency, determine  $P_{max}$ , the maximum VSWR and  $P_{min}$ , and the minimum VSWR, as shown in Fig. 3.
8. Calculate  $P_F$  and  $P'_B$  from equations (1) and (2)

$$P_F = \sqrt{P_{max} P_{min}} \quad (1)$$

$$P'_B = \sqrt{P_{max}/P_{min}} \quad (2)$$

where

$P_F$  = the cable-to-rigid line VSWR associated with the input or front end connector under test.



$\rho'_B$  = the attenuated cable-to-rigid line VSWR associated with the output or back end connector under test, seen at the input.

If the attenuation of the cable is known, the cable-to-rigid line VSWR of the back end juncture can also be found by computing the back end reflection coefficient  $K_B$  from equation (3)

$$K_B = K'_B \epsilon \frac{\gamma l}{8.69} \quad (3)$$

where

$l$  = length of cable (in feet)  
 $\gamma$  = attenuation of cable (in decibels per foot)

$$K'_B = \frac{1 - \rho'_B}{1 + \rho'_B}$$

and then the back end cable-to-rigid line VSWR,  $\rho_B$ , is found from equation (4)

$$\rho_B = \frac{1 + K_B}{1 - K_B} \quad (4)$$

Illustrative Example:

Shown in Fig. 3 are sample measurement data taken at a nominal frequency of 3000Mc.

From the plotted data,

$$\rho_{\max} = 1.15 \text{ and } \rho_{\min} = 1.02$$

From equations (1) and (2)

$$\rho_F = \sqrt{\rho_{\max} \rho_{\min}} = 1.08 = \text{cable-to-rigid line VSWR of the input connector.}$$

$$\rho'_B = \sqrt{\rho_{\max} / \rho_{\min}} = 1.065 = \text{cable-to-rigid line VSWR of the output connector seen at the input.}$$

Since the attenuation of the cable is known ( $\gamma = 0.18\text{db/ft.}$ ),  $\rho_B$ , the cable-to-rigid line VSWR of the back end, can be calculated.

$$K'_B = \frac{1 - \rho'_B}{1 + \rho'_B} = \frac{0.065}{2.065} = 0.0314$$

$$\therefore K_B = 0.0314 \epsilon \frac{\gamma l}{8.69} = 0.0314 \epsilon \frac{0.18 \times 10}{8.69}$$

$$= 0.0314 \epsilon \times 0.207 = 0.0314 \times 1.23 = 0.0386$$

$$\therefore \rho_B = \frac{1 + K_B}{1 - K_B} = \frac{1 + 0.0386}{1 - 0.0386} = 1.08$$

#### Variable-Short-Circuit Method

An alternate method of measuring the cable-to-rigid line VSWR is called the variable-short-circuit method<sup>3</sup> and is based on the conformal transformation

of a variable reactance (such as a shorting plunger) on the end of a cable into a circle on the Smith Chart representing the input impedance. It has the advantage that less time is required in making the measurement, since the oscillator frequency does not have to be varied as in the frequency variation method (with corresponding adjustments of the load termination tuners). Furthermore, it does not require the assumption that the VSWR of the connector under test varies slowly with frequency.

The arrangement of equipment for the variable short circuit of cable-to-rigid line VSWR measurement is shown in Fig. 4. Except for the variable short circuit, the equipment is the conventional type used for making VSWR measurements described in Section 2.02, *Handbook*. Although the variable short circuit may be either coaxial or waveguide, for simplicity of illustration, the conventional waveguide non-contacting shorting plunger is indicated in Fig. 4. Details of non-contacting shorting plunger designs are presented in many places<sup>4,5</sup>.

Follow this measurement procedure:

1. Arrange equipment as shown in Fig. 4 and follow the general warm-up and tuning procedures as indicated (Section 2.02, *Handbook*). Measure



Fig. 1. A cable-to-rigid line connection.

Fig. 2. Block diagram for the frequency-variation measurement method.

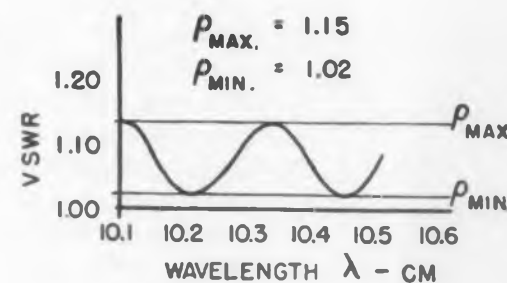
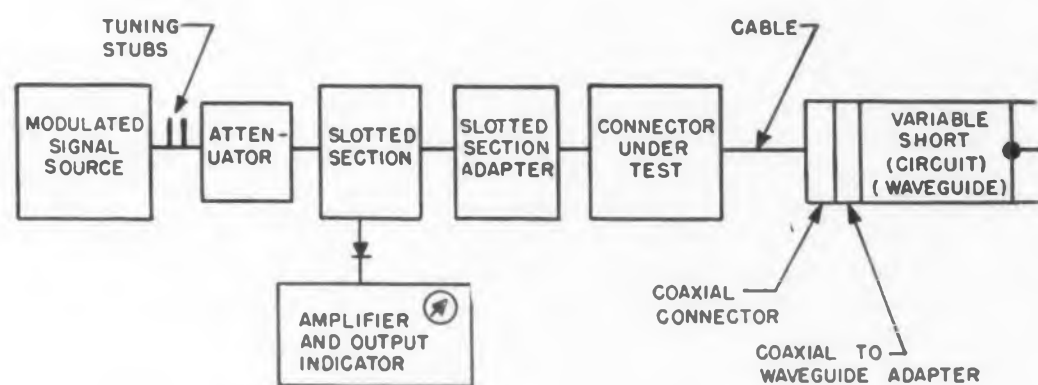
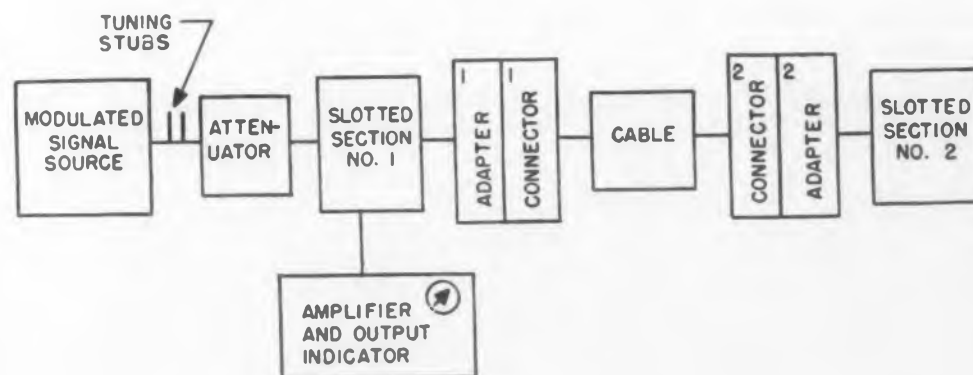


Fig. 3. A sample plot produced by the frequency-variation method.

Fig. 4. The test arrangement for the variable-short-circuit method.





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the frequency of the signal source. (See Section II, *Handbook*, for detailed procedures for the measurement of frequency and wavelength.)

- Adjust the position of the variable shorting plunger until a maximum VSWR is measured in the slotted section. Record this value of VSWR,  $P_{max}$ , and the position of the minimum.
- Adjust the variable short position until a mini-

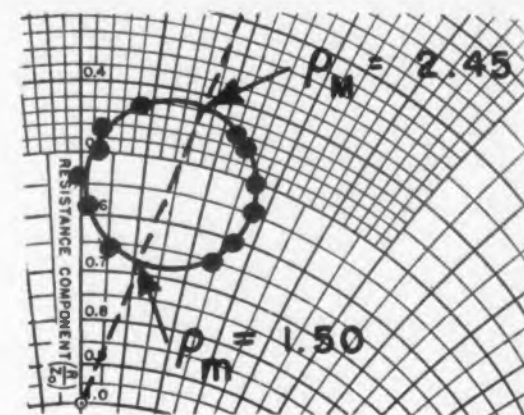


Fig. 5. A portion of a Smith chart showing a sample plot for determining  $P_{max}$  ( $P_M$ ) and  $P_{min}$  ( $P_m$ ).

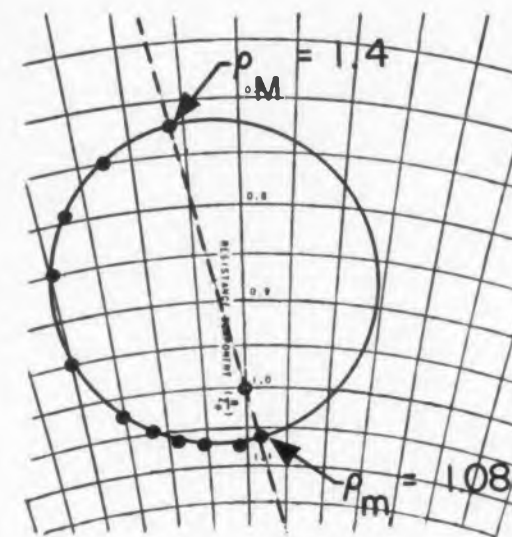


Fig. 6. A variation in the variable short circuit method produces this plot on an expanded portion of the center of the Smith chart.

imum VSWR is measured in the slotted section. Record this value of VSWR,  $P_{min}$ , and the position of the minimum.

In one case, if the position of the minimum for step (2) and step (3) are identical or separated by a multiple of one-half wavelength, the VSWR of the connector,  $P_{co}$ , located between the cable and slotted section is given by:

$$P_{co} = \sqrt{P_{max} P_{min}} \quad (5)$$

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In this case, the VSWR of the connector is greater than that measured at the input end of the cable. The VSWR value,  $\rho_{co}$ , corresponds to that measured in the slotted section with a match in the cable.

In a second case, if the position of the minimum for step (2) and step (3) above are separated by an odd multiple of one-quarter wavelength, the VSWR of the connector located between the cable and the slotted section is given by:

$$\rho_{co} = \sqrt{\rho_{max}/\rho_{min}} \quad (6)$$

In this case, the VSWR of the connector is less than that measured at the input end of the cable.

### Illustrative Example

Shown in Figs. 5 and 6 are the results of plotting the VSWR and position of minimum as the short circuit at the output end of a cable is displaced. (The actual measurement procedure does not require the plotting of the data on a Smith Chart. It is included here to illustrate the circular locus of the reflection coefficient for the two cases discussed.) To obtain the high VSWR readings illustrated in Fig. 5, a mismatch was deliberately introduced in the connector under test by increasing the diameter of the inner contactor.

From the plot in Fig. 5

$$\rho_{max} = 2.45 \text{ and } \rho_{min} = 1.50$$

therefore, from equation (5)

$$\rho_{co} = \sqrt{2.45 \times 1.50} = 1.92$$

From the plot in Fig. 6

$$\rho_{max} = 1.4 \text{ and } \rho_{min} = 1.08$$

therefore, from equation (6)

$$\rho_{co} = \sqrt{1.4/1.08} = 1.14$$

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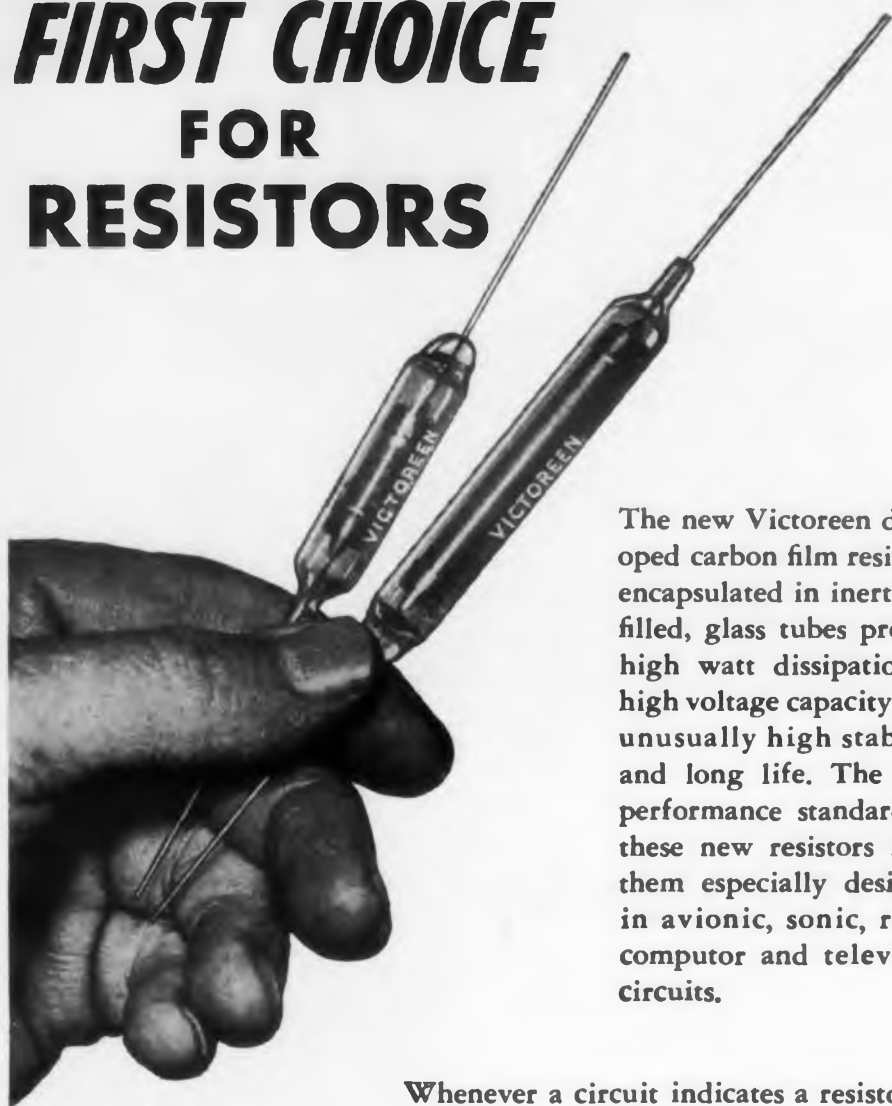
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Fig. 1. By using "Penny Size" components, the servomechanism system at the right was redesigned into the system on the left, which is only one-half as high.



# Miniature Servomechanism Components

Fig. 2. Featuring high accuracy, these miniature components have the same diameter as a penny.

ONLY 3/4" in diameter, "Penny Size" servo motors and their components, two of which are shown in Fig. 2, feature increased accuracy over this firm's larger servomechanism components. Units available in this size for use in control systems include servo motors, synchro transmitters, control transformers, differentials, and resolvers.



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An example of weight-saving and size-reduction resulting from use of these components is shown in Fig. 1.

A subminiature servo amplifier, Type T3100, designed for use with these synchros is also shown in Fig. 2, left. Only the tubes in this amplifier are not hermetically sealed in a potting compound. The amplifier and the other components are all made by Kearfott Company, Inc., 1378 Main Ave., Clifton, N. J.

"Penny Size" components are constructed with an integral stator-housing assembly and a straight-through bore. The servo motor shown in Fig. 1 has a maximum no-load speed of 6500rpm, a stall torque of 0.1 in-oz, and a weight of 1.2 oz. The input-phase power and voltage are 1.5w and 18v, respectively. Another motor in this same size and with the same characteristics except for high inherent damping and a maximum no-load speed of 4000rpm is designed for simple instrument servos.

The synchro transmitters, control transformers, and differentials have maximum error limits of 10 minutes from electrical zero. For use in conjunction with the motors, they provide the sensors and error detectors of the servo loop. These units measure 3/4" diam x 1.658" long and weigh 1.75 oz.

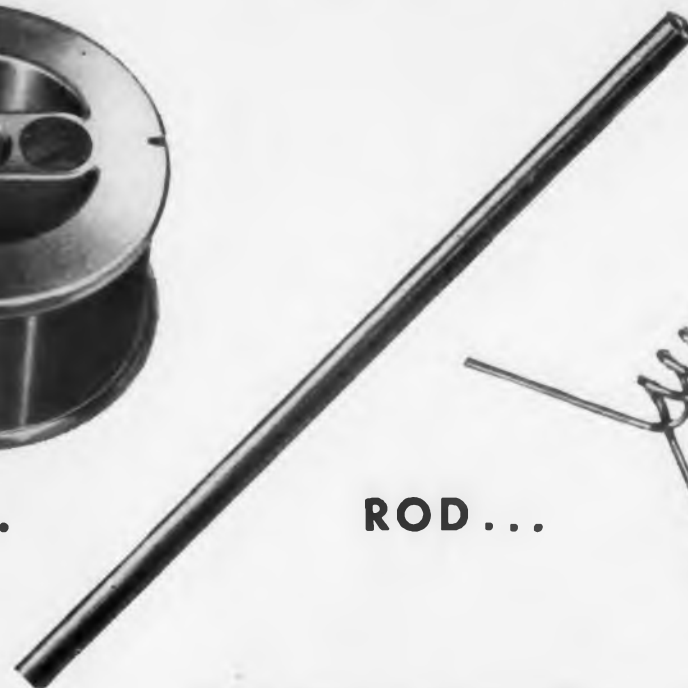
An integral servo motor-damping generator in the 3/4" diameter size will be available soon. For more information on these components, turn to the Reader-Service Card and circle ED-25.

ELECTRONIC DESIGN • September 1954

## TUNGSTEN AND CHEMICAL PRODUCTS



WIRE...



ROD...



COILS... POWDERS

Sylvania Tungsten wire, rod, and components are quality controlled from ore to finished products and tested in the laboratory and in the field. Suppliers to all leading manufacturers in the radio and television industry, Sylvania offers you tungsten and chemical products that meet the highest standards of purity, precision, and uniformity.

### Let Sylvania help you

Sylvania maintains large diversified metallurgical and chemical laboratories for the development and perfection of its many products. Today,

these facilities are also available to help you. Sylvania engineers, Sylvania "know-how," and Sylvania equipment will aid you in product development or in the solution of tough manufacturing problems.

If it's a question concerning anything... from a precision, custom-made tungsten wire to a specially-ground tungsten part, or from a high-purity phosphor to germanium dioxide for your crystals... put it up to Sylvania. A note on your letterhead will bring you the information you require. Address: Department 4T-1409, Sylvania Electric Products Inc., 1740 Broadway, N. Y. 19, N. Y.

### HIGH PURITY SYLVANIA TUNGSTEN and CHEMICAL PRODUCTS NOW AVAILABLE INCLUDE:

#### Tungsten

Radio Heater and Grid Wire  
Support Wire and Rod  
Gold Plated Wire  
Ground Seal Rod  
Formed or Ground Parts  
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Wire, Rod  
Metal Powder

#### Special High Purity Chemicals and Compounds

Potassium Silicate • Etching Inks  
Carbonate Emission Coatings  
Mica Spray Coatings  
Basing Cements

#### Metal Powders

Silicon • Germanium

#### Phosphors

Cathode Ray Tube Phosphors



Initial sintering of a tungsten ingot formed by high compression of tungsten metal powder.

Section of metallurgical laboratory of Sylvania engineering department.



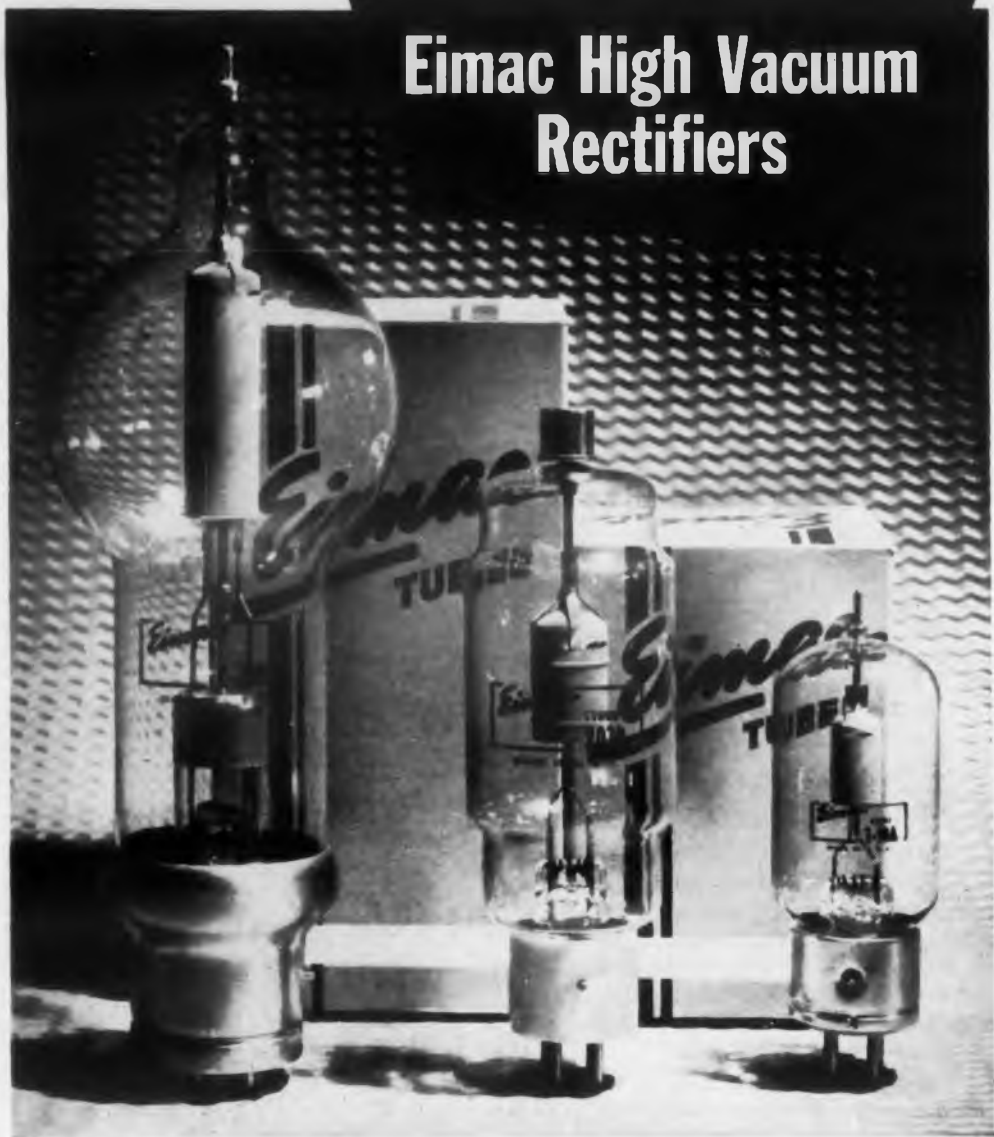
# SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION



CIRCLE ED-26 ON READER-SERVICE CARD FOR MORE INFORMATION

# Eimac High Vacuum Rectifiers



## LOW CURRENT, HIGH INVERSE VOLTAGE OPERATION

Eimac's complete line of eight high vacuum rectifiers cover a wide range of average current, 15ma to 750ma and peak inverse voltages from 25,000v to 75,000v. In power supply units, voltage multipliers, pulse service or special applications at high frequencies, extreme ambient temperatures and high inverse voltages, Eimac high vacuum rectifiers are ideal. They give reliable performance at high frequencies and high volt-

ages without generating radio frequency transients and have no lower limit to ambient operating temperature. Ruggedly constructed, Eimac high vacuum rectifiers contain many of the famous Eimac transmitting tube features such as an instant heating thoriated tungsten filament, that allows application of filament, plate voltages simultaneously; an exclusive radiation cooled pyrovac\* plate; and elimination of internal insulators.

- For additional information about Eimac high quality, high vacuum rectifiers, contact our Technical Services department.

\* An Eimac trade name.

EIMAC HIGH VACUUM RECTIFIERS

TYPE	PLATE			FILAMENT	
	Average Current MA	Dissipation Watts	Peak Inverse Voltage	Volts	Amps
2-25A	50	15	25,000	6.3	3.0
2-50A	75	30	30,000	5.0	4.0
8020	100	60	40,000	5.0	6.5
2-150D	250	90	30,000	5.0	13.0
250R	250	150	60,000	5.0	10.5
253	350	100	15,000	5.0	10.0
2-240A	500	150	40,000	7.5	12.0
2-2000A	750	1200	75,000	10.0	25.0

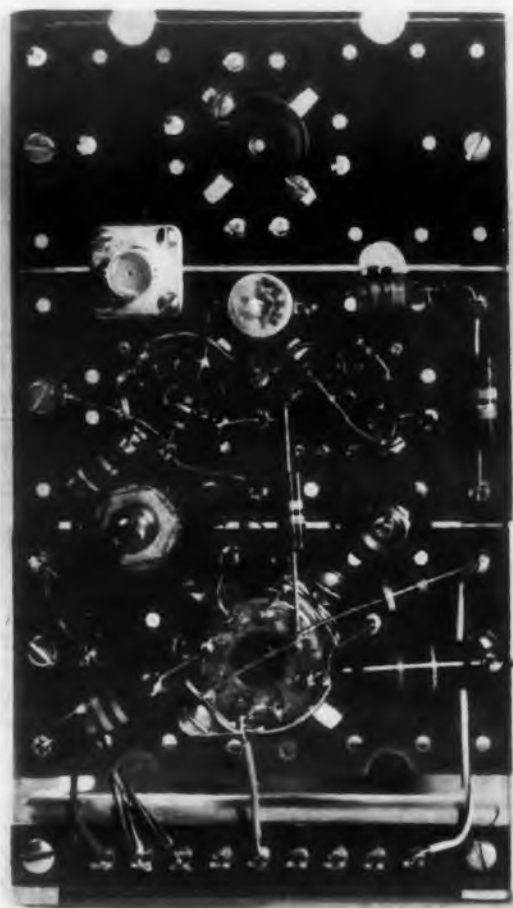


**EITEL-McCULLOUGH, INC.** SAN BRUNO CALIFORNIA  
The World's largest manufacturer of transmitting tubes.

CIRCLE ED-27 ON READER-SERVICE CARD FOR MORE INFORMATION



# Universal Circuit Breadboard Chassis



**P**ROTOTYPE construction as well as printed wiring layouts are implemented by use of the Universal Circuit Breadboard Chassis shown in Fig. 3. A complete variety of components can be placed on the chassis without using a single power tool.

The units can be used individually, mounted side-by-side, or stacked, as shown in Fig. 4, enabling the designer to utilize them in the construction of large equipment prototypes of "modular" design. The chassis can also be mounted end-to-end. They are held together by 6-32 self-tapping screws.

Because the sub-chassis are made of phenolic, prototype printed-wired circuits can be drawn on their surfaces for experi-

Fig. 1. Details of a prototype circuit constructed on the breadboard with various types of subchassis.

Fig. 2. A partially completed prototype.



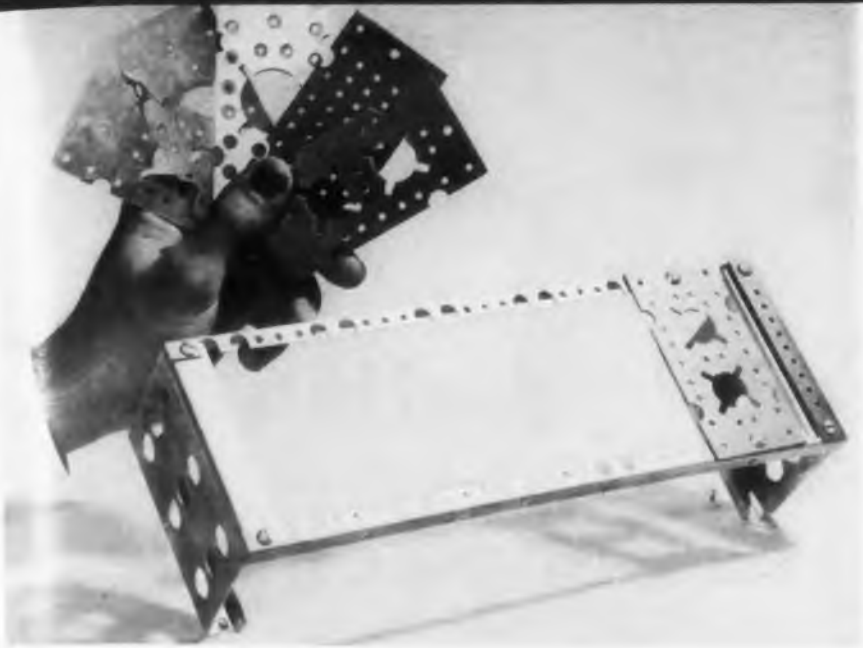


Fig. 3. The Universal Circuit Breadboard Chassis with its sub-chassis. The middle type has a metal ground overlay.

mentation. The sub-chassis come in four basic designs to accommodate various sizes of sockets. A terminal strip is also provided. The sub-chassis are also available with matching metal ground plane overlays to simulate metal chassis surfaces. One example of a sub-chassis with metal overlay for grounding is shown in Fig. 3.

The cadmium-plated chassis frame is

4" wide x 12" long x 3" high. The end brackets of the frame have a series of 1/2" holes to accommodate regular and miniature potentiometers, fuses and switches as shown in Figs. 2 and 4. The chassis are manufactured by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. For more information, turn to the Reader-Service Card and circle **ED-28**.

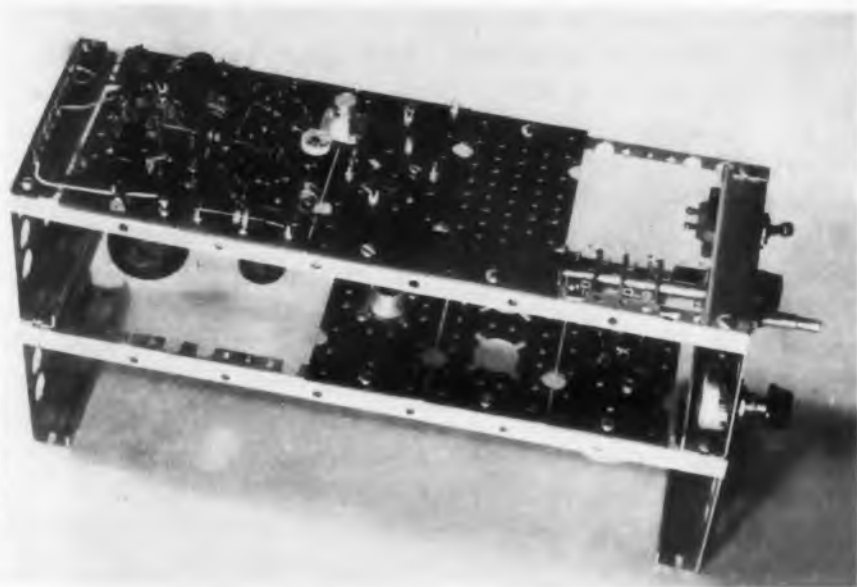
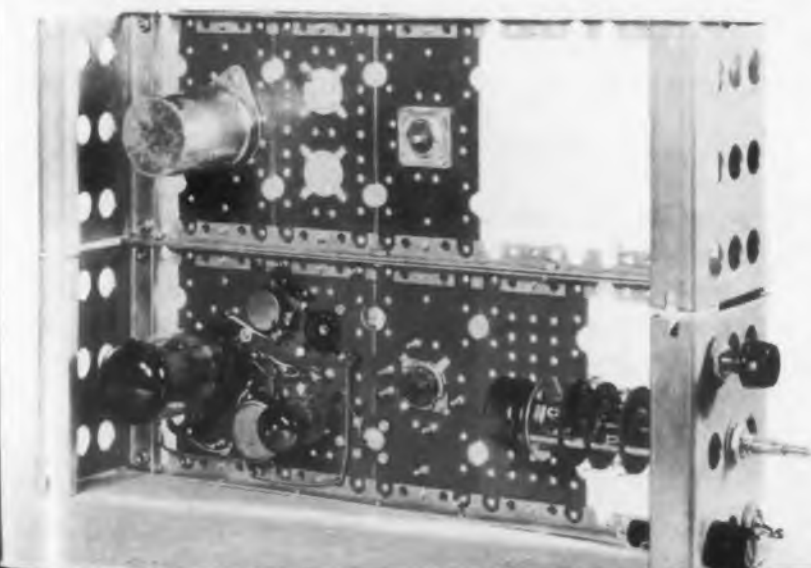


Fig. 4. Example of "stacked" and side-by-side arrangement of the breadboards in a modular construction. The units can also be mounted end-to-end.



*a new achievement in  
fast-print oscilloscope  
recording...*

**Simple to Operate.** Uses standard Polaroid® magazine and fast self-developing film. Delivers finished black field print in 60 seconds. **Automatically Records** 3 to 16 traces per print. Provides full size image on 3" scope, half-size image on 5" scope. No reversal of image.

*The Aremac Automatic*

## **RECORDOSCOPE 1185**

a fully automatic oscilloscope camera that reduces engineering time and costs ...

**Sturdy Camera Mount** with swing-a-way adapter. Camera easily swung aside when not in use. Provides data card exposure. Versatile camera can service several 3" and 5" scopes of different makes when equipped with adapter mounts and heads. Can be interfaced in various ways. Exposure plus automatic development in self-developing film can be accomplished in three ways: (1) manual shutter release, (2) strobe release, (3) remote operating circuit.

### **Manual**

## **RECORDOSCOPE**

The manually operated version of the RECORDOSCOPE 1185

offers many of the precision engineered advantages found in the companion automatic model. Though basically designed for manual release and advance of film, this camera can be factory modified for automatic operation.



*Model 1185 is the improved version of the Polaroid Corporation*

*The Aremac*

## **RECORDOSCOPE 1073**

**Synchronous Camera for Continuous Motion or Single Frame Oscilloscope Recording**

The Aremac 1073 Recordoscope is a compact self-contained unit mounting an f/2 six-element 50 mm lens and special Aremac powered magazine. Shutter interlock system prevents film motion when shutter is closed. Synchronous film speeds range from 256"/sec. to 1/8"/sec. in 12 steps of 2:1 ratio. The camera can be stopped and restarted with practically instantaneous speed synchronization. Periscope mounts camera vertically. Provision for automatically illuminated data cards and strobe contacts.

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# Mechanized Production of Printed-Wired Subassemblies

**L**OW-COST, rugged, compact electronic subassemblies utilizing printed wiring and standard components can be readily manufactured by the flexible, mechanized process described and illustrated on these pages. This production method was developed by James E. Huggins, Jr., Ordnance Corps, Frankford Arsenal, Philadelphia, Pa.

The completed "sandwich" assemblies, one of which is shown in Fig. 3, can incorporate much more complex circuitry than the familiar "two-dimensional" printed-wiring board because two printed-wiring plates are used, one at the bottom and one at the top.

Design changes are readily accomplished and do not call for any modification of the basic assembly equipment shown in Fig. 2. Service problems are reduced to disposing of the entire unit because of its low cost. In addition, the assembly has all the familiar advantages of printed wiring.

The components and hardware used in this process are shown in Fig. 1. The through wires that are used to interconnect the two printed-wiring plates have a sleeved portion that prevents the wire from slipping through the plate hole after assembly. The component leads do not have to be unduly straight and are clipped short at only one end. The assembly procedures are illustrated in Figs. 4 to 9.

After dip-soldering, the leads are clipped flush against the plate, as shown in Fig. 3. The three subminiature tubes are manually inserted in the remain-

ing plate and the same dip-soldering procedures followed to complete the unit.

This design and assembly method will lend itself quite simply and economically to fully automatic production. Hopper feeding of components from bulk will prove easy, since the component leads are left straight rather than being preformed. An individual hopper or vibratory elevator feeder will be used for each component. The feeder will place the component in a simple inspection device which will carry "intolerance" components to a stack awaiting assembly. A relatively simple device will be used to trip a component from each stack simultaneously. Each component will be tripped into a tube which will convey it by gravity to a central master catacomb. This master catacomb will be located above the automatic assembling mechanism. All feeding of components will be accomplished by gravity. Components will be dropped from the master catacomb and assembled into the final unit, as previously described. After being assembled, the unit will be conveyed through fluxing and dip-soldering operations, after which the excess leads will be cut.

The "sandwich" type design has several additional welcome advantages. Components are rigidly mounted between the two plates and the unit is quite rugged when completed, even without a catacomb. Component leads require no sleeving. The design and method of assembly are flexible in that no machinery changes

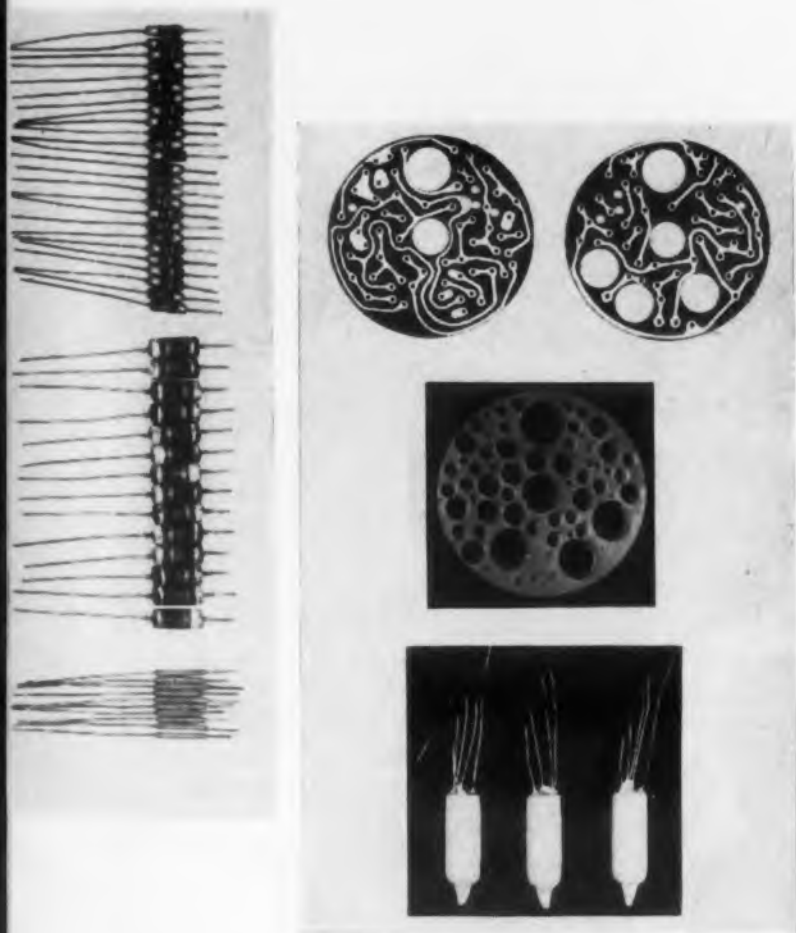


Fig. 1. Parts for the three-tube subassembly shown in Fig. 3. The "through wires" for interconnecting the two round printed-wire plates are at the bottom, left.

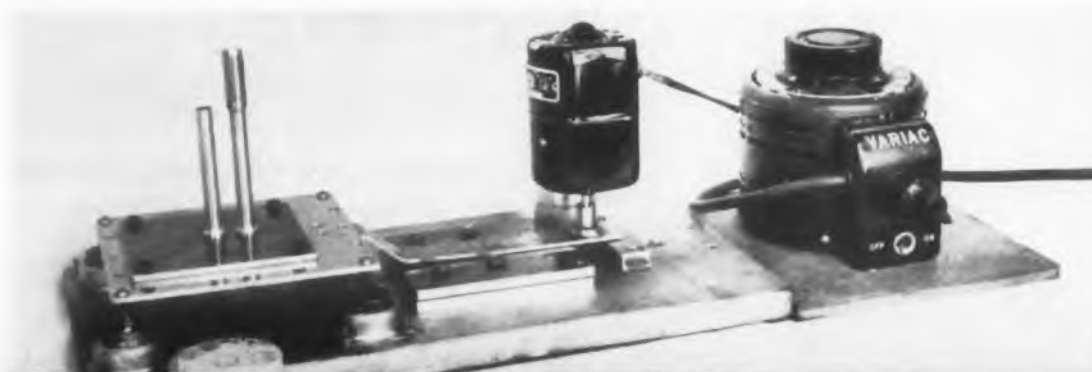


Fig. 2. The equipment required for producing a "sandwich". The pilot catacomb, pin No. 2, and pin No. 1 are in the foreground. The pilot catacomb is exactly like the assembly's catacomb except for greater length. The variac and motor provide the vibrations necessary to shake the components into position.

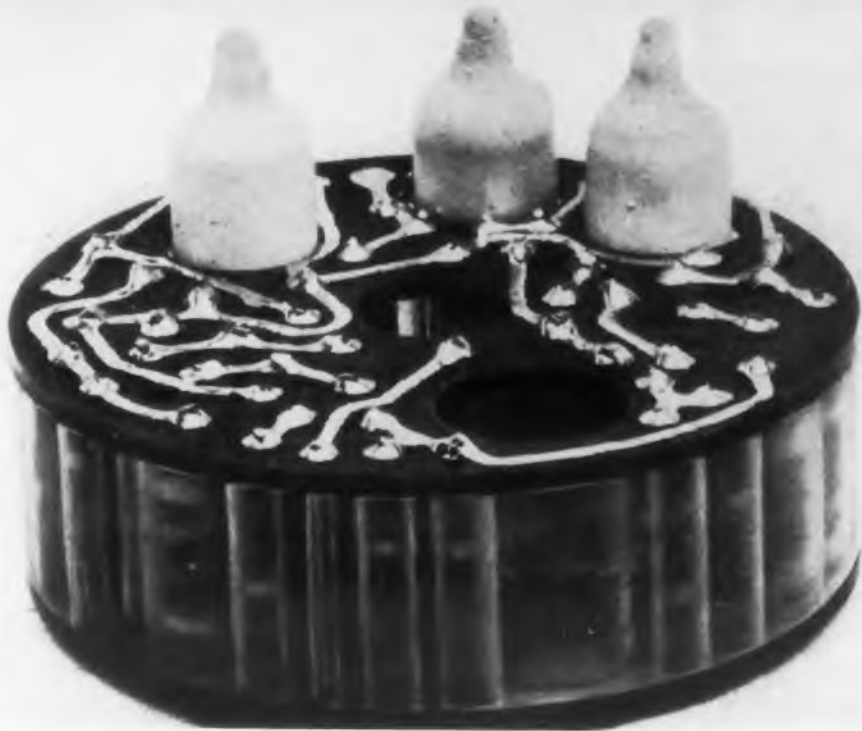


Fig. 3. A complex wired "sandwich"

are required to change from one size of component body to another. Components of widely varying lengths and diameters may be handled with equal ease because catacombs can be made any size, and at relatively low cost once the die is made. For that matter, catacombs are not required: a removable-type catacomb can be designed and used if one desires to build units without a catacomb. Furthermore, there is the natural advantage of the ease of circuitry change simply by changing the master circuit print. One of the main advantages of this method of assembly is that close tolerances are not required.

Complex electronic equipment can be subdivided into small units which can be designed and assembled in this manner. These units would be disposable when found to be faulty in the field and would help decrease costly trouble shooting. Repair of the unit after failure from use is rather difficult and, as such, uneconomical. Repair during manufacture would be unnecessary, with adequate inspection of components and controlled manufacturing processes, as a result of the virtual elimination of human error.

The method described herein will result in large savings because of the decreased manual labor required. Further advantages lie in the fact that automatic machinery for this method will be relatively inexpensive and flexible. Less indirect labor is required because component leads are not formed, sleeving is not required, and component inspection can be readily accomplished.

Demands for cost and size reductions are forcing the design engineer to consider the final physical form in the earliest stages of the development of a new product, perhaps even before the circuit is conceived. Exciting new production techniques rather than advances in circuitry may lead to the solution of many of these problems. The electronic design engineer must now include a knowledge of production systems like printed-wired "sandwich" construction in the tools of his trade.

Fig. 4. The first stage in the assembly procedure after pin No. 1, a plate, and the catacomb have been positioned on the shafts with the proper holes in line.

Fig. 5. Hand loading of components begins after the pilot catacomb has been placed over the catacomb.

Fig. 6. The components have been vibrated into position and the pilot catacomb has been removed.

eted printed-  
subassembly.



Fig. 7. The top printed-wire plate has been added and pin No. 2 has been threaded into pin No. 1.



Fig. 8. The catacomb is moved flush against the top plate prior to inverting the assembly.

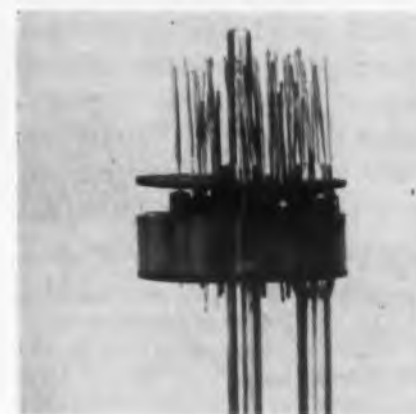


Fig. 9. The assembly has been inverted and replaced on the shafts. Some of the component leads have already slipped through their holes in the plate. Vibrations will now shake the other leads into place.





# TUNG-SOL®



## BEAM POWER AMPLIFIER

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

### **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 is manufactured under laboratory conditions accompanied by the most severe tests. It is rugged both mechanically and electrically, with tremendous overload capacity. The 5881 maintains high efficiency throughout its life and provides low cost operation through reduced maintenance.

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

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 this and other types are available on request to TUNG-SOL Commercial Engineering Department.



**Tung-Sol Electric Inc., Newark 4, N. J.**

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

# TUNG-SOL ELECTRON TUBES

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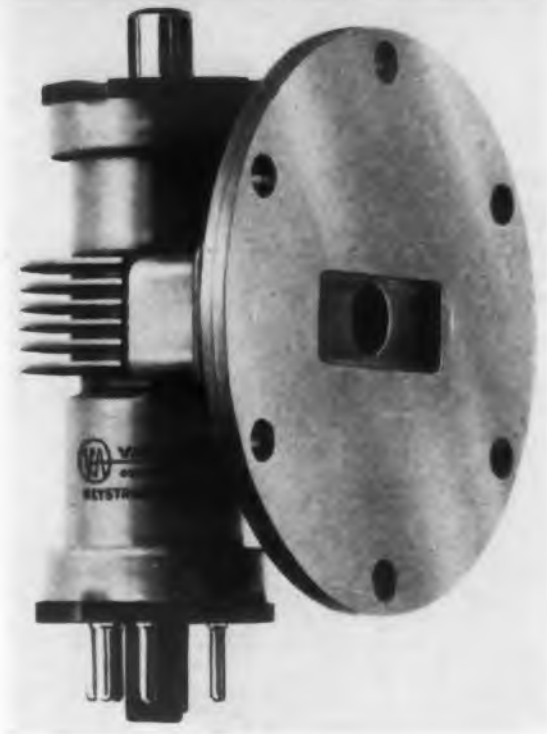
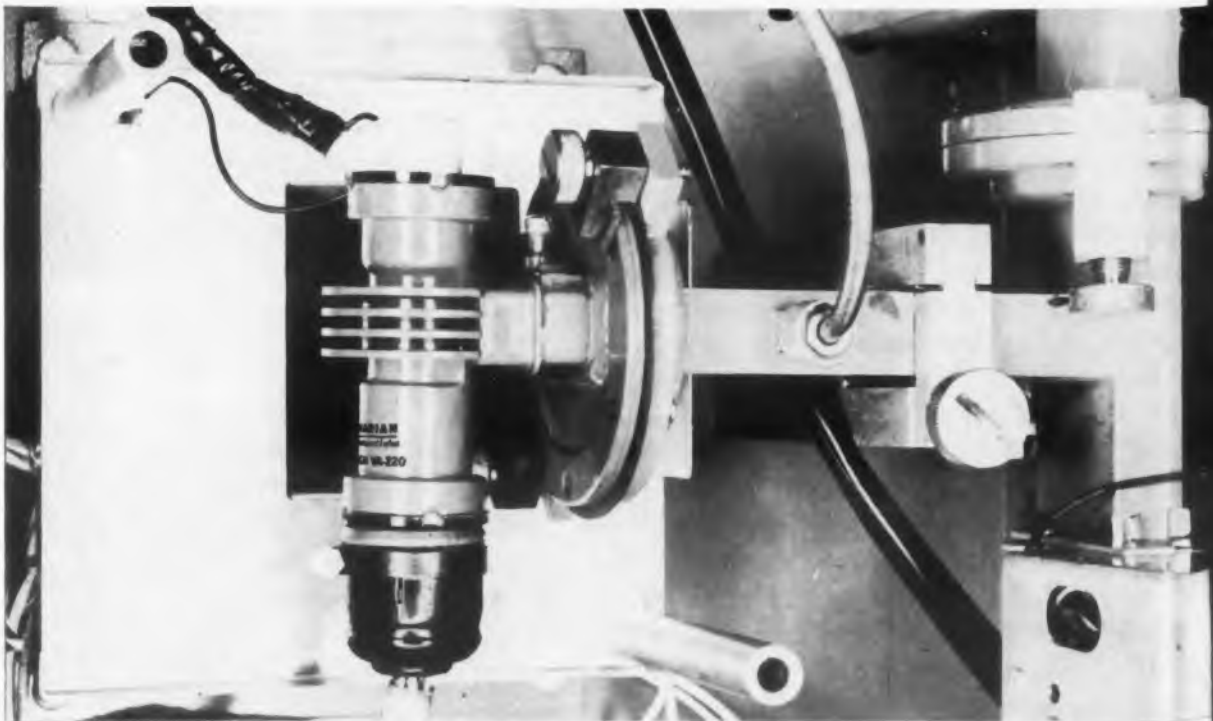


Fig. 1. One of the VA-220 Series Relay Klystrons, which are available in five frequency ranges.

# Relay Klystron

**F**EATURING negligible frequency drift, easier tuning and ample power to override noise, the long-life VA-220 Series Relay Klystrons offer significant advantages for all relay applications in the 6000-8000Mc band. Inherent noise and f-m distortion is 60db below a 1Mc deviation. In addition, the tubes, one of which is shown in Fig. 1, are offered at half the cost of this firm's earlier klystrons of comparable performance.

Fig. 2. A klystron in a modern relay system.



w TS  
2 0  
1 5  
1 0  
0 5  
VOLTS  
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300  
200  
100  
6

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CORPORATION

# Silicone News

FOR DESIGN ENGINEERS

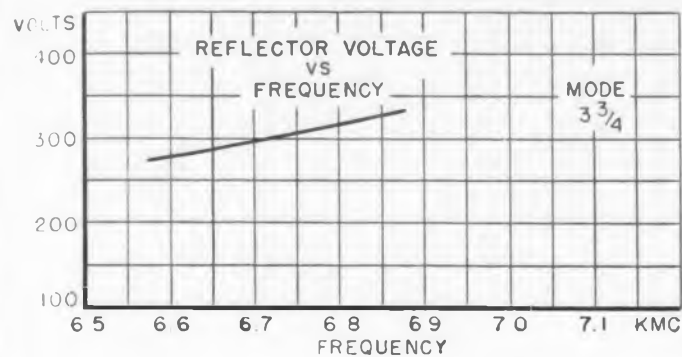
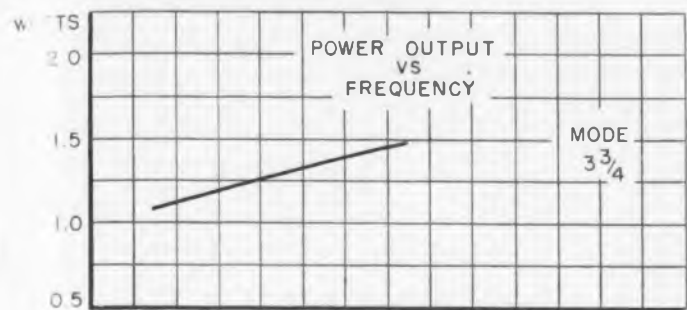


Fig. 3. Two characteristics of the Type D tube.

Various characteristics of these klystrons are given in the accompanying curves. Typical operation of one of the units calls for a resonator voltage of 750v for a power output of 1.2w, a bandwidth of 35Mc, and a modulation sensitivity of 375ke/v. Reflector capacity is 6mmfd maximum. Frequency ranges for the various models in the VA-220 Series are: Type F, 5925-6225Mc; Type E, 6225-6525Mc; Type D, 6575-6875Mc; Type C, 6875-7125Mc; and Type B, 7125-7425Mc.

Life expectancy of the tubes is 10,000 hr, and they are guaranteed for 2000 hr of operation. Forced air cooling of 30cfm is required for the units, which are manufactured by Varian Associates, 611 Hansen Way, Palo Alto, Calif. Dimensions of the tubes are 2.375" x 3.75" x 3.19". The output connection mates with a UG-343/U choke. The tubes do not have any modulation anomalies.

The units may be operated in any position. The base is the small wafer octal type, and they have a signal-screw tuner. For more data on these tubes, turn to the Reader-Service Card and circle **ED-31**.

## Modified Silicone Finish Used On Vehicle Heaters For Its Superior Heat And Salt Spray Resistance

Heaters manufactured for use in Ordnance vehicles by the Southwind Division of Stewart-Warner Corporation must withstand temperatures far higher than those involved in civilian applications. In the process of selecting the best finish for these units, the relative heat and corrosion resistance of organic and modified silicone paints were severely tested. The photograph shows the results.

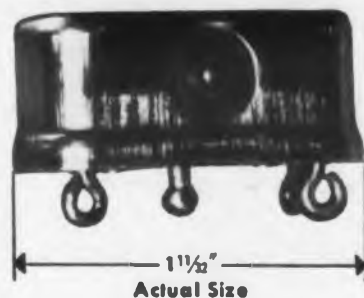


The heater shell at left was sprayed with a modified silicone paint which is formulated by Midland Industrial Finishes, and baked for 30 minutes at 400 F. A similar unit, at right, was sprayed with conventional olive drab (TT-E-485b), and baked for 45 minutes at 250 F. Panels in the foreground illustrate the appearance of both finishes before testing.

Both shells were held at 500 F for 4 hours. The conventional finish was then exposed to salt spray for 100 hours. The modified silicone finish was similarly exposed to a salt spray for 300 hours or three times as long. The organic finish was stained, faded, and badly disintegrated, while the silicone coating remained virtually unchanged. As a result, Stewart-Warner specified the modified silicone finish for all such heaters. *No. 1*

"What's a Silicone?" is the title of a 32-page booklet which answers that often asked question. Indexed and illustrated, this booklet is an interesting and informative description of silicones. *No. 2*

## Miniature Snap-Switch Sealed with Silastic Has Longer Life and Greater Reliability

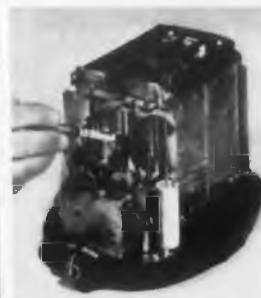


A Silastic\* diaphragm has enabled Haydon Switch, Inc., of Waterbury, Connecticut, to produce a hermetically sealed snap-action switch that weighs only about half an ounce and operates with less than half the effort required by standard "aircraft quality" switches.

"Tall Tales and Fabulous Facts" a 24-page booklet in which a parallel is drawn between the tall tales our ancestors told about legendary characters and some equally fabulous facts about Dow Corning silicones. *No. 3*

## Westinghouse is Always Sure With Silicone Lubricants

For the past six years Westinghouse Electric Corporation has employed Dow Corning silicone fluids and greases to assure lifetime lubrication for their automatic toasters. Besides being used on the latch lever pivot, Dow Corning 41 Grease is also brushed on the guide bars and latch bar, as shown in photograph. A Dow Corning fluid lubricant, 710R, is applied to the pivots and bearings of the toaster timer.



Westinghouse that they are ideal lubricants for the job. *No. 4*

Despite operating temperatures ranging up to 400 F, these silicone lubricants stay in place without oxidizing or hardening. Six years of trouble-free service have convinced

The Silastic diaphragm remains so flexible that the operating force on the actuator need not exceed 32 ounces even at -90 F. Fatigue problems and subsequent unreliability associated with metal diaphragms are eliminated. Operational life in the range of a million cycles is far in excess of the best metal diaphragm or bellows.

Accelerated permeability tests indicate that the Silastic diaphragm maintains an effective hermetic seal for more than 10 years. Internal pressures up to 100 psi have failed to produce leakage or rupture, and no change in the diaphragms has been observed even after 72 hours' immersion in salt, fresh or soda water, or in automotive or AN-0-6 aircraft oil.

Originally designed for aircraft, fire control and guided missile service, the new miniature switch is being applied to domestic and commercial washing machines, machine tools and other equipment exposed to liquids or moisture.

That's the kind of performance that has established Silastic as an ideal diaphragm material where pressures must be maintained despite temperatures from -100 to 500 F, weathering and oxidation, or in contact with a variety of oils and chemicals. Silastic is also unique among resilient dielectric materials because it combines high thermal conductivity with excellent resistance to moisture, corona and to fatigue. *No. 5*

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

### Design Edition 1

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How new Edison  
Relay with  
polarized operation  
helps simplify  
design problems



Current flow deflects the rotor of Edison's Sensitive Magnetic Relay in a direction determined by current polarity. Changing the operating current gradually causes the moving contact to follow the rate of change until it touches one of the stationary contacts. This basic operation adapts the Edison Relay for use as a null detector in a bridge circuit — and as a sensing element in a contactor servo circuit.

For designers of electronic equipment, Edison's Sensitive Magnetic Relay — a product of the world-famous Edison Laboratory — offers other outstanding features:

▶ **Low power operation** — Standard types close on input currents as low as 30 microamperes — available in special circumstances for even lower current.

▶ **Versatility** — Interchangeable coils can be supplied with resistances from 0.5 to 23,000 ohms. Normal closing power may be increased 10,000 times without adverse effects.

▶ **Contacts** — Platinum-iridium wire, either SPST or SPDT, with capacity of  $\frac{1}{3}$  ampere at 28 volts D.C. non-inductive.

▶ **Stability** — Test relays have exceeded 8,000,000 cycles without calibration change.

▶ **Shock and vibration resistant** — Relay will withstand shock of 50 g's in all planes without damage.

*Write us for complete data on this new Edison development.*

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Fig. 1. Attenuation in decibels is read directly at the window in the Type 30 Precision Attenuator.

**D**ESIGNATED the Type 30 Precision Attenuator, a continuously variable attenuator of the piston type featuring high accuracy, rugged construction and a direct-reading counter-type attenuation indicator is shown in Fig. 1. Attenuation is set to the desired value by the knob and is read from the indicator in tenths of a decibel without the necessity for interpolation.

The standard model has input and output coils tuned to a center frequency of 30Mc, and is intended for use over the range from 25 to 35Mc. Damping resistors in the standard model provide input and output impedances of 50 ohms. The unit has an attenuation range of 80db above a minimum insertion loss of 25db (at 30Mc). Actual attenuation above minimum insertion loss is within  $\pm 0.2$ db of the value indicated by the counter at any frequency from 25 to 35Mc. Input and output connections of 1/5 ohm impedance are provided by panel-mounted BNC connectors.

Fig. 2 is a view of the attenuator proper without the case. The body of the attenuator consists of a casting that houses the fixed input coils and pro-



Fig. 2. The rugged construction of the unit is apparent when it is removed from its case.

vides a piston type rugged construction from minimum to maximum. The piston type attenuator. The construction as a counter. This is to provide while and e. The a piston bevel type of or balanced leakage maintenance. The Airborne Counter case for ease of complex measurement weighing attenuator impedance than formation turn t. ELECT

# Precision Attenuator

vides the cylindrical attenuation chamber in which a piston carries the movable output coil. The rugged construction of the attenuator assures maximum long-term calibration accuracy and freedom from adverse effects of shock and vibration.

The fluted control knob drives the attenuator piston through a pair of stainless-steel bevel gears. The drive gear is internally threaded, thus acting as a driving nut for the internally threaded piston. This bevel gear is of the split, spring-loaded type to prevent play between the gear and the piston while still allowing the unit to operate smoothly and easily.

The shaft of the counter indicator is driven by a pinion from a second set of teeth on the split bevel gear, so that the counter gives a true indication of piston position without the effects of play or backlash. A set of piston rings prevents signal leakage past the end of the piston. Accuracy is maintained over the full attenuation range.

The Type 30 Attenuator is manufactured by Airborne Instruments Laboratory, Inc., 160 Old Country Rd., Mineola, N. Y. Housed in a walnut case for laboratory use, it is also available without case or panel for use as a component of more complex test equipment. In the case the attenuator measures 11" long x 4" wide x 3-3/4" high and weighs 3-1/4 lb. On special order, the attenuator can be supplied with input and output impedances other than 50 ohms and for use in other than the standard frequency range. For more information on this useful laboratory instrument, turn to the Reader-Service Card and circle **ED-34**.

## ASTRON Hy-Met<sup>®</sup> scaled for small size, light weight



Metalite Hy-Met\* ASTRON capacitors are crafted to feature small size, light weight, and to operate up to 125°C for all types other than cardboard tubular MLL (100°C). ASTRON technicians process the fine quality materials that comprise the famous Hy-Met capacitor line with skillful attention to minute details. *Self-healing* Hy-Met capacitors accept momentary overvoltages and surges without permanent damage—possess high dielectric strength and vastly improved insulation resistance over conventional metallized paper types—are *effectively protected* from humidity—give *low r.f. impedance* due to small size—are ideal for R.F. filters and noise suppression. All these features are common to the Metalite Hy-Met *plus* the greater dependability and longer life derived from added care in construction and quality control. Write today for ASTRON capacitor and filter literature.

\*Trademark

**ASTRON**  
CORPORATION

255 GRANT AVENUE



EAST NEWARK, N. J.

Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y.  
In Canada: Charles W. Painton, 6 Alcina Ave., Toronto 10, Ontario

CIRCLE ED-35 ON READER-SERVICE CARD FOR MORE INFORMATION



## Mobile "Master" Computer

**D**YSEAC, the mobile digital computer illustrated on these pages, can function as a computer by itself or serve as the "master computer" in a complex data-processing network in which it controls other digital computers or is controlled in turn by them. The instrument has extreme versatility of control and great latitude for expansion. While serving as a valuable scientific aid, it can also be the proving ground for evaluating certain novel control features and component packaging techniques. It was developed by the Electronic Computers Laboratory of the National Bureau of Standards, Washington 25, D. C.

At first glance the most striking feature of the instrument is its mobility. It is mounted in two standard 40-foot trailers. The control console, magnetic-wire input-output gear, computer, memory, and

a 12-ton capacity air conditioner are in one trailer. The second van houses regulated d-c power supplies, some of the special instruments that may be connected to the computer, and provides a work area as well as storage space. Where standard 3-phase, 208v power is not available, a third vehicle will carry two 50kva alternators to power the computer. Since DYSEAC requires a minimum of 55kva, enough power is available from the mobile power plant to operate associated devices, thus making up a completely self-contained computer center.

When serving as the nucleus of a data-processing system, DYSEAC can solve problems fed directly to it, while simultaneously aiding remote external devices on other problems and sharing its memory with them. It can regulate the speed of its own computa-

tions to match those of "annexed" external computers, or interrupt its own computations entirely and devote itself to the external situation or new special problems. Among the devices that can be attached to the computer are those that store, tabulate, file, convert, display and sense information. Communication between DYSEAC and the external instruments can take place at any time, on a completely unscheduled basis, and in both directions at once.

As a consequence, supervisory control over the common problem may initially be loosely distributed throughout the system, and then temporarily concentrated in one computer, or even passed rapidly from one machine to another as the need arises. The special joint-control properties of DYSEAC could not be secured satisfactorily by the use of program-

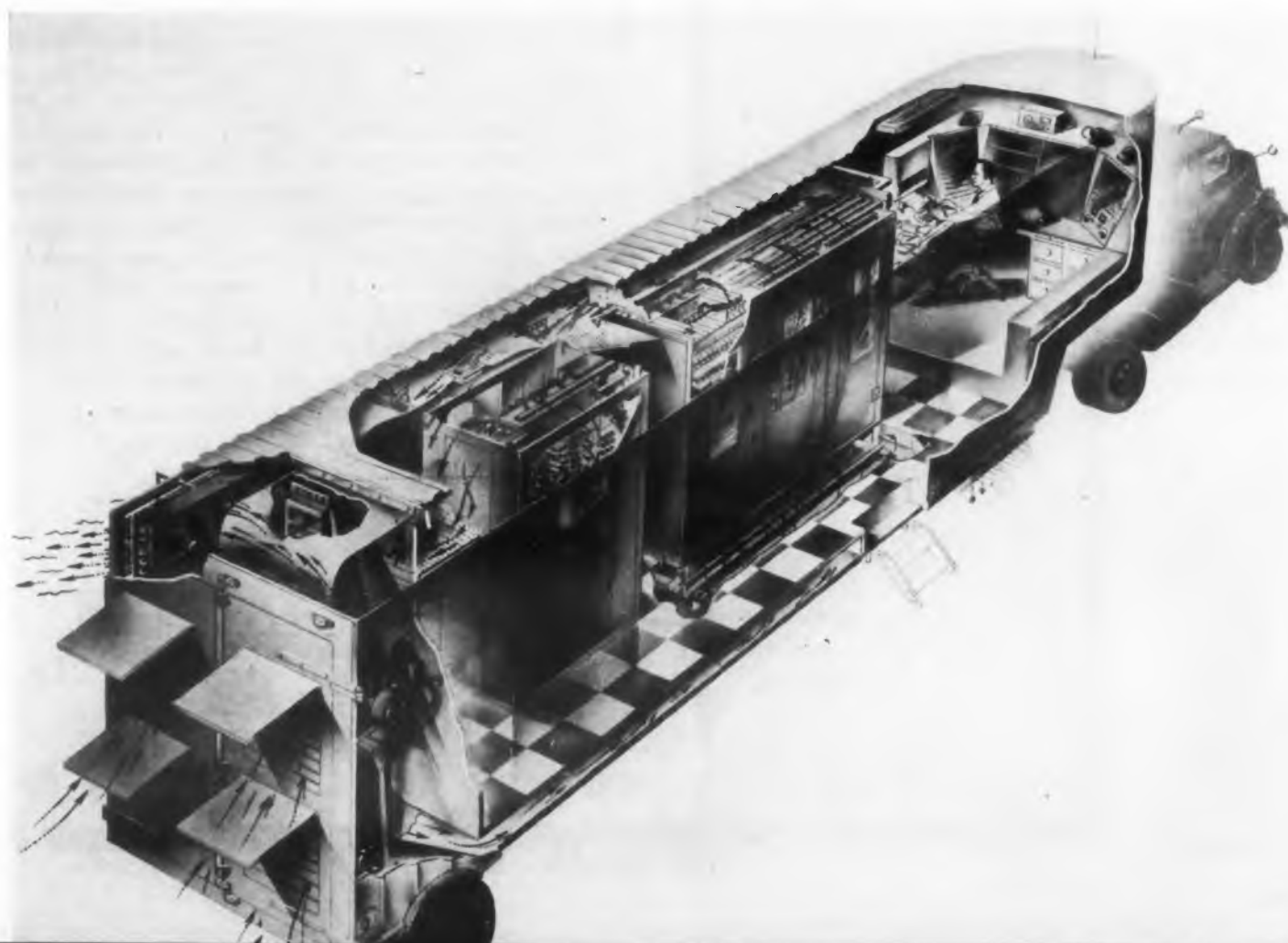


Fig. 1. One of the trailers housing (from left to right) the air-conditioning unit, memory, computer, control console, and input-output gear. The trailer has a false floor underneath which cooling air is carried as indicated by the arrows.

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**Fig. 2.** There are three racks like this one supporting 80 plug-in circuit packages each.



ming procedures alone, but required new techniques.

Only two types of etched-circuit plug-in packages are required as basic building blocks in DYSEAC. These modular units are assembled in groups of 80 on three racks, one of which is shown in Fig. 2. One modular unit, consisting of an amplifier tube, a pulse transformer, and a number of diodes, is adaptable with minor changes to the majority of circuit needs. This unit serves as a low-impedance pulse driver, a flip-flop, and for a number of gating functions. A second type of package houses delay lines used for interconnection between the stages. The 524 tube packages and 251 delay-line packages, containing 21,000 diodes and 3800  $1/4\mu\text{sec}$  delay-line segments constitute about 90% of the total circuit requirements of the computer exclusive of the acoustic memory and the input-output equipment. The racks, as well as the memory cabinet, are shock-mounted for protection while moving.

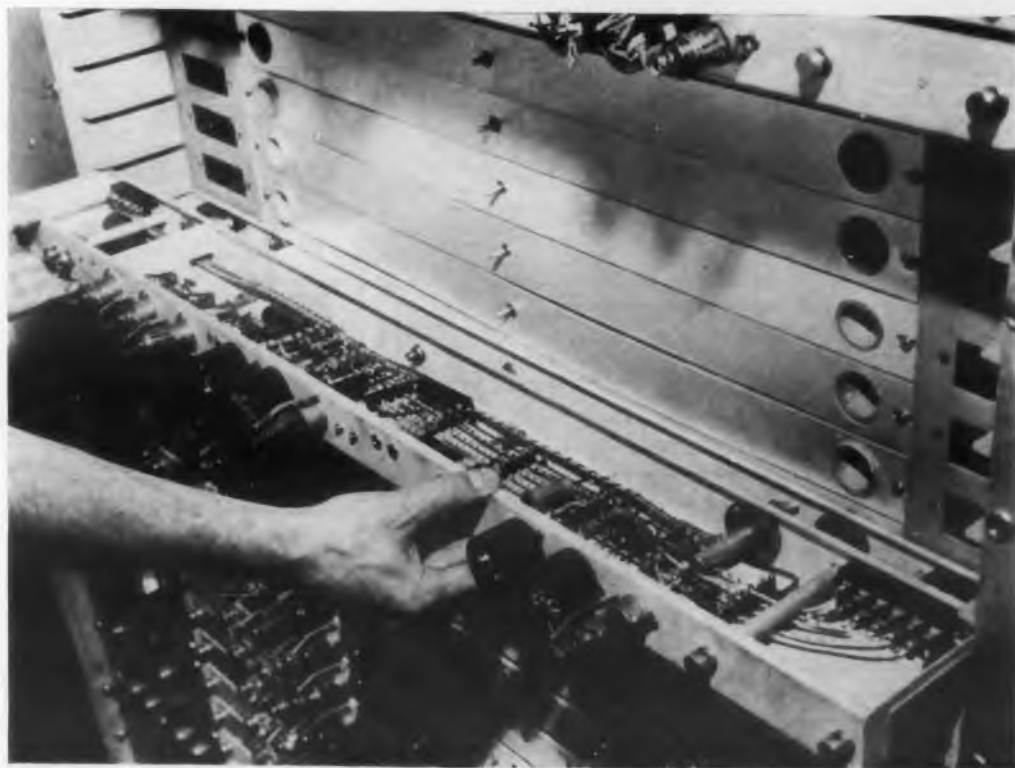
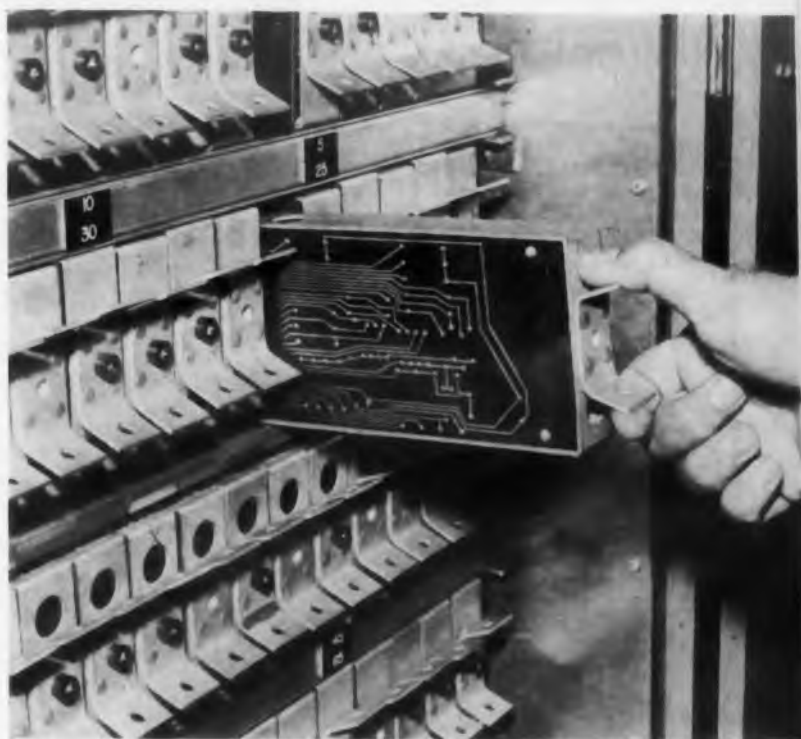
In designing DYSEAC, provision was made for expanding the high-speed storage from an initial capacity of 512 words up to a total capacity of 4096 words. The memory consists of 64 mercury acoustic delay line packages, one of which is shown in Fig. 4. This expansion is most significant, since the computer is organized around the memory unit. The memory has a normal 1Mc internal repetition rate.

The unusual control features of DYSEAC combined with its mobility represent an ingenious solution to the problem of setting up a data-processing network. At the same time, this computer is testing new construction methods. If DYSEAC is successful in demonstrating the feasibility of harnessing together a number of data-processing devices, including computers, it can help in the establishment of a standard method of feeding data to computers. Such a standard method, like the binary code employed in DYSEAC, combined with the joint control features, would multiply the total computation capacity of the nation's computers. The design of DYSEAC has implemented the concept of the "master computer" a stimulating idea for all designers of computers.

**Fig. 4.** One stage of the acoustic delay line memory is being removed for servicing by an operator. These stages are shock-mounted for protection while the trailer is being moved.



Fig. 3. The printed-wired circuit packages are quickly removed from the racks for servicing.





## "Vasco" Petite Iron



IS RIGHT:

THE RIGHT HEAT • THE RIGHT TIP



**For Service and Manufacture  
of Printed Circuits**

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REPRESENTATIVE IN MAJOR CITIES  
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Mitchell Industries

Mineral Wells, Texas

CIRCLE ED-92 ON READER-SERVICE CARD FOR MORE INFORMATION

## POWER OSCILLATOR

MODEL 1040

PRICE  
**\$11900**  
F.O.B.  
NEW YORK

**A COMPACT  
PRECISION OSCILLATOR  
PROVIDING 3 WATTS OUTPUT**

- Excellent Accuracy and Stability
- Transformer Isolated Output
- 3 Output Impedances
- Low Internal Impedance
- Output Variable Up To 120 Volts

### SPECIFICATIONS

Frequencies.....400 or 1000 C.P.S. by selector switch  
(other frequencies on request)  
Distortion.....Less than 1 %  
Hum Level.....Approximately .05 % of rated output  
Output Power.....3 watts into matched resistive load  
Power Supply.....115 volts, 60 C.P.S., 40 watts  
Dimensions.....5-11/16 x 9 x 6 1/8 inches

*Representatives in Principal Cities*

**INDUSTRIAL TEST EQUIPMENT CO.**  
55 EAST 11th STREET • NEW YORK 3, N. Y.

CIRCLE ED-36 ON READER-SERVICE CARD FOR MORE INFORMATION

# New Products . . .

## Miniature Resistor Surpasses MIL-R-10683A

The Type HFR 1/4w high-frequency miniature resistor is constructed of special solid ceramic rods to which a thin resistive film is permanently bonded. Featuring axial leads, it surpasses specification MIL-R-10683A.

The entire body assembly, including lead caps, is

coated with a moisture-resistant protective coating especially designed for high frequency application. The unit is recommended for use in circuits requiring excellent frequency response over a wide band of frequencies and where low shunt capacity is desirable. Standard tolerance is  $\pm 20\%$ , with  $\pm 10\%$  and  $\pm 5\%$  available. Body length is  $9/16''$ ; body diameter (over caps)  $3/32''$ , lead length  $1-1/2''$ , and lead diameter  $0.025''$ . International Resistance Co., Dept. ED, 401 North Broad St., Philadelphia 8, Pa.

CIRCLE ED-37 ON READER-SERVICE CARD FOR MORE INFORMATION

## Time Delay Relay Plug-In Type



The type F "Silic-O-Netic" plug-in Time Delay Relay operates on the hydraulic-magnetic silicone operating principle. These compact, lightweight units are hermetically sealed against dust and moisture with an inert-gas fill optionally available.

The relay is provided with standard time delays from  $1/4$  to 120 sec.

These relays are furnished with either octal-pin or solder-lug terminals for operation on 24v to 220v, a-c, or 12v to 125v, d-c. Contact capacity is 3amp at 120v, a-c, or lamp at 50v, d-c, with spst through dpdt switching actions available. Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N.J.

CIRCLE ED-38 ON READER-SERVICE CARD FOR MORE INFORMATION

## Telephone Relays With up to 12 Contact Springs



The Series 5M relay incorporates all of the features of this firm's Series M relay, plus the additional features of: up to 12 contact springs (forms A to C); hermetically sealed construction;

7, 9 and 14 pin "plug-in" header; nitrogen filling; and ability to withstand 75g shock test. It is intended for use in all equipment where adverse climatic or environmental conditions exist.

The relay measures  $2-11/16'' \times 1-5/8'' \times 1-13/32''$  overall. The hermetic sealing simplifies maintenance and renders the relay tamper-proof. The dry nitrogen gas produces high sparking potential or arc suppression. Hundreds of coil and contact combinations are available, and numerous additional features are available for special applications. Kurman Electric Co., Dept. ED, 35-18 37th Street, Long Island City 1, N. Y.

CIRCLE ED-39 ON READER-SERVICE CARD FOR MORE INFORMATION

## Servo Motor Precision Miniature Design

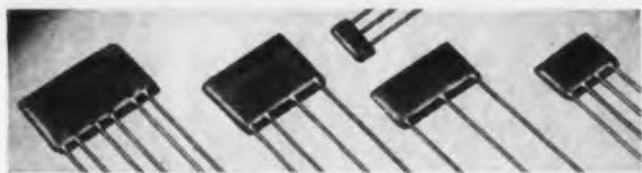


The Model 1050 Servo Control Motor, was specifically designed to operate this firm's "Micropots", but can be used in many other servo applications or where a precision,

high-quality motor is desired. A compact unit, it has three threaded holes in the housing for mounting the motor on a panel. Approximate dimensions are  $1-1/2''$  diam x  $1-1/2''$  long, with a  $1/2''$  shaft extension.

Minimum locked rotor torque is 0.82 oz-in in either direction when operated at 115v. Other characteristics are: induction type, 2-phase, 115v, 400cy, 5500rpm no-load speed. Borg Equipment Division, The George W. Borg Corporation, Dept. ED, Janesville, Wis.

CIRCLE ED-40 ON READER-SERVICE CARD FOR MORE INFORMATION



## save money, time, trouble, with Bulplate® Printed Circuits and Multiple Capacitors

With Sprague Bulplates, you have fewer parts to purchase, inspect, handle, and stock . . . fewer soldering operations, faster assembly with less chance of wiring errors. They're more compact, lighter in weight, and Bulplates frequently cost less than the conventional components they replace.

Bulplate *Multiple Capacitors* with integral connecting circuitry are available in both general application and temperature compensating ceramic bodies. Bulplate *Printed Circuits* have highly stable resistor elements added to the capacitor elements of Bulplate Multiple Capacitors. In addition to the many standard designs shown in Engineering Bulletins 600 and 650C, Sprague will engineer specials to fit your needs.

### SPRAGUE ELECTRIC COMPANY

347 Marshall Street

North Adams, Mass.

# SPRAGUE

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**NEW!**

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**PORTABLE!**

it's  
**ECONOMICAL!**

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**DS-660  
FREQUENCY  
METER**



Designed for portability and low-cost as well as accuracy, the newly developed DS-660 will count and display any electrical or mechanical event which can be converted into a varying voltage of sufficient amplitude — from 10 to 100,000 events per second. Derives its time base from the 60 cycle line — which determines the accuracy — approximately .1%. Here is new and amazing reliability and circuitry available in one unit.

#### FEATURES:

SELF CHECKING

AUTOMATIC and  
MANUAL RESET

DISPLAY from  
1 to 10 SECONDS

LIGHTWEIGHT  
— only 16 lbs.

UTILIZES STANDARD  
PLUG-IN DECADES

BASIC UNIT READS  
OUT TO 10 KC (4 decades)

AIR COOLED (Fan)

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CIRCLE ED-42 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## Precision Potentiometers

### Standard 3-Turn Design



The "Series 930 Micro-pots" are standard 3-turn precision potentiometers designed to provide great flexibility of application. Either or both mechanical stops may be used as phasing points due to the adjustability of the contact drive assembly. This feature also provides greater accuracy in the four basic types of linearity without modification of the potentiometer.

Low starting and running torques make it possible to use these 3-turn units in lieu of single-turn pots and thereby gain greater accuracy and resolution. They are available in standard models from one to five-gang. Each model is produced with single-ended or double-ended shaft and with servo or bushing mount at either or both ends.

Additional advantages include extra-long life due to automatic compensation contact wear and the scanning action of the bar contact; no backlash between mechanical rotation and electrical rotation; finer resolution due to a longer Kohlrausch winding; welded terminal leads; and a plastic housing that embeds resistance element, lead wires, and terminals into a rigid, well-insulated assembly. Borg Equipment Division, The George W. Borg Corp., Dept. ED, Janesville, Wis.

CIRCLE ED-43 ON READER-SERVICE CARD FOR MORE INFORMATION

## Flashlight Battery

### Features No Corrosive Leakage



"Eveready" D99 flashlight battery. In this battery the carbon electrode is on the outside, and the zinc electrode is on the inside.

The insert carbon wall keeps the battery sealed even when the zinc is consumed and the battery is exhausted. This leakproof battery will not swell. The construction also provides efficient consumption of the zinc, and, therefore, means a longer life. National Carbon Co., Dept. ED, 30 East 42nd St., New York 17, N. Y.

CIRCLE ED-44 ON READER-SERVICE CARD FOR MORE INFORMATION

## TRANSFORMERS . . .

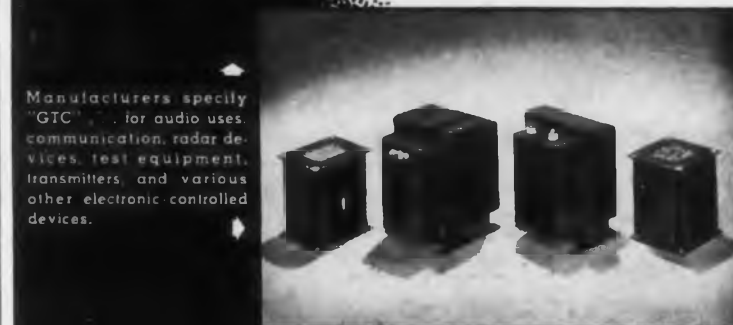
. . . specified for the usual  
. . . demanded for the  
unusual



"GTC" Transformers for television receiver applications . . . custom designed for high quality at minimum cost.



"GTC" Transformers for industrial and commercial applications . . . accurately engineered and fully recognized for finest quality.



Manufacturers specify "GTC" . . . for audio uses, communication, radar devices, test equipment, transmitters and various other electronic controlled devices.



"GTC" Military Transformers . . . designed to meet rigid government specifications and to perform under the most severe and continuous operating conditions. MIL-T-27 and JAN-T-27.

Skilled engineering techniques make GTC a source for transformers in highly specialized and extremely unusual applications. Utilization of these techniques results in greater dependability, quality and better construction.

Our completely self-contained plant's modern equipment guarantees transformer production in any quantity, to meet your requirements. We welcome your inquiry and will supply production samples where desired.



## GENERAL TRANSFORMER COMPANY

serving industry since 1928

18240 Harwood Avenue, Homewood, Illinois  
(Suburb of Chicago)

CIRCLE ED-46 ON READER-SERVICE CARD FOR MORE INFORMATION



## New Products...

### Blueprint Pencil

#### Eight Colors Available

A new blueprint pencil specifically designed for checking and marking on all blue or white prints and coarse tooth papers is resistant to oil, dirt, and grime and also unaffected by sunlight or moisture. The lead does not reflect light and results in opaque markings that give excellent reproductions without ghosts.

The specially formulated lead gives brilliant, insoluble, contrasting color markings. The pencil can be sharpened to a fine point and will not powder or smudge. They are marketed in an 8-color pack including a special obliterating blue pencil for eliminating white marks on blueprints. Colors are green, yellow, red, vermilion, light blue, dark blue, white, and black. A sample pencil is available on request. American Lead Pencil Co., Dept. ED, Hoboken, N. J.

CIRCLE ED-47 ON READER-SERVICE CARD

### Lubricating Coatings

#### Applied by Dispersions

Two new "dag" dispersions can be used to coat all types of surfaces with dry lubricating coatings having epoxy resin bases. Typical uses for these products include dry lubricating films for high-temperature screw threads, precision gears, bearings, shafts, etc.

Dispersion No. 213, containing colloidal graphite, can be sprayed full-strength. Dispersion No. 223 contains colloidal molybdenum disulphide. Films properly formed with these dispersions show excellent adhesion and wear resistance. They are unaffected by oils and solvents, and can be used wherever temperatures do not go above 500°F.

In certain applications where electrical conductivity along with good heat stability is desired, Dispersion No. 213 also provides these properties. Acheson Colloids Co., Dept. ED, Port Huron, Mich.

CIRCLE ED-48 ON READER-SERVICE CARD

CIRCLE ED-49 ON READER-SERVICE CARD ➤

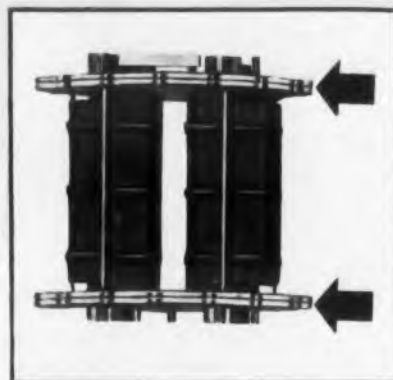
# MOST RELIABLE TUBES YOU CAN INSTALL!



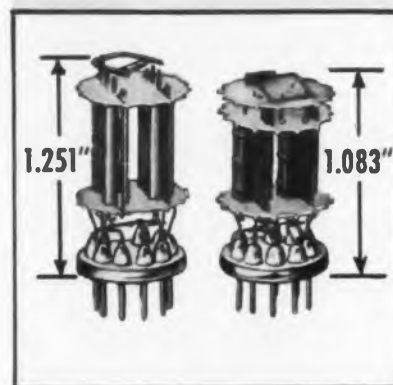
## 5-Star Tubes



... for aircraft navigation, control, and communications.



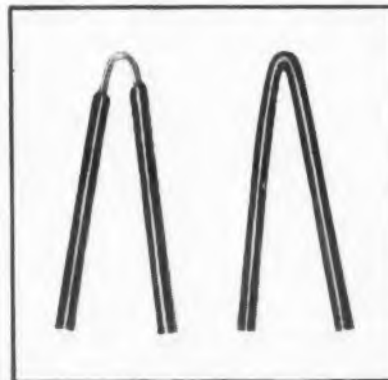
● Double mica spacers at top and bottom brace 5-Star Tube structures . . . widen surfaces in contact with glass envelope . . . make for a tube that will stand up in hard service.



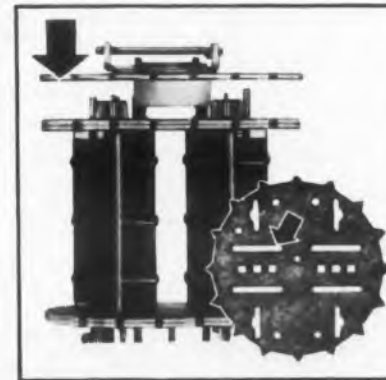
● Compact, sturdy tube cages withstand shocks and vibration. Note that 5-Star GL-5751 (right) is 13% shorter than 12AX7 prototype, with heavier, more substantial design.



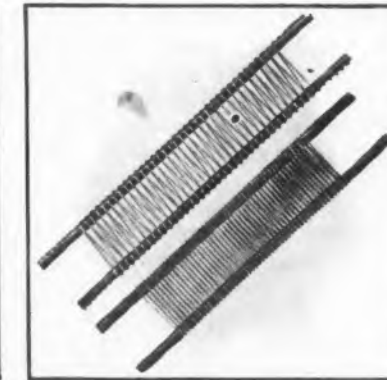
● 5-Star Tube getters are double-staked to the mica spacer beneath. This gives firm support against shocks—is characteristic of strong tube construction throughout.



● 5-Star heater-wire bends are coated a second time to prevent "shorts". Left, how flaked-off coating can expose wire. Right, after special insulating treatment.



● Double plate-to-grid leakage protection in many types! Left: getter flash shield wards off conductive deposits. Right: spacer slots interrupt leakage paths.



● Grid legs of 5-Star Tube (right) are smooth, not nicked. This assures a tight fit where legs pass through spacers, reducing grid vibration and microphonic noise.

### SPECIALLY DESIGNED!

Superior dependability of G-E 5-Star Tubes is designed in, with many special features contributing to performance.

NOT selected tubes, but tubes engineered at the drawing-board level for greater reliability! General Electric 5-Star Tubes are special in every aspect of their design.

Resistance to shocks and vibration is superior to standard tubes because of double mica spacers, sturdy tube cages, double-staked getters, and other built-in strength and safety features.

Fewer "shorts", more uniform electrical characteristics—these result from heavier, better-insulated heater wire; from steps taken to prevent inter-element leakage; from still other 5-Star design improvements that pay off in stable performance.

Millions of General Electric 5-Star Tubes—now giving far more reliable service for a longer period of time—prove that increased receiving-tube dependability starts at the design stage!



# SPECIFY THEM FOR CRITICAL APPLICATIONS!



... for 2-way radio emergency communications.



... for radar installations.



... for remote-controlled transmitters and unattended relays.



... for studio and transmitter equipment in AM-FM-TV broadcasting.

## SPECIALLY MANUFACTURED!

Utmost care in manufacture follows. G-E 5-Star Tubes are built to only one standard of quality... the highest!

INCREASED reliability brought about by special tube design, is further accented by pre-assembly inspection of individual parts, painstaking manufacture, and thorough testing.

5-Star Tubes are built in separate G-E factory areas, by selected operators whose output features quality, not quantity. Advanced optical equipment is used to magnify parts and to check measurements. Many such inspections involve every 5-Star Tube.

The industry's strictest quality-control standards are observed. Final tube tests are comprehensive and exacting. All G-E 5-Star Tubes receive a final 46-hour "burn-in" before shipment.

Design, manufacture, testing—all focussed on dependability—join to make G-E 5-Star Tubes the best and most reliable you can install! Tube Dept., General Electric Company, Schenectady 5, N. Y.



### ATTENTION: EQUIPMENT DESIGNERS!

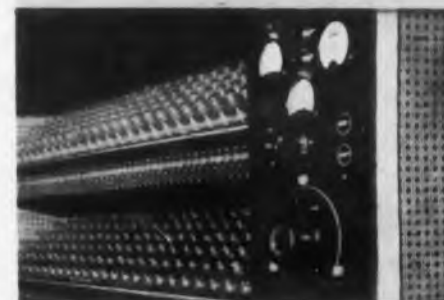
33 G-E 5-Star Tubes—19 miniatures, 1 glass octal-base, 2 metal, 11 subminiatures—give you a wide choice, enabling you to put high reliability in virtually every socket. Ask for new Bulletin ETD-548C, with full tube listing and application data!



● 5-Star Tube parts are individually inspected by microscope. Grids are micrometer-gaged for accurate dimensions. These are pre-assembly checks with every G-E 5-Star Tube.



● During rigid short-circuit tests, 5-Star Tubes are tapped with a cork mallet. A single flicker of the short test indicator brings immediate tube rejection.



● Every 5-Star Tube receives a 46-hour "burn-in" under Class A conditions. This avoids early life failures, and assures stable electrical performance.

## Audio Cables

### Polyethylene Insulated

A new, complete line of cables for audio, intercommunication, microphone, TV camera and other audio applications are made with polyethylene insulation. This insulation features low loss, long life, good flexibility, and high dielectric strength. Non-marring "Chrome Vinyl" jackets, durability, minimum maintenance, and ease of stripping are outstanding qualities of the new cabling.

The thermoplastic materials used are moisture-resistant, abrasion-resistant, and impervious to oil, grease, and most chemical fumes. Conductors are color coded for circuit identification. All leads are tinned to simplify soldering operations. Components Div., Dept. ED, Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.

CIRCLE ED-50 ON READER-SERVICE CARD

## "O" Rings

### Made to 0.020" ID

Available in sizes as small as 0.010" cross-section and 0.020" ID, subminiature "O" rings and other rubber parts are used in cables, micro switches and other electronic applications. They are made by an injection molding process. Minnesota Rubber and Gasket Co., Dept. ED, 3630 Wooddale Ave., Minneapolis 16, Minn.

CIRCLE ED-51 ON READER-SERVICE CARD

## Laminates

### Flame-Resistant

A new series of flame-resistant and flame-retardant laminates, impact phenolics, and fibrous materials can be blanked and punched as easily as standard grades of the same products. The flame-resistant ingredients of the laminates are a component part of the materials and not just a surface treatment. The entire series falls into Class A insulating materials. Rogers Corp., Dept. ED, Rogers, Conn.

CIRCLE ED-52 ON READER-SERVICE CARD

◀ CIRCLE ED-49 ON READER-SERVICE CARD

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\*KOILED KORDS is the trademark of Koilied Kords, Inc.

CIRCLE ED-54 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Pulse Generator For Both Delay and Gate Uses



Utilizing block-unitized construction, the Model 2315A pulse generator consists of three semi-independent units and a power supply, providing either a variably delayed, variable-width pulse, or two variable-width pulses with no delay, or two variably delayed blocking oscillator pulses whose delays may be paralleled or cascaded from the sync pulse.

An internal oscillator source generates positive and negative variable amplitude sync pulses from 10cy to 100kc, direct reading in four decade related ranges, along with a sync pulse delayed 2μsec with respect to the initial sync pulses. External triggering and single shot operation are also provided.

Delays are direct reading and variable from zero (with respect to the delayed sync pulses) to 10,000-μsec in five decade related ranges. Jitter is 0.02%, and the units are calibrated to an accuracy of 0.5% of full scale. Blocking oscillator delayed outputs of both polarities and of variable amplitude are available.

Gate pulse rise and fall times are 2μsec, and widths are direct reading and variable from 2μsec to 10,000μsec in the same ranges and with the same accuracy as the time delays. Positive and negative pulses are simultaneously available and are variable in amplitude to at least 50v across an internal 5000-ohms. Electro-Pulse, Inc., Dept. ED, 11811 Major St., Culver City, Calif.

CIRCLE ED-55 ON READER-SERVICE CARD FOR MORE INFORMATION

### Crystal Shock-Proof Unit



This 1Mc crystal unit in an HC-6 holder assures high stability in the low-frequency range. It utilizes a new nylon nest, permitting it to go

down to 500kc. The crystal is firmly secured against shock without any hampering of its oscillating quality. It is built to meet all the requirements of the following MIL types: CR 18, 19, 27, 28, 35, 36, and 48/u. Reeves-Hoffman Corp., Dept. ED, Cherry & North Sts., Carlisle, Pa.

CIRCLE ED-56 ON READER-SERVICE CARD FOR MORE INFORMATION

## It's the Principle . . .

Relay Basic Unit  
A-1105



This structure is the principle contained in 3 AN approved Hermetically Sealed type relays, manufactured by Electrical Products Corporation.

Used for control of vital airborne electronic equipment, it is unusually rugged and provides exceptional resistance to shock, vibration and acceleration.

Has balanced rotary armature with unique, close-coupled contact linkage for speedy, low-inertia operation.



A-1104  
(AN-3306-1)



A-51-108  
(AN-3311-1)



A-1106  
(AN-3307-1)

#### SPECIFICATIONS:

Nominal Coil Voltage . . . . . 24-28 VDC  
Dimensions . . . . . 1 1/8 x 1 3/8 x 1 1/8 inches  
Weight . . . . . 3 ozs.  
Contacts . . . . . DPDT  
Rated (Resistive and Inductive) . . . . . 10 amps.  
Also available in other enclosures.

#### Electrical Products offers:

\*Uniformly high quality by rigid inspection and testing.

\*Extra rugged construction on all type Relays.

Send for Brochure and Specifications on our complete line.



## Electrical Products Corp.

1100 North Main Street, Los Angeles 12, California

CIRCLE ED-57 ON READER-SERVICE CARD FOR MORE INFORMATION

**FORD**  
Helical Type  
Precision  
Potentiometers

# Multipot

THE MARK OF QUALITY

Electrically Quiet —  
Mechanically Smooth  
Four basic types featuring the  
finest of materials and crafts-  
manship:

1. Standard Series, 1 1/2" dia.
2. "A" Series, 1" dia. x 1" long.
3. "B" Series, 1" dia. x 1" long.
4. "HN" Series, HERMETICALLY SEALED, 1" dia. x 1-9/16" long.

Above dimensions - are for 10-  
turn units. Any Multipot may  
be supplied with any rotation  
from 320° to 3600°. Resistances  
from 1 ohm to 400,000 ohms.  
Send for Catalog.

FORD ENGINEERING COMPANY  
UPLAND, CALIFORNIA  
PHONE YUKON 322-321

CIRCLE ED-58 ON READER-SERVICE CARD FOR MORE INFORMATION



Have you a similar use for this 1-piece fastener?



It's a Shelf Support... For ranges or refrigerators—in plastic and metal. Leading appliance makers have achieved substantial installation savings through it.



It's a Lifter Knob or Dashboard Plug... Plastic Spring-Lock heads are molded around steel inserts, giving strength at point of load or impact. Any shape head can be molded in any color.



It's a Cabinet Door Strike... Simple to install; eliminates welding and cuts assembly cost. Any head can be designed without affecting fastening principle.



It's a Blind Rivet... Or a removable fastener. It locks and unlocks with a 90° clockwise rotation. No mating parts such as nuts or receptacles.

#### What's Your Application?

... Tell us how you can use Spring-Lock Fasteners in your products. We'll be glad to work out the details with you.

Send for more data and Free Samples today.

## Simmons Fasteners

QUICK-LOCK • SPRING-LOCK  
ROTO-LOCK

SIMMONS FASTENER CORP., 1763 North Broadway, Albany 1, N. Y.

CIRCLE ED-59 ON READER-SERVICE CARD FOR MORE INFORMATION

### FOR PRINTED CIRCUITS...



## INSUROK.

Copper-Clad Plastic Laminates have Superior Electrical Properties after Humidity Conditioning

CHARACTERISTICS —AVERAGE VALUES	T-725 COPPER-CLAD	T-812 COPPER-CLAD
*Power Factor	.003	.031
*Dielectric Constant	4.7	4.6
*Loss Factor	.16	.14
*Insulation Resistance	70,000 Meg.	100,000 Meg.
Bond Strength, Copper to Laminate	Avg. 7 lb.	Avg. 7 lb.
*Water Absorption on 1/16" thick	0.90%	0.76%

\*Conditioned 96 hours at 40° centigrade, 90% relative humidity.  
\*Tests made with copper surfacing removed.

The RICHARDSON COMPANY

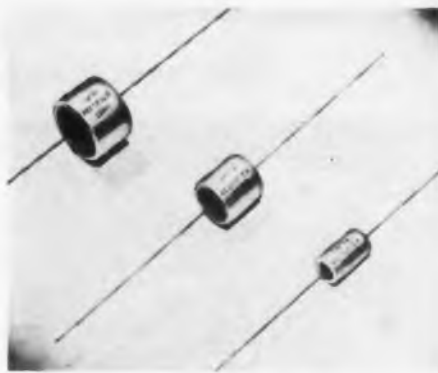
2682-T Lake Street, Melrose Park, Illinois (Chicago District)

CIRCLE ED-60 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## Selenium Rectifiers

For Load Currents Under 50ma



For electronic equipment requiring a load current of 50ma or less, the "CR" series of miniature rectifiers consists of a number of selenium cells assembled within a cylindrical aluminum housing.

Size ranges from the smallest type (CR08), 0.375" diam x 0.625" long, to the largest (CR58), 0.750" diam x 0.625" long.

The rectifiers are rated for maximum rms input voltage of 130v and 160v for operation into a capacitive load, and have a d-c output current from 10ma to 50ma. For example, Type CR28 of this series is rated for a maximum of 130v input and will deliver approximately 170v d-c at 20ma with a capacitive filter. International Rectifier Corp., Dept. ED, 1521 E. Grand Ave., El Segundo, Calif.

CIRCLE ED-61 ON READER-SERVICE CARD FOR MORE INFORMATION

## Receptacle

For Etched or Printed Circuit Cards



This 20-contact receptacle for etched or printed circuit cards is interchangeable with present 18-contact receptacles both in mounting and in contact spacing. It

makes it possible to expand etched or printed circuits without increasing the space required for the connector.

Made of beryllium copper wire, the contacts are formed, not stamped or machined, to assure constant pressure and dimensional uniformity. They are then heat-treated to give extra spring action. Each contact functions independently of the receptacle body. The contacts are stronger than the wires to be connected to them. They are gold-plated over silver for maximum conductivity, soldering ease, and corrosion-resistance.

The connectors come complete with 20 contacts, including one dummy contact for positive polarization. They are supplied with either pierced tabs, as shown, or unpierced. The connectors are available with either a "Melamine" or an "Alkyd" 440A body, and a mounting hole with or without a threaded insert. Viking Electric, Dept. ED, 1061 Ingraham Street, Los Angeles 17, Calif.

CIRCLE ED-62 ON READER-SERVICE CARD FOR MORE INFORMATION



## Encapsulated Precision Wire Wound Resistors Defy Shock, Vibration and Extreme Changes

Completely sealed in epoxy resin and wound on steatite bobbins, RPC has engineered Type L Resistors that are protected against extreme humidity, temperature and altitude conditions, mechanical damage, while maintaining dimensional stability.

Type L Resistors, in many tests, have withstood 30 humidity cycles of MIL-R-93A moisture resistance tests without deterioration. They fully meet the requirements of U.S. Govt. Specifications MIL-R-93A. Not affected by extremes in humidity, altitudes, and corrosive influences; protected against outside elements.

RPC can supply Type L on short notice with lug type terminals or wire leads; in a complete line of standard, midget and sub-miniature sizes. Wide range of performance! Write for catalog or additional details.

Sales representatives in all principal cities of the U.S.

## RESISTANCE PRODUCTS CO.

714 RACE STREET • HARRISBURG, PENNA.

Makers of Resistors—High Megohm, High Voltage, High Frequency, Precision Wire Wound

CIRCLE ED-63 ON READER-SERVICE CARD FOR MORE INFORMATION



# Miniaturization Engineers

**FOR RESEARCH,  
DEVELOPMENT  
AND APPLICATION  
OF  
SUBMINIATURIZATION  
TECHNIQUES**

*Significant advancements in the fields of guided missiles, airborne electronic systems and commercial electronic computers are requiring further applications of miniaturization techniques in the Hughes Advanced Electronics Laboratory. Positions are open for engineers qualified in this work.*

## THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, form one of the nation's leading electronics organizations. The personnel are presently engaged in the development and production of advanced electronic systems and devices.

## AREAS OF WORK

Techniques involved are those dealing with printed and etched circuits, encapsulation, plastics, metallurgy, dip-soldering, spot-welding, electrochemistry and materials. Development activities are concerned with plug-in units, auto-assembly techniques, potted units, new wiring methods, electromechanical de-

vices, hardware and production techniques. These techniques are used to achieve compactness, reliability, ease of manufacture, serviceability and interchangeability.

## THE FUTURE

Engineers who enjoy a variety of developmental problems find outlets for their abilities and imaginations in these activity areas. New semiconductor components are opening new avenues of miniaturization and are certain to have widespread application commercially in the next few years. Hughes engineers will have full benefit of working experience in this fundamental development.

*How to apply*

Write today, giving details of qualifications and experience. Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

*Scientific and Engineering Staff*

# Hughes

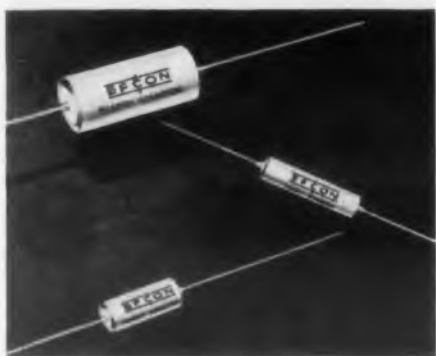
RESEARCH  
AND DEVELOPMENT  
LABORATORIES

*Culver  
City,  
Los Angeles  
County,  
California*

## New Products . . .

### Capacitors

#### Use "Mylar" Insulation



An economical process for constructing plastic film capacitors makes it possible to offer these units with close tolerances on a standard production basis. Designated Type MH, they are

high quality, hermetically sealed tubular capacitors are available in any value from 0.01mfd to 1mfd with tolerances of 5%, 2%, and 1%.

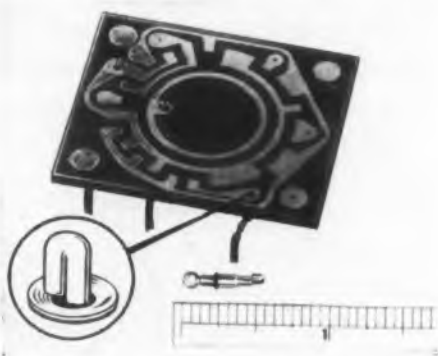
The capacitors utilize moisture-proof "Mylar" polyester film, providing high insulation resistance combined with very low dielectric absorption and extremely low power factor. They are hermetically sealed in metal tubular cases with glass-to-metal seal terminals at each end, in standard miniature case sizes. Non-inductive extended foil type construction with leads soldered directly to the foil insures minimum contact resistance.

Capacitors are offered in voltage ratings of 200v, 400v, and 600v d-c and are production tested to withstand a d-c voltage of 250% of rated voltage at 25°C, between terminals and between terminals and case. Absolutely no de-rating is necessary between -20° and +125°C. Change in capacitance is less than 5% between -30° and +90°C. Electronic Fabricators, Inc., Dept. A, 682 Broadway, New York 12, N. Y.

CIRCLE ED-65 ON READER-SERVICE CARD FOR MORE INFORMATION

### Connector

#### Automatic-Locking Subminiature Type



The Type "C" Subminiature Connector has all the features of the "Interlock" line: automatic locking, quick disconnect action, vibration-proof lock, and low contact resistance. Slightly over 1/2"

long, it is especially suited for printed circuit use.

The connector is shown applied to a rotary switch plate circuit, illustrating how the wired plugs enter through set-in eyelets and lock automatically. Harvey Hubbell, Inc., Interlock Dept. (ED), Bridgeport, Conn.

CIRCLE ED-66 ON READER-SERVICE CARD FOR MORE INFORMATION

## Complicated Electronic Parts Now



## INVESTMENT CASTINGS



Base plate for super-sensitive measuring device which must be dimensionally stable at wide variations in temperature.

Material—Invar



Wave Guide

Material—Aluminum #356T6



Lever arm for an Electronic Computer

Material—Stainless Steel type 303

Send Us Your Drawings For  
Quotations On Parts Where  
**EXTRA QUALITY Must Be  
Maintained.**



**ENGINEERED  
PRECISION CASTING CO.**

MATAWAN-FREEHOLD ROAD  
MORGANVILLE, N. J.

CIRCLE ED-67 ON READER-SERVICE CARD

The leading  
quartz crystal  
developments  
of the past  
25 years have  
been produced by  
Standard Piezo!

For an exact match of exacting specifications, it pays to choose frequency control crystals from the world's largest, most complete line . . . fully tested and proved in the world's most critical services.

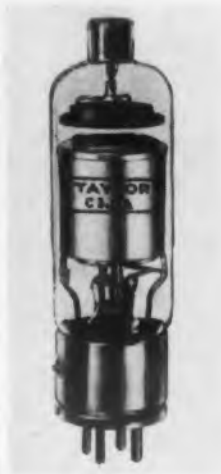
NEW 20-PAGE  
CRYSTAL CATALOG  
SENT ON REQUEST

STANDARD PIEZO COMPANY  
Carlisle, Pa.



CIRCLE ED-68 ON READER-SERVICE CARD

**Thyratron Tube**  
**Has Sharp Cut-Off**



The 5684/C3J/A is an improved version of the C3J/A Xenon Thyratron. It features grids constructed with the "Gold Flow" process, assuring sharp cut-off characteristics throughout tube life. Other features include an arc-resisting, high-emission cathode, nickel-brazed anode assembly, automatic gettering action, and metalized graphite anode. It is applicable to high-shock installations.

Average anode current is 3amp, and average arc drop is 8v. Ambient temperature limits are  $-55^{\circ}$  to  $+85^{\circ}$ C. Warm-up time is 30sec. The tube also features a substantial overload capacity and a low deionization time of less than  $500\mu$ sec.

Life expectancy is over 2000 hours when operated within ratings. Size is  $6\frac{1}{4}$ " long x  $1\frac{9}{16}$ " diam. Taylor Tubes, Inc., Dept. ED, 2312 W. Wabansia Ave., Chicago 47, Ill.

CIRCLE ED-69 ON READER-SERVICE CARD FOR MORE INFORMATION

**Screen-Room Filters**  
**Current Capacity to 100amp**



Based on extensive experience with screen-room requirements, six standardized models of filter units are now available in single, double, and triple-line types. All models have attenuation equal to or exceeding that of the screen room itself. Units are housed in sturdy steel casings

with  $1\frac{1}{4}$ " diam countersunk mounting holes to permit flush mounting on the screen-room wall.

Removable covers at the ends facilitate wiring. Case sizes range from  $2\frac{3}{8}$ " x  $2\frac{3}{8}$ " x 10" for a 30amp, single-line model, up to  $4\frac{3}{8}$ " x  $4\frac{3}{8}$ " x 22" for a 100amp, single-line filter. Voltage ratings range from 250 to 500v at line frequencies from d-c to 1000cy. Attenuation characteristics range from 100db or more from 14kc to 1000Mc. Aerovox Corp., Dept. ED, New Bedford, Mass.

CIRCLE ED-70 ON READER-SERVICE CARD FOR MORE INFORMATION



# WIDE-RANGE FREQUENCY METER 85-1000 MEGACYCLES



## TS-175A/U

**Government Approved**

**Calibration Accuracy:**  
.005 %

**Stability:**  
.0025 %

**Resettability:**  
.0025 %

**IMMEDIATE  
DELIVERY**

### **A VERSATILE PRECISION MEASURING INSTRUMENT**

**Recommended Applications:**

- Precise Measurements of Frequencies
- Production Testing
- Alignment of Transmitters and Receivers
- Laboratory Testing
- Portable Field Testing
- A Secondary Frequency Standard
- Signal Generator Calibration
- U.H.F. and V.H.F. Television Alignment

**Calibration:** Each instrument is individually calibrated, without interpolation, at 50 Kilocycle intervals throughout its range.

**Frequency Range:** The unit covers the calibrated range of 85 to 1000 megacycles. The fundamental of the precision variable frequency oscillator is 85 to 200 megacycles.

**Sensitivity:** The Frequency meter can detect a radio frequency signal of 20 microvolts with an audio power output up to 50 milliwatts depending on the frequency.

**Internal Modulation:** When desired, amplitude modulation of 1000 cycles in frequency can be employed. The modulation percentage is approximately 30%.

**Radio Frequency Output:** The output voltage from a 50 ohm source, varies from 300 to 100,000 microvolts, within the range of 85 to 1000 megacycles.

**Secondary Frequency Standard:** A 5000 Kc. oscillator incorporating a CR-18/U crystal can be used as a secondary frequency standard with harmonics of 5 megacycles up to 200 megacycles.

*Territories for representation available.*

*We offer a complete automatic recalibration service on all frequency meters.*

**COLORTONE**

**ELECTRONICS, Incorporated**

238 William Street, New York, N. Y. • COrtlandt 7-5160

Executive Offices: 400 Duffy Ave., Hicksville, Long Island

## New Products . . .

### Vacuum Tube Electrometer Has High Input Impedance



The Model 210 is a line-operated d-c vacuum tube voltmeter with an extremely high input impedance. Basic specifications includes an input greater than  $10^{14}$  ohms, grid current below  $10^{-13}$  amp, and drift within 10mv per hr. Five voltage ranges are provided: zero to 0.8v, 2v, 8v, 20v, and 80v, respectively, in either polarity.

The electrometer has output terminals for driving balanced or unbalanced recorders and recorder amplifiers, oscilloscopes, and galvanometers. The output amplifier drives the Esterline-Angus 0-1 milliamperere recorder directly, or delivers 10v out on each range for full-scale input. Frequency response of the output amplifier is 0-5000cy, making the Model 210 useful as a d-c preamplifier wherever an ultra-high input impedance is needed.

The unit can be used not only as a d-c voltmeter, but as an extremely sensitive micromicroammeter, megohmmeter, and kilovoltmeter. Maximum full-scale sensitivities are  $8 \times 10^{-13}$  amp,  $3 \times 10^{14}$  ohms, and 20,000v. Typical applications include potential measurements of charged capacitors, vacuum tube electrodes, and piezo-electric units. Keithley Instruments, Dept. ED, 3868 Carnegie Ave., Cleveland 15, Ohio.

CIRCLE ED-73 ON READER-SERVICE CARD

### Waveguide Switch Compact Unit



This waveguide switch, Model ASWI-X01, makes available to the microwave field a compact unit,  $3/4'' \times 1-1/2''$  guide size. It includes such features as: vswr, 1.05 to 1 maximum;

crosstalk, 50db minimum; actuator, 110v 60cy; actuation time, 0.5sec maximum; vswr during switching, 1.2 to 1; power handling ability, approximately 0.35 megawatts cw. Thompson Products, Inc., Dept. ED, 2196 Clarkwood Road, Cleveland 3, Ohio.

CIRCLE ED-74 ON READER-SERVICE CARD



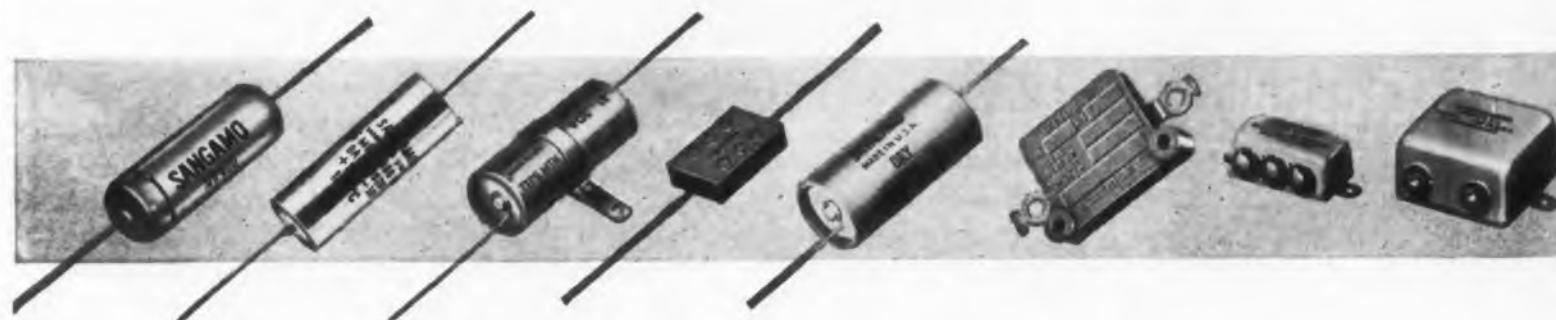
*Credentials that Qualify*

## ...that's why IBM uses Sangamo

The amazingly complex IBM "702" electronic calculator is hailed as the fastest and most flexible commercial data processing system ever devised. The central Arithmetical and Logical Unit performs calculations and makes decisions at a rate of more than 10,000,000 operations in an hour. Data and instructions for processing are stored in an electrostatic memory bank of cathode ray storage tubes. Output can be in the form of punch cards at the rate of 100 per minute.

A machine like this needs components that assure maximum performance to meet its exacting demands. That's why several different types of Sangamo Capacitors are used in the 702.

If you need capacitors for demanding electronic applications, Sangamo engineers can help you. You can choose from a complete line of paper, mica, electrolytic and button type capacitors for every industrial, electronic, and radio application.



## SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION

**SANGAMO  
CAPACITORS**

**Longer Life  
at High Temperatures**

**Stability  
Under All Conditions**

**Capacitors in the new 702**



*Those who know...*



*choose Sangamo*

CIRCLE ED-75 ON READER-SERVICE CARD FOR MORE INFORMATION

9C54-9

### Power Triode

#### Rugged Tube for D-C Supplies



Tube Type 6337 features high plate dissipation and high perveance, plate current held within  $\pm 10\%$ , and absence of plate current drift. Compact in design, this tube is capable of withstanding 500g shock. A hard glass envelope and a button stem that strengthens the mount, provide high immunity to extreme shock and vibration. Wide interlead spacing practically eliminates electrolysis.

Characteristics include: plate supply, 225v; bias resistor, 100 ohms; amp factor, 2.7; plate resistance, 60 ohms; plate dissipation, 80w; transconductance, 45,000 $\mu$ mhos; plate current, 450ma; heater power, 6.3v, 7.25amp, a-c or d-c. Chatham Electronics Corp., Dept. ED, 630 Mt. Pleasant Ave., Livingston, N. J.

CIRCLE ED-76 ON READER-SERVICE CARD

### Power Supply

#### With 0.001% Regulation



The Model UHR-220 power supply features ultra-high regulation over its entire operating range under all conditions. It provides 0-200ma at 0-500v, with 0.001% regulation and ripple less than 100 $\mu$ v. The d-c impedance is less than 0.01 ohms and the a-c impedance is

less than 0.1 ohms in series with 0.1 $\mu$ h (4" of wire). Transient response is 0.001millisec.

Output voltage is kept extremely stable even at low voltages by the use of drift cancelling differential amplifiers with regulated heaters, a new high stability reference tube, and low-temperature-coefficient wire-wound resistors. Full current can be drawn at any line voltage from 105v to 125v with a substantial safety factor. There is an additional negative supply of 0-5ma at 0-150v with less than 2mv of ripple. Center-tapped 12.6v a-c at 4amp is also supplied.

The two front panel meters are ruggedized and hermetically sealed with ranges of 0-50v and 0-500v and 0-200ma. Dimensions are 7" x 10" x 13" deep. Krohn-Hite Instrument Co., Dept. ED, 580 Mass. Ave., Cambridge 39, Mass.

CIRCLE ED-77 ON READER-SERVICE CARD



# Low T-C Plastic Film CAPACITORS



The newly developed Type GC plastic film dielectric capacitors have been designed specifically for the following applications:

Integrating circuits  
Tuned Filters  
Timing Oscillators

**Features:**

0.1 mfd.  
100 to 1000 volts  
T-C plus/minus 30 PPM/°C  
Excellent retrace  
Ultra-high resistance  
Ultra stable with life  
Temperature range—minus 60°C to 85°C  
Hermetically sealed

Write for free information.

- Plastic Film Capacitors
- High Voltage Power Packs
- Pulse Forming Networks



*Plastic Capacitors, Inc.*  
2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

CIRCLE ED-79 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products...

### Power Supplies For Use With Transistors



Because of the rapidly increasing use of transistors, this firm has developed closely regulated d-c tube-type power supplies for powering transistors. Models embody two basic types. Model T-100-B is a meter-equipped regulated dual-voltage power supply with two duplicate outputs. Each of these outputs has three ranges: positive or negative 0-1v, 0-10v, 0-100v; adjustment of the three ranges is made by decade switches and potentiometers. Maximum d-c current output is 100ma.

A similar unit, the Model T-100-D, has no meters. It provides the same output ranges as the Model T-100-B, but adjustment is by direct-reading decade switches in steps of 0.1v, with 0.1% accuracy.

Regulation of both units is 0.05% from no-load to full load. D-c internal impedance is 0.6 ohms, 0.1 ohm at 120cy, 0.4 ohm at 50ke. Input regulation is 0.1% change per ±10% variation in line voltage. Ripple is 1mv, maximum.

Size of the transistor power supplies is 5-1/4" x 19"; shipping weight is 40 lb. Units are for rack panel mounting and include dust cover and removable end plates. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE ED-80 ON READER-SERVICE CARD FOR MORE INFORMATION

### Shunt Wound Motor Rated 0.02hp at 12,000rpm



This shunt wound d-c motor, designed for military use, operates on 28v. It is rated 0.02hp at 12,000rpm and is furnished complete with noise filter and high altitude brushes. The motor employs precision ball bearings and stainless steel shafts for extra-heavy duty. All parts are finished in accordance with rigid military specifications. Electro Engineering Products Co., Dept. ED, 609 W. Lake Street, Chicago, Ill.

CIRCLE ED-81 ON READER-SERVICE CARD FOR MORE INFORMATION

## CORRECT COMBINATION

*of Size and Power Rating—offered  
by Jennings Vacuum Capacitors!*



1. JCSL 1000 mmfd.; 3 KV; 42 amps rms  
2. JCS 1000 mmfd.; 7.5, 10, 12 KV; 42 amps rms  
3. MC-1 1000 mmfd.; 10, 15 KV; 75 amps rms  
4. MC 1000 mmfd.; 10, 15, 20 KV; 120 amps rms  
5. MLC 1000 mmfd.; 25, 30 KV; 120 amps rms  
6. MMHC 1000 mmfd.; 35, 40, 45 KV; 125 amps rms

The wide choice of size and power ratings for a given capacity is illustrated by these five units all having capacities of 1000 mmfd. JENNINGS functional designs thus permit you to select the smallest fixed or variable vacuum capacitor that will meet your voltage and current requirements.

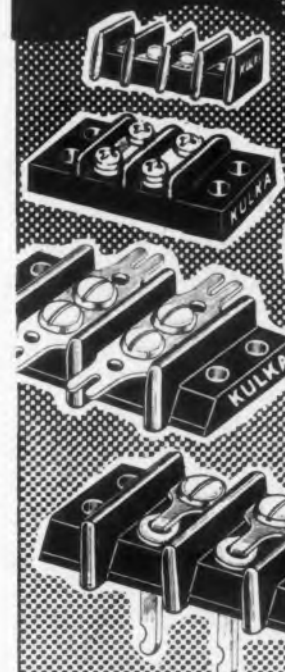
Send for our catalogue summary describing over 150 types and sizes of vacuum capacitors and switches.

JENNINGS RADIO MANUFACTURING CO. • 970 McLAUGHLIN AVE. • P. O. BOX 1278 • SAN JOSE 8, CAL.

CIRCLE ED-82 ON READER-SERVICE CARD FOR MORE INFORMATION

## ...KULKA TERMINAL BLOCKS

CUT COSTS... SPEED PRODUCTION



- SIMPLIFY WIRING •
- NO SPLICING
- NO LEAKS OR SHORTS

Molded Barrier-type Terminal Blocks in approved materials and several styles, ranging in size from miniature to jumbo (90 amps). With or without plain or printed Marker Strips in fibre or bakelite.

Catalog on Request

**KULKA ELECTRIC MFG. CO., Inc.**

Manufacturers of Electrical Wiring Devices  
MOUNT VERNON, N. Y.

CIRCLE ED-83 ON READER-SERVICE CARD FOR MORE INFORMATION

### Pocket Pyrometer Handy Laboratory Device

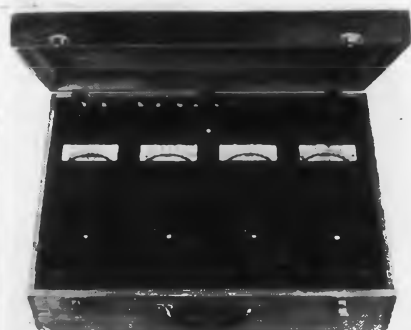


The "Cybertronic" Pocket Pyrometer (Model 240-T) offers quick, accurate measurement of surface and sub-surface temperatures through the use of interchangeable thermocouples. Housed in

a shock-absorbing rubber case which protects the instrument against normal shock, it is available in six standard ranges, starting at 400°F. It is 3-7/8" x 1-1/2" x 1-3/4" in size and has a 2.4" direct-reading indicator scale. Cybertronic Corp. of America, Dept. ED, Industrial Center, Third and Mortan Avenues, Chester, Pa.

CIRCLE ED-93 ON READER-SERVICE CARD FOR MORE INFORMATION

### A-C Test Set For 60cy Measurements



The Universal "60" Alternating Current Test Set is a compact, rugged, and accurate set of instruments, designed to be used together and capable of giving the complete picture of

60cy voltages, currents, power, and power factor.

There are four separate instruments: two 18-range wattmeters, providing from 5w full scale to 2000w full scale, which can be used down to power factors of 10%; an ammeter with seven current ranges from 10ma full scale to 10amps full scale; and a voltmeter with four ranges from 30v full scale to 300v full scale. Sensitive Research Instrument Company, Dept. ED, 9-11 Elm Ave., Mount Vernon, N. Y.

CIRCLE ED-94 ON READER-SERVICE CARD FOR MORE INFORMATION

### Servo Transmission Has Two Magnetic Clutches

This differential transmission for servo systems contains two magnetic clutches and a suitable gear train which affords starting, stopping, and reversing of any load within the rating of the unit. This is accomplished on any desired duty cycle with continuous input-shaft rotation.

The transmission is available in any desired fractional horsepower rating and gear ratio. Electrical input by means of plug or barrier terminal strip is provided. B & W Electronic Research Laboratories, Dept. ED, 5629 Goodwin Ave., Dallas 6, Texas.

CIRCLE ED-95 ON READER-SERVICE CARD FOR MORE INFORMATION

## A NEW CHAMPION SUBMINIATURE VOLTAGE REFERENCE TUBE RAYTHEON CK5783WA



LOOK AT ALL TEN of these important performance features of the Raytheon CK5783WA Subminiature Voltage Reference Tube.

1. Tightened Voltage Drop Range: 83-89 volts.
2. Low dark starting voltage — only 115 volts maximum — no higher than for light starting.
3. Wider Ambient Temperature Range: -55°C to 150°C.
4. Lower Temperature Coefficient only -5 mV/°C maximum, from 25°C to 75°C.
5. Reduced voltage jump\*. Maximum value: 5 mV.
6. Reduced drift\*\* (1 hour). Typical value: 50 mV change.
7. Improved repeatability\*\*\*. Typical value: 20 mV change.
8. Improved stability over 500 hour period (150°C ambient). Typically less than one volt change.
9. Improved stability over 5000 hour period (30°C ambient). Typically less than one volt change.
10. Ability to meet every requirement for military reliable tubes, including shock and vibration.

Notes: \*Voltage jump — Maximum sudden jump in operating voltage when operating current is varied slowly over specified range.  
\*\*Drift — Maximum operating voltage change during the period of operation.  
\*\*\*Repeatability — Maximum shift in operating voltage between successive firings of the tube.



The Raytheon CK5651WA Miniature Voltage Reference Tube likewise possesses each and every one of these ten great performance features.

You now have your choice of Subminiature or Miniature for the most exacting Voltage Reference Tube applications.

NOTE: Type OB2WA now available to MIL specifications.

### RAYTHEON VOLTAGE REGULATOR AND REFERENCE TUBES

give you this complete range to choose from — each and every one a great performer

Type	Max. Dimensions		Min. Starting Voltage Supply	Operating Voltage (Approx.)	Min. Operating Current Ma.	Max. Operating Current Ma.	Max. Regulation Volts
	Height (Inches)	Diam. (Inches)					
OA2	2.63	.75	180	150	5.	30.	6
OB2	2.63	.75	127	108	5.	30.	3.5
OB2WA	2.63	.75	133	108	5.	30.	4
CK1022	2.69	.75	1100	1000	0.005	0.055	20
CK1037	1.75	.40	730	700	0.005	0.100	15
CK1038	1.75	.40	930	900	0.005	0.055	15
CK1039	1.75	.40	1230	1200	0.005	0.100	25
CK5651*	2.13	.75	115	87	1.5	3.5	3
CK5651WA*	2.13	.75	115	84.5	1.5	3.5	2
CK5783*	1.63	.40	125	87	1.5	3.5	3
CK5783WA*	1.63	.40	125	86	1.5	3.5	3
CK5787	2.06	.40	135	100	5.	30.	6
CK5787WA	2.06	.40	135	100	5.	25.	4
CK5962	2.69	.75	730	700	0.002	0.055	15
CK6213	1.38	.40	200	130	1.0	2.5	2

\*Voltage Reference Tube



RAYTHEON MANUFACTURING COMPANY

RAYTHEON MAKES ALL THESE

CIRCLE ED-96 ON READER-SERVICE CARD FOR MORE INFORMATION

# SIE

## MODEL R-1

### VOLTMETER

*Designed and Engineered  
for Design Engineers*

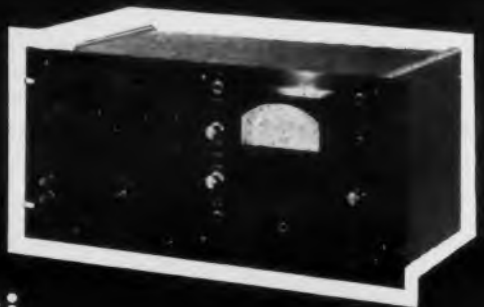


#### FEATURING:

- ★ DC Volts & Millivolts  
Accurate to 1½% of full scale
- ★ AC Volts & Millivolts  
Accurate to 3% of full scale
- ★ Balanced D-C Amplifier  
Flat ±½ db. to 100 KC
- ★ Ohmmeter  
with Expanded Scales
- ★ Regulated Power Supply  
unaffected by line transients
- ★ Illuminated Weston Meter  
accurate to 1% of full scale

... and the SIE Distended DC Scales, the most useful feature ever incorporated in a vacuum-tube voltmeter, enabling changes as small as one part in 10,000 to be read accurately.

The new rack-mounted version of the R-1 includes all of these features in a unit specially designed for this application.



#### SPECIFICATIONS:

AC & DC Volts Ranges: 1 mv. to 1000 v., full scale  
Ohmmeter Ranges: zero ohms to 500 megohms  
Maximum Gain, D-C Amplifier: 200  
Drift (after warm up): less than 3 mv./hr.  
Tube complement: 13  
Weight: 34 lbs.

# SIE

Price, f.o.b. Houston: **\$620.00**

rack mounted: **700.00**

**SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.**

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CIRCLE ED-88 ON READER-SERVICE CARD FOR MORE INFORMATION



## New Products . . .

### Special Amplifier

Generates Arbitrary Functions



The Type G-1A Arbitrary Function Generator is a special form of amplifier whose output signal can be related to input by any predetermined, arbitrary function of the form  $y = f(x)$ . Originally de-

signed as a high-precision analog computer component, it is also well suited for handling non-linearities such as those encountered in missile telemetering and recording systems. Signal from zero frequency to several kilocycles can be handled.

Desired functions of the form  $y = f(x)$  are plotted, and reproduced on standard lantern-slide templates. The slide is inserted in the instrument between its cathode ray tube and photoelectric tube follower, which is arranged to follow the slide's  $y = f(x)$  outline. The voltage required to position the cathode-ray-tube beam in the  $y$  direction is amplified and used as the output signal. Instantaneous output signal is thus related to the instantaneous input signal in the same manner as  $y$  values on the template relate to  $x$  values.

The instrument has sufficient gain to permit operation with input signals as low as 0.1v for full scale. Output can provide up to  $\pm 100v$  or  $\pm 0.015amp$  full scale. The instrument operates from 117v, 50-60cy, and may be rack mounted or used on a table top. Wm. Miller Instruments, Inc., Dept. ED, 325 N. Halstead, Pasadena, Calif.

CIRCLE ED-89 ON READER-SERVICE CARD FOR MORE INFORMATION

### Servo Motors

Can Operate at 160°C

These servo motors include BuOrd Mark VII and Mark VIII types, as well as 15 other variations. They are available with a wide choice of plain or pinion shafts.



High torque to inertia rational units, they can operate in the region of 160°C. They meet all military humidity, salt spray, and fungus test requirements. American Electronic Mfg. Co., Inc., Dept. ED, 9503 W. Jefferson Blvd., Culver City, Calif.

CIRCLE ED-90 ON READER-SERVICE CARD FOR MORE INFORMATION



## Miniature AN CONNECTOR ASSEMBLY

consists of



HHB 3358  
PRESSURIZED  
RECEPTACLE

HHB 3359  
WATERPROOF  
PLUG  
ASSEMBLY



HHB 3310  
TUBING  
CLAMP

**—for limited space requirements**

This compact connector assembly (approx. 2 3/8 -in. long x 1 1/4 -in. dia.) is a forerunner of miniature AN Components design to be pioneered by HHB design and engineering departments.

Components include 38 contact receptacle and plug—two 35 Amp. (No. 12 wire) and thirty-six 5 Amp. (No. 18 wire) contacts. Shell adapter and clamp of gray anodized aluminum. Features the new HHB 3300 Series flexible plastic tubing clamp instead of standard AN cable clamp.

Write for complete data.

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**H. H. BUGGIE, Inc.**  
726 STANTON STREET  
TOLEDO 4, OHIO

CIRCLE ED-91 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 1954

## Insulation

### For High Voltages

"Panelyte" Grade 471 melamine canvas is intended for use in TV high-voltage insulation requirements. It features flame retardancy, which makes it valuable for such applications as terminal boards, filament holders, high-voltage shields, and fly-back transformers. It has superior water absorption, arc resistance and dielectric strength properties. Panelyte Division, Dept. ED, St. Regis Paper Co., 230 Park Ave., New York 17, N. Y.

CIRCLE ED-84 ON READER-SERVICE CARD

## Picture Tubes

### Two Aluminized Types

Two monochrome-TV picture tubes, models 17QP4 and 27SP4, are 17" and 27" types, respectively. Both feature all-glass construction, rectangular, aluminized screens, gray-filter spherical faces, single-field ion traps, and external conductive coatings.

The 17" type is magnetically focused and deflected with a deflection angle of 70°. It has a screen area of 149 sq in. Its over-all length is 19-3/16". The 27" type is electrostatically focused and magnetically deflected with a deflection angle of 90°. Over-all length is only 23-1/16". Total picture area is about 425 sq in. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE ED-85 ON READER-SERVICE CARD

## Coil Forms

### Made to Specification

This firm supplies coil forms in any shape, size, length, ID, or OD within critical tolerances. Sizes from a fraction of an inch to 9" ID can be furnished without extra tooling charges. The forms can be wound from a wide range of dielectrical materials such as kraft, fish paper, acetate or combinations. Phenol impregnation is also available. Precision Paper Tube Co., Dept. EDN, 2035 W. Charleston St., Chicago, Ill.

CIRCLE ED-86 ON READER-SERVICE CARD

CIRCLE ED-87 ON READER-SERVICE CARD

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# CHICAGO Audio Transformers

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Public Address  
Broadcast  
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Industrial  
and other  
applications

CHICAGO audio transformers feature the famous "sealed-in-steel" construction. They have seamless drawn steel or cast cases for greater strength, moisture resistance and maximum shielding. These units are truly the world's toughest transformers.

These rugged transformers are designed to provide minimum leakage and hum pick-up, along with optimum coupling. Harmonic and intermodulation distortion are extremely low over the specified frequency ranges.



Most CHICAGO audio transformers are available in a choice of mounting styles, including hermetically sealed cases. You're almost sure to find the unit you require in the CHICAGO line of stock transformers.

**FREE**

**Chicago Catalog CT-554** listing complete electrical and physical specifications on over 500 CHICAGO transformers. Available from your CHICAGO distributor or from Chicago Standard Transformer Corporation.



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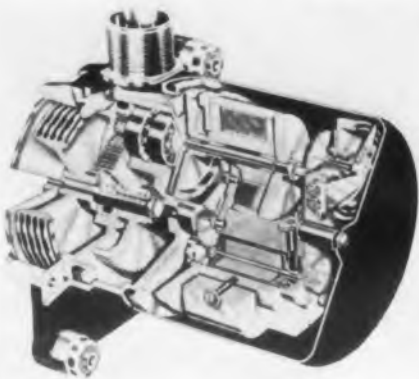
CIRCLE ED-97 ON READER-SERVICE CARD FOR MORE INFORMATION



# New Products...

## Position Servo Actuator

Features High Torque, Fast Response



A torque-to-inertia ratio of 200,000 rad/sec<sup>2</sup> coupled with an acceleration constant of 10 millisecc are outstanding features of the Model 205 servo-actuator. It is offered in two basic versions: one for piloted, the

other for pilotless aircraft. Each contains a drive motor, radio noise suppression network, low inertia precision gear train, and a follow-up potentiometer. In addition, the piloted model contains an overload and disconnect clutch, and the pilotless model an overload clutch. These elements are housed in a sealed, waterproof case 5-3/4" x 3-3/4" that weighs only 4-3/4 lb for the former and 4-1/2 lb for the latter. The output capstan of the unit is free to rotate 360°.

For a fixed supply voltage, output speed of the actuator is inversely proportional to applied load; for a constant load, speed of the actuator is proportional to the applied voltage. Control relays dynamically brake the motor when the control signal is removed. This quality allows the servo to maintain torque loads with only intermittent input power.

Maximum continuous torque at 28v is 200 in-lb. Additional torque outputs are available to customer requirements. Equivalent motor stall torque at 28v is 1200 in-lb. Operating voltage range is 5-35v. Operating current is 0.4amp at no load plus 0.1amp per in-lb of loads. Summers Gyroscope Co., Dept. ED, 2328 Broadway, Santa Monica, Calif.

CIRCLE ED-98 ON READER-SERVICE CARD FOR MORE INFORMATION

## Phenolic Molding Material

Mica Filled

Resinox 3001, a mica-filled phenolic molding material, features improved moldability and mechanical strength. A thermosetting compound, it can be molded under the same conditions as other mica-filled phenolics.

The material is recommended for use in radio tube sockets, radio tube bases, electrical connectors, terminal strips, and miscellaneous electrical components where good electrical and mechanical strength are required. Monsanto Chemical Co., Dept. ED, Springfield, Mass.

CIRCLE ED-99 ON READER-SERVICE CARD FOR MORE INFORMATION



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## SLIP RINGS

...AND SLIP RING ASSEMBLIES



BRUSHES — CONTACTS — ASSEMBLIES

... Use **SILVER GRAPHALLOY** for applications requiring low electrical noise; low and constant contact drop; high current density and minimum wear.

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**SELSYNS • GUN FIRE CONTROLS  
ROTATING THERMOCOUPLE and  
STRAIN GAGE CIRCUITS  
ROTATING JOINTS • DYNAMOTORS**

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*Other Graphalloy Products*



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CIRCLE ED-100 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 1954

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At FLEXROCK we have licked this problem. New TEFLON producing equipment has been added. We have substantially increased capacity. We can't take on all things just yet. But soon we will be ready to "throw the book at you" with a complete range of TEFLON services. RIGHT NOW we are set to ship you TEFLON Rod and Tube, extruded or molded, Sheets, and small parts — no matter how intricate — machined from Rod and Tube. We can promise good delivery — yes, FAST DELIVERY . . . with closest possible tolerances on your small parts. Tell us your needs — we will be happy to quote delivery and price.

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for tetrafluoro-  
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- We are enclosing sample, specs, and quantity for our TEFLON requirements. Please furnish quotation.
- Please send us your TEFLON Bulletin including stock list.

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Company .....

Address .....

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

CIRCLE ED-109 ON READER-SERVICE CARD

## 400cy Transformers Withstand High Temperatures



These stock 400cy power and filament transformers and filter reactors are designed to meet MIL-T-27, Class B specifications for high-temperature operation. They are housed in seamless drawn steel, hermetically sealed cases with stud type terminals. Available

in a full line, these units have ratings that were chosen after discussion with organizations engaged in the development of standards for aircraft, guided missiles, and related equipment.

All transformer primaries are rated 105/115/125v, 380-1,000cy. A wide variety of secondary voltages are available in the transformers. Chicago Standard Transformer Corp., Dept. ED, 3501 Addison St., Chicago 18, Ill.

CIRCLE ED-110 ON READER-SERVICE CARD FOR MORE INFORMATION

## Conductive-Coatings Kit Makes 12 Coatings

Design and development engineers concerned with or contemplating use of conductive coatings for printed circuits and other applications will be aided by this Basic Laboratory Kit, Type S31. The kit contains six electrically conductive silver coatings, six resistance coatings, six accessory chemicals, manuals, and technical data. Quantities of each material range from one ounce to one pint. Micro-Circuits Co., Dept. ED, New Buffalo, Mich.

CIRCLE ED-111 ON READER-SERVICE CARD FOR MORE INFORMATION

## Shields Protect and Ventilate Tubes



"Ventilator" shields are designed to improve tube performance by dissipating heat. Their design makes for low cost of manufacture.

Easily handled, the shields are compression fitted to ground terminals on laminated or printed wiring sockets. They are available in lengths of 1-11/16" or 2-1/6", with one standard diameter which fits either seven- or nine-pin tubes. They can be furnished with tin or black oxide finish. Methode Manufacturing Corp., Dept. ED, 2021 Churchill St., Chicago 47, Ill.

CIRCLE ED-112 ON READER-SERVICE CARD FOR MORE INFORMATION

**complete testing** with one  
convenient

unit...

**Kearfott**  
**MICROWAVE**  
**TESTING**  
**EQUIPMENT**



**Combined in this equipment** are means to measure power...observe transmitter spectra distribution...measure frequency and supply artificial signals. You can analyze bandwidth characteristics. A self-contained square wave generator aids in making standing wave measurements. *One* portable unit does *all*—on the bench or in the field—efficiently and at much lower first cost than with separate instruments.

**Quick function selection**—merely flick the front panel switch to the function desired. Controls are grouped for easy operation by personnel with minimum training. After initial warm-up, any function is immediately available for use.

**Unitized construction**—each test section is mounted on a separate plug-in sub-chassis. For unusual applications, special units can be provided which are interchangeable with standard sections. Service and maintenance is simple and quick.



*Write for  
complete description  
and specifications.*

**FEATURES:**

**SIGNAL GENERATOR:** CW, Square Wave, FM or pulse mod. RF, 8.5 to 10 KMC.

**POWER MONITOR:** Measures average power of signals from 8.5 to 10 KMC, Accuracy  $\pm 2$  db of full range.

**WAVEMETER:** Reaction cavity wavemeter, 8.5 to 10 KMC, accurate to 0.03% at standard temperature and humidity.

**SPECTRUM ANALYZER:** 8.5 to 10 KMC displayed on 3" CRT, 1 F bandwidth of 15 kc for optimum pulse rendition.

**SIZE:** 18" x 11½" x 14"  
**WEIGHT:** 45 lbs.



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Sales Offices Eastern Office: 1378 Main Ave., Clifton, N.J.  
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CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION



# Bomac

combines **4** COMPONENTS  
into **1**

## A complete Duplexer NOW in One Compact Unit

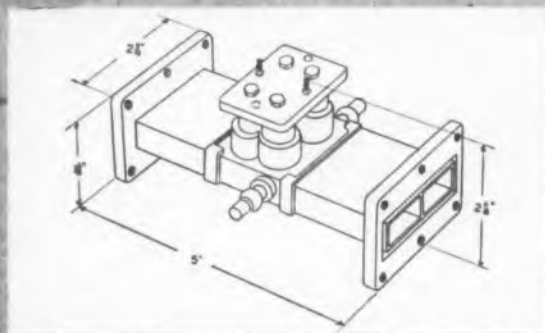
For the first time, Bomac offers to the electronic industry a complete duplexer as a single component . . . the **BL-509**.

Combining (1) a Bomac TR tube having (2) integral shutters, with (3,4) two hybrid junctions, the BL-509 eliminates the necessity of specifying these components separately. Light weight and compact, it also assures superior electrical performance and mechanical strength.

This duplexer may be fabricated to customer's configurations.



### DIMENSIONS



### RATINGS

Shutter Holding Current	0.060 amp
Shutter Operating Current	0.280 amp
Shutter Operating Voltage	28 V.
Ignitor Current	100-200 $\mu$ Adc
Ignitor Interaction, 100 $\mu$ Adc (max.)	0.1 db
Voltage Drop, 100 $\mu$ Adc	200-375 Vdc

### CHARACTERISTICS

Duplexer Loss (max.)	1.2 db
Arc Loss (max., at 4 KW)	0.6 db
Spike Leakage (at 40 KW)	0.1 erg
Flat Leakage (at 40 KW)	20 MW
Bandwidth	8490-9578 MC
Center Frequency	9000 MC
Recovery Time (at 200 KW)	7 $\mu$ sec.
Shutter Attenuation (min.)	40 db
Isolation	20 db min. at center, 15 db min. at ends

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## Bomac Laboratories, Inc.

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GAS SWITCHING TUBES · DIODES · HYDROGEN THYRATRONS · DUPLEXERS · MAGNETRONS  
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Beverly, Mass.

## New Products...

### Nameplates Non-Tarnishing

Made of 0.003" or 0.005" thick anodized aluminum, "Thinplate" nameplates will not tarnish or oxidize and are highly resistant to abrasion, humidity, and salt spray. They are backed by a pressure-sensitive adhesive that passes all military tests.

Available in anodized colors, these nameplates can be cut to any size or shape, and can be serial numbered in any typewriter. Park Nameplate Co., Dept. ED, 61-07 Thirty-Second Ave., Woodside 77, N. Y.

CIRCLE ED-106 ON READER-SERVICE CARD

### Metal Bellows Have Small Diameters

Hydraulically formed, seamless metal bellows of 1/4" and 5/16" diameters are available with a wide range of characteristics. These sizes serve as components of switches designed for aircraft.

The bellows are made of brass, phosphor bronze, beryllium copper and monel. Typical examples are 1/4" diam, two-ply, phosphor bronze bellows, and a 1/4" beryllium copper bellows that will withstand maximum external pressure of 2300psi. Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., Dept. ED, Bridgeport 1, Conn.

CIRCLE ED-107 ON READER-SERVICE CARD

### Protective Coating Applied by Spray

Effective protection against short circuits, corrosion and corona loss is provided by coatings sprayed on by "Sprayon" Plastic Sealer. The coating is high in dielectric strength and dries quickly to a non-tarnishing, flexible finish. It also acts to waterproof parts. The coating is applied by a handy 12-oz aerosol can with a non-clogging nozzle that requires only finger-tip pressure to operate. Champion Bronze Powder & Paint Co., Inc., Dept. ED, 2101 N. Elston Ave., Chicago 14, Ill.

CIRCLE ED-108 ON READER-SERVICE CARD

◀ CIRCLE ED-105 ON READER-SERVICE CARD

new!



## CANNON "K" MINIATURES



90° end bell

30% LIGHTER THAN STANDARD CONNECTORS  
 NYLON INSERTS  
 GOLD PLATED 5 AMP. CONTACTS FOR #20 WIRE  
 DESIGNED FOR POTTING  
 1250v AC AND 2400v AC SERVICE  
 HERMETICALLY SEALED RECEPTACLES AVAILABLE  
 A SEA LEVEL CONNECTOR THAT CAN BE USED AT 70,000 FT. ALTITUDE

Originally designed for the computer field. High performance and maximum flexibility. Six polarizing positions. 10, 20, and 30 contact insert arrangements. Exceeds environmental and electrical tests of MIL E 5272A and MIL C 5015B. Arc resistance 115 sec (min). Dielectric strength 100v/mil. Physical and mechanical strength—50g. Write for full information TODAY!

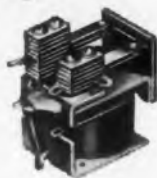
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**CANNON PLUGS**

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CIRCLE ED-120 ON READER-SERVICE CARD FOR MORE INFORMATION

## COMAR RELAYS



for countless industrial and military applications

Aircraft Controls  
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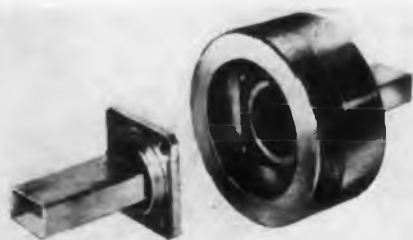
RELAYS • SOLENOIDS • COILS • TRANSFORMERS • SWITCHES • HERMETIC SEALING

CIRCLE ED-121 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## Waveguide Quick Disconnect

No Tools Required



The Waveguide Quick Disconnect provides a reliable method of rapidly making and breaking waveguide connections. No tools of any kind are re-

quired. Connections are made by simply inserting the flange and hand tightening the outer ring. Proper alignment is automatic.

In addition to its uses as a piece of laboratory equipment, the disconnect is well suited for incorporation in microwave test sets as a front or rear panel fixture. It is available in sizes to fit the standard chokes and flanges of Types RG-51/U, RG-52/U, and RG-91/U waveguides. Aircraft Armaments, Inc., Dept. ED, P.O. Box 1777, Baltimore 3, Md.

CIRCLE ED-122 ON READER-SERVICE CARD FOR MORE INFORMATION

## Time Delay Network

Continuously Variable



Type 303 continuously variable time delay passive network is very suitable for use as a time delay matching device in television systems, variable time delay for pulses, or precision measurement of small time intervals. Both the bandwidth and the transient response are excellent.

The rise time is less than 7% of the time delay at any point, and the amount of overshoot is less than 2%. Resolution time is less than  $5 \times 10^{-10}$  sec, passing signals of any waveform. There is no time jitter.

This instrument consists of an input amplifier, an output amplifier, and a continuously variable delay line of which the time delay may be adjusted continuously by the front panel dial. Ten different types of continuously variable delay lines are available, with the shortest one being 0 to 0.05  $\mu$ sec and the longest being 0 to 0.8  $\mu$ sec.

The input impedance is 1 megohm shunted with 20mmfd. The output impedance is 1 megohm shunted with 15mmfd. Both the input and the output impedance can be made lower by shunting the terminals with proper resistors. Both amplifier stages have 15Mc bandwidth and 10v peak-to-peak maximum signal level. Accuracy can be maintained within  $\pm 1\%$  after calibration. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-309 ON READER-SERVICE CARD FOR MORE INFORMATION

**PERKIN**

TUBELESS !!  
 MAGNETIC AMPLIFIER  
 REGULATED D.C.



**POWER SUPPLIES**

Model MR 532-15  
 5-32 V. @ 15 amp.

**PERKIN... has a standard**

**Power Supply for your every need!**

TYPICAL MODELS  
 REGULATED & FILTERED TO 1% MAXIMUM

MODEL	VOLTS	AMPS	MODEL	VOLTS	AMPS
6-5WX	6 $\pm$ 10%	5	MR1032-50	10-32	50
6-15WX	6 $\pm$ 10%	15	MR2630-100	26-30	100
MR532-15	5-32	15	MR2232-300	22-32	300
28-20WX	28 $\pm$ 10%	20	115-5WX	115 $\pm$ 10%	5
MR1040-30	10-40	30	230-5WX	230	5

Immediate shipment from stock on many models!

Send for complete literature!

**PERKIN**

**ENGINEERING CORP.**

345 KANSAS STREET • EL SEGUNDO, CALIFORNIA

CIRCLE ED-123 ON READER-SERVICE CARD FOR MORE INFORMATION

## UHF Grid Dip Oscillator



The model U-4, GDO head is self contained, exclusive of power supply. Every effort has been made to provide a small, light compact unit which would permit ready access to tank circuits having a wide range of configurations. Thus it is possible to couple to a cavity, a transmission line, or butterfly type of tank with the same facility experienced at lower frequencies using conventional coil-type GDO units.

### FEATURES:

- Covers 460-900 MC without coil change
  - Probe link-coupled for complete isolation
  - Small probe permits access to any tank circuit
  - No sliding contacts
  - 8" L x 3 1/2" H x 2 3/4" W
  - Can be used with any G.D.O. Power Supply
- WRITE FOR CATALOG  
 Model U-4 G.D.O. \$120  
 Model U-4P Power Supply \$25

**LINEAR**

**EQUIPMENT LABORATORIES, INC.**

BRIGHTWATER PLACE

MASSAPEQUA, N. Y.

CIRCLE ED-124 ON READER-SERVICE CARD FOR MORE INFORMATION



for the best in **TEFLON**\*

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**JOHN CRANE**

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and  
facilities



\*DuPont trade-mark for tetrafluoroethylene resin

When you use John Crane Teflon products you get *all* the advantages of this remarkable material—because you get the finest in fabrication “know-how” and quality.

“John Crane” fabricates Teflon for countless applications, including rods, tubing, tape, sheets, gaskets, bellows, washers, insulators, electrical parts, valve discs, “C-V” Rings, braided packings, coverings for dough sheeting rolls and heat sealing jaws, and a wide variety of other forms. Our engineers are ready to work with and assist you in your particular needs or problems.

Let us know your requirements. Send for our 12-page illustrated catalog. Crane Packing Co., 1841 Belle Plaine Ave., Chicago 13, Illinois.



**JOHN CRANE CRANE PACKING COMPANY**

In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont., Canada

CIRCLE ED-114 ON READER-SERVICE CARD FOR MORE INFORMATION

Versatility

with a  
**GREEN  
ENGRAVER**

ENGRAVES

PANELS

DIALS

PLATES

Mark your own symbols, numbers, lettering, on your small parts, tools, identification and name plates . . . easily, simply, quickly . . . tracing from a master with the GREEN ENGRAVER.

Widely used in electronic and plastic fields, in machine tool shops and wherever permanent marking is needed.

The GREEN ENGRAVER engraves equally well on metals, plastic, wood, hard rubber and glass.

Routs Models Profiles Engraves Etching attachment and other special equipment for industrial uses are available.

Fact-filled folder on request showing how economies in costs, labor and time are achieved with the GREEN ENGRAVER.



**GREEN**

INSTRUMENT COMPANY  
361 PUTNAM AVE., CAMBRIDGE MASS.

CIRCLE ED-115 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### Oscilloscope

#### Precision Low Cost Unit



By combining engineering advances with large scale production, this firm is able to offer the same precision features in the Model 600 as in oscilloscopes selling up to twice its price. Some of the features of the new design are: a 5UP1-5" scope tube for sharp focusing and good intensity; a retrace blanking amplifier that

eliminates confusion and gives clear, sharp pictures; a two-step compensated attenuator input; and a two-stage push-pull vertical amplifier with sensitivity 0.02v per inch.

Synchronization is also available on either positive or negative phase of input voltage through the vertical amplifier or from an external source. Electronic Measurements Corp., Dept. ED, 280 Lafayette St., New York, N. Y.

CIRCLE ED-116 ON READER-SERVICE CARD FOR MORE INFORMATION

### Compressor Amplifier

#### Provides Constant Output



The Type 501-A Compressor Amplifier is ideal for stabilizing varying signals to eliminate the necessity of adjusting levels when measurement or observation of sig-

nals are to be made with oscilloscopes, bridges, phase comparators, or wave analyzers. The instrument accepts input signals of variable amplitude between 1.25 and 50v and delivers an output signal of the same waveform but held at a substantially constant amplitude of 0.25v ( $\pm 4$ db) by a servo-controlled distortionless variable attenuator.

Compression ratio is 40 to 1 (32db) from 500cy to 1Mc, slightly less below 500cy. Frequency range for complex signals at any compression condition is 50cy to 50kc, within  $\pm 3\%$ . Input impedance is 10 megohms shunted with less than 10mmfd, and output impedance is less than 100 ohms for frequencies above 500cy. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE ED-117 ON READER-SERVICE CARD FOR MORE INFORMATION

Read **TORQUE** like you read the **TIME**



### WATERS

## TORQUE WATCH

New — two pocket-sized torque meters

Easy To Read — linear scale on a one-inch watch face

Compact — 1 1/8 in. diameter and 3 7/16 in. long

Versatile — reads starting and moving torque

Wide Range — 0.010 to 2 inch-ounces or 1.0 to 20 inch-ounces

Accurate — repeat accuracy of 5% over a rotation of 300 degrees

Flexible — Jacobs chuck fits shafts up to 1/4 in. diameter

Stop guessing — Read torque accurately on potentiometers, servo mechanisms, variable condensers, spring mechanisms.

Model 6000-1	0.010 to 1.2 inch-ounces
Model 6000-2	1.0 to 20 inch-ounces



**WATERS MANUFACTURING, inc.**

Waltham 54, Massachusetts

APPLICATION ENGINEERING OFFICES IN PRINCIPAL CITIES

CIRCLE ED-118 ON READER-SERVICE CARD FOR MORE INFORMATION

*Linde* synthetic sapphire

... for excellent optical transmission

**PLUS** physical strength and chemical inertness

Sapphire is hard, strong, chemically inert and transmits a high percentage of radiation in the important ultra-violet and infra-red regions. At 1750A forty per cent of the radiation is transmitted by a .059 inch section; at 5.7 microns forty per cent is transmitted by a .100 inch section. This unique combination of properties makes it ideal for optical systems that require resistance to abrasion and corrosion and high temperature strength as well as excellent optical transmission.

Now single-crystal sapphire windows are available in diameters up to 2 inches in several finishes. For further information, call or write your nearest LINDE office.

### LINDE AIR PRODUCTS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION  
30 East 42nd Street, New York 17, N. Y.  Offices In Other Principal Cities

In Canada: DOMINION OXYGEN COMPANY  
Division of Union Carbide Canada Limited, Toronto

"Linde" is a registered trade-mark of Union Carbide and Carbon Corporation.

CIRCLE ED-119 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954



## Slug Capacitors

Designed for Color TV Needs



Developed primarily for the critical requirements of color TV, these "Cartwheel" slug ceramic capacitors are available in ratings up to 30kv and are capable of oper-

ating under extreme humidity and at elevated temperatures. They are encased in casting compound as distinguished from the usual thermosetting molded plastic.

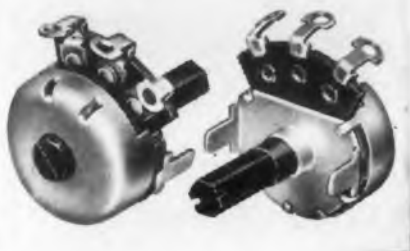
The sealing technique results in much higher corona-starting voltages, greatly increased dielectric strength, excellent arc-resistance properties, and an insulation resistance greater than 50,000 megohms. They have a power factor of 1.5% maximum at 1000cy and a long service life.

Cartwheels are available in a choice of sizes, voltages, and capacitance as well as several terminal styles. Hi-Q Division, Dept. ED, Aerovox Corporation, Olean, N. Y.

CIRCLE ED-102 ON READER-SERVICE CARD FOR MORE INFORMATION

## Variable Resistor

Shaft Adjustable at Both Ends



Designated Type LR6, a low-cost, tab-mounting variable resistor features a Bakelite shaft that is adjustable at both ends. The units are designed for use as

rear-of-chassis and concealed front panel controls in TV receivers, as pre-set gain controls in multiple-input pre-amplifiers, and in other circuits requiring only occasional adjustment. The insulated shaft feature is particularly desirable where the chassis or mounting plate is operated above ground.

The slotted hexangular shaft extending forwards is adjustable by hand, 7/32 hex nut driver, or screwdriver. The rear portion of the Bakelite shaft is round with a screwdriver slot and projects slightly beyond the cover of the control. The units are available with shaft lengths of 3/16", 1/2", 5/8", 3/4" and 1" in all resistance values, tapers and other specifications according to RETMA Standards. Electronic Components Div., Dept. ED, Stackpole Carbon Co., St. Marys, Pa.

CIRCLE ED-103 ON READER-SERVICE CARD FOR MORE INFORMATION

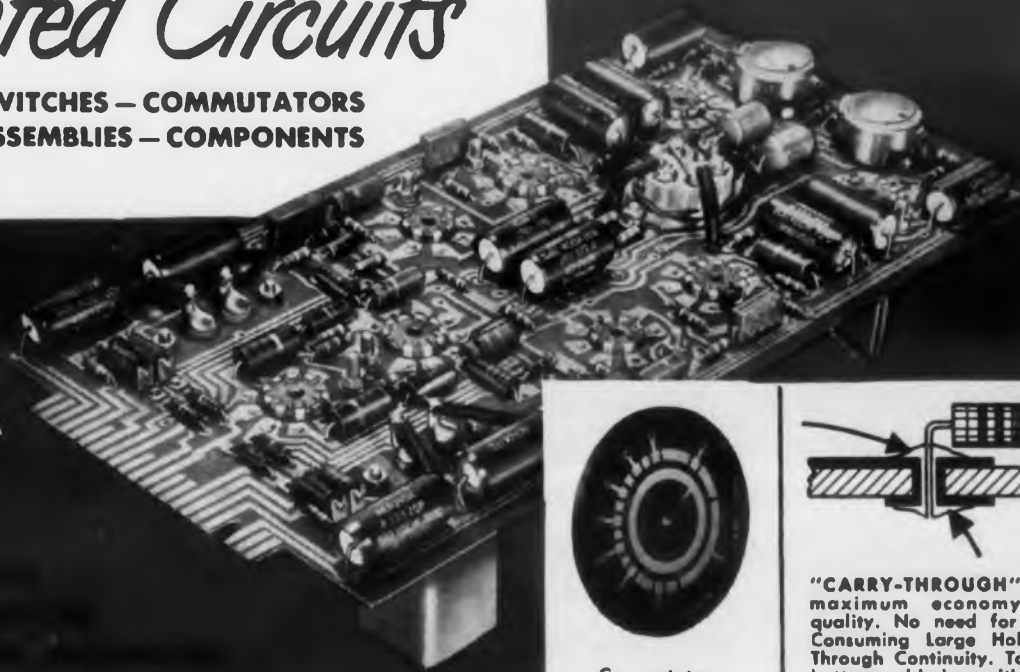
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YOUR "Quality" SOURCE FOR  
*Carry Through*  
*Printed Circuits*

SWITCHES - COMMUTATORS  
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Commutator—  
Courtesy of  
Remington-Rand, Inc.



"CARRY-THROUGH" For maximum economy and quality. No need for Space Consuming Large Holes for Through Continuity. Top and bottom soldering with selective dip-soldering of the bottom side only is an advantage, as shown.



*Insulated Circuits*  
INCORPORATED

115 ROOSEVELT AVENUE, BELLEVILLE, N. J.



CIRCLE ED-104 ON READER-SERVICE CARD FOR MORE INFORMATION

**FREE SAMPLE KIT  
PROVES BIG  
TIME SAVINGS!**

**SEMS-by-SHAKEPROOF**



Tedious separate lock washer handling is completely eliminated. Specially designed SHAKEPROOF® Lock Washers are pre-assembled to screws — two parts are handled as one! Held on by the rolled thread, the washer can't drop off!

**SEND FOR FREE TEST KIT NOW!**

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

**SHAKEPROOF**

*"Fastening Headquarters"*

DIVISION OF ILLINOIS TOOL WORKS  
St. Charles Road, Elgin, Illinois  
Offices in principal cities

CIRCLE ED-125 ON READER-SERVICE CARD FOR MORE INFORMATION

**NEW tubeless electronic  
AC VOLTAGE STANDARD**

for calibration  
of meters and  
oscilloscopes



the SORENSEN  
Model VRS-AC10

This new instrument can be used for direct checking and calibrating of vacuum tube voltmeters. It can also be used for indirect checking of power meters.

**SPECIFICATIONS**

Range: 1 mv to 100 mv  
100 mv to 1 v  
1 v to 10 v  
Accuracy:  $\pm 0.25\%$   
Input: 115 VAC  $\pm 10\%$ , 1 $\phi$ , 60 or 400 $\sim$   
Output loading:  $\frac{1}{2}$  megohm or higher. However, not damaged by short circuit.

Write for full information. Please note: we solicit your inquiry for AC standards of other voltage and current ratings.

**SORENSEN**

375 Fairfield Ave.  
Stamford, Conn.

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

**New Products ...**

**Peak Reading Voltmeter**

Measures up to 100kv



The High Voltage Vacuum Tube Voltmeter is a peak reading device designed to measure audio, supersonic, and r-f voltages that exceed the voltage range of most oscilloscopes or vacuum tube voltmeters. Utilizing two vacuum capacitor voltage dividers, it has five voltage ranges, including a 50kv range

for single-ended use and a 100kv range for double-ended use.

Frequently response is flat from 50cy up to 20Mc (or up to 50Mc if derated to half voltage). Loading capacity is less than 4mmfd, making the unit extremely useful in measuring and viewing high voltage pulses. It has a time delay of 0.16sec.

Transient viewing is facilitated by the oscilloscope connection provided for each divider with a division ratio of 300:1 and a resonant point of 220Mc. Oscilloscope calibration is simplified by a provision for easy switching from the scope to the meter. Jennings Radio Manufacturing Corp., Dept. ED, P. O. Box 1278, 970 McLaughlin Ave., San Jose 8, Calif.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

**Trimmer Potentiometers**

Have Infinite Resolution



Featuring infinite resolution, the Type RFT "Metfilm" miniature trimmer potentiometers are made in a wide range of total resistance values. They embody

a deposited metal resistance element that is tough and smooth and has excellent characteristics of noise and wear.

The sliding contact rides upon the adjusting screw and contacts all of the available resistance variation with approximately 25 turns of this screw. A 90° turn of the drive screw results in an approximate voltage change of 1% of the applied voltage. Voltage settings can be maintained with great precision. With a mounting surface about 3/8" square, these potentiometers can be stacked so that seven units occupy a square inch of panel space. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION



**New BRADLEY  
RECTIFIER  
MANUAL**

**FOR THE ENGINEER... AN INVALUABLE TOOL!  
FOR THE PURCHASING AGENT... A HELPFUL GUIDE!**

Accurate, up-to-the minute and complete, the Bradley Metallic Rectifier Manual is the most comprehensive guide available on selenium and copper oxide rectifiers. Types, designs, circuitry, applications, characteristics, all are discussed in the book's 128 pages. Your manual will be kept up-to-date, too; as new developments occur, revisions and additions will be mailed to you automatically.

● For prompt delivery send in your order today. The price is only \$2.00 for each copy.

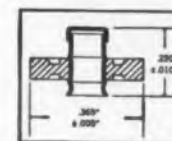


BRADLEY LABORATORIES, INC., 174 Columbus Ave., New Haven 11, Conn.

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION



**NEW, SMALLER DISC CATHODES  
BASIC FOR COLOR TV TUBES**



To fill a need for tri-gun color TV picture tubes with more slender necks, Superior Tube Company has developed new, "miniature" disc cathodes.

With length reduced by .092" and diameter of ceramic by .125", they require only half (in some cases) the heater power of cathodes used in monochromatic tubes. Yet they actually give equal or better emission. The regular Superior Tube advantages—wide choice of materials, close control of "E" dimension—are also offered on these new smaller disc cathodes.

For technical information on fine small tubing for electronic applications, write for Data Memos 5 and 19. Superior Tube Company, Electronics Division, 2050 Germantown Ave., Norristown, Pa.

**Superior Tube**

THE BIG NAME IN SMALL TUBING

All analyses .010" to 3/4" O.D.  
Certain analyses in light walls up to 2 1/2" O.D.

CIRCLE ED-130 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954



## NYLON CABLE HANGER . . . high-strength clip resists temperature extremes, chemicals



Eleven standard diameter sizes accommodate single cables or bundles from 3/16" to 2". Several sizes have two or three-hole tongues, to permit diameter adjustment in installation.

Combining the best features of metal clips with the advantages of nylon, Burndy molded nylon cable hangers weigh 70% less than metal cable clips of comparable size, yet have sustained loads of more than 300 lbs., in the larger sizes. Extremely flexible, these nylon cable hangers are preformed, for ease of installation, requiring no shaping or forming on the job and retaining their shape permanently. Resistant to sustained temperatures from -60°F to 250°F, these cable hangers are also unaffected by oils, gasoline, alcohol, or hydraulic fluid. An insulator itself, this type of cable hanger cannot cause grounds or short circuits and is free from hysteresis losses. Smooth, rounded-edge, non-abrasive surfaces facilitate installation and prevent injury to insulation.

For information on Burndy nylon cable hangers, write Department ED, BURNDY, Norwalk, Connecticut.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

## Linear Accelerometers Withstand Wide Temperature Range



This series of linear accelerometers in ranges from  $\pm 0.5g$  to  $\pm 15g$  is designed to satisfy the need for acceleration transducers that perform reliably under variable temperature conditions, such as are encountered in flight

operations. Operation through the ambient temperature range of  $-65^\circ$  to  $\pm 120^\circ$  is afforded by means of an electrical heater jacket with a peak power input of approximately 20w to 30w.

Illustrated is the Model A17 accelerometer, which is offered in ranges from  $\pm 1g$  to  $\pm 15g$ . The transducing element is the Statham unbonded resistance strain gage. Statham Laboratories, Inc., Dept. ED, 12401 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE ED-133 ON READER-SERVICE CARD FOR MORE INFORMATION

## D-C Power Supply Precision Laboratory Unit



This "super-precision" d-c power supply is designed for laboratory applications requiring very closely-regulated power. Designated the Model D3-300-E Multiple Power Supply, it is actually four power supplies in one.

One supply output is rated from 0 to 300v d-c, at 300ma. Regulation from no-load to full load is 0.003v load variation (0.001%). Ripple is 0.01millisec. A second output is identical, except for a current of 150ma.

Another rating of the supply provides continuously variable voltage from 0 to -150v, negative in respect to Output No. 2, with maximum current of 5ma regulated to line voltage but delivered through a 25,000 ohm, 10-turn "helipot". A fourth output provides continuously adjustable, unregulated filament voltage, 0 to 10v a-c at 10 amps maximum. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE ED-134 ON READER-SERVICE CARD FOR MORE INFORMATION

## NEW ALL-METAL VIBRATION ISOLATORS

Operate at Extreme Temperatures



Series M24 Isolator



Series M44 Isolator



Series M64 Isolator

New, miniature, ALL-METAL BARRYMOUNTS — Series M24 — have been added to the Barry line. The stainless-steel spring and wire-mesh construction of this tiny, new mount enable it to provide excellent isolation at extreme high or low temperatures. The M24 series meets all pertinent requirements of MIL specifications, as also do the larger M44 and M64 ALL-METAL BARRYMOUNTS.

The weights and load ranges of ALL-METAL BARRYMOUNTS are: miniature Series M24 — 1/2 oz., 9 load ratings covering range of 0.1 to 3 lbs.; JAN-size 1, Series M44 — 1 1/2 oz., 6 load ratings covering range of 1/2 to 10 lbs.; JAN-size 2, Series M64 — 4 1/4 oz., 8 load ratings covering range of 2 to 40 lbs. Write for Product Bulletins 542(M24), 534(M44), or 536(M64).

Special and standard mounting bases using any of these three ALL-METAL BARRYMOUNTS can be furnished; detailed recommendations on request.

BARRY CORP. 775 Pleasant St., Watertown 72, Mass.

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

## DC-AC CHOPPERS

For 60 Cycle Use

Built to rigid commercial specifications.

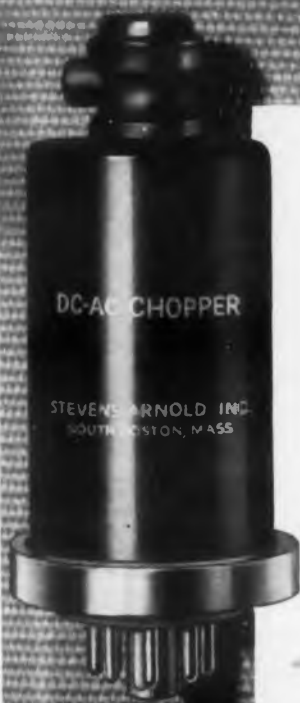
Twenty-two types, both single and double pole.

Long life.

Low noise level.

Extreme reliability.

Write for Catalog 370.



DC-AC CHOPPER

STEVENS ARNOLD INC.  
SOUTH BOSTON, MASS.

**STEVENS  
INCORPORATED  
ARNOLD**

22 ELKINS STREET  
SOUTH BOSTON 27, MASS.



S/A-10

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION

**SAVE**  
with MILWAUKEE  
**ECONOMY**  
RESISTORS



RESISTORS MUST BE GOOD before they can bear the "Milwaukee" name! That's what we said when we set about developing these ECONOMY resistors. Our engineers checked many materials and worked with factory production to assure top ranking performance. THE RESULT — resistors embodying more costly raw materials, but greatly reduced in cost by the new manufacturing techniques these materials afford. They are available in the same sizes and ohmages as our vitreous enameled resistors. Write, wire or phone for quotations — samples!

**MILWAUKEE RESISTOR COMPANY**  
702 W. VIRGINIA ST., MILWAUKEE 4, WIS.

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION





## Need a relay for AUTOMATION controls?

Whether it's for automation, traffic, elevator or instrument control, Ward Leonard's Bulletin 110 relays provide the millions of trouble-free operations required.

Our mechanical design, quality-controlled manufacturing methods and materials, and ample safety factors (both electrical and mechanical) insure this exceptionally long life.

Write today for Relay Bulletin 110. Ward Leonard Electric Co., 77 South St., Mount Vernon, N.Y.

4.11

**WARD LEONARD ELECTRIC CO.**  
*Result-Engineered Controls Since 1892*  
 RHEOSTATS • RESISTORS • MOTOR CONTROLS • CHROMASTER

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**DURANT Specials**  
 For RADAR • ELECTRONIC • INSTRUMENT Applications

High speed, direct reading. Indicates increment of measurement in radar navigation instruments.

"Y" Rotary Counter used in navigating instruments.

Special counter for Tape Recorder to indicate position of tape passing through recorder.

Special high speed Y-type for Goniometer application.

**DURANT MANUFACTURING CO.**  
 1993 N. Buffum St. Milwaukee 1, Wis.      193 S. Water St. Providence 3, R. I.  
 See you BOOTH 852 INSTRUMENT EXPO.

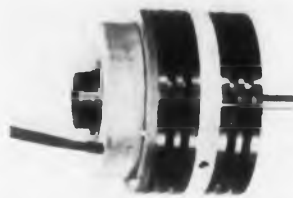
**PRODUCTIMETERS** *Count Everything*

CIRCLE ED-138 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products...

### Magnetic Fluid Clutch

High Torque, Smooth Action Device



The 731B Magnetic Fluid Clutch is for use as a clutch element in reversing or speed changing transmissions, as a precision take-up device, and for many other applications. It utilizes a grease-like lubricant in which extremely fine magnetic particles are suspended. The application of a-c to the coil may be made from the plate of conventional vacuum tubes or suitable rectifiers. This causes the fluid to "stiffen" in proportion to the current. The fluid thereby acts as a clutch "lining", and the varied current produces torque much like the varied clutch pressure of a conventional clutch.

The clutch allows for 40w of heat dissipation and develops up to 50 in-lb of torque. At the maximum recommended speed of 800rpm, it can transmit up to 475w (2/3hp). The standard coil resistance is 1700 ohms, and a coil current of 75ma gives full torque, thus delivering a power gain of 50 at 800rpm.

Ball bearings and fluid seals result in a high precision device with high torque, smooth action. Weight is only 3-1/2 lbs. Size is 3-1/4" diam x 3-19/64" overall length. Raymond Engineering Laboratory, Inc., Dept. ED, Middletown, Conn.

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

### Boro-Carbon Resistors

Meet Specification MIL-R-10509A



Known as the "Borohm" series, a line of 1/2, 1, and 2w boro-carbon resistors exceed all requirements of MIL - R - 10509A, Characteristic "R" as proved by temperature cycling, moisture resistance, and load life tests. The units have a tough epoxy resin coating that withstands rough handling.

Three styles are available. Type BC20 is rated 1/2w, Type BC25 is rated 1w, and Type BC30 is rated 2w. Standard resistance tolerances are 1, 2 and 5% with stability averaging 0.2% after 1000hr load life tests. Shallerross Manufacturing Co., Dept. ED, Collingdale, Pa.

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

*is this your timing problem?*

*Sorry...*  
**A. W. HAYDON CO.**  
*can't help you.*  
 Only instruction, practice, and patience can improve your score!

**But...if your problem is PRECISION TIMING**  
 you may save time, trouble and money by investigating what our timing engineers have done for others. Our A.C. and D.C. achievements may already include the solution of your most complex problem. Why not find out?

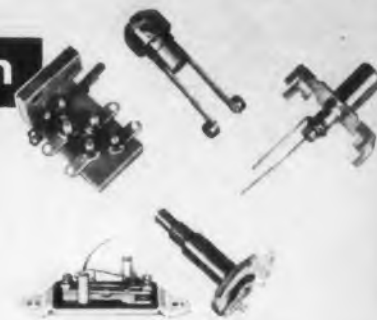
Send for latest catalog manual

**The A.W. HAYDON COMPANY**  
 227 NORTH ELM STREET  
 WATERBURY 20, CONNECTICUT  
 Design and Manufacturer of Electrical Timing Devices

CIRCLE ED-141 ON READER-SERVICE CARD FOR MORE INFORMATION

**precision**

parts  
 components  
 assemblies



**...to your specifications**

**ELECTRONIC • ELECTRO-MECHANICAL  
 AIRCRAFT • AUTOMOTIVE**

We are staffed and equipped to give you every assistance in the design and manufacture of those tough small parts and assemblies. Long experience in miniaturization and weight reduction qualify us for your most intricate problem.



Complete cooperation assured...  
 Try us!

47 N. SAXON AVE., BAY SHORE, LONG ISLAND, N. Y.

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ELECTRONIC DESIGN • September 1954

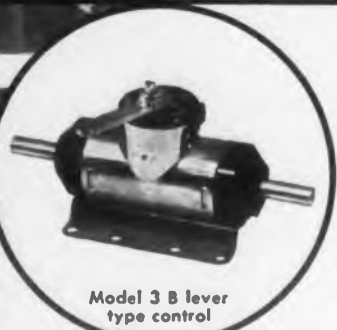
## Design Simplified...



with the  
**Metron**  
VARIABLE  
SPEED DRIVE

- Permanently lubricated
- Your choice of 6 controls
- Speeds up to 10,000 RPM
- Nominal output .025 HP

• For further information about how Metron units can simplify your costly speed changing problems, write for Bulletin 99.



Model 3 B lever type control

Design engineers at Century Geophysical Corporation make use of the Metron Variable Speed Changer to give them continuously adjustable chart speeds in their miniature oscillograph. Century engineers find that it is simpler and more economical to use Metron Miniature units as components than to design and build their own. Metron Variable Speed Changers are designed into countless products that call for changes in speed. The units are small—only 4 3/16" long—to fit minimum space. They are smooth and accurate in operation and cover infinitely variable output speeds from 5:1 step down thru 1:1 to 1:5 step up.

**Metron**

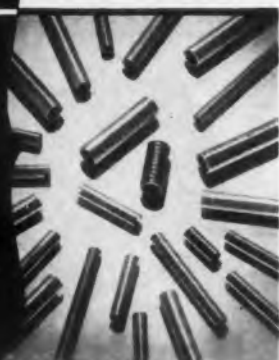
**INSTRUMENT COMPANY**  
450 LINCOLN ST., DENVER 9, COLO

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

## RESINITE

...can increase efficiency of your iron core insertion production by 20%

### EMBOSSED COIL FORMS



Special embossed construction eliminates torque control problems and stripping. Custom fabrication to your exact specification assures correct dimensions to within the most critical tolerances.

We will furnish—without charge—a pilot production run of custom-made embossed forms to fit your particular application.

Contact us now for full details about this special offer. Request technical bulletin, *Use of Threaded Tubes, Threaded Iron Cores VS. Torque Control.*

**RESINITE CORPORATION**

#### Sales Representatives in:

<b>New England:</b> Framingham, Mass., Framingham 7091	<b>Philadelphia:</b> Philadelphia, Pa., Chestnut Hill 8-0282
<b>New York, New Jersey:</b> Jersey City, New Jersey, Journal Square 4-3574	<b>Northern Ohio, Western Pennsylvania:</b> Cleveland, Ohio, Atlantic 1-1060
<b>Upstate New York:</b> Syracuse, N.Y., Syracuse 76-8056	<b>Indiana, Southern Ohio:</b> Logansport, Indiana, Logansport 2555
<b>Maryland:</b> Baltimore, Maryland, Plaza 2-3211	<b>Missouri, Southern Illinois, Iowa:</b> St. Louis, Missouri, Sterling 2318
<b>Canada:</b> Montreal, Quebec, Canada, Walnut 2715	<b>California:</b> Pasadena, California, Sycamore 8-3919



**PRECISION PAPER TUBE COMPANY**  
2035C W. CHARLESTON ST. • CHICAGO 47, ILLINOIS

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## Vacuum Tube Voltmeter Has Wide Frequency Range



The Model 400D high accuracy vacuum tube voltmeter covers all frequencies from 10cy to 4Mc. It measures voltages from 0.1mv to 300v, and is accurate to within 2% up to 1 megohm. Input impedance is 10 megohms so circuits under test are not loaded. The instrument has

a new amplifier circuit providing approximately 56db of feedback in mid-range for high stability and freedom from calibration changes caused by external conditions.

Ranges are selected on a front panel switch that changes sensitivity in accurate 10db steps. This switch plus calibration of the 4" meter directly in decibels means direct readings are available without calculation or conversion between -72dbm and +52dbm. Readings are always in the upper part of the scale where maximum accuracy is obtained.

In addition to measuring gain, response and output level, the voltmeter measures hum and noise directly, determines power circuit and broadcast high frequency voltages, serves as an audio level meter and high gain broad band amplifier, detects nulls, monitors waveforms, and measures coil "Q", capacity, and resonance. Hewlett-Packard Co., Dept. P, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

## Sampling Switch

Only 2" diam x 1" long



Contact plates molded with high quality mica-filled resin are employed in this high-speed precision switch. The design shown measures only 2" diam x 1" long. It is made in the same way as larger and subminiature commutators of

standard form used for telemetering, thermocouple correction of multiple amplifiers, and for other uses.

Switches are available with any of a large variety of contact materials selected according to the amplification, and with a variety of features, such as number of contacts, number of poles, and sampling rates. They can be supplied with single or double-ended shaft, or integrally mounted with driving motor. General Devices, Inc., Dept. ED, P.O. Box 253, Princeton, N.J.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

## New RF Choke Kit Contains 14 pie-wound chokes

Chokes are on LPB-3 forms, which have axial leads and are only 5/32" in diameter by 1/2" long. Windings are 1/8" wide, varying up to 1/2" approximately in diameter. All units varnish-impregnated for moisture and fungus-proofing. Inductances are RMA preferred values from 6.8 microhenries to 1.0 millihenry, with color-coding enabling easy recognition of values.



Modern packaging adds to the advantages of the kit for laboratory or experimental use. Supported in a foam plastic block, the chokes are protected from damage in transit and can easily be removed and reinserted. Block stands on any flat surface. Chart on inside cover of kit gives necessary electrical data, plus C.T.C. part numbers for ordering separately or in bulk. Kit price is \$4.25 F.O.B., Cambridge, net 30. Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Mass.

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

## ANOTHER FLASH-O-LENS AT WORK AIDING METALLURGICAL INSPECTION AT U.S. Steel



Rigid standards of inspection guard every production step in the plants of the world's largest steel maker. Here a U. S. Steel metallurgist checks a sample of tin plate for surface imperfections with a FLASH-O-LENS, the unique inspection tool that illuminates the area it magnifies.

If minute visual inspection plays a part in quality control of your product, chances are you can save time, increase accuracy with FLASH-O-LENS. Made in battery and plug-in models and in a wide range of precision lenses to meet your needs. Prices from \$10.65.

For fully descriptive literature write . . .

**E. W. PIKE & COMPANY, Inc.**  
492 NORTH AVENUE ELIZABETH 3, NEW JERSEY

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION





## Fielden ELECTRONIC TEMPERATURE CONTROL

- \* High Sensitivity ( $\pm 0.2^\circ F.$ )
- \* Low first cost, low operating cost
- \* Wide range ( $-200^\circ C.$  to  $+500^\circ C.$ )
- \* On-Off or 2 Zone Control

The new Fielden Electronic Temperature Control is a simplified, low cost instrument with high sensitivity—an ideal controller in many industrial fields. This control can be employed for numerous tanks, vats, ovens, kilns, or dryers, in conjunction with electric, steam, or hot water heaters using solenoid, pneumatic, or electric motorized valves. Available in a wide selection of ranges, with either platinum or nickel bulbs. Aside from the many industrial uses, this control has proved very successful in the laboratory for low cost, reliable and accurate control of test chambers, water baths, and similar applications. Write today for complete information.

## Robertshaw-Fulton

CONTROLS COMPANY



FIELDEN INSTRUMENT DIVISION  
2920 N. 4th St., Dept. Q, Philadelphia 33, Pa.

CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

When Contact Reliability  
is most important...

the NEW  
8QA  
MULTI-CONTACT D.C.

Phil-trol  
RELAY

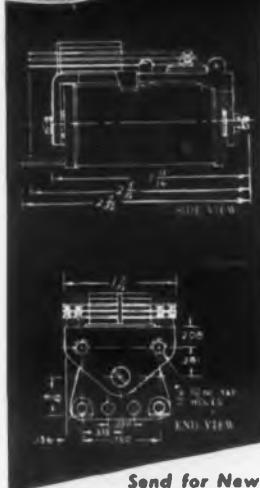


Dependability plus high sensitivity have made this new Phil-trol relay an immediate favorite with engineers and designers. Compactness and adaptability provide new answers to problems confronting electronic and control engineers.

Features include immediate response; fast closing and opening; contact springs with twin contacts; heavy duty, long-life bronze bearings; light weight.

Like all standard Phil-trol relays, the 8QA is available in a wide range of modifications. Coils may be single or double wound, and equipped with copper slugs or sleeves for slow release or for slow operation.

Phil-trol engineering experience and design facilities are available to help you solve any new application problem.



Send for New  
Phil-trol Catalog

## Phil-trol

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A THOR CORPORATION SUBSIDIARY • OFFICES IN ALL PRINCIPAL CITIES

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products...

### Single-Sideband Filter

Utilizes Toroid Coil



The Type S-15000, a low-cost, single-sideband filter, utilizes a toroid coil instead of costly crystal filters. It is similar to this firm's SSB filters and is designed to be a mass-produced SSB filter for in-

corporation into new designs by set manufacturers.

The filter features compact size and ease of installation. Fixed tuned and hermetically sealed, it requires no adjustment, is rugged and trouble-free. It may be installed in any existing amateur receiver now in use. It makes possible long-range reception with reduced interference and distortion not only of SSB signals, but of any a-m transmission. It utilizes 50ke as a 2nd i-f, and provides a narrow-band, sharp cut-off response which insures maximum intelligibility and maximum signal intensity. Burnell & Company, Dept. A, 45 Warburton Ave., Yonkers, N. Y.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

### Volt-Ohm Microammeter

Waterproof Construction



The PL 1004 "Multimeter" is identical to this firm's TS352B/U waterproof volt-ohm microammeter built to Specification MIL-M-4269 (USAF) and sup-

plied to the armed forces. Now available for commercial and industrial use, it is a self-contained instrument used for testing elements of electronic and electrical circuits to determine specific electrical characteristics, and to check current, resistance, and voltage in existing circuits. It is adaptable for both a-c and d-c measurements.

Environment-free features include: a rugged, sealed 4-1/2" meter; waterproof jacks; and a design that permits immersion in its gasket-sealed cover without affecting accuracy. Test leads and accessories are provided with the instrument. Phaotron Co., Dept. ED, 151 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

## NEW DATA AVAILABLE ON PRECISION SERVO MOTORS

An informative new catalog about Servo Motors is now available from G-M Laboratories Inc. Known as Servo Motor Catalog Number 4, it gives dimensions and characteristics on standard types of G-M precision Servo Motors which can be sampled or produced in quantity within the shortest time possible. By using this catalog as a guide, it is easy to pick out a standard unit to meet dimension and performance specifications. Engineering drawings and characteristics charts are in easy-to-read form. A description of the quality and variety of materials that go into these precision motors is included; also a simplified outline to be followed when ordering standard motors.



G-M LABORATORIES INC.  
4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

## ANOTHER NEW FAIRCHILD POTENTIOMETER



TYPE 751  
7/8" LINEAR

The small size — 7/8" diameter, 0.693" length (from front of servo flange to rear of case) — and the 13-gram weight, make the Type 751 the perfect transducer for guided missile systems. Internal clamp rings permit ganging without increasing over-all diameter — length is increased only 1/2" for each added cup. Standard linearity is  $\pm 0.5\%$ , in a resistance range of 400 to 20,000 ohms, with a maximum resolution of 0.071%. Terminals are gold-plated for reduced contact resistance and easier soldering.

### SAMPLES AVAILABLE ON ORDER

The Type 751 is another important reason why Fairchild can help you solve all your precision potentiometer problems. For more information write Fairchild Camera & Instrument Corporation, Potentiometer Division, 225 Park Avenue, Hicksville, L. I., N. Y., Department 140-52N.

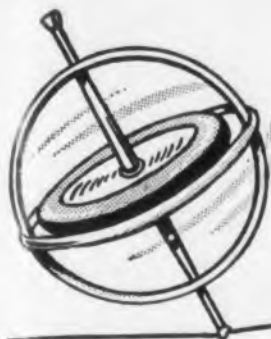
## FAIRCHILD

PRECISION POTENTIOMETERS

CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954





## CASTELL push button LOCKTITE lead holder has PERFECT BALANCE

Perfect balance makes Push Button CASTELL LOCKTITE Holder the king of its class.

Exclusive collet holds lead in **bull dog grip**, preventing slipping or turning.

No graphite dust stains your fingers—because with one-hand push-button action you extend and retract the lead. *No need to touch graphite.* Comfortable "wood-pencil" feel—not metallic.

Equipped with easily-replaced clutch, giving your LOCKTITE indefinite life.

Imported CASTELL 9030 Lead inserted in your LOCKTITE Holder gives you the combination for brilliant results on your drawing board. Ask your Dealer for both—LOCKTITE Holder and Imported CASTELL 9030 Lead in 19 degrees, 7B to 10H.

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PENCIL COMPANY, INC., NEWARK 3, N. J.

CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION

## Now Constant Stability of Tolerances at 1,500,000 CYCLES!

**ELECTRO SNAP**

Type S2  
STANDARD

## BASIC SWITCH

Gives You More Than Just Long Life!

- Maintains accurate repeatability and positive snap-action . . . even at 1,500,000 cycles and over!
- Long life lowers switch costs . . . minimizes "down-time" and increases efficiency of operation.

• Durable, compact plastic case permits great flexibility of application. Available in a wide selection of models, including "reset". Rated at 10 amps 125/250 v. AC; 30 v. DC inductive.

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ELECTRO-SNAP SWITCH AND MFG. CO.  
4724 West Lake Street Chicago 24, Illinois

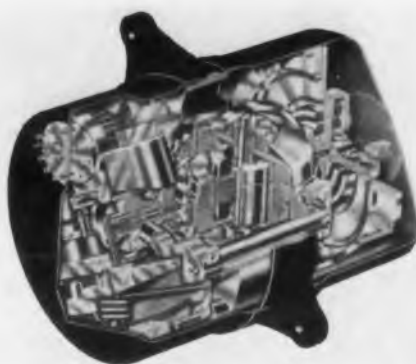


CIRCLE ED-156 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## Reference Gyro

Reaches Control Speed in 10sec



The Model 221 airborne reference gyro accelerates to operational control speeds in only 10sec. It is designed to withstand extreme acceleration and shock up to 60g. It will successfully operate, with-

out excessive drift, during vibration up to and including 10g at 1500cy.

The unit is a two-degree-of-freedom gyro that measures displacement about two axes by means of a pick-off placed on each gimbal axis. Use of an electrically operated caging device permits the caging cycle to be completed in 4sec for normal displaced positions. With the gimbal displaced 180°, maximum caging time is 20sec. The gyro can be completely uncaged in less than 0.1sec.

The unit is offered with either a 28v d-c, a 115v d-c, 400cy single phase, or a 115v d-c, 400cy three-phase power supply. Pickoffs are supplied as either potentiometer type or a special "pancake" type precision synchro. Maximum drift will not exceed 0.1° per minute in either a-c or d-c units. The unit with a-c pickoff is contained in 3-1/2" diam x 5-1/8" long case. Length with d-c pickoff is 5". Weight is 4-3/4 lb. Summers Gyroscope Company, Dept. ED, 2328 Broadway, Santa Monica, Calif.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

## Square Wave Generator

For Testing Wide Band Amplifiers



A new generator, Model 183, provides square waves suitable for testing the transient and frequency response of wide band amplifiers, and accurately measures their amplitude. The frequency range is from 10cps to 1Mc,

continuously variable over decade steps.

This unit has a low impedance output which provides 10v, peak-to-peak. At high impedance, 100v, peak-to-peak, is available. A 60db step attenuator and a 20db continuous attenuator (which do not affect wave shape) provide means of using the generator as a voltage calibrator. New London Instrument Co., Dept. ED, P. O. Box 189, New London, Conn.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

## low-priced, HIGH QUALITY Vacuum-Tube Voltmeter



★ A-C OPERATED

★ 0.1 v to 150 v, a-c, in 5 ranges to 100 Mc

★ Completely-Shielded Probe

★ Large and Easily Read Meter

★ Accuracy of 3% Full Scale on All Ranges

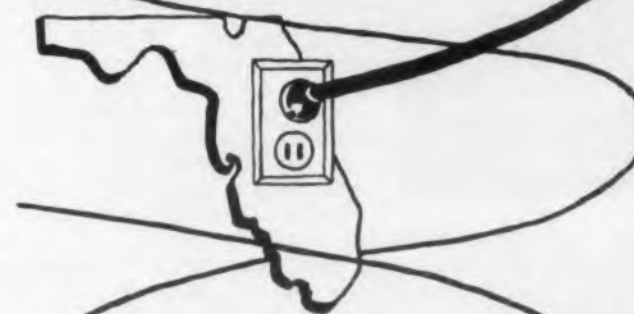
★ Minimum Meter Variations with Line-Voltage Changes

Type 1803-A  
Vacuum-Tube Voltmeter  
\$155

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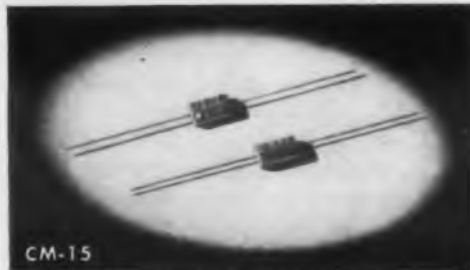
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trifles make PERFECTION . . .  
but PERFECTION is no trifle

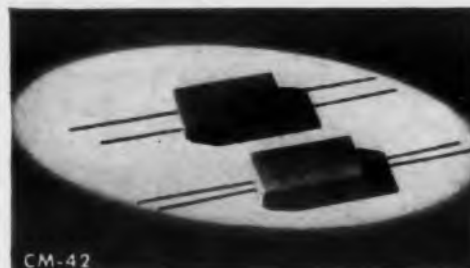
*3 1/2 oz. of perfection*

. . . is VITAL to 61 TONS of  
MAGNIFICENT PERFORMANCE

#1 In a Series of  
Tremendous Trifles



CM-15  
Smallest Molded Mica Capacitors 9/32" x 1/2" x 3/16"



CM-42  
Made to Meet All MIL-C-5 Requirements. Largest Molded Mica Capacitors of Wire Terminal Type 13/16" x 1 1/2" x 5/16"

Jobbers and distributors are requested to write for information to Arco Electronics, Inc., 103 Lafayette St., New York. Large stocks on hand—spot shipments for immediate delivery. Sole Agent for Jobbers and Distributors in the United States and Canada.



WRITE FOR FREE SAMPLES AND CATALOG ON YOUR FIRM'S LETTERHEAD

When the mighty giants of the air lift their massive wings to fly, a thousand and more "tremendous trifles" instantly go to work in harmonious unison to give life and power. It is the perfection of these "trifles" that makes possible the magnificent performance of today's luxurious air liners.

The EL Menco Capacitor — CM-15 — is one of these "tremendous trifles" that plays such a vital part in the efficient operation of aircraft communication.

EL Menco IS THE ONE OUT OF MANY CHOSEN FIRST

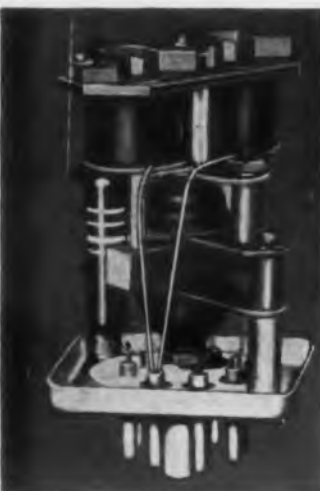
Whether you use our *high* capacity CM-42 (10-25,000 mmf) or our *midget low* capacity CM-15 (2-525 mmf) you have guaranteed assurance of job-tested, job-rated capacitors — tremendous trifles of perfection so vital to the magnificent performance of YOUR product.

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MOLDED MICA **EL-Menco** MICA CAPACITORS TRIMMER

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Here is a pair of "Problem-Solvers"  
For Designers of Electrical Control Systems

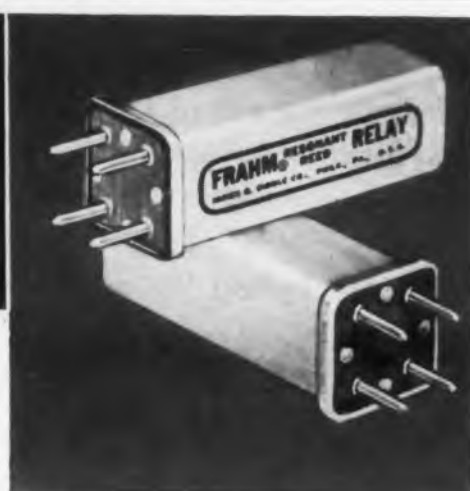
FRAHM® REED RELAYS

FRAHM® OSCILLATORS

Frahm Resonant Reed Relay is an electro mechanical device which responds to an alternating signal having frequency and amplitude values that lie within specified bands. A number of control signals over a single circuit is possible with all types of communication circuits, including radio. A signal is transmitted either on a wire line, or as a modulated carrier to some remote location

where it operates a reed relay to indicate the control function at that point. Since each reed relay will respond only to a narrow band of frequencies, it is possible to operate a number of relays simultaneously by making use of an equal number of source generators arranged so that none of the operating frequency bands overlaps. In a range of 200 to 500 cycles it is possible to operate up to 16 channels with no interference.

Frahm Oscillator controls are miniature tuning forks for use in electronic oscillators to provide stable output frequencies. By their use good sine wave signals with output better than 1 volt can be obtained. They are available for any frequency in the range of 50 to 1000 cps with accuracies better than 0.2%. A series of standard units is available to match the standard Frahm Reed Relays.



Frahm Reed Relay and Oscillator combinations may be used for controlling, signalling, monitoring, and protection and frequency matching. Check coupon for new bulletin on Frahm Relays and Frahm Oscillator Controls.

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Gentlemen:  
Please send me  Bulletin 33-ED—  
Frahm Relays  
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Oscillators

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**JAMES G. BIDDLE CO.**

• ELECTRICAL TESTING INSTRUMENTS  
• SPEED MEASURING INSTRUMENTS  
• LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET  
PHILADELPHIA 7, PA.

## New Products . . .

### Transformers

#### Miniature Plug-In Designs



These audio transformers are built into a molded octal base, 1-15/32" high x 1-1/32" diam. To assure maximum leakage resistance, they are

embedded in a high melting point resin. They have the same nominal ratings as this firm's previously cataloged items. On special order, they are available with buss-type leads to enable use in printed circuits; the lead size varies from #22 for the "Miniature" size transformer, to #26 for the "Veri-Miniature" type.

Units of this type are being used in guided missile and encapsulated construction, as well as for radio paging and hearing aid applications. Microtran Co., Dept. ED, 84-11 Rockaway Beach Blvd., Rockaway Beach 93, N. Y.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

### Delay Line

#### Provides 0-1.2μsec Delay



The Model V-104 Delay Line provides a variable delay of from 0-1.2μsec. The delay is obtained with a lumped-constant circuit consisting of 60 coil and capacitor sections. The delay of each section is 0.02-μsec. A 60-contact rotary switch is used to tap the

delay line at the desired delay. Since the switch is of the shorting type, an incremental delay of 0.01μsec is obtained with the switch in the shorted position, thus providing 120 steps.

Overall accuracy is 5%. The rise time varies with delay from less than 0.02μsec to approximately 0.04μsec. Nominal impedance is 2700 ohms.

The unit is useful as a laboratory instrument for all types of pulse work, including computers, radar, television, etc., and can also be used accurately to provide and measure phase shifts. It may be connected in series with other units of the same impedance manufactured by this company. Other models, both fixed and variable delay types, are available. Control Electronics Co., Inc., Dept. ED, 1925 New York Ave., Huntington Station, N. Y.

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Electronic Supply Guide

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Curtis  
Terminal Blocks  
Make Better  
Connections  
Economically —  
Quickly.  
A type for every  
purpose.

## CURTIS Type "K" Blocks with "lock-in" feature



- No Pull-Out
- No Drop-Out

The Curtis Type "K" offers several noteworthy features promoting convenient and safe wiring — (1) Note how the spade lugs actually lock in place — no pull-outs, (2) the "K" requires minimum space, (3) available in any number of terminals from 1 to 18, (4) a solid base insulates screw from base.

Write for Bulletin DS-114.  
Also ask about wide selection  
of other Curtis Blocks  
available.

**CURTIS DEVELOPMENT & MFG. CO.**

323. North 33rd Street, Milwaukee 16, Wisconsin

CIRCLE ED-168 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## Gain Measuring Set For Microwave Measurements



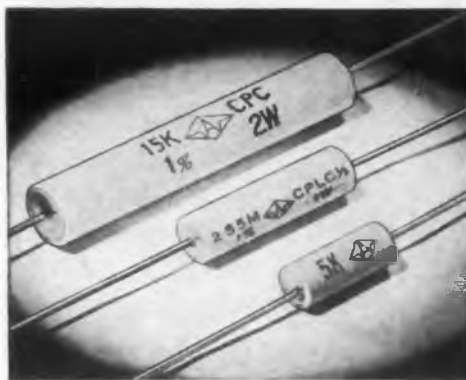
The new "Radalyzer" gain measuring set has a 30Mc i-f for low low-level microwave measurements. It has the following features: gain-loss measuring range is 0 to more than 60db vswr; 0 to more than 60db insertion loss or gain; receiver frequency of 30Mc; and operating (signal) frequency range from 40Mc to 10Mc (furnished by external equipment under test).

Input rating is 50mv maximum at 30Mc into a 50 ohm line. Attenuators are 0-101 db (steps—1, 2, 3, 5, 10, 20, 20, 20, 20). The unit has a 0-10db precision 10-turn potentiometer, calibrated. Regulated voltages are furnished for two external klystrons by the power supply. Pre-amp gain is linear over input level changes of more than 60db. Kay Electric Company, Dept. ED, 14 Maple Ave., Pine Brook, N. J.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

## Precision Resistors

Have Hermetically Sealed Ceramic Case



Designated as Type CPC, a ceramic-case version of the "Carbofilm" precision resistor is housed in a ceramic tube with metallized ceramic end-seals for complete and permanent

hermetic sealing. There is no capacitance effect between element and casing. The leakage path is very long.

The resistors, made to guaranteed tolerance of  $\pm 1\%$ , have excellent stability with respect to temperature changes, voltage, noise, etc. They withstand extreme humidity and heat. Available in 1/2w, 1w, and 2w sizes. Hi-Q Division, Dept. ED, Aerovox Corporation, Olean, N. Y.

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AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY

# acrylic rods and tubes

SIZES AVAILABLE

### RODS

1/8"	9/16"
3/16"	5/8"
1/4"	3/4"
5/16"	7/8"
3/8"	1"
7/16"	1 1/8"
1/2"	1 1/4"

### TUBES

1/16" wall	1/8" wall
1/4" O.D.	1/2" O.D.
5/16" "	3/4" "
3/8" "	1" "
1/2" "	1 1/4" "
5/8" "	1 1/2" "
3/4" "	1 3/4" "
1" "	2" "

CLEAR CRYSTAL METHYL  
METHACRYLATE—Rods  
and tubes for industrial,  
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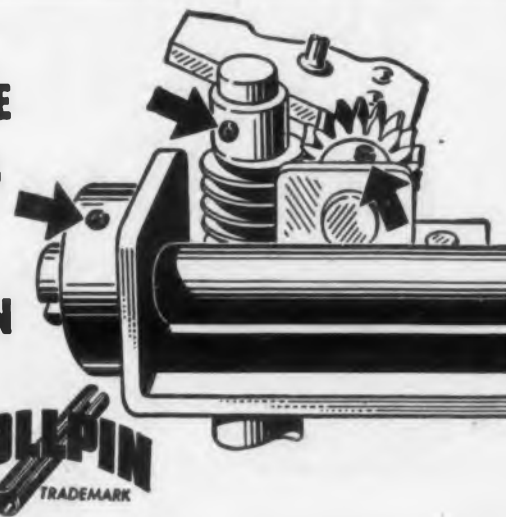
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**FAST,  
ACCURATE  
PINNING  
OF  
PRECISION  
SHAFTS  
WITH ROLLPIN**



Rollpin speeds production alignment of close tolerance shafts. The slotted, hollow steel spring pin, with chamfered ends, is simply pressed or driven into holes drilled to normal production tolerances. It compresses as driven, is self-locking and vibration-proof. Rollpin is light, easily removable, reusable and has a shear strength greater than a solid pin of the same diameter. Diameters from 1/16" to 1/2".

Rollpin, in place of rivets, set screws, dowels and stop pins can cut production costs as much as 90%. For detailed information on any electronic fastening problem, write: Elastic Stop Nut Corporation of America, 2330 Vauxhall Road, Union, New Jersey. Address Dept. R26-957.



**ELASTIC STOP NUT CORPORATION  
OF AMERICA**

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

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907

## Electrical Noise in Wire-Wound Potentiometers

BY IRVING J. HOGAN

Research and Development Division  
Helipot Corporation

Presented at the 1952 WEST COAST I.R.E. CONVENTION

387



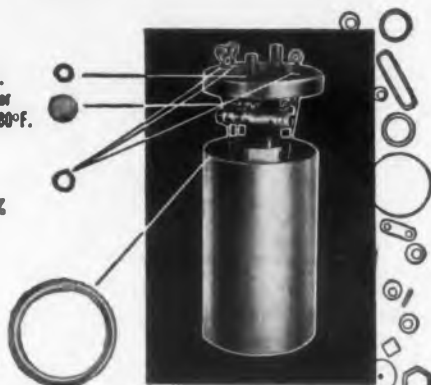
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## Soldering Operations in 1 Easy as ABC with KESTER "SOLDERFORMS"

**A** Solder screws and stud to can cover. "Solderform" Disc & Rings 5% Silver—95% Lead Alloy. Melting Point 680°F.

**B** Solder glass terminals to cover. "Solderform" Rings 63% Tin—37% Lead Alloy. Melting Point 361°F.

**C** Hermetically seal cover on can. "Solderform" Ring 28.5% Bismuth—28.5% Tin—43% Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

**KESTER**  
SOLDER COMPANY

4266 Wrightwood Avenue • Chicago 39, Illinois  
Newark 5, New Jersey • Brantford, Canada

CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products...

### Voltmeter

For 5-150kc Carrier Measurements



A compact precision-built voltmeter, the Model 104 is designed for measurements on communication systems. It covers a frequency range from 5kc to 150kc and has a frequency calibration accuracy of  $\pm 1$ kc. The signal measurement range is  $-80 +42$ dbm at 600 ohms impedance, and signal measuring accuracy is  $\pm 2$ db over the range  $-70 +42$ dbm.

Input impedance is 10,000 ohms in the pass band, and is appreciably higher in the rejection band. The instrument has unusually high selectivity; response is down 3db at 300cy of resonance, 45db at 1,500cy of resonance. It reads direct in dbm, and is designed for operation into an unbalanced 600 ohm line. It may be converted quickly to balanced operation for 135 ohm or 600 ohm balanced line measurements with the Model 155 Line-Bridging Transformer. This transformer may be readily plugged into the input terminals on the front panel. Sierra Electronic Corporation, Dept. P, 1050 Brittan Ave., San Carlos 2, Calif.

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

### Power Supply

Provides Constant Current or Voltage



The "Spineo Duostat" provides facilities for both constant-current and constant-voltage operation. Energized from a standard 115v 50/60cy power outlet, it can provide currents from 5ma to 50ma, automatically regulated to  $\pm 2\%$  at voltages from 100v to 500v. In its constant voltage mode of operation, it is self-regulated to  $\pm 1\%$  from 160v to 500v, over a load current range of 0 to 50ma.

Output is relatively unaffected by line voltage changes between 105v and 150v. Housed in a portable metal cabinet measuring 9-1/2" x 10-1/4" x 9-1/2", it has a top-mounted carrying handle and weighs 11-1/2 lbs. Specialized Instruments Corp., Dept. ED, 532 O'Neill Ave., Belmont, Calif.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION



Unit dimensions: 2 3/8" h.  
X 1 3/4" w. X 9/16" d.

**ULTRA-PRECISION Controls**

Standard overall tolerance plus/minus 5%. To 0.5% where resolution permits.

Voltage ratio accuracy of 0.005. Life of over 1,000,000 cycles.

Mechanical rotation to 340°. Also for continuous rotation.

These units exceed applicable JAN-R-19 specifications.

★ The plug-in version (Series 52) of Clarostat's ultra-precision controls used in the most critical electronic assemblies. Single units of 2 to 18 section tandems. Prong terminals engage with corresponding jacks for convenient plug-in circuitry. Write for literature. Let us quote.



CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

here's what **DIE CAST** **GRC** ZINC ALLOY **FASTENINGS** mean to you...

in terms of a better product, in terms of a more economical product!

Every Quality Feature is an Economy Feature!

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- Closer tolerances ● Cleaner threads
- Greater dependability, durability
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- LOWER PRICED!
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CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

*pieces in crystal craftsmanship*

**Bliley  
CRYSTALS**

**TECHNICAL LITERATURE AVAILABLE:**  
 Bulletin No. 47—Crystals, Frequency Standards, MIL-type Specification Index  
 Bulletin No. 45-A—Solid Ultrasonic Delay Lines  
 Bulletin No. 46-A—"Bantam BX" Crystals  
 Bulletin No. 44-B—Amateur, Standard Frequency, Ship-to-Shore, and TV Service Crystals

Bliley is your dependable crystal source—the Company that for 24 years has been making craftsmanship a career! From subminiature crystal units to reference standards mounted in ovens, Bliley leadership in design, development and production has been a proven fact by military and commercial usage.

**BLILEY ELECTRIC CO., UNION STATION BUILDING, ERIE, PA.**

CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

# Do you have this handy catalog?

You'll find it mighty useful. It covers the whole standard line of Speer Resistor Division Products:

**FIXED COMPOSITION RESISTORS • MOLDED WINDING FORMS  
 IRON CORES • SLEEVE CORES • COIL FORMS**

It tells everything you'll want to know about these products—their specifications, their characteristics, their applications.

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**OTHER SPEER PRODUCTS FOR THE ELECTRONICS INDUSTRY**  
 anodes • contacts • fixed carbon resistors • coil forms • discs • brushes  
 battery carbon • graphite plates and rods  
 also R.F. Coils • ceramic capacitors • capristors • high voltage condensers • disc capacitors • chokes made by Jeffers Electronics

**SPEER RESISTOR DIVISION  
 SPEER CARBON COMPANY**  
 St. Marys, Pennsylvania  
 Other Divisions: Jeffers Electronics  
 International Graphite & Electrode

CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION

## Plastic Panels For Edge Lighting Uses



These edge-lighted plastic panels are for a wide variety of electronic equipment-mounting applications. They are highly durable due to a special molded laminate process, and are practically impervious to scratches and nicks which might cause light leakages. The panels are accurately sized, and the molded edges are an integral part of the front and back. The recessed engraved lettering is easy to clean.

Suggested uses for the rugged panels are in aircraft, mobile police transceivers, radio, television, and other broadcasting equipment.

The panels meet requirements of MIL-P-7788, including the tests for temperature change, humidity-moisture, salt spray, vibration and shattering, parallax, gloss, contrast, and altitude. The firm also produces a complete line of lighted or plain dials and knobs, which are equal in durability to the panels. Knobs and dials are made to match the panels, if desired. Kerreo Products, Dept. ED, Box 414, Hastings, Nebraska.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

## WRITE, WIRE or PHONE FOR YOUR CATALOG

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Star Stainless screws have CLEAN, BRIGHT-AND-SHINY HEADS

- Bolts & Cap Screws
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- Wood Screws
- Pipe Fittings
- Class 3 Screws
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**Star STAINLESS SCREW CO.**  
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 Direct New York Telephone: Wisconsin 7-9041

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

# Gibson Upright Food Freezers

— are power-supplied by

## PHALO Lord!

The famous 11 cu. ft. GIBSON Food Freezers, tops in food freezing conveniences, give their customers the best in power supply cords with special PHALO cord SPT-3.

Join the "current" swing to PHALO-cords . . . and ask us about PHALO Color Cord-O-Nater . . . the fashion-styled line of color cords and cord sets.

The GIBSON Food Freezers are products of The Gibson Refrigerator Company, Greenville, Mich. Ask For Your Copy of The New PHALO Catalog

**PHALO PLASTICS CORPORATION**  
 25-1 FOSTER STREET, WORCESTER, MASSACHUSETTS  
 Southern Plant: Monticello, Miss.

**Insulated Wire and Cables — Cord Set Assemblies**  
 CIRCLE ED-183 ON READER-SERVICE CARD FOR MORE INFORMATION

## Get This Informative Free Booklet on New Uses for Straits Tin

New, 20-page booklet tells important story of Straits Tin and its many new uses today. Fully illustrated. Includes sections on new tin alloys, new tin solders, new tin chemicals. Covers tin resources and supply, Malayan mining. Booklet is factual, informative—could well prove profitable to you. Mail coupon now.

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CIRCLE ED-184 ON READER-SERVICE CARD FOR MORE INFORMATION

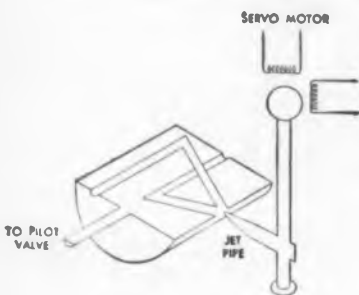


# KEARFOTT-ASKANIA ELECTRO JET



*accurately*  
*positions heavy duty equipment*  
*by means of*  
*minute electrical signals*

This Electro-Hydraulic Servo System is ideally suited for industrial controls to maintain flows, ratios, levels, pressures, speeds and for machine tool positioning. It is a 5¼" cube self-contained unit and weighs but 12 pounds.



The Kearfott Electro Jet utilizes the Askania jet pipe principle, characterized by high frequency response, rugged construction and highly accurate shaft positioning. Rated output is 200 inch pounds torque through  $\pm 60$  degrees. Maximum torque rating is 333 inch pounds. Frequency response is flat (within 3 db) up to 25 cycles. Resolution of the output piston positions is one part in 500 or better.

Write today for full information about the Kearfott Electro Jet. It may help in the solution of your control problem.

#### KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Send for Bulletin giving data of components of interest to you.



#### KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.

Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas

West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

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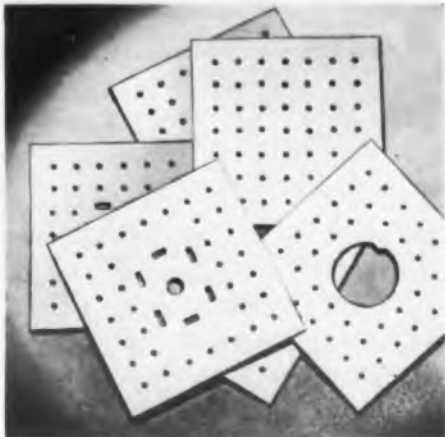
CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION



# New Products . . .

## Printed-Wiring Boards

With Pre-Punched Holes



To avoid the need for special tooling for punching the necessary holes in a printed-wiring board, designers can utilize pre-punched standard boards known as "Quad-Kards". Furnished in standard 2" square segments with or

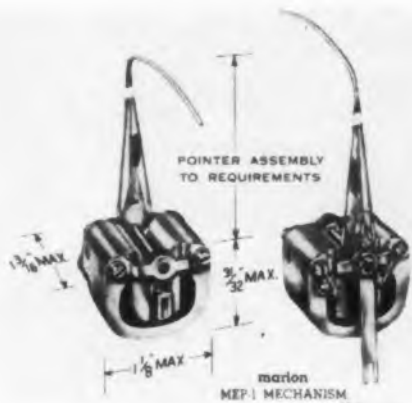
without conductors printed to specification, Quad-Kards have standard hole punchings for tube sockets, transformers, and capacitors, plus a grid pattern of 0.050" diam holes on 1/4" centers for conductors.

These boards may be abutted, angled, or stacked during incorporation into finished assemblies. Methode Manufacturing Corp., Dept. ED, 2021 W. Churchill St., Chicago 47, Ill.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

## Meter Mechanism

With Gyro-Like Stability



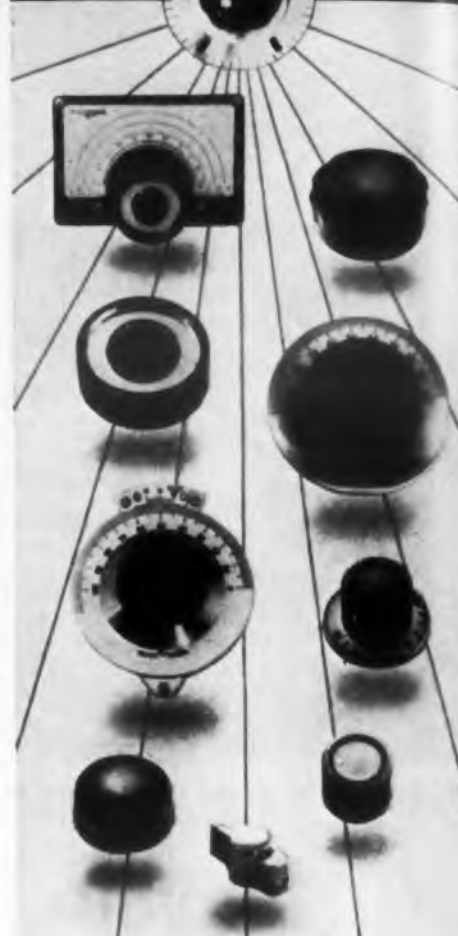
The mechanical design of this meter mechanism provides performance stability typical of that of a gyro. It is especially applicable in aircraft instruments and similar applications where the effects of vibration

and rapid attitude changes must be considered.

Designed to develop maximum torque for a given volume of magnetic material, the mechanism employs an end-pivoted coil assembly with a one-piece bearing shaft and precise mechanical assembly that operates in a self-shielded magnet structure. This construction produces approximately 6000 gauss in a single air gap. Operation of the moving coil, of long turning radius, in a magnetic field of such strength, achieves gains in torque and eddy current damping.

Performance characteristics of the new mechanism also suggest application as the sensitive element in control devices where it is required to initiate a control function. Marion Electrical Instrument Co., Dept. ED, 400 Canal St., Manchester, N. H.

CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION



## POPULAR DIALS AND KNOBS

For years, NATIONAL dials and knobs have been the popular choice of amateurs, experimenters, and commercial users.

NATIONAL dials feature smooth, velvety action, easily-read scales and quality construction. Many dials, like the N and ACN dials shown, can be specially calibrated or supplied with blank scales for commercial applications.

NATIONAL knobs — distinguished by their clean, functional, chrome and plastic styling and sturdy construction — are the most popular of their type ever produced. All fit 1/8" shafts. For commercial applications, they can be supplied in special colors and with special calibrations.

Write for new NATIONAL catalog of dials and knobs to Dept. ED-954



NATIONAL COMPANY, INC.  
61 SHERMAN ST.  
MALDEN 48, MASS.

CIRCLE ED-188 ON READER-SERVICE CARD

## TV-Receiver Tubes

### For "Series-String" Circuits

Twenty-six vacuum tube types designed for "series-string" operation in TV receivers feature a common heater current of 600ma at a variety of heater voltages ranging from 2.35v to 25v. The tubes, with their prototype with the same electrical characteristics given in parentheses, are as follows: 2AF4 (6AF4), 3AL5 (6AL5), 3AU6 (6AU6), 3BC5 (6BC5), 3BE6 (6BE6), 3CB6 (6CB6), 4BQ7A (6BQ7A), 4BZ7 (6BZ7), 5AN8 (6AN8), 5AS8 (6AS8), 5T8 (6T8), 5U8 (6U8), 6AU7 (12AU7), 6AX7 (12AX7), 6S4A (6S4), 6SN7GTB (6SN7GTA), 12AX4GTA (12AX4GT), 12B4A (12B4), 12BQ6GT (6BQ6GT), 12BH7A (12BH7), 12L6GT (25L6GT), 12BY7A (12BY7), 12W6GT (6W6GT), 19AU4 (6AU4GT), and 25CD6GA (25CD6G). Tung-Sol Electric, Inc., Dept. ED, Newark 4, N. J.

CIRCLE ED-189 ON READER-SERVICE CARD

## Name Plate

### Flexible Yet Tough

Designed for use as a name plate, a laminated plastic called "Gravoflex" is flexible yet scratch-proof, weather-proof, and stain-proof. It can be bent by hand to any shape. Being a sandwich material, it is easily engraved with any pantograph machine. Lettering cut through the top layer will stand out permanently on a contrasting background.

The material can also be stamped or embossed. It can be cut with an ordinary scissor, paper cutter, or metal shears. Edges will not chip, and they do not require bevelling. It can be nailed without pre-drilling, and can also be stitched or stapled. Gravoflex is available in sheets, strips, or cut name plates in various thicknesses. The colors are black surface with white core, or white surface with a red core. Hermes Plastics, Inc., Dept. ED, 13-19 University Pl., New York 3, N. Y.

CIRCLE ED-190 ON READER-SERVICE CARD

CIRCLE ED-191 ON READER-SERVICE CARD >

# Spotlight

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AVAILABLE IN A  
WIDE RANGE OF  
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ECONOMICALLY MEET  
SPECIAL REQUIREMENTS!

*Economical E-I standardized hermetically-sealed terminals and miniature closures are available to meet almost any electronic application. Samples and recommendations on your particular needs will be supplied promptly on receipt of your data. Call or write for complete E-I catalogs, today!*



High Standardization



# hermetically-sealed terminations and miniature closures\*

● **MULTIPLE HEADERS** — Strain-free, modular high headers featuring cushioned glass construction. Silicons treated for maximum dielectric strength and tin dipped for easy soldering.

● **SEALED TERMINALS** — These E-I terminals offer high thermal shock resistance and feature cushioned glass construction. Available in many economical preferred types and special designs.

● **OCTAL HEADERS** — Both plug-in and multiple types feature a new principle of hermetic sealing. Solid metal blanks afford maximum rigidity and mechanical strength.

● **E-I END SEALS** — Completely strain-free. Provide a permanent hermetic seal. For condensers, resistors and other tubular-type components. Available in many standard types.

● **COMPRESSION TYPE HEADERS** — Super rugged, practically indestructible and absolutely rigid. Exclusive E-I process affords increased resistance to shock and vibration.

● **LUG-TYPE, LEAD-THRU INSULATORS** — Compression sealed, super rugged. For applications requiring voltage ratings from 2000 to 4000 (rms.) — transformers, "bath-tub" condensers, etc.

● **MINIATURE CLOSURES** — For transistors and other components requiring hermetic sealing. Square, rectangular and round cases. Supplied in E-I standard types or custom designs to specifications.

● **COLOR-CODED TERMINALS** — Featuring glass inserts with permanent coloring in the glass. All types offered in standard, easily-identified RMA color codes.



**ELECTRICAL INDUSTRIES**

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DIVISION OF AMPEREX ELECTRONIC CORP.



## New Products...

### Piezoelectric Ceramic Formed Into Any Shape

Designated "Ceramelex", this polycrystalline barium titanate ceramic performs in much the same manner as the natural piezoelectric crystals. It can be formed and polarized in any shape.

Polarized discs of this material have a very high coupling coefficient and are low-impedance devices because of their high dielectric constant. A "Ceramelex" Kit is available to design engineers. It contains 17 discs and cylinders of various sizes, with and without metal contacts, a research paper on the properties of the ceramic, and application notes. Erie Resistor Corp., Dept. ED, Erie, Pa.

CIRCLE ED-193 ON READER-SERVICE CARD

### Insulating Compound Protects Tool Handles

Featuring a dielectric strength per coating of 1200 to 1500v, "E-33", a dipping compound, is easily applied to tool handles. Available in either red or black, the compound can be used in the laboratory to coat electrical tools such as screwdrivers and pliers. The compound is chemically inert and is not affected by oils, greases, or ordinary acids or alkalis. Insl-X Sales Co., Dept. ED, 26 Rittenhouse Sq., Ardmore, Pa.

CIRCLE ED-194 ON READER-SERVICE CARD

### Random Noise Generators Noise Output is 15.8db

Additions to this firm's line of "Microwave Mega-Node" random noise generators employ new gas tubes. These tubes have approximately zero temperature coefficient and are independent of operating temperatures. Units with frequency ranges from 1200Mc to 26,500Mc are available. Accuracy is  $\pm 0.25$ db. Noise output is 15.8db. Kay Electric Co., Dept. ED, 14 Maple Ave., Pin Brook, N. J.

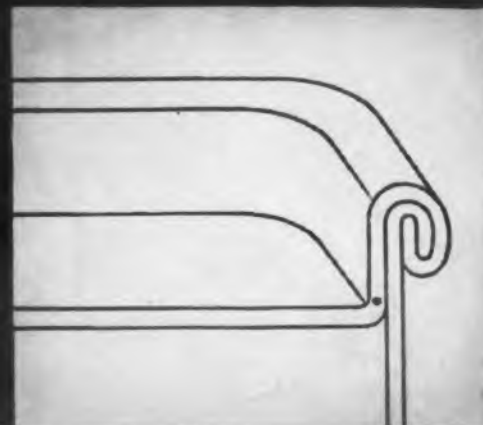
CIRCLE ED-195 ON READER-SERVICE CARD

CIRCLE ED-196 ON READER-SERVICE CARD ➤

# General Electric announces another

### OTHER G-E CAPACITOR FIRSTS

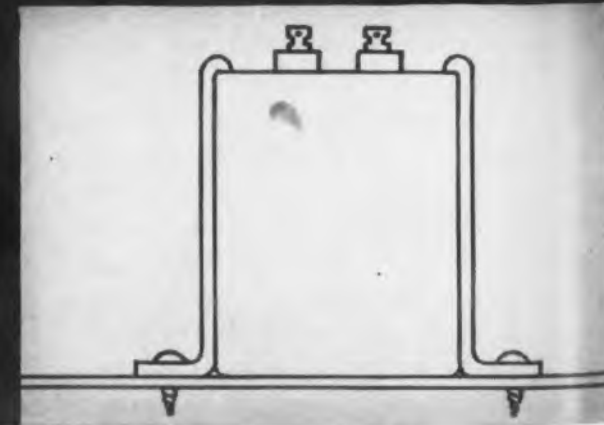
- ★Thin kraft-paper dielectric
- ★Pyranol\* liquid impregnant
- ★Drawn-oval capacitors with double-rolled seams
- ★Silicone bushings with stud-welded construction
- ★Permafil solid impregnant



SOLDERLESS DOUBLE-ROLLED COVER SEAM makes a mechanically strong, hermetic seal that remains leakproof.



DRAWN-RECTANGULAR CASE has no soldered seams . . . does not depend on solder for mechanical strength and effective sealing.



UPRIGHT OR INVERTED MOUNTING is possible, using footed brackets (above). Bottom of case is indented for inverted mounting.

# FIRST to the electronics industry

## NEW DRAWN-RECTANGULAR CAPACITORS

- ★ Solderless, double-rolled cover seam
- ★ Seamless case with standard dimensions

To answer the needs of the electronics industry, General Electric's capacitor engineers have developed a fixed paper-dielectric capacitor in a seamless, solderless case with standard dimensions. Because these new capacitors are the same sizes and have the same mounting dimensions as fabricated units, they can be applied to existing electronic equipment without changing component layouts.

**Drawn construction** offers the user important advantages. The seamless case is virtually leakproof. There is no dependence on solder for mechanical strength and effective sealing. The double-rolled seam between case and cover further assures a true hermetic seal.

**G-E Drawn-rectangular capacitors** can be supplied with suitable bushings for a wide range of voltage ratings or special applications. The new units comply with or exceed MIL specifications.

**Proof of the dependability** of the rugged construction of these new drawn-rectangular capacitors can be found in another General Electric pioneered development, the drawn-oval capacitor, of which there are more than 55 million being used in electrical and electronic equipment today.

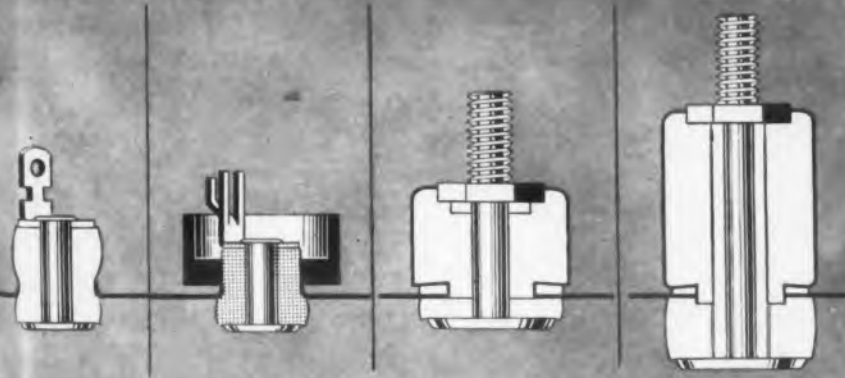
For further information contact your nearest G-E Apparatus Sales Office.  
*General Electric Company, Schenectady 5, New York.*

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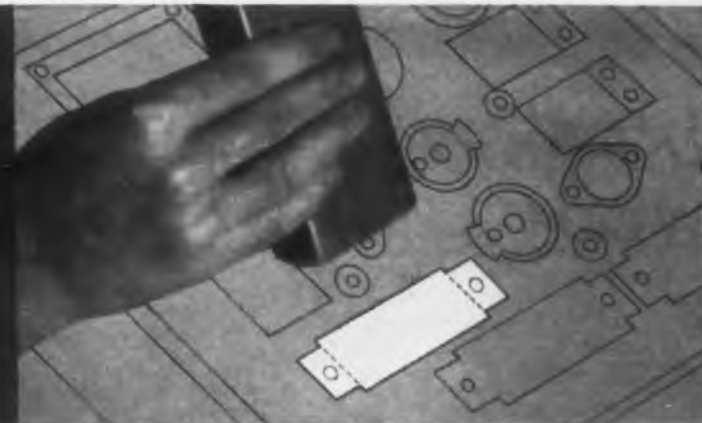
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GENERAL  ELECTRIC



FOUR BUSHING STYLES can be furnished, depending on rating and application requirements. All bushings are designed to provide a liquid-tight seal along with generous air-strike and creepage distance.



STANDARD CASE SIZES of G-E Drawn-rectangular capacitors are interchangeable with existing fabricated styles. This makes it unnecessary to change drawings or circuit layouts.

### Computing Service

#### Formulates and Solves Problems

A group of highly trained mathematicians offers a service featuring the mathematical formulation and complete solution of a problem from given physical data. Charts and nomographs of a high degree of complexity for the solution of electronic design problems can be prepared. Problems can be submitted for an estimate. Mathematical Computing Service, Dept. ED, 105 Court St., Brooklyn 2, N. Y.

CIRCLE ED-197 ON READER-SERVICE CARD

### Power Transistor

#### Collector Dissipates 500mw

The Type HD-197 p-n-p germanium junction transistor is capable of 500mw collector dissipation without the use of a heat sink. Suitable for switching circuits, class B circuits, and servomechanisms, the unit has a base-to-collector current gain of 10.

Power gain, measured in a grounded-emitter circuit with an input impedance of 100 ohms and a load impedance of 5000 ohms, is 30db. Cutoff frequency is 150kc. Maximum operating temperature is 55°C. CBS-Hytron, Div., Columbia Broadcasting System, Dept. ED, Danvers, Mass.

CIRCLE ED-198 ON READER-SERVICE CARD

### Cement

#### Has High Strength

Applied with moderate heat and little or no pressure, "Tygoweld", an organic cement, makes metal-to-glass, metal-to-porcelain, and metal-to-metal bonds that surpass high peel and shear tests. The bonds have been subjected to tensile strength tests where over 4000 lb/sq-in has been applied to standard lap shear specimens.

The following materials can be successfully bonded to themselves or to each other: aluminum, cast iron, copper, magnesium, sintered metals, ceramics, fiberglass, thermosetting plastics, wood, and nylon. It is furnished in rod, paste, or powder form with special colors and filleting characteristics available. U. S. Stoneware Co., Dept. ED, Akron 9, Ohio.

CIRCLE ED-199 ON READER-SERVICE CARD

◀ CIRCLE ED-196 ON READER-SERVICE CARD



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## New Products...

### Rubber Coating Vulcanizes Without Heat

Applied like paint by brush, spray, or dipping, "Rub-R-ize" is a liquid natural rubber that vulcanizes at normal temperatures into a flexible protective coating resistant to both heat and cold. It has the same insulation qualities as natural rubber.

The coating can be used to impregnate printed-circuit boards, insulate high-voltage cages, chassis, and antennas, protect components against humidity, and be used on phonograph turntables instead of flock. In the laboratory it can be used to repair frayed line cords, insulate tool handles, insulate the edges of work benches against grounding, and to coat leads instead of spaghetti. It can also be used as a sound absorbant material in bass reflex cabinets. Rubber Magic, Inc., Dept. ED, 4312 Third Ave., Brooklyn 32, N. Y.

CIRCLE ED-201 ON READER-SERVICE CARD

### Photosensitive Metal Sheets For Nameplates and Dial Faces

Photosensitive, anodized-aluminum sheets known as "Metalphoto" are designed for photographic reproduction by standard darkroom methods. The sheets can be used for nameplates, dial faces, wiring diagrams, instructions, instrument and sliderule scales, and other products where resistance to abrasion is vital.

Photographs and drawings are processed from ordinary photographic negatives. The image or written matter is sealed behind the hard, anodized layer. This layer protects the dimensionally stable image from abrasion, temperatures up to 1000°F, as well as acids, salts, and organic solvents.

The sheets, which measure 0.020" in thickness, are furnished in 4" x 5", 8" x 10", and 10" x 12" sizes. The sheets may be colored with the proper dyes. Metalphoto Corp., 2903 East 79th St., Cleveland 3, Ohio.

CIRCLE ED-202 ON READER-SERVICE CARD

← CIRCLE ED-200 ON READER-SERVICE CARD



# Stop Corrosion with

## RHODIUM PLATING

New uses for Rhodium Plating are constantly being found by electronic design engineers where hard, corrosion resistant electrical contact surfaces are required.

**RHODIUM PLATE** offers these advantages:

- assures low and stable contact resistance
- allows higher pressures to be used in sliding contacts
- not affected by atmospheric changes
- oxide-free contacts eliminate partial rectification and unwanted signals
- provides low noise level for moving contacts
- extremely long-wearing

These properties are particularly well-suited to electrical and electronic applications. RHODIUM plate affords excellent protection against atmospheric corrosion for printed circuits and permits incorporation of sliding contacts as part of the circuit.

Write for free, detailed booklet on RHODIUM PLATING.

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& COMPANY INC. **PRECIOUS METALS**

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CIRCLE ED-203 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLIFY CIRCUIT TRIMMING with

**BOURNS sub-miniature TRIMPOTS**

- Resolution: As low as 0.25%
- Power Rating: 0.25 watt at 100° F.
- Weight: Only 0.1 oz.

One of many applications when space is at a premium

BOURNS **TRIMPOT** is a 25 turn, fully adjustable wire-wound potentiometer, designed and manufactured exclusively by BOURNS LABORATORIES. This rugged, precision instrument, developed expressly for trimming or balancing electrical circuits in miniaturized equipment, is accepted as a standard component by aircraft and missile manufacturers and major industrial organizations.

Accurate electrical adjustments are easily made by turning the exposed slotted shaft with a screw driver. Self-locking feature of the shaft eliminates awkward lock-nuts. Electrical settings are securely maintained during vibration of 20 G's up to 2,000 cps or sustained acceleration of 100 G's. BOURNS **TRIMPOTS** may be mounted individually or in stacked assemblies with two standard screws through the body eyelets. Immediate delivery is available in standard resistance values from 10 ohms to 20,000 ohms. BOURNS **TRIMPOTS** can also be furnished with various modifications including dual outputs, special resistances and extended shafts.

BOURNS also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.

**BOURNS LABORATORIES**

6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA

© B. L. PATENTS PENDING

Technical Bulletin On Request, Dept. 232

CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1954

## D-C Solenoids Miniature Types



Type 20288 and 20287 solenoids are designed for applications requiring d-c solenoids considerably smaller

than standard types. The former has a coil enclosed in a steel cylinder and the latter an open coil. They may be used for the operation of keyboards, light springs, control board signal flags, etc.

They measure 3/4" diam x about 1-1/2" length. Either may be wound for a wide range of d-c voltages. Their weights are 0.122 and 0.141 lb, respectively. The nylon bobbin is used as a bearing surface, thus providing self-lubrication as well as excellent insulation. Armatures are of high-grade soft iron.

An example of pull characteristics is the 24v, 13amp type which is operated on intermittent duty, 5sec max on time at 20°C ambient to pull 25 oz for a 3/4" stroke. Cannon Electric Co., Dept. ED, 418 West Ave. 33, Los Angeles 31, Calif.

CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

## Tracing Carbon Paper For Reproducing Drawings

Greater line opacity for engineering drawings, necessary for Bruning, Ozalid and similar process reproduction, is gained by use of this single-use tracing carbon paper. Yellow on one side and black on the other, it also produces a duplicate copy in black. Columbia Ribbon & Carbon Manufacturing Co., Dept. ED, Glen Cove, N. Y.

CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

## Marker Generator For All U-H-F TV Channels



The "Ultra-Marker" is an u-h-f marker generator with crystal controlled narrow-pip-type markers at picture and sound carrier frequencies of all u-h-f channels.

By switching means, crystal controlled narrow-pip-type markers are provided on every fourth u-h-f channel starting with Channel 15.

Maximum frequency error is 200kc, and mean percentage of error is 0.03% (percentage of error at center of band is 0.007%). Picture and sound carrier spacing is 4.5Mc ± 0.01%. Input requirement is 10mv across 70 ohms from any sweeping oscillator covering the frequency range. Kay Electric Co., Dept. ED, 14 Maple Ave., Pine Brook, N. J.

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION



- ① Glass-hermetically sealed sub-miniature paper tubular. Manufactured to the highest commercial standards and engineered to the exacting performance requirements of Military Specification MIL-C-25-A.
- ② Oil paper capacitors of finest possible commercial quality, meeting MIL-C-25A and Jan-C-25 standards of precision.
- ③ Electrolytics of superior commercial performance characteristics, meeting Jan-C-62.

Write for Catalog J-8 for further detailed information. Or call your local Pyramid Sales Representative or write to:

**PYRAMID ELECTRIC COMPANY**  
Dept. 123, 1445 North Hudson Blvd., North Bergen, New Jersey

CIRCLE ED-207 ON READER-SERVICE CARD FOR MORE INFORMATION

# MICROWAVE SIGNAL GENERATORS

Complete coverage of the range 950-11,500 mcs/sec.

with Polarad single dial operation

Four new Microwave Signal Generators covering the range 950-11,500 mcs/sec. All with famous Polarad single dial operation. Each provides the maximum working range possible in one compact signal generator.

These features assure fast and simple operation: direct reading, single dial frequency control that tracks reflector voltages automatically . . . direct reading attenuator dial . . . complete internal pulse and FM modulation as well as provisions for external modulation . . . conveniently placed controls, in logical sequence . . . high visibility on the face of each instrument.

Practical for laboratory or factory assembly line. Engineered ventilation assures continuous and stable operation. Additional Polarad Microwave Signal Generators are available to cover 12.8 to 39.7 kmc.

Write directly to Polarad or your nearest Polarad representative for details.



MSG-1, 950-2400 mc

MSG-2, 2150-4600 mc

MSG-3, 4450-8000 mc

MSG-4A, 7000-11,500 mc

PROVEN RELIABILITY  
**Polarad**

"The finest Signal Generators of their kind"

**ELECTRONICS CORPORATION**

100 METROPOLITAN AVENUE, BROOKLYN 11, NEW YORK

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

# FAST...economical assembly of motors, gear trains, electro-mechanical computing and transmission devices with **mechanical development apparatus**

Servomechanisms, Inc., versatile Mechanical Development Apparatus is intended for numerous applications in the research, instrumentation, and servo control fields. Typical applications of these precision built components include analog computers, signal generators, process programmers ... Assembly is made with standard tools ... each component is designed for repeated use.

A typical development assembly including servo motors and synchros.



**SERVOMECHANISMS**  
INC.  
PACKAGED FUNCTIONAL COMPONENTS

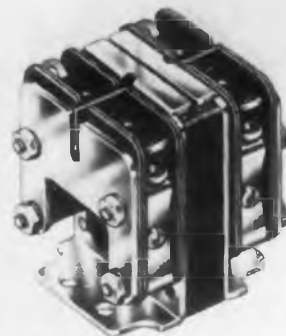
Components Division, 625 Main Street, Westbury, N. Y.

West Coast Division, 316 Washington Street, El Segundo, California

CIRCLE ED-209 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products ...

### Heavy Duty Relay Meets MIL-R-5757B Spec.

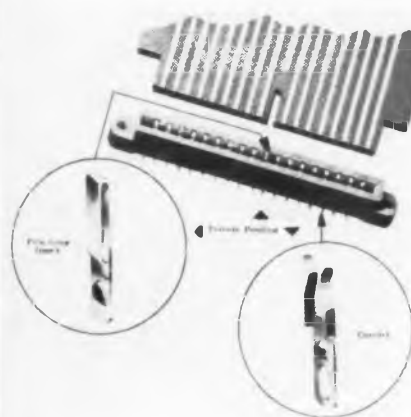


Designed to meet industrial requirements and comply with Specification MIL-R-5757B, the type RP 2pdt relay features a novel contact construction of high current carrying capacity. This construction and its linkage with the actuating mechanism make possible elimination of the usual flexible leads to the movable contacts.

The magnetic circuit is thoroughly laminated to reduce eddy current losses. The magnet winding is imbedded in a moisture-proof compound giving excellent resistance to ground. The electromagnet can be modified to operate the relay for up to 250v a-c or d-c interrupting a resistive load of 25amp 30v d-c or 110v a-c. At rated load the minimum life expectancy is 1,000,000 operations. The relay is available open or hermetically sealed. The Five Star Co., Inc., Dept. ED, West Main St., Plantsville, Conn.

CIRCLE ED-210 ON READER-SERVICE CARD FOR MORE INFORMATION

### Printed Card Receptacles Permit Easy Removal and Change



These printed card receptacles feature ease of removability and changeability by means of tongue pinching on contact. They have multi-wire connections to terminals, and afford dependable performance on repeated insertions over a range of card thickness from 0.061" to 0.071".

The contact or polarizing insert snaps into firm position on insertion into the molded body and is easily removed or its position changed by simply pinching the tongue and pushing out. Performance is assured by the high channel strength design of the contacts.

The insulating body is available in mineral-filled melamine, Alkyd 440 A, or Diallyl Phthalate. Contacts are spring phosphor bronze or beryllium copper, silver plated with gold flash. U.S. Components, Inc., Dept. ED, 454-462 East 148th St., New York 55, N. Y.

CIRCLE ED-211 ON READER-SERVICE CARD FOR MORE INFORMATION

## TOROIDS

a Torrid Topic?

SEE A  
**C-A-C**  
MAN



**UNCASED,  
CASED  
OR  
MOLDED  
PLASTIC**



### Stocked for RUSH DELIVERY

Since CAC introduced the first miniaturized line of toroids in 1948, it has maintained a policy of prompt service and high quality. Standard types of cased, uncased and molded plastic toroids are maintained for immediate delivery. By special order, any conceivable arrangement of closely coupled windings and multiplicity of taps may be supplied.

If toroids are a problem ...

### SEE YOUR CAC MAN

**NEW YORK**—Harold Gray Assoc.—LA. 4-4258  
286 Fifth Ave., New York, N. Y.  
**PHILADELPHIA**—Charles R. Hile Co.—Elgin 6-2266  
Hillview Rd., Bx. 144, Paoli, Pa.  
**BALTIMORE**—Charles R. Hile—Boulevard 1202J  
(L. G. Korman) 5006 Kenwood, Baltimore 6, Md.  
**CHICAGO**—Gassner & Clark Co.—Rogers Pk. 4-6121  
6349 N. Clark, Chicago, Ill.  
**KANSAS CITY**—E. W. McGrade Co.—Delmar 9242  
6315 Brookside Plaza, Kansas City, Mo.  
**LOS ANGELES**—Samuel O. Jewett—State 9-1214  
13537 Addison St., Sherman Oaks, Calif.  
**HAMBURG**—Cooper-Morgan, Inc.—Emerson 3405  
P. O. Bx. 152, Hamburg, N. Y.  
**SYRACUSE**—Naylor Electric Co.—2-3894  
State Tower Bldg., Room 317, Syracuse 2, N. Y.  
**MERIDEN**—Henry Lavin Assoc.—7-4555  
(Henry Lavin) P. O. Bx. 196, Meriden, Conn.  
**NEEDHAM**—Henry Lavin Assoc.—3-3446  
(Robt. V. Curtin) 82 Curve St., Needham, Mass.  
**CLEVELAND**—Ernie Kohler Assoc.—Olympic 1-1242  
8905 Lake Ave., Cleveland 2, Ohio

**COMMUNICATION ACCESSORIES CO.**  
Hickman Mills, Missouri

CIRCLE ED-212 ON READER-SERVICE CARD



**YOU CAN'T SHAKE  
'EM LOOSE!**



**BIRTCHER  
TUBE CLAMPS**



**BIRTCHER TYPE 22  
TUBE CLAMP**

*... will securely hold tubes throughout the entire range of JAN base tolerances.*

Even *unusual* jarring or vibration will not shake a tube loose when secured by a BIRTCHER CLAMP! Made of *stainless steel*, BIRTCHER CLAMPS are wear-and-weather resistant, made for all types of tubes: glass or metal—chassis or sub-chassis mounted.

*There's a Birtcher Clamp  
For Every Purpose*

CATALOG AND SAMPLES SENT BY  
RETURN MAIL

**Send this coupon today**

**The BIRTCHER CORPORATION**

4371 Valley Blvd  
Los Angeles 32, California

Dept. ED 9-4

Please send Bulletin which describes and illustrates Tube Clamps in detail.

Company.....  
Attention of.....  
City..... State.....

CIRCLE ED-213 ON READER-SERVICE CARD

**Power Supply**

**Provides 0.01% Regulation**



The Model 712B Power Supply is designed for heavy-duty laboratory or production work and is useful in powering temporary electronic circuitry, oscillators, small transmitters,

complex experiments, and many types of klystrons.

It provides 0.01% regulation for all conditions of load variation and power supply variation. In addition, it has extremely low internal impedance of 0.1 ohm in series with 25mh, a transient response of less than 1 millisecc, and a hum voltage of less than 500mv.

The unit has four output options including a 0 to 500v, 200ma regulated supply; a fixed -300 regulated supply which may be in series with the 500v supply providing a 50ma, 500v to 800v variable supply for klystron tube operation; a 6.3v, 10amp a-c unregulated supply; and a continuously variable regulated bias voltage from 0 to 150v. There is less than 50mv change in the regulated supplies from no load to full load and for ±10% line variation. Other features include separate voltage and current meters and generous overload protection. Hewlett-Packard Co., Dept. P-ED, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION

**Power Supply**

**For Use in Modular Systems**



The Model 2 Modular Power Supply is especially designed for use with this firm's Modular System of electronic units. It provides power to operate three or

more modular units, depending on those used. It aids in the quick assembly of special function devices and in the design and construction of electronic equipment. Modular units are mechanically locked together, interconnected by special patchcords, and the electronic function desired from each unit is selected by a multi-position switch.

The new power unit is only 15" long x 4-3/4" wide x 7-1/2" high, with a weight of 11 lb. It has an output of 80ma, +300 v d-c; 15ma, -150v d-c; and 8amp, 6.3v a-c. It is connected to units by standard Modular power plugs. Audio Products Corp., Dept. ED, 2265 Westwood Blvd., Los Angeles 64, Calif.

CIRCLE ED-215 ON READER SERVICE CARD FOR MORE INFORMATION

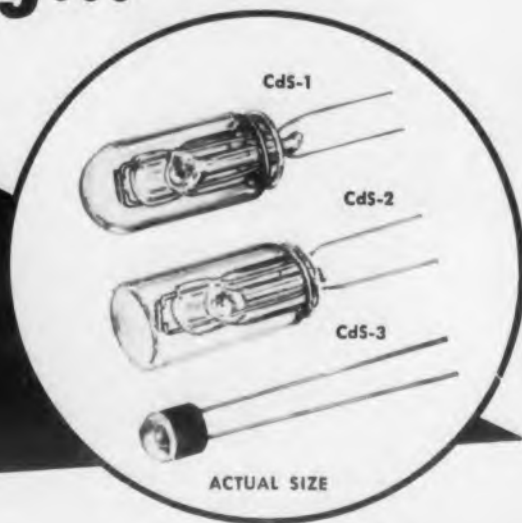


# Announcing...

STANDARD  
PIEZO

## CdS Crystal Photocells

(CADMIUM SULFIDE TYPES)



# FOR IMPORTANT COST SAVINGS ON PHOTOELECTRIC ASSEMBLIES!

- **NO AMPLIFICATION REQUIRED** in 4 out of 5 applications. Cell activates inexpensive sensitive relay directly.
- **FAST RESPONSE TIME** — 5 milliseconds. Better than most fast relays.
- **SENSITIVITY** per unit area comparable with conventional photo-multipliers.
- **LINEAR RESPONSE . . . TINY 2MM<sup>2</sup> SENSITIVE ELEMENT** means greater accuracy for delicate measuring devices.
- **SMALLER IN SIZE . . . FAR LOWER IN COST.**

STANDARD PIEZO COMPANY, Carlisle, Pa.



### ENGINEERING DATA

Write, wire, or 'phone today for Engineering Bulletin PC-10, giving complete details.

From counters, headlamp dimmers, burglar alarms, process control and inspection devices to sensitive photoelectric measuring devices, these new Standard Piezo CdS Crystal Photocells pave the way to drastic cost and size reductions—even to the point of making photoelectric automation feasible for many home and industrial uses where equipment costs have been prohibitive in the past.

Using a special cadmium sulfide sensitive element, these tiny photocells deliver from 1 to 2 milliamperes when illuminated with 50 to 100 foot-candles and with a bias of approximately 100 volts. Inexpensive sensitive relays and the smallest batteries or power supplies can readily be used.

Standard Piezo CdS Crystal Photocells are supplied in two hermetically-sealed glass types and one subminiature type measuring only  $\frac{1}{4}$ " in diameter by  $\frac{1}{4}$ " long including built-in lens. Still smaller styles with identical characteristics can be made to order.

# STANDARD PIEZO

Leaders in modern crystal development  
. . . for over 25 years.

CIRCLE ED-216 ON READER-SERVICE CARD FOR MORE INFORMATION



**NOW!** For knots that tie easier, faster, tighter—and **DO NOT SLIP!**



**FUNGUS-PROOF  
NYLON**

## Lacing Cords and Flat Braided Tapes

- Revolutionary synthetic resin coating prevents knots from slipping. Lacing actually tightens *itself* after knot is made.
- Greater strength means minimum breakage—minimum rejects.
- Special coating retains desirable malleability of wax and yet has a melting point of over 190°F. Non-toxic to humans
- Complies with ALL requirements of Gov. Spec Jan-T-713 and Jan-T-152.

*Also available with wax finish*

### FREE SAMPLES!

The Heminway & Bartlett Mfg. Co., ELECTRONICS DIV., 500 5th Ave., New York 36.  
Sales Offices: Chicago, Philadelphia, Boston, St. Louis, Cincinnati, Dallas, San Francisco, Los Angeles, Charlotte, N. C., Gloversville, N. Y., Lynchburg, Va  
Foreign Agent: Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE ED-232 ON READER-SERVICE CARD FOR MORE INFORMATION

**NEW**

**NEW**

**ADC's** new line  
of sub-miniature transformers and chokes

Hermetically sealed • Only  $\frac{3}{4} \times 1\frac{1}{16} \times 1\frac{3}{8}$  • Weight: approximately 1.8 oz. • Furnished with steel or mu-metal cases • Available in production quantities • Power level for voice range—without unbalanced DC, up to 3-5 watts, or for single tube output, up to 1 watt.

INPUT TRANSFORMERS	Catalog No.	Primary Impedance	Secondary Impedance	Primary Inductance ( $\pm 5\%$ at 10 mv 50 cps)
	220A	500 (125) ohms	to 150,000 ohms CT	8.5 hy.
OUTPUT TRANSFORMERS	320E† 320Y† 320Z‡	20,000 ohms CT 15,000 ohms CT 10,000 ohms (10 MA DC)	to 50/25/12½/6.25 ohms to 600 (150) ohms 2 watts to 600 (150) ohms ½ watt	( $\pm 5\%$ at 1v 50 cps) 1200 hy. 1 db—250—15,000 cps. 1 db—300—10,000 cps.
INDUCTORS	Catalog No. 420D	Inductance 1500 hy.	Percentage Taps 3—2%	Q at 0.1v 50 cps. 12

†Push Pull plates

‡Single plate

For complete information, write to:



**AUDIO DEVELOPMENT COMPANY**

2833 13th AVENUE SOUTH  
MINNEAPOLIS, MINNESOTA

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products...

### Relay For Crowded Chassis



This sensitive relay is designed primarily for use in electronic chassis which have sufficient height but little adjacent space.

The unit provides a hermetically sealed dpdt combination, and has a capacity up to 3amp inductive load. It is equipped with a standard octal socket. Wattage consumption is 0.1w and less, depending on the contact arrangement, or less than 1ma, depending on the voltage used. Coil resistances can be furnished up to 30,000 ohms. D-c relays have a drop-out approximately 80% of the pick-up. Hedin Tele-Technical Corp., Dept. ED, 640 W. Mt. Pleasant Ave., Livingston, N. J.

CIRCLE ED-234 ON READER-SERVICE CARD

### Varistor Unit

#### Eliminates Thermostat Arcing



Arcing, the main cause of contact failure in mercury-in-glass thermostats, can be eliminated by the use of the "Stat-Varistor". Normally, arcing occurs when

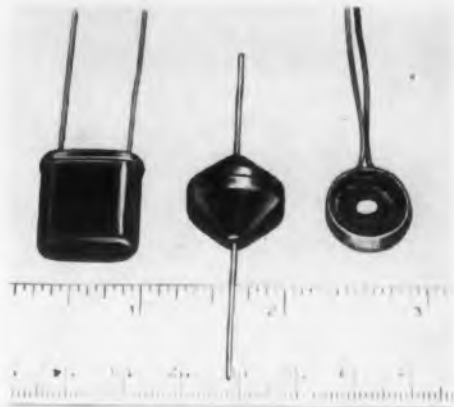
the thermostat circuit opens. At this moment the magnetic energy stored in the relay changes quickly to surging electrical energy that unloads through the unit.

All of this firm's thermostats can now be provided complete with the "Stat-Varistor". In addition, the device is available as a separate unit for use on existing installations or as a component for other new relays. Precision Thermometer & Instrument Co., Dept. ED, 1434 Brandywine St., Philadelphia 30, Pa.

CIRCLE ED-235 ON READER-SERVICE CARD

### Subminiature Toroids

#### Packaged for MIL-T-27



These subminiature toroids are available in three lines. They are designed for: use in the 1kc to 1Mc range, with Q's of 100-200, at a tolerance  $\pm 1\%$ , with high stability over the temperature range of  $-55^\circ$  to  $+85^\circ\text{C}$ , and inductances from  $4\mu\text{h}$  to 1h.

The QL050 Series are wax impregnated with flexible high temperature leads. Size:  $5/8"$  OD x  $1/8"$  ID x  $9/32"$  high.

MP050 Series are molded plastic units with axial wire leads suitable for point-to-point wiring, or terminal board mounting.

The HS050 Series are hermetically sealed metal cans with wire leads. They can be wired in subminiature sockets or soldered to printed circuit boards. They will withstand tests of MIL-2-27, Class A, Grade 1. Case dimensions:  $5/16"$  x  $11/16"$  x  $49/64"$  high. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

CIRCLE ED-236 ON READER-SERVICE CARD

### Thermal Time Delay Relay

#### In Variety of Ratings



"Snapper" thermal relays feature "snap action" of contacts in an inert gas-filled atmosphere. Units are spdt and are available in 7- or 9-pin miniature or octal metal envelopes.

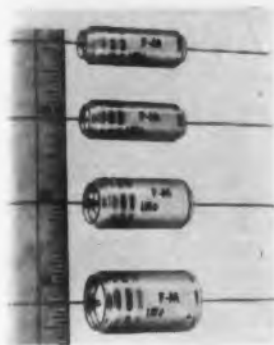
Designed for ambient temperature operation ranges of  $-60^\circ$  to  $+80^\circ\text{C}$ , the relays operate on 6.3v, 26.5v, 115v, a-c or d-c, or as required. Time delay is from 2sec and up. The units withstand vibration of 30g at frequencies of 5 to 55cy. Elly Electronics Corp., Dept. ED, P.O. Box No. 395, Fairlawn, N. J.

CIRCLE ED-237 ON READER-SERVICE CARD



## Hermetically Sealed Coils

### From Stock or Custom-made



This series of hermetically sealed coils for electronic applications is offered in a wide range of electrical and mechanical characteristics. Features include: hermetic sealing to provide absolute protection

against the effects of moisture; true glass-to-metal sealing technique; an insulated metal case; and specifications exceeding the most rigid requirements.

One typical unit has an inductance of 20mh, current rating of 120ma, and dimensions of 0.735" diam x 1-1/16" long. Another coil has an inductance of 4.7 $\mu$ h, current rating of 600ma, and dimensions of 0.450" diam x 1-1/16" long. In addition to a standard line, hermetically-sealed coils can be produced in types and sizes to customer specifications. Fugle-Miller Laboratories, Dept. ED, 398 Main St., Metuchen, N. J.

CIRCLE ED-238 ON READER-SERVICE CARD

## Resistors

### High Reliability Sub-miniatures



Subminiature Type J Precision Wire-Wound Resistors, designed for top reliability and performance in spite of small dimensions, employ an improved method of terminating the winding to the wire leads.

Type JA is 1/4" diam x 1/4" long. Maximum resistance is 125,000 ohms. Military power rating is 0.1w. Type JG is 1/4" diam x 3/8" long. Maximum resistance is 250,000 ohms. Power rating is 0.15w. Tolerance of 1% is standard, with 0.05% also available.

The resistors have a mounting hole for a No. 2 machine screw. Leads are of heavily tinned copper wire. All resistors are furnished with low temperature coefficient alloys unless otherwise specified. Special wire and impregnation is available for increased power rating. Resistance Products Co., Dept. ED, 714 Race St., Harrisburg, Pa.

CIRCLE ED-240 ON READER-SERVICE CARD

## Variable Time Delay

### Used at Audio Frequencies



The "Echo-Vox" is designed to provide a wide and continuously variable time delay at audio frequencies. One application is for the proper phasing of speakers in large areas where objectionable echoes exist.

Specifications are: frequency response, 40cy to 12,000cy; flutter, less than 0.3%; harmonic distortion, 2% maximum; intermodulation distortion, 5% maximum; input impedance, 600 ohms; output impedance, choice of 600 ohms, 8 ohms, and 3.4 ohms; output power, 25w max. for speaker drive.

Single echo time delay is continuously variable from 100-500 millisecc. There is an adjustable feedback for multiple reverberation. Power input is 115v 60cy, 160w. Dimensions of the carrying case are 9-1/4" x 15" x 20". Weight is 54lbs. Kay Electric Co., Dept. ED, Pine Brook, N. J.

CIRCLE ED-241 ON READER-SERVICE CARD

## Toroid Coils

### Provide Adjustable Inductance



Adjustable toroid coils which provide a simple method for varying inductance are announced by the company. Coils are factory adjusted to within  $\pm 5\%$  of nominal inductance values and are

economically priced due to the elimination of critical adjustment and impregnation.

Especially useful in resonant L-C circuits, these units are available with maximum Q factors from 120 to 200. Sizes range from 1" OD x 3/8" to 2-1/4" OD x 1". Hycor Sales Co. of Calif., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.

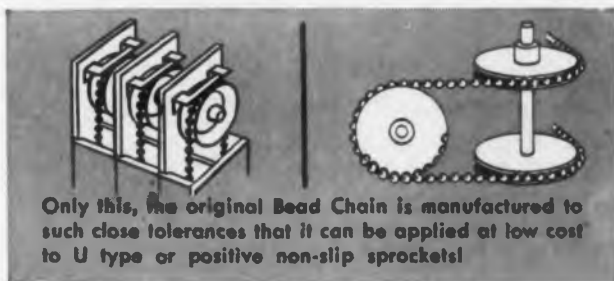
CIRCLE ED-242 ON READER-SERVICE CARD

FOR POSITIVE, LOW-COST  
**SPROCKET DRIVES...**

it will pay you to use genuine  
**Bead Chain**



Only the manufacturer of *genuine* Bead Chain offers you a new, more versatile belt drive that will accurately time and control the movement of all types of devices. Among such applications are radio and television tuners, recorders, air conditioners and timing devices. Costly gearing mechanisms can be eliminated and efficiently replaced by the specially designed sprockets that accurately fit the individual beads *without slippage and backlash*. Friction is at a minimum and tensile strength of the Bead Chain belt (from 15 to 200 lbs.) is very high in proportion to size and weight.



Only this, the original Bead Chain is manufactured to such close tolerances that it can be applied at low cost to U type or positive non-slip sprockets!

**B**

Write to us today for detailed information about sprockets and Bead Chain belts. It can save you a lot of time and money later.

**THE BEAD CHAIN MANUFACTURING CO.**  
 92 Mountain Grove St., Bridgeport, Conn.

Please send me information about  
 Bead Chain sprocket drives.

NAME.....

TITLE.....

ADDRESS.....



THE BEAD CHAIN MANUFACTURING CO., Bridgeport 5, Conn.  
 original and world's largest producers of bead chain

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION



"J.B. bothers less with details since he started using TEFLON\* made by ETHYLENE "

\* DuPont trade name for tetrafluoroethylene resin\*\*

This amazing material is chemically inert, has excellent dielectric properties, resists heat and cold, is nonadhesive, and possesses great flexural strength. We make it in a great variety of sizes, of the finest quality, and for quick shipment. May our experts help you?

Write for Catalog E54

\*\* Converted by Ethylene into the best basic forms in the world, undoubtedly.\*\*\*



EXTRUDED OR MOLDED RODS, TUBES, AND SPECIAL SHAPES. NON-POROUS SHEETS

\*\*\* We think.

"Pioneers and Specialists in TEFLON products"

**ETHYLENE CHEMICAL CORPORATION**

245 Broad St. • Summit, New Jersey

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION

## New Products . . .

### D-C Power Supplies Magnetic Amplifier Controlled



These magnetic-amplifier-controlled d-c power supplies contain neither moving parts nor tubes, and require no warm-up time. They are constructed to withstand rough operating conditions and their life is rated in terms of years of maintenance-free operation. They have been successfully used in various applications, such as servomechanisms, bias supplies, reference supplies, filament power supplies, battery chargers, computer power supplies, and heavy-duty regulated sources of d-c power.

Typical specifications include: voltage regulation,  $\pm 1\%$  from no-load to full load for  $\pm 10\%$  change in line voltage; response time, 0.2sec or less; ripple voltage, 1% rms of nominal d-c output voltage; controls, one variable potentiometer for d-c output voltage range adjustment; line voltage, 115v, single-phase, 208/230/440v, three phase; d-c output voltage range, 28.5v nominal, 22-30v d-c; d-c output currents available, 5, 10, 50, 100, 200, 500amps. Mag-Electric Products, Inc., Dept. ED, 12822 Yukon Ave., Hawthorne, Calif.

CIRCLE ED-219 ON READER SERVICE CARD FOR MORE INFORMATION

### Power Relays Miniature D-C Units



Series 4B Power Relays are miniature d-c power contactors with high current contacts. They are small in size (1-23/32" length) and light in weight (3 oz. approx.), with the added feature of having the capacity to handle large currents through the contacts.

The relay's large coil capacity permits high-contact pressure and large contact gap with minimum power consumption in the coil. Operating voltage is up to 200v d-c. Maximum coil resistance is 16,000 ohms. The relays are available single or double wound.

The contact assembly is rated 20amps, 125v, continuous; 60amps, 280v inrush. Standard contacts are 1/4" silver contacts. Other contacts are available for special applications. The design is double make only. Phillips Control Corp., Dept. ED, 84 W. Jefferson St., Joliet, Ill.

CIRCLE ED-220 ON READER-SERVICE CARD FOR MORE INFORMATION



When a measured delay is required in sequencing an electronic control system, Tarrytron thermal time delay offers a practical and economical solution.

Qualified to MIL-R-6106 by Inland Testing Laboratories and thoroughly flight tested by practically everything that flies, Tarrytron provides a reliable, small, light weight, hermetically sealed timer.

It weighs 4 1/2 ounces and measures 2 1/16" x 1 5/8" x 1 13/32" displacing only 4.75 cubic inches. Time Delay Range settings range from 1/2 to 120 seconds and can be calibrated to 28 volts DC or 115 Volts AC.

We invite your inquiry.

**Cook Electric Company**

Established 1897

2700 Southport, Chicago 14, Illinois

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CIRCLE ED-221 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 1954



# New Literature . . .

## Microwave Test Equipment 223

This firm's first catalog covers its full line of precision microwave test equipment, which includes all the required units and components for operation in the microwave region. The company also has a custom engineered and built line of antenna pattern analyzers, high power pulse modulators, and waveguide components for test and production applications. The catalog is well illustrated and firmly bound in multi-ring leatherette binders. Electronics and X-Ray Div., F-R Machine Works, Inc., 44-14 Astoria Blvd., Long Island City 3, N. Y.

## Improved Tube 224

An 8-page booklet (No. ETD-881) describes the new *GL-2C39-BB* metal and ceramic "Lighthouse" tube, an improved version of a similar metal and glass tube. The new high-mu triode is designed for use in v-h-f—u-h-f circuits as a grounded-grid class C power amplifier, oscillator, or frequency-multiplier, at frequencies up to 2500Mc. Technical data and typical operating conditions are included. General Electric Tube Dept., Schenectady 5, N. Y.

## Metal Stampings 225

"Trims, Panels and Escutcheons" is the title of a 4-page booklet that illustrates the use of decorated metal stampings as functional component parts. It shows many examples of modern planning that reduce original tool costs by using stock dies in numerous cases. Samples shown cover a wide range of end product uses which vary from locomotives to table model radios. Piece size variation is from less than 1 sq" to a stove panel 37" x 8" wide. American Name Plate & Mfg. Co., 4254 West Arlington St., Chicago 24, Ill.

## Transformer Laminations 226

Two new catalog pages on 1-3/4" E and I transformer laminations are now available from this company. Complete technical data is listed including dimensional drawings, stacking factor, specifications, weight and count. Type T-175 RH features the new RETMA corner mounting holes and Type T-175 H has standard mounting holes. Temple Manufacturing Co., Bryn Mawr at Damen, Chicago 26, Ill.

## Training Method 227

An improved plan for training and testing proficiency of personnel to service electronic equipment is described in a 46-page illustrated folder. The method is covered in detail, and might be valuable for training assistants for electronic designers. Van Valkenburgh, Nooger & Neville, Inc., 15 Maiden Lane, New York 7, N. Y.

## Indicating Instruments 228

A 48-page catalog covers various indicating instruments, laboratory portables, and panel meters of finer accuracy. It provides illustrations and specifications of the more popular sizes of round, square, flush, semi-flush, switchboard, horizontal, edge-wise, and fan type meters, as well as 250° are-sealed and ruggedized types presently available. Hickok Electrical Instrument Co., 10525 Dupont Ave., Cleveland 8, Ohio.

## Casting Resins 229

Potting and casting resins for high and low temperature applications are covered in this 16-page booklet. It presents technical data on a number of "Airtemp" resins which are of the epoxy type. Aries Laboratories, Inc., 270 Park Ave., New York 17, N. Y.

for all applications  
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 READ-BACK SIGNAL  
 LOW NOISE FACTOR  
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 OPERATION



Librascope read-record heads are designed for recording and reading on magnetic drums or other magnetic storage systems and consist of a center-tapped coil wound on a toroidal core and molded into a temperature-stable epoxy resin package  $\frac{3}{4}$ " long. Optimum read-back signal at high frequencies is made possible by sintered ferrite core, a winding with low distributed capacity and with back gap eliminated. Positioning dowel hole permits precise mounting. All heads subjected to 1200 volt RMS high potential test. Write for catalog

### SPECIFICATIONS:

Crosstalk limited to minus  
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 above 500 KC  
 Track width: .090 in.  
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# Johnson Miniatures

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Requiring a panel area just  $\frac{3}{8}$ " wide by  $\frac{3}{4}$ " high (the longest models extend only 1-11/64" behind panel), these miniatures provide the ideal solution to compact design problems. Rugged, Johnson Miniature Air Variables will stand up under the most rigorous conditions, delivering peak performance throughout the VHF ranges. Soldered plate construction, oversize bearings, and heavily anchored stator supports provide extreme rigidity—torque is steady; rotor stays "put" where set. Bridge type stator terminal provides extremely low inductance path to BOTH stator supports. Silver plated rotor contacts for low noise level at high frequencies—all other metal parts nickel plated. DC-200 treated steatite end frames maintain high insulation resistance.

SINGLE SECTION						
Cat. No.	Type No.	Cap. per Sec.		Plates per Sec.	L	Net Price
		Max.	Min.			
160-102	5MA11	5	1.5	5	$\frac{11}{16}$ "	\$0.95
160-104	9MA11	8.7	1.8	9	$\frac{13}{16}$ "	1.00
160-107	15MA11	14.2	2.3	15	1"	1.15
160-110	20MA11	19.6	2.7	21	$1\frac{1}{16}$ "	1.30
160-130	30MB	32	3	28	$1\frac{11}{16}$ "	1.35

BUTTERFLY						
Cat. No.	Type No.	Cap. per Sec.		Plates per Sec.	L	Net Price
		Max.	Min.			
160-203	3MB11	3.1	1.5	5	$\frac{11}{16}$ "	1.35
160-205	5MB11	5.1	1.8	9	$\frac{13}{16}$ "	1.50
160-208	9MB11	8	2.2	15	1"	1.70
160-211	11MB11	10.8	2.7	21	$1\frac{1}{16}$ "	1.90

DIFFERENTIAL						
Cat. No.	Type No.	Cap. per Sec.		Plates per Sec.	L	Net Price
		Max.	Min.			
160-303	6MA11	5.0	1.5	5	$\frac{11}{16}$ "	1.40
160-305	9MA11	8.7	1.8	9	$\frac{13}{16}$ "	1.55
160-308	15MA11	14.2	2.3	15	1"	1.75
160-311	19MA11	19.6	2.7	21	$1\frac{1}{16}$ "	2.00

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# New Literature . . .

## Component Catalog 247

A very wide variety of products for the electronics industry is listed in this 30-page catalog (No. C-1154). Foundation chassis, chassis parts, plugs, tools, sockets, switches, tube shields, coils, terminals, hardware, and hundreds of other components are illustrated and described. Insuline Corporation of America, 36-02 35th Ave., Long Island City 1, N. Y.

## Time-Delay Relays 248

This bulletin (No. TD400) discusses the Series 6400, 11400, and 23300 miniature, hermetically sealed time delay relays. Delay settings from 2 sec to 3 hr for either a-c or d-c units are available. The relays are furnished in one-, two-, or three-switch units. Mounting is by flange or stud. A. W. Haydon Co., 230 N. Elm St., Waterbury, Conn.

## Instrument Generator 249

A permanent magnet, continuous duty generator recommended as a precision voltage source is described in this leaflet, Form GPM-44A. The brochure illustrates the unit, provides dimensioned outlines, and tabulates physical and electrical characteristics. Operating parameters of phase voltage vs load-per-phase are presented graphically for operating speeds of 1200, 2100, and 4500 rpm, giving frequencies of 20, 35, and 75cy. It weighs 9 oz. Dalmotor Co., 1326 Clay Street, Santa Clara, Calif.

## Pressure Transducers 250

Bulletin No. PT-1 (12 pages) describes instruments for the measurement of gage differential, and absolute pressures. The transducers are based on the principle of the firm's unbonded strain gage which translates pressure into an exact electrical analog output by means of a complete balanced bridge of strain-sensitive resistance wire. The bulletin includes drawings, specifications, and selection tables for eight designs for pressure measurements from 0-0.05 to 0-10,000psi. Statham Laboratories, Inc., 12401 West Olympic Blvd., Los Angeles 64, Calif.

## Clutches 251

Catalog No. B-54 depicts a line of miniature, one-way-roller clutches that permit drive in one direction with free-wheeling action in the opposite direction. Design and installation data and dimensions are given for roller assemblies as well as complete clutches. Typical applications for one-, two-, and three-clutch assemblies, with photographs and drawings, are included. Mini-clutch Co., 379 Morse St., Hamden, Conn.

## R-F Filters 252

A complete line of r-f filters, low-pass, high-pass, band-pass, band-rejection, and complementary, is described with characteristics in this 4-page, bound bulletin. Actual-size photographs of typical response curves illustrate what can be done in extremely compact units to give maximum attenuation over the desired stop band with minimum insertion loss and VSWR over the pass band. Balco Research Laboratories, 49-53 Edison Pl., Newark 2, N. J.

## Vibration Isolation 253

How to stop vibration and shock, reduce noise, and cut down on the wear and tear of industrial machinery is the subject of this booklet, designated No. 850. It describes a new concept of vibration and shock control based on the employment of resilient, primary load-carrying cushions of knitted metal wire. Examples of typical industrial mounts and mounting systems are illustrated and engineering data given. Applications range from delicate precision equipment to massive machinery. Robinson Aviation, Inc., Teterboro, N. J.

## Hand Tachometers 254

This manufacturer's Bulletin No. 103 describes a series of new three-in-one hand tachometers which dependably measure the speeds of rotating parts and moving surfaces. Incorporating three separate ranges in one instrument, only one range appears at a time, thereby minimizing reading errors. Ranges are selected by flipping a switch, and there is no fear of damage due to over-speeding or selection of the wrong range. Metron Instrument Co., 432 Lincoln Street, Denver 3, Colo.

**Plastic****255**

A reinforced alkyd plastic known as "Plaskon" is described in this bulletin with all its advantages for the electronics industry listed. It is reinforced with glass fibers. Barrett Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

**Test Chamber****256**

A temperature test chamber with a range from  $-65^{\circ}\text{F}$  to  $+350^{\circ}\text{F}$  is described in this 4-page bulletin. The test chamber is 7" x 15" x 7-1/2" deep. Statham Development Corp., 12411 West Olympic Blvd., Los Angeles 64, Calif.

**Metal Processor****257**

A description of the services of a processor of common, precious, and little-used metals and alloys into wire, ribbon, and foil is given in this 4-page bulletin. Such metals as indium, tellurium, palladium, etc. are extruded into wires used extensively as precision resistance elements. Baker & Co., Inc., 113 Astor St., Newark 5, N. J.

**Environmental Testing****258**

Tests for vibration, shock, acceleration, high and low temperature shock, humidity, high altitude and explosion, salt spray, sand and dust are covered in this 4-page illustrated folder. Some of the environmental equipment used in making the tests is also illustrated and described, the more common types of equipment being listed for quick reference. A brief review of other fields of testing specialized in this organization is also included. New York Testing Laboratories, Inc., 47 West St., New York 6, N. Y.

**D-C Indicating Amplifier****259**

A new design approach, the highly stable performance, and the unique principle of operation of this firm's Type 2HLA-3 D-C Indicating Amplifier are described in this engineering bulletin. It should be of particular interest to engineers in fields of automation, process control, and instrumentation. The bulletin (No. 1A) also includes a photographic illustration, detailed description, typical applications, and a discussion of the principle of operation. Doelean Corp., 1400 Soldiers Field Road, Boston 35, Mass.

**Co-axial Components****260**

Various type connectors, adapters and waveguides for co-axial applications are described and illustrated in this 16-page catalog. An index by military types is also included. Electro Precision Products, Inc., 139-30 34th Road, Flushing, N.Y.

**Galvanizing****261**

A method of galvanizing ferrous metals by brushing or spraying a fluid known as "Galvicon" on the surface at room temperatures is described in a 10-page booklet. It leaves a coating of 96 parts, by weight, of zinc. The coating dries in 48 hr. Galvicon Corp., 40 W. 29th St., New York 1, N. Y.

**Germanium Diodes****262**

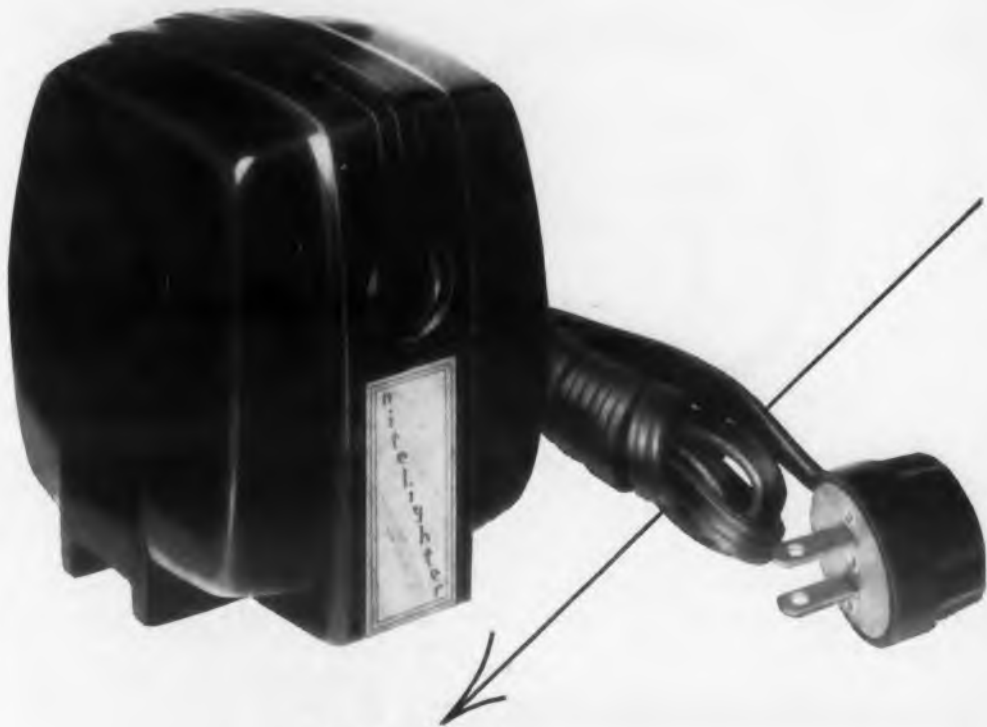
A complete crystal diode replacement chart is included in this 4-page bulletin (No. GD-1A), which lists ratings and specifications on this firm's line of germanium diodes. Included are the "Red Dot" line of diodes for  $100^{\circ}\text{C}$  applications. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

**Vibration Isolation****306**

"Shock and Vibration Control Notes" is the title of this company's new technical house organ, the first of its kind devoted exclusively to shock, vibration, and noise isolation. Published quarterly, it is intended to provide a medium for the collection and propagation of ideas and information in the shock and vibration isolation fields. It will contain material dealing with specific technical problems and reports based on continuous research in these fields, as well as articles based on problems sent in by engineers, the solutions of which would be of interest to industry. The Barry Corp., 718 Pleasant St., Watertown 72, Mass.

**Flexible Ducting****307**

A 4-page illustrated brochure describes "Flexflyte", one of this company's new forms of flexible ducting. It covers the various types of Flexflyte, its method of manufacture, standard coatings and diameters available, and method of installation. Complete engineering and data sheets are provided with the booklet. Flexible Tubing Corp., Guilford, Conn.



... So you'll  
**NEVER COME HOME TO DARKNESS**

We can't resist the opportunity to plug one of our old stand-bys (perhaps too long forgotten), and at the same time give a boost to a product of our affiliate, The Fisher-Pierce Co.

Fisher-Pierce, now well-established and in its eighth year in the photoelectric street lighting control business, recently decided they should have a consumer product as well. The result was just what you might expect: an inexpensive (\$15.95 retail) little light control for home use.

F-P calls it the NITELIGHTER,\* since it turns on a light at dark, when daylight ceases to energize its phototube. Its special plug goes in the AC wall outlet and takes the plug from your favorite lamp. For you who don't like to come home to darkness, want to make burglars think you're home when you're not, or have some other use for a daylight-sensitive light switch — the NITELIGHTER could be the answer. (In case you don't really need a NITELIGHTER, they're fun to just fool around with.)

The "old stand-by" is one of our Series 41 relays, originally designed as a "streamlined" version of our "4", for people who didn't need all the fancy features of the "4" and who were spending their own money. This particular 41 does very well in its intended applications, however, and switches up to 300 watt lamp loads on 0.15 watt coil signals in the NITELIGHTER. Relay mechanical life equals at least twice the lifespan of a NITELIGHTER owner. The 41 should be considered when high sensitivity, high speed, 5 ampere contact ratings and nominal cost are what you need.



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## New Literature . . .

### Wire Thread Inserts 264

Designers concerned with fastening and mounting and other users of wire thread inserts will be interested in this new 4-page bulletin (No. 708). By presenting all basic information on the manufacturer's wire thread inserts and tools in condensed form, it saves time in designing, specifying, and ordering inserts. Illustrations and tables present data and installation instructions on inserts and tools for National Course and Fine, Unified Course and Fine, Spark Plug, and Pipe Thread Series. Heli-Coil Corp., Danbury, Conn.

### Catalog Index 265

Bulletin 100-C lists all current literature available from this company. Numbers and titles of all catalogs, bulletins, specification sheets, and instrumentation data sheets are included. Minneapolis-Honeywell Regulator Co., Industrial Division, Wayne and Windrim Aves., Philadelphia 44, Pa.

### Actuator Motor 266

A series-wound 25w miniature motor designed for use as a driving element in low or high-speed linear or rotary-actuator applications is described in a new leaflet, Form SR-43. One of a series, the leaflet provides all primary data required for the design engineer. The motor is illustrated, detailed in dimensioned outline drawings, and defined in a listing of electrical and physical characteristics. Performance data, given in graphic form, covers rpm, efficiency, output watts, and input amperes over the torque output range to 4.25 oz in. Dalmotor Co., 1326 Clay St., Santa Clara, Calif.

### Air Data Computer 273

An 8-page technical brochure gives information on the company's Master Air Data Computer which provides a single coordinated source of information and eliminates much duplication. Schematic diagrams show how the plug-in type computer permits calculation of complex functions with a minimum of equipment. Servomechanisms, Inc., Post and Stewart Aves., Westbury, L. I., N. Y.

## An Announcement

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Doing Research and Design Work in  
the Entire Audio Frequency Range.

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An outstanding feature of ROTOROID is that, at maximum inductance, it provides the full Q of the toroid it contains. Thus, the user is at once able to take advantage of the high Q characteristics of toroids while at the same time having available a variable inductor not previously available in a toroid.

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Just a few of the many possible uses of ROTOROID are:

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- Electro-Mechanical Control Systems

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## Inductor Curves

A set of characteristic curves for the firm's "Vari-L" electrically variable inductors has been made available in the form of a series of data sheets. The units are high frequency saturable core reactors designed to control the resonant frequency of a tuned circuit as a function of a d-c or a-c current. The curves show the control characteristics of a number of typical units. Vari-L Company, Inc., P. O. Box 1433, Stamford, Conn.

## Hardware

A folder gives a quick view in illustrations and text of all the products the company makes for the electronics industry. Included are socket head cap screws and shoulder screws, socket set screws, button head and flat head socket screws and dowel pins, "Flexloc" self-locking nuts, "Hallowell" steel collars, and "Sel-lok" spring pins. The folder, entitled "One Source of Supply For Your Fastener Requirements", lists the sizes of all the products, their materials, and the plating they are available in. Standard Pressed Steel Co., Jenkintown, Pa.

## Sintered Metals

This bulletin (No. 1) provides an introduction to the art of powder metallurgy. It describes the general types of metal powder offered by the company, and stresses the large number of grades required for different applications. Also included in the pamphlet are references to some of the other major uses for metal powders such as the fabrication of special electronic and magnetic parts. Among the metals available in powdered form are steel, nickel, manganese and silicon. Plastic Metals Division, National Radiator Co., Johnstown, Pa.

## TV Tube Types

A 12-page booklet (No. ETR-886) lists recommended receiving and cathode ray tube types for AM, FM, and TV receivers. These are compiled in tabular form to cover essentially every requirement of the radio and television manufacturer. Included are characteristics reference charts on the tube types listed, and interpretation of technical data. General Electric Tube Dept., Schenectady 5, N. Y.

**FLUSHING FANS**

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Motors are totally enclosed, mount in ANY position and do NOT require to be accessible for lubrication. Special, low-temperature rise, shaded-pole motors, allow continuous operation in high ambient temperatures. Have no commutators or sliprings and require no phase-splitting capacitors. Fans are beautifully finished and are an asset to any piece of equipment.



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- ★ Accuracy  $\pm 1$  cycle,  $\pm$  crystal stability 10<sup>-7</sup>
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First digital-reading meter FCC-approved as a standard broadcast station frequency monitor, the BERKELEY Model 5570 offers outstanding advantages for rapid, precise determination of unknown frequencies or frequency stability. Its basic 0-42 megacycle range is readily extendable to 515 mc with BERKELEY VHF and UHF Converter Units.



BERKELEY Model 5570 Frequency Meter, 0-42 mc range. Dimensions, 32" x 21" x 16"; price \$1650.00 f.o.b. factory.

BERKELEY Model 5580 VHF and UHF Converter Unit extends range of Model 5570 to 515 mc by use of plug-in units (below). Dimensions 21" x 11" x 15"; price \$300.00 f.o.b. factory.



Plug-in units covering 13 fixed bands from 42-515 mc eliminate costly wide-band amplifiers. Price, \$100.00 each except for 42-155 mc Model 5581/4, which is \$150.00 f.o.b. factory.

Berkeley technical representatives throughout the U.S. and Canada gladly offer prompt and practical assistance on your instrumentation problems. Wire now for Model 5570 specifications, and name of nearest representative.

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# Patents . . .

## Regenerative Transistor Amplifier . . .

Patent No. 2,670,445. Jean H. Felker. (Assigned to Bell Telephone Laboratories.)

The transistor circuit shown in Fig. 1 is a regenerative pulse amplifier that is useful in high-speed switching systems common in computers. In these systems low-level pulse signals are amplified and reshaped. Basically, the circuit is a flip-flop circuit having low and high current states. The input signal triggers the circuit from the low current state to the high current state. Either a p-type or an n-type transistor may be used with reversal of the battery and rectifier polarities. The circuit given calls for an n-type unit.

The circuit parameters are chosen so

that the circuit operates in that region of transistor characteristic curve, as shown in Fig. 1, where the curve of emitter voltage versus current reaches a peak at or about zero emitter current and then the curve slopes off to a valley after which the curve again slopes upwardly. The potentials of battery 18, 12v, and battery 20, 1v, are also selected so that the respective load lines of resistor 19 and crystal diode 21 intersect at a point slightly displaced from but adjacent to the peak in the emitter characteristic curve. Battery 20 also serves to return the emitter to a small negative voltage. The junction of crystal diode 23 and coupling condenser 22 is maintained negative by battery 24, which delivers 8v. Crystal diode 23 serves to isolate



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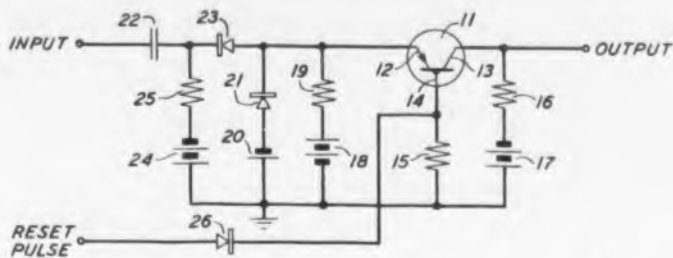
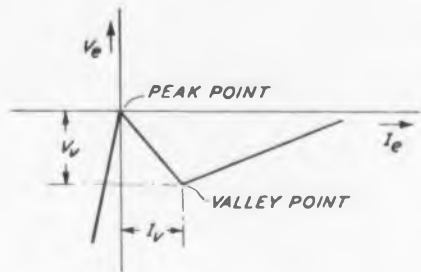


Fig. 1. A flip-flop transistor circuit that functions as a pulse amplifier and an explanatory characteristic curve.



the flip-flop circuit for the transistor from the preceding circuit.

Resistor 19, 24,000 ohms, and resistor 25, 3900 ohms, are selected so that when no emitter current flows the transistor rests at a voltage just below the peak of the characteristic curve or below the bias on diode 21. An input pulse raises the voltage above the peak point and diodes 21 and 23 are cut off. Positive emitter current then flows, which causes the emitter voltage to fall to the valley point of the

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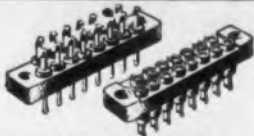
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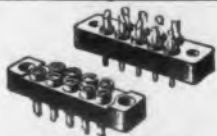
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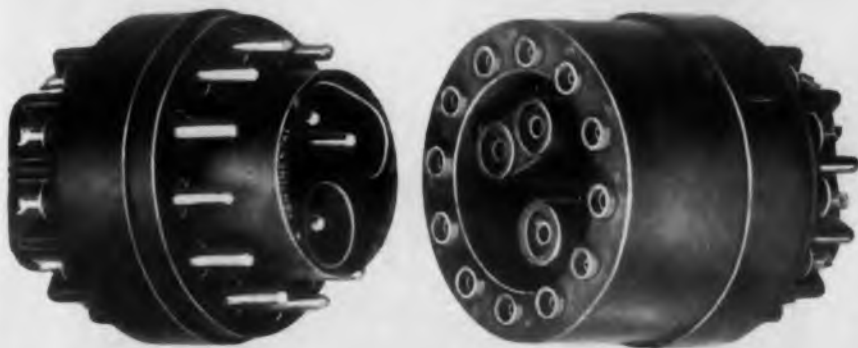


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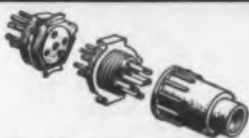
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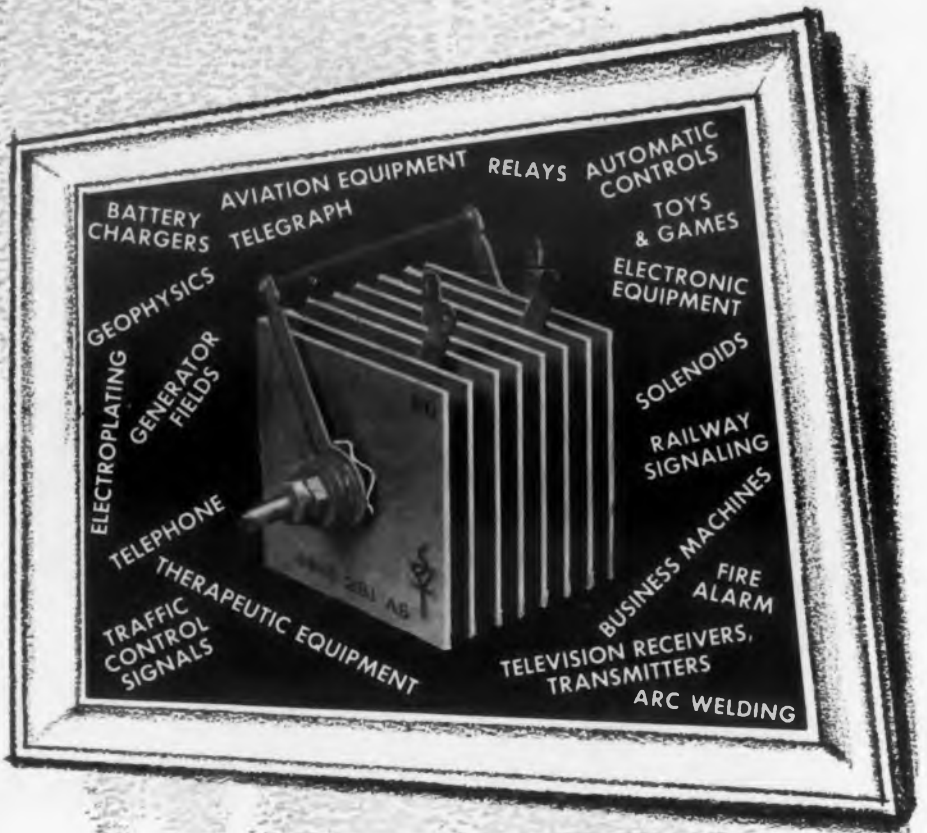
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# Patents . . .

**Antenna . . . Patent No. 2,671,855.** Lester C. Van Atta, Winchester, Mass. (Assigned to the United States.)

In microwave antenna systems for the radiation or reception of short waves of the order of centimeters in length, it has been known that there is a reflection of energy from the reflector back into the feed or transmission line. By using matching transformers, this reflection of energy back into the feed line has been kept at a level where it is not troublesome for the frequency at which the system is designed to operate. If, however, there should be a slight change of operating frequency such as may well occur by a change in the transmitter tube, the present methods of keeping to a minimum the energy reflected back into the line do not function as well as desired because the components used as well as the antenna itself are frequency sensitive or lack broadband characteristics.

The antenna system illustrated in Fig. 2 has broadband characteristics gained by

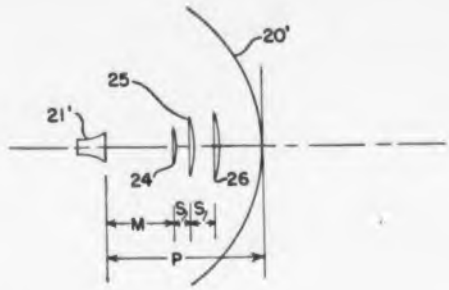


Fig. 2. Microwave antenna system.

placing one or more matching or compensating reflectors (24, 25, and 26) of small size on the axis of the reflector 20' and between the antenna 21' and the reflector. Its location should be approximately one eighth of a wave length in front of reflector, although in order to reduce the incidence of side lobes and a loss of antenna gain the compensating reflector may be located an even number of half waves from the position illustrated.

In a location farther removed from the reflector the matching reflector may be smaller. The compensating reflector has a size which has the effect of compensating or canceling out the energy reflected back

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EA-48	160 to 1500 Volts	0-125 MA	Less than 20 MV	0.5%

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into the feed line from the reflector 20, but should be small enough not to interfere with the directive function of the system. The optimum location and size of the matching reflector may be determined by test. The compensating reflector may have practically any desired shape. With more than one matching reflector, more effective broadband characteristics will be secured.

**Semiconductor Translating Device . . .**  
*Patent No. 2,672,523. William Shockley.*  
*(Assigned to Bell Telephone Laboratories.)*

A transistor of the kind in which the body is of one type and a zone thereof is of the other type experiences a direct current bias of substantial proportions during operation between the P and N portions of the device at the collector. A P-type region may be made in an N-type body in various ways such as by nuclear bombardment of the surface. A transition region (24, Fig. 3) between the two type regions intersects the surface, and because of the potential difference between collector 12 and the body (10), there is a strong field

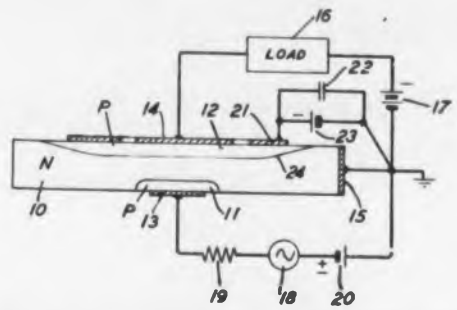


Fig. 3. Tapered P-type zone transistor.

present and leakage currents do occur. These cause noise in the output circuit.

A reduction in the field may be achieved by tapering the P-type zone near its margin. Other ways of tapering the zone are described in addition to the method illustrated. The leakage current can be further reduced by supplying an auxiliary electrode (21) surrounding collector 14 in the vicinity of the intersection. A condenser (22) between this electrode and the base (13) assures that it is at alternating current ground potential. A potential source (23) may bias the auxiliary electrode at a potential intermediate between that of the collector and base.

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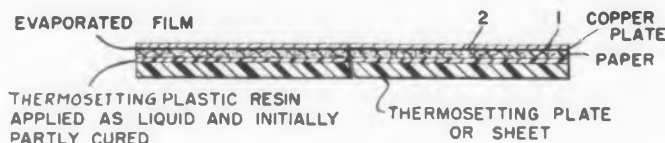
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# Patents . . .

**Method of Manufacturing A Conductive Coated Sheet and Said Sheet . . .**  
*(Patent No. 2,680,699) Milton D. Rubin, Rochester, Mass.*

Of primary importance in printed circuitry, a process for securing an adhering metallic coating upon an insulating plate is set forth in the patent. The process starts with a paper material that has a

metallic film evaporated on one surface. A metallic coating is then plated on the film, and the sheet is thoroughly cleaned. The unplated side of the paper sheet is then impregnated with a thermosetting resin that is only partially cured. A thermosetting base sheet is then applied under pressure to the partially cured impregnated surface, and the latter is then fully cured. With this method, a strong bond is secured between the metallic conductive coating and the insulating material (Fig. 4).



**Fig. 4. Cross-section of the printed-circuit laminate.**

## AEC Patents For Industry

Additional patents owned by the Atomic Energy Commission have been made available for licensing. Licenses will be granted to applicants on a non-exclusive, royalty-free basis. Applicants should apply to the

Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. Of the 25 patents released, the following ones are particularly interesting to electronic design and development engineers.

*Coincidence Circuit (Patent No. 2,677,759); R. Madey, inventor.* The patent relates to an improved fast coincidence circuit which is highly



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discriminatory with respect to single pulses. The coincidence circuit is designed so that it will reject single pulses and only pass a pulse to the output when coincidence pulses having a selected magnitude occur.

**Linear Cathode** (Patent No. 2,677,778); *W. R. Baker and D. A. Vance, inventors.* The patent pertains to an improved dispenser type thermionic cathode which is rugged, efficient, simple and easily disassembled.

**Mechanical Register** (Patent No. 2,678,773); *W. E. Glenn, Jr., inventor.* The patent pertains to a counting device having a magnetic rotor disposed between the poles of one magnet in cooperating relation with another magnet and indicating means for determining the angular disposition of the rotor. The low friction and low-inertia mechanism overcomes many of the disadvantages of existing mechanical registers.

**Protective Circuit** (Patent No. 2,680,212); *P. E. Frazier, inventor.* The patent relates to a protective circuit adapted for cooperation with a parallel-connected ignitron for recording various types of operating faults and for de-energizing the tubes upon the occurrence of operating faults of predetermined seriousness.

**Electronic Controlled Pumping System** (Patent No. 2,682,364); *D. S. Schover, inventor.* The patent describes an electronically controlled gas pumping system of the toepler type. Electronic means are provided for alternately evacuating and applying pressure to the fluid pumping apparatus.

**Variable Voltage Wave Form Generator** (Patent No. 2,683,807); *G. D. Parson, inventor.* The patent relates to an electronic circuit for generating a voltage waveform having a plurality of variable voltage points which may be varied independently without disturbing the value of the voltage at other points of adjustment of the waveform.

**Ion Beam Measuring Device** (Patent No. 2,683,814); *R. L. Mather, inventor.* The patent covers an ion beam energy measuring device and particularly to determining the angle of emission of secondary radiation generated by the bombarding beam. The angle of emission of the secondary radiation generated is a function of the energy of the bombarding beam, which may be determined thereby.

**Shock or Vibration Isolating Means** (Patent No. 2,684,825); *E. K. Arnold, D. W. Laviana, and G. L. Cooper.* The patent relates generally to means for isolating objects from shocks or vibration. The apparatus comprises a combination of steel springs and variable rate silicone springs in parallel to achieve isolation and protection at extreme high and low temperatures and regardless of the positioning or attitude of the moving system.

**Resonant Type Shake Table** (Patent No. 2,686,427); *D. M. Ellett and W. E. Baker inventors.* The patent covers an adjustable-frequency shake table capable of large excursions with small input energies. The table is caused to move to vibrate, by an electromagnetic motor, the energization of which is adjustable in frequency.

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VC 10	.5 to 8	+50 ± 100	Glass	Invar	-55°C to +125°C
VC 30	.7 to 8	+600 ± 100	Glass	Brass	-55°C to +125°C
VC 40	1 to 18	+600 ± 100	Glass	Brass	-55°C to +125°C
VC 110	.7 to 12	+100 ± 50	Glass	Invar	-55°C to +125°C
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# Books . . .

**Form In Engineering Design . . .** By *J. Beresford-Evans*, 96 pages, Oxford University Press, 114 Fifth Ave., New York 11, N. Y. \$1.70.

Written for the engineer and not the artist or industrial designer, this book is based on the assumption that anyone has the ability to recognize good form. This assumption is followed to two conclusions: good appearance means good sales, and engineers can be trained to design products with pleasing appearances. Not simply a how-to-do-it handbook, the volume considers how a designer functions and what design is as a concept.

Beginning logically with the total form, which the writer holds is closely related to function, the work progresses to important details such as meters, handles, knobs, and

finishes. The author makes the worthwhile point that a knob should indicate by its shape how it is manipulated. In other words, an on-off switch should not have a round knob, which indicates continuous rotation. The proper lettering for meter faces is also discussed.

The final chapter, entitled "Presentation", tells how to present a sketch in the manner most likely to enhance it and thereby gain approval from management. There are three appendices. The first is a bibliography with one-paragraph abstracts for each work listed. The second discusses perspective, and the third recommends various water-color washes to be used on sketches submitted for approval. Each chapter is well illustrated with drawings, and a group of photographs of outstanding technical designs is bound in the book.

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**OUTPUT:**

**POLARITY:** Positive or Negative pulse selected by front panel switch.

**PULSE CHARACTERISTICS:** Triangular pulse of approximately 1  $\mu$ sec. rise time, 4  $\mu$ sec. width and 50-60 volt amplitude.

**POWER REQUIREMENTS:** 105-125 volts, 50-60 cycles, approximately 175 watts.

**SIZE:** 10-1/2" x 19" x 13" deep

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**RISE TIME:** .001  $\mu$ sec. from 10% to 90% amplitude

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**A Survey of Automatic Digital Computers, 1953 . . . 109 pages, paper cover.** Prepared by the Office of Naval Research. Available from U. S. Department of Commerce, Office of Technical Services, Washington 25, D. C. \$2.00.

Electronic design laboratories requiring the services of a digital computer will find this publication of great value. It is the result of the latest world-wide O.N.R. survey of digital computers in operation. The first such survey was undertaken in 1947. Ninety-eight different types of computers in the United States and 11 foreign countries are listed on separate pages with all pertinent data such as their capacity, speed, and availability. An alphabetical index of the computers by name and a listing of the computers and their builders by the state or nation they are located in are also given.

**Acoustics . . . By Leo L. Beranek, 481 pages. McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. \$9.00.**

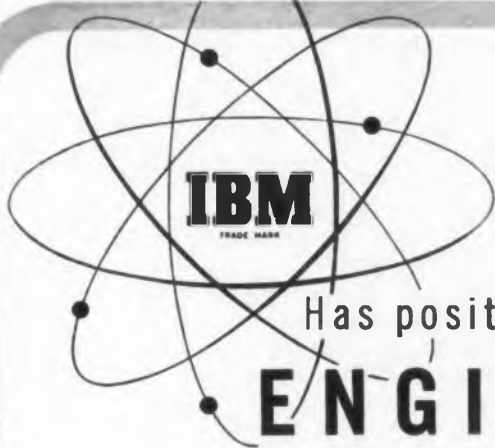
Based on the author's experience in teaching at the Massachusetts Institute of Technology and designed as a textbook, this well-illustrated volume should serve

as a valuable introduction to or reference on acoustics for many electronic designers. Beginning with a discussion of the terminology in the field, the author devotes many pages to the wave equation, considers all types of sound producing and receiving equipment, and ends with a chapter on hearing, speech intelligibility, and psychoacoustic criteria.

The last chapter is of value to engineers seeking to determine the minimum frequency band or maximum noise level permissible to still convey speech or intelligibility. There is also a chapter on acoustic measurements. This work should help to secure the position of acoustics as a precise science.

**Television Factbook . . . 400 pages, paper cover. Television Digest, Wyatt Building, Washington 5, D. C. \$4.00.**

Designers of equipment for the television industry will find the *Television Factbook*, of which this is the 19th semi-annual edition, of interest. All the TV stations in the United States and 110 stations in 32 foreign countries are listed together with many other industry statistics. The text of the FCC color standards is given.



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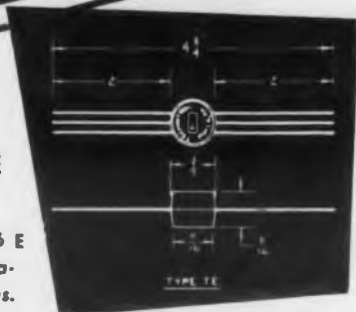
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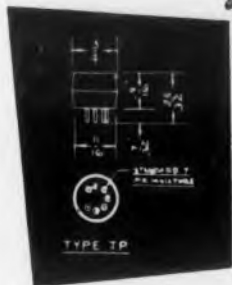


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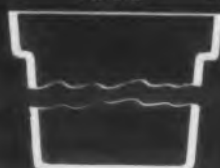
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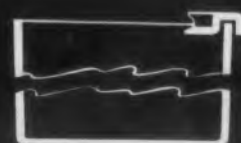
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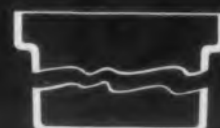
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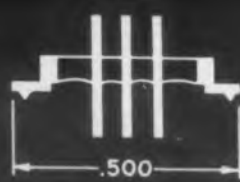
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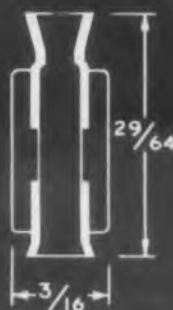


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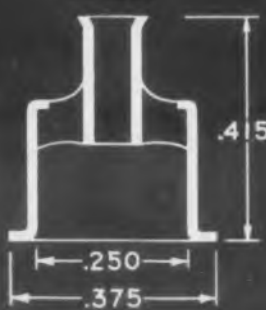


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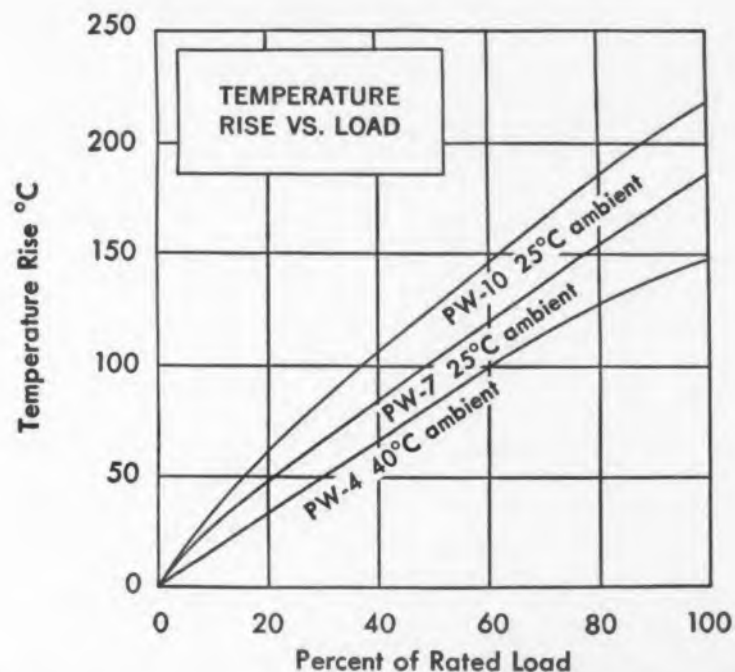
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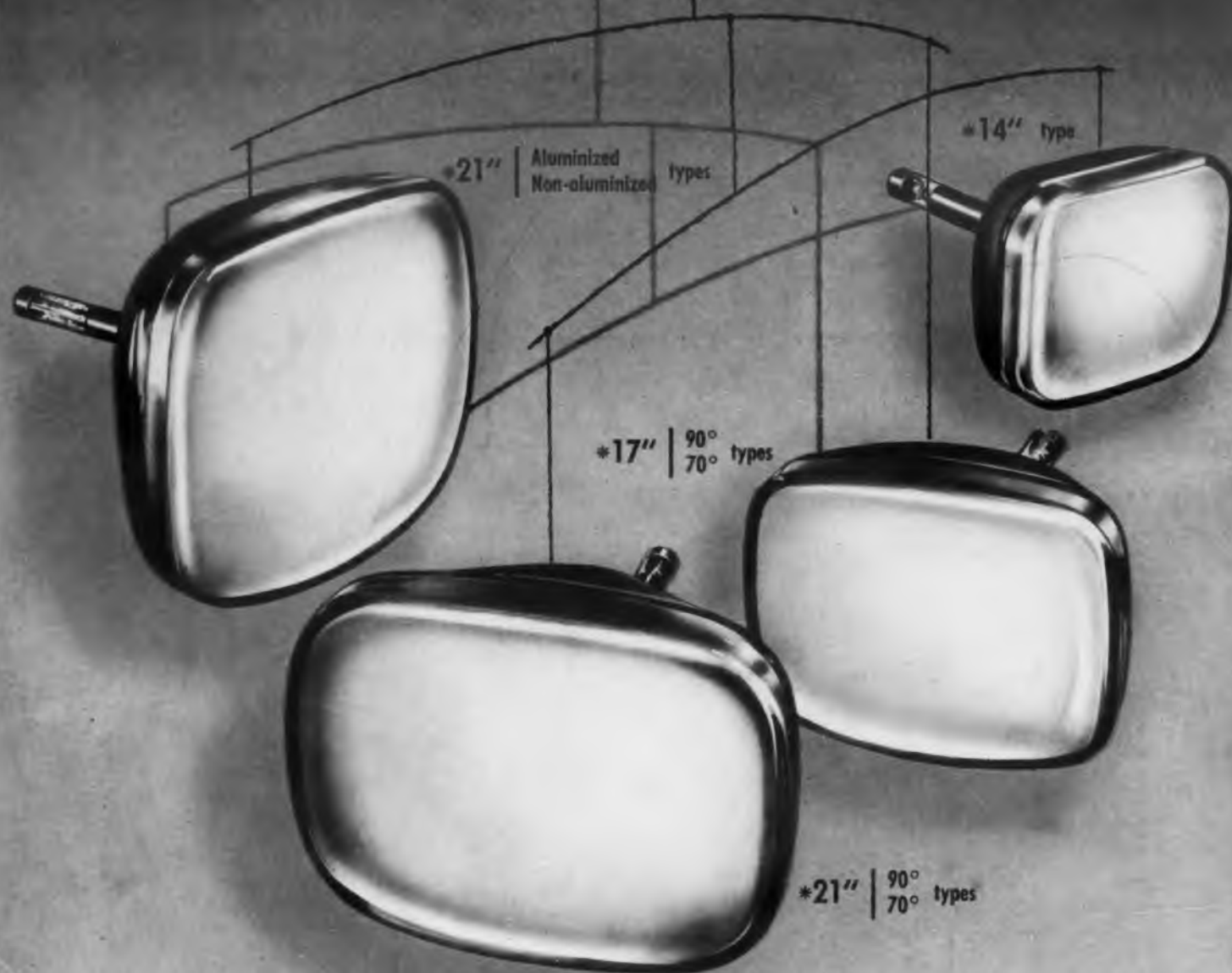
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