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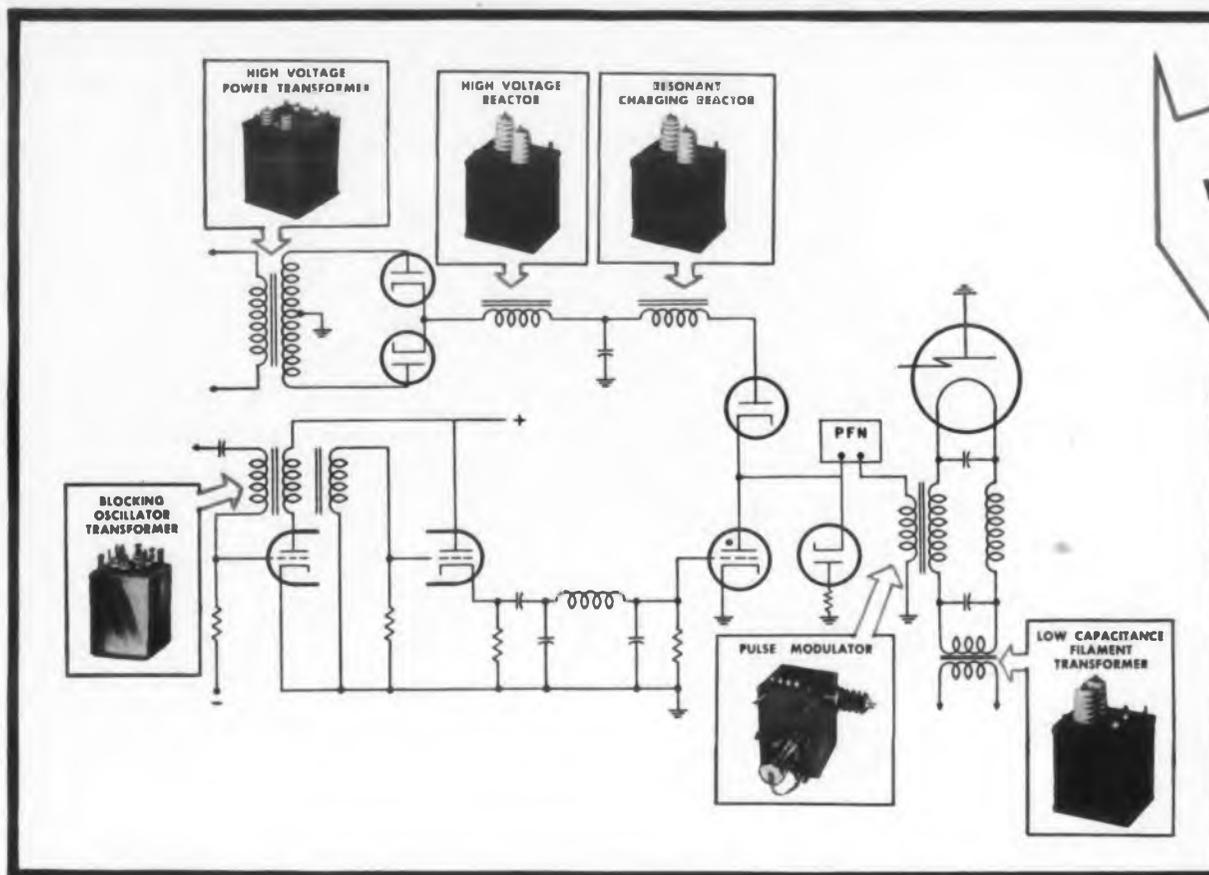
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MAY 17 1955

ELECTRONIC DESIGN

Vol. 3, No. 5
May 1955

Contents

Cover	(See page 38)
Editorial	4
Engineering Review	5
Features	
Design for Automation, by Robert C. White	24
Using Glass in Electronic Designs—I. Properties of Glass, by William H. McKnight	28
Encapsulated Plug-In Circuits	32
Electro-Mechanical Circuit Elements	34
Glass-Teflon Dielectric	38
Swing-Coil Compensator	40
Selecting Miniature Bearings, by H. M. Dardani	42
Potted Resistor Networks	46
Range-Finding VTVM	48
Miniature Step-Up Vibrator	52
Plastic Magnetic Core	54
Miniature Magnetic Clutches	56
Precision Phase Shift Measurements, by Raymond Rothschild	58
Background for Designers	
Human Measurements	36
Design Forum	
Vertical-Chassis Radio	30
News for Design	
Gas Diode Memories	50
Departments	
New Products	62
New Literature	130
Patents	146
Books	154
Advertisers' Index	157

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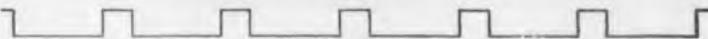
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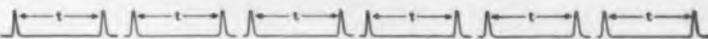
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Try this for size

**For guided missiles, airborne equipment,
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In these and related fields, where lack of space is the problem, manufacturers have turned to miniaturization. Daven's new ceramic switch occupies a panel area of less than $1\frac{1}{2}$ square inches—incorporates features that ensure long life and trouble-free operation.

Despite its small size, this switch is extremely rugged and has been designed to withstand all types of field service. Coin silver contacts, rotors and slip rings are provided for low and uniform contact resistance and excellent electrical characteristics. Ceramic parts are silicone impregnated to function under extreme humidity. Sturdy solder terminals are supplied for wiring.

Single pole style has 18 shorting type contact positions available. 2 or 3 pole types may also be obtained. Several sections may be "ganged" by adding supplementary wafers. Flash-over voltage at 60 cycles is 1000 volts peak . . . current carrying capacity is 2 amperes.

This sturdy, high-quality switch is precision produced . . . will give years of service in fine commercial and military equipment. DAVEN's expert engineering staff is at your service for help with special problems or orders to your specifications. Write today for further information.



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R O F A T T E N U A T O R S

Editorial

Stockpiling Security

We hear a lot these days about "stockpiling for security". We have a sizeable stockpile of nuclear bombs. Certain strategic materials are being stockpiled. Recently, the Department of Defense announced that we will stockpile finished machine tool equipment and among other things, vacuum tubes.

We realize the necessity for these actions but they do give rise to a number of important questions. How much material and equipment should we stockpile? How far can we go in this direction without stifling creativeness because we must design equipment around what we have stockpiled? Do we not run into the danger of obsolescence if we rely too much on stockpiling—especially when it comes to finished equipment? There is also the danger of building a kind of "technical Maginot line" which would give us a false sense of security.

Naturally we could err by not stockpiling anything at all. Tubes are an especially critical item, and certain standard test equipment could probably be stockpiled to some advantage.

But let's proceed carefully, fully cognizant of the dangers involved. Our best defense insurance lies in having a flexible productive capacity and men who know how to use it to the greatest advantage. Let's do everything we can to "stockpile" that most important and irreplaceable commodity—trained technical manpower.

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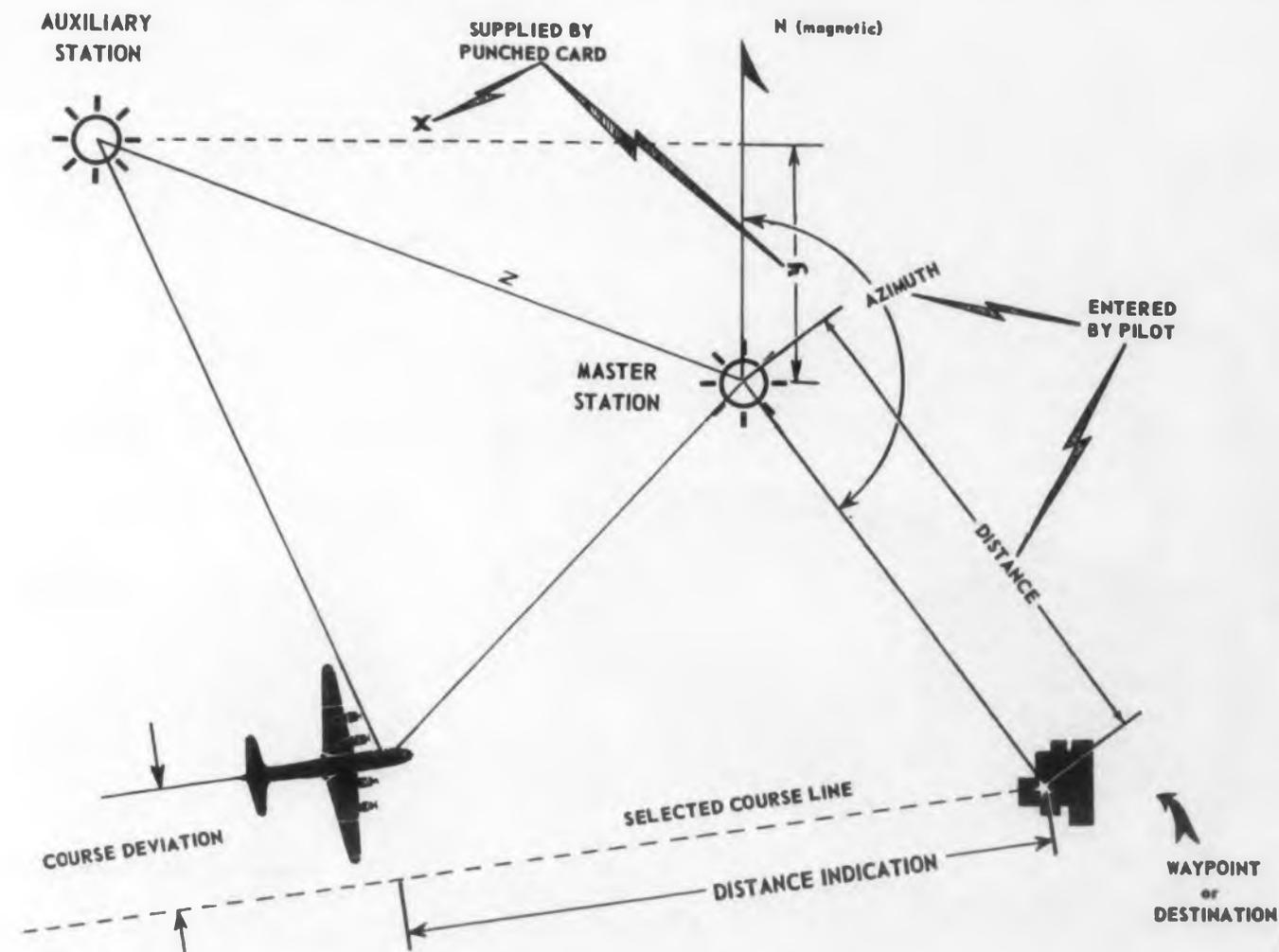
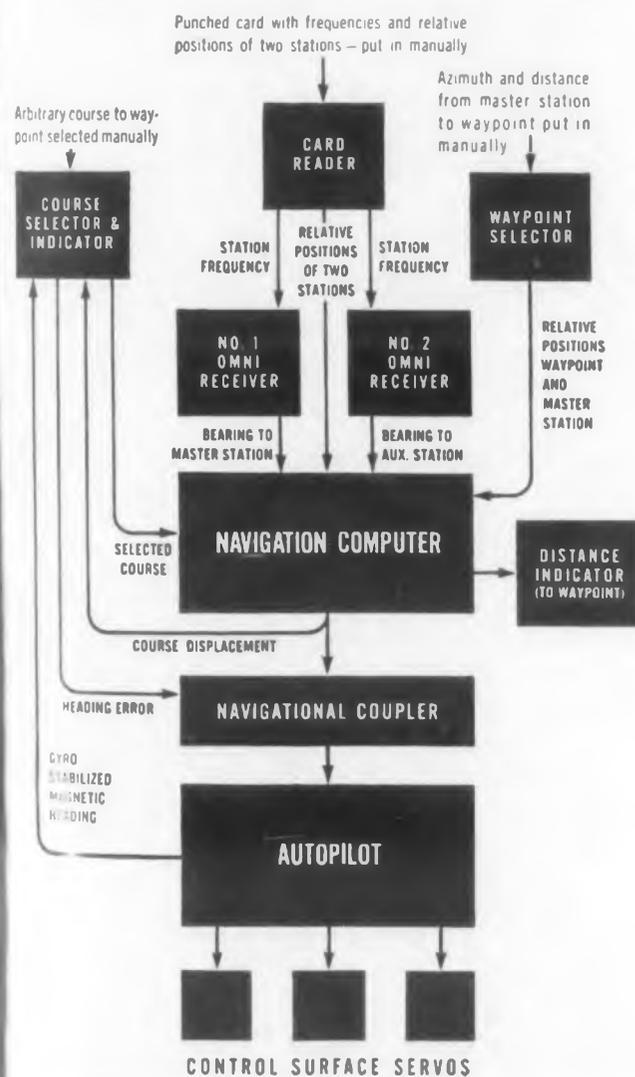
Engineering Review . . .

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

Computer Flies Plane . . . A system for automatically flying a plane to a destination that does not have a radio beacon has been developed. As illustrated, a computer feeds the proper directional signals into a standard autopilot by electronically triangulating two v-h-f omnidirectional range stations. The location of

the destinations and the frequencies of the range stations are initially inserted into the computer by a punched-card reader.

The automatic navigation system is being installed in Learstar twin-engine transports, manufactured by Lear, Inc., 3171 S. Bundy Dr., Santa Monica, Calif. The computer is an NC-101 radio-navigation waypoint computer made by Collins Radio Co., Cedar Rapids, Iowa. Any destination can be selected that is within range of radio-navigation ground facilities. There need not be a radio facility of any kind at the destination. The autopilot is a Lear F-5.



The block diagram at the left shows how the computer flies the plane on its course without requiring a radio beacon at the destination.

Dry High-Vacuum Pump . . . A new type of "dry" high-vacuum pump employs evaporating titanium and ion pumping (*ED, June, 1954, pp. 10-11*) to remove gas molecules. Developed to evacuate large-high-voltage particle accelerators, the pump will be made in smaller versions for evacuating power electron tubes, picture tubes, large X-ray tubes, and mass spectrometers.

The pump was invented by Prof. Ray Herb, Univ. of Wisconsin Physics Dept. It will be made by Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y., under a licensing agreement with Wisconsin Alumni Research Foundation. The pump, which has no moving parts, will be marketed under the name of "Evapor-Ion".

Radar Monitor . . . Operating with any search radar, a newly developed device provides visual and audio alarms whenever a pip appears in a predetermined zone. The device would be especially valuable for merchant vessels that do not have many men on watch or at small airports. It is called "Raytector".

Developed by Miller Associates, Lakeville, Conn., the instrument includes alarms to indicate failure of either the radar or the Raytector. In the event of such a failure, built-in simulated radar signals can be employed to localize trouble in either equipment.

Atomic-Powered Merchantman . . . In his recent nation-wide address the president revealed that an atomic-powered merchant vessel would be constructed as part of a program to develop peace-time uses for atomic energy. If a number of such vessels are constructed, the market for electronic radiation-detecting and reactor control devices would be greatly extended.

Another possible extension of uses for atomic power plants would be in power station barges such as are presently in use in many parts of the world to supply power to disaster areas or where a temporary power shortage exists. Once an atomic power barge is towed to its destination, it would not have to be supplied with fuel.

Phone Capacity Tripled . . . A new military phone system that can handle three times as many conversations over a single wire as comparable Korean and Second World War systems has been developed for the Signal Corps. Recently developed miniaturized parts are credited with reducing the weight and size of the new equipment.

Basic equipment for the new system is contained in units about the size of large suitcases which can be handled by only one or two men. These units are designed to be stacked. The equipment was developed by Bell Telephone Laboratories, 463 West St., New York 14, N. Y., and is being manufactured by Western Electric Co., Kearny, N. J.

The system, providing for 12 simultaneous conversations, can be used for distances up to 200 miles. Another new 4-channel system can be employed up to 100 miles. Several of these wire systems linked together can form a communications system of about 1000 miles. They can also be operated in conjunction with a new radio relay system developed at the Laboratories. The cables for these systems can be strung on poles, laid on the ground, or buried.

Complete with its power supply, the new 4-channel unit weighs 178 lb and occupies only 5-1/2 cubic feet. The earlier 4-channel unit weighed 474 lb and occupied 20 cubic feet. Important new features facilitate testing and maintenance while all regular channels are in service. A portable test set provided with the 12-channel system contains a transistor oscillator.

Automatic Production of Printed Circuits . . . An automatic system for producing printed circuits under development for some time (*ED, Sept. 1954, p. 12*), has now been placed in limited production. The system developed by United Shoe Machinery Corp., Boston, Mass., utilizes components mounted on parallel belts. The components are inserted in previously prepared printed circuit boards by special insertion heads. Since the first announcement of this system last year, insertion heads for tube sockets and transformers and an automatic dip soldering machine have been developed.



Small-Craft Radar

Revealing objects from 20 miles down to 25 yards, this inexpensive radar is designed for use by small craft. Made by Edo Corp., College Point, N. Y., the X-band equipment features a slotted waveguide antenna. On the 2-mile range, two objects on the same bearing may be differentiated if they are as close as 30 yards.



New Magnetic Material . . . A newly developed magnetic material has a coercive force of 3800 oersteds. Known as "Bismanol", the material, which is not available commercially, is made of compacted particles of manganese bismuthide. The material has been used to reduce the weight of a traveling wave tube from over 100 lb to 3-1/2 lb.

Bismanol was developed at the Naval Ordnance Laboratory, Silver Springs, Md., by Edward Adams, William M. Hubbard, and Albert M. Syeles. Magnets made from this material show a field stability of ± 5 gauss at temperatures ranging from -67 to $+250^{\circ}\text{F}$. It has a very high flux density in magnets where the length-to-diameter ratio is one or less. In the traveling-wave tube the Bismanol magnets replaced a heavy copper-wire solenoid whose function is to prevent diffusion of the electron beam moving in the helix.



"So far so good. From here on, it's engineering's baby."

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Bacteria Counter . . . An electronic device that can count a variety of objects from bacteria colonies to nuts and bolts has been demonstrated. The counter employs a special cathode-ray tube with a 1000-line raster, about twice the resolution of the standard TV camera tube.

Known as the "Iconumerator", the instrument was developed by Allen B. Du Mont Laboratories, 760 Bloomfield Ave., Clifton, N. J. The count, which can go up to one million, is indicated on an electrical tote board in digits. The instrument can also feed the results to a printing device.

Objects to be counted are placed in a compartment in front of the tube. The tube scans the compartment line by line. The light from the scanning spot is passed through a lens system to a photocell. The electrical signal from the photocell is passed through special circuits that correct deficiencies in the lens and then to a computer. The computer determines the count.

The unit will count irregularly shaped objects correctly. For example, a penny and a doughnut are counted as two objects. If the penny is placed in the hole of the doughnut, the count is still two. Even objects that overlap may be counted as individual units. The Iconumerator was built for the specific purpose of counting bacteria colonies in a Petrie dish.

Weather Map Reproducer

Continuous transmission of weather maps and other pictorial matter is possible with this device. It holds 100' rolls of electrosensitive paper, and it is made by Alden Electronic and Impulse Recording Equipment Co., Westboro, Mass.



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New!! Compact!!

28 VOLTS @ 100 AMPERES
± 1/2% REGULATION

SPECIFICATIONS

DC OUTPUT: 24-32 Volts at 100 amperes

AC INPUT: 230 or 460V. ±10%, 3 phase, 60 cycles

RIPPLE: 1% rms

VOLTAGE REGULATION: ± 1/2%: (a) from no load to full load; (b) from 24-32 Volts DC; (c) for 230 (or 460) Volts ±10%

RESPONSE TIME: 0.2 seconds **WEIGHT:** 250 lbs.

DIMENSION: 25" long x 15" deep x 15" high

Price: \$1,149.00, including meters & cabinets

PROMPT DELIVERY



MODEL MR532-15

5 to 32 VOLTS @ 15 AMPS (CONT.)
IMMEDIATE DELIVERY!!!

REGULATION: ± 1% (a) from 5-32 Volts D.C.; (b) from 1.5 to 15 amps.; (c) from 105-125 Volts A.C. (Single phase, 60 cps.)

RIPPLE: 1% rms @ 32 Volts and full load, increases to max. of 2% rms @ 5 Volts and full load.

RESPONSE: 0.2 seconds

METERS: 4 1/2" Rectangular AM and VM—2% Accuracy

DIMENSIONS: 22" x 17" x 14 1/2"

MOUNTING: Cabinet or 19" Rack Panel

FINISH: Baked Grey Wrinkle

WEIGHT: 150 lbs.

Price: \$524 w/o cabinet, \$549 w/cabinet

All prices F.O.B. El Segundo. Terms: 1%—10 days, net 30.
Phone collect for quantity discounts.

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Model MR2432-100X

24 to 32 volts @ 100 amps



MODEL M60VMC

0 to 32 VOLTS @ 25 AMPS (CONT.)
IMMEDIATE DELIVERY!!!

REGULATION: ±1%* (a) At 28 Volts D.C.—Increases to 2% max. over the range 24-32 V.; does not exceed 2 volts regulation over the range 4-24 volts D.C.; (b) from 1/10 Full Load to Full Load; (c) at a fixed A.C. Input of 115 volts.

RIPPLE: 1% rms @ 32V. and Full Load — 2% rms max. @ any voltage above 4 volts.

A.C. INPUT: 115 Volts, Single Phase, 60 cps

FINISH: Baked Grey Wrinkle

WEIGHT: 130 lbs.

DIMENSIONS: 22" x 15" x 14 1/2"

*This unit is an economical solution to your power supply needs if stabilization for A.C. Voltage changes are not required. If this is required, write for spec. on Model MR1040-30.

Price \$439 w/o cabinet, \$474 w/cabinet

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-  Compact, 1-3/8" O.D. by 3/16" thick
-  Designed for space cell or direct operation
-  Temperature stability
-  Available for prompt delivery



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Delivery!

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JUNCTION DIODES?

CIRCLE ED-5 ON READER-SERVICE CARD FOR MORE INFORMATION

Holes Punched in Printed Circuits Automatically
... A machine that punches holes in a printed circuit board automatically according to instructions from a control tape has been developed. The costs of setting up the machine to punch out a specific board are a small fraction of tooling costs by the punch-and-die or drill methods. Set-up time is only about four hours.

The machine punches any pre-selected combination of holes in a 6" x 17.6" board in 45 sec. It will punch 60 boards of this size in one hour, including loading and unloading time. Holes are punched anywhere in 1/16" or 1/32" thick boards at 0.10" grid intersections. Known as the "Programmed Punching Machine", it was developed by Radio Corp. of America, Engineering Products Div., Camden 2, N. J. The machine offers considerable savings on short runs. It only requires one semi-skilled operator. It weighs 1500 lb.

Molten-Salt Semiconductor ... Recent metallurgical research has discovered that molten copper sulphide conducts electronically like a semiconductor rather than ionically as expected. Although electronic conduction effects have been noted previously in molten ferric sulphide, that salt displays a negative temperature coefficient of conductivity. Like solid semiconductors, the molten Cu_2S has a positive coefficient.

The discovery was made by Drs. Gerhard Derge and G. M. Pound, metallurgists associated with the Metals Research Laboratory, Carnegie Institute of Technology, Pittsburgh 13, Pa. They were examining the electrical character of many melts using a four-terminal cell and an a-c potentiometer circuit to measure liquid conductivity. The conductivity of Cu_2S was more than ten times that expected from ordinary ionic conduction. When they passed direct current through the liquid, they noted virtually no transfer of mass, indicating no appreciable ionic contribution to conductance.

Molten iron sulphide was also tested and found to conduct about ten times better than molten Cu_2S , but it has a negative coefficient, like metals. The conductivities of mattes made by mixing these two salts together approach the rule of mixtures behavior.

Existing theories on the nature of semiconduction cannot account for the new discovery since they apply exclusively to solids such as the transistor and not to liquids where the atoms are in a state of disorder.

The purpose of this research is to discover more about the nature of metal salts and refining and smelting processes and perhaps to improve these processes. Although this research may lead to a greater insight into the nature of semiconductors, it is not likely to lead to any practical new semiconductor.

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Mobile Laboratory . . . A completely equipped instrumentation laboratory has been constructed in a 28' trailer van for use on projects where it is impractical to move equipment or material to a fixed laboratory. The laboratory can measure and record 22 simultaneously occurring phenomena.

Constructed for the Armour Research Foundation, Illinois Institute of Technology, Chicago, Ill., and outfitted by the foundation's mechanism and dynamics research engineers, the laboratory is equipped to measure and record pressure, stress, strain, thrust, torque, acceleration, velocity, temperature, and many other mechanical phenomena. It also includes a photographic darkroom.

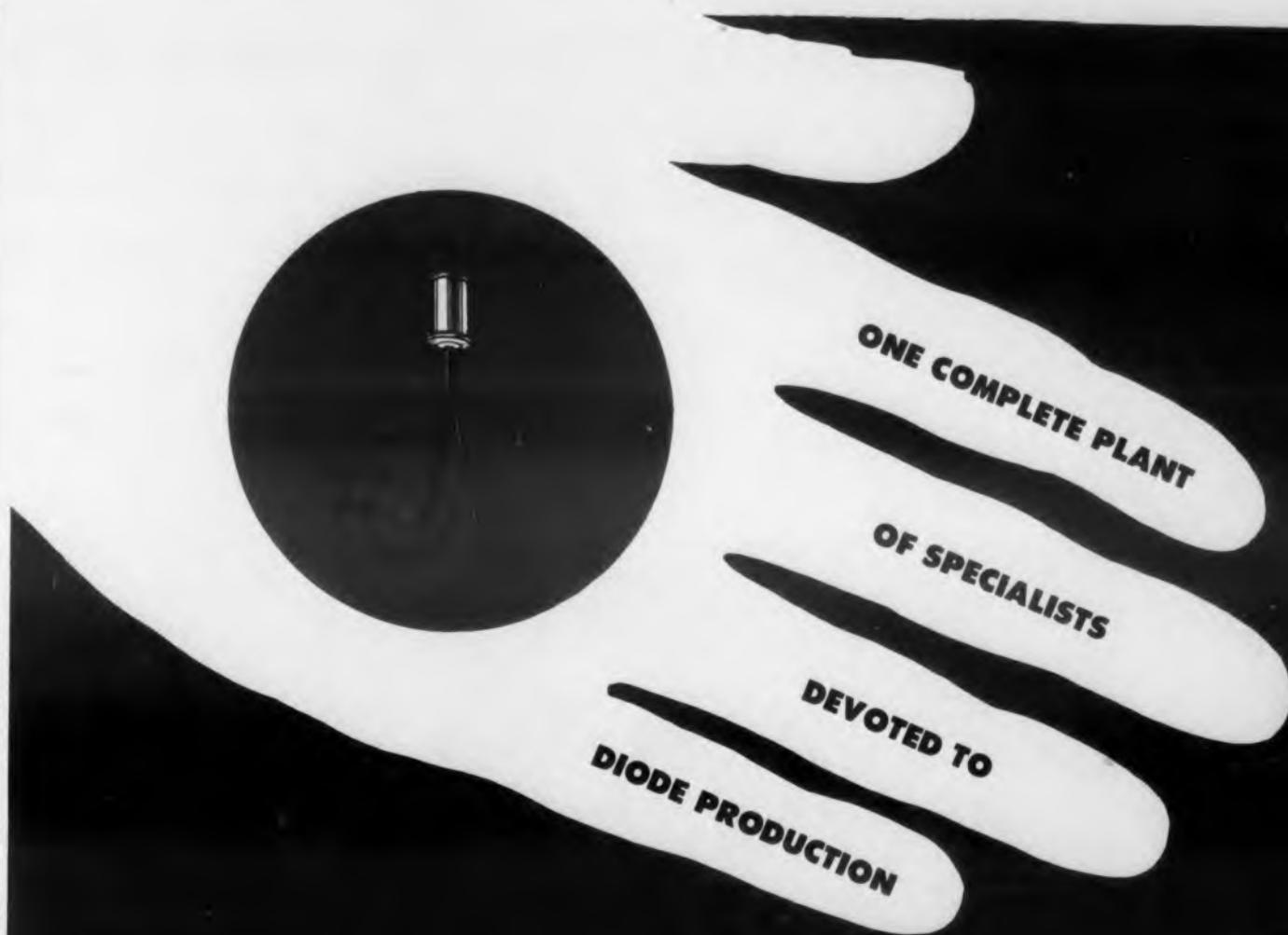
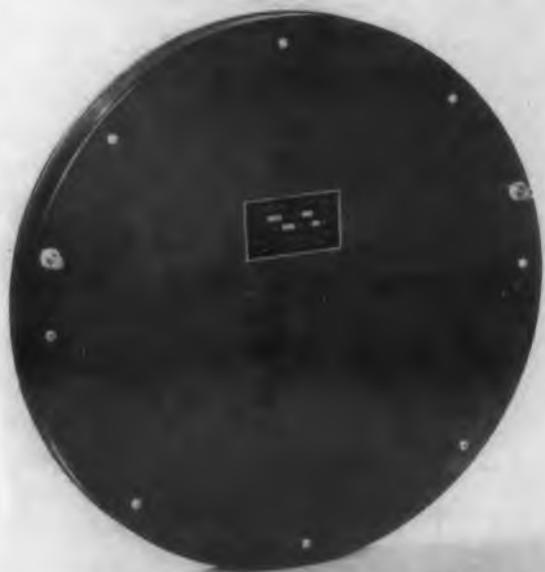
Since it has its own 5kw gasoline generator, the trailer can be used in locations where commercial power is not available. Fully insulated, it carries an automatic propane gas heater and a 3/4-ton air conditioner.

The laboratory carries a 4-channel cathode-ray oscilloscope in a specially constructed shock mount.

Long Quartz Delay . . . The solid fused quartz delay line illustrated on this page produces a delay of 4100-microsec in a radar. This delay is equivalent to more than 300 nautical miles of radar range.

The unit was developed by Anderson Laboratories, Inc., 39 Talcott Rd., West Hartford, Conn. The carrier frequency is 8Mc, with a bandwidth of 2Mc. Attenuation is 56db when terminated by a tuned 100-ohm load. The spurious response ratio is 40db. The manufacturer reports that units of longer delay and higher carrier frequency are possible.

This fused quartz delay line is mounted in a 18-1/2" diam x 1-1/2" deep enclosure.



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**Immediate
Delivery
in all
Quantities**

Specific Applications:

- High Temperature Operation
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- Matched Pairs
- Function Generators
- Diode-Capacitor "Memory" Units
- Magnetic Amplifiers
- Diode as Constant Voltage Source
- Surge Protection
- Clipping and Limiting

IN 29 RANGES . . . maximum reverse working voltage

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IN138A		18	A3B		3.3
IN137A		36	A4B		3.9
IN200		6.8	A5B		4.7
TO		TO	A6B		5.6
IN222		470			

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2. Power factor less than 1%.
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CAPACITORS FOR E N C E

Especially sturdy capacitors capable of withstanding vibrational stresses of high acceleration and frequency, and severe shock conditions encountered in guided missiles and airborne equipment.

Utilize new, rugged compression-seal type, glass-to-metal solder-seal terminals. Terminals will not work loose or rotate under any operating conditions.

Functional operating range from -55°C to $+125^{\circ}\text{C}$.

Operates normally under severe humidity conditions.

Production tests for voltage breakdown, capacitance, power factor, insulation resistance and seal are performed on a 100% basis.

Capacitance range: .001 mfd. to 1.0 mfd.; voltage range: 100 to 600 V.D.C. operating; can be provided to standard tolerance of $\pm 20\%$ or to closer tolerances, if desired.

+ FACTORS



Solar-Atomic Battery . . . Activated interchangeably by either light or radioactivity, a newly developed semiconductor battery produces enough power to operate a special low-drain transistor radio. A previously announced germanium solar battery (*ED, May, 1954, p. 5*) was activated by light only, while various batteries that convert atomic radiation into electric power have been developed (*Sept., 1954, p. 5, and November, 1954, p. 5*).

The new battery was developed at the David Sarnoff Research Center, Radio Corp. of America, Princeton, N. J., by a research team including Dr. Ernest G. Linder, Paul Rappaport, and Dr. J. J. Loferski. Like this firm's previously announced experimental atomic battery (*ED, February, 1954, p. 15*), the battery derives its power from a semiconductor junction exposed to radiation. In both batteries, the beta-particle source is strontium-90. The junction is about $1/4''$ in diameter and $1/100''$ thick.

Twelve of the units in parallel provide $10\mu\text{w}$ to operate a radio consisting of a diode detector and three transistors. The radio picked up a nearby commercial station.

Train Reservations Memorized . . .

In another application of electronics to railroading, a magnetic drum memory will be employed to keep track of 100,000 reservations per month. Installed at Stamford, Conn., along with an attendant computer, the reservation control will be tied by telegraph lines to both ends of the New Haven Railroad at New York and Boston as well as to New Haven, Hartford, and Providence. Agents will be able to tell customers within seconds if the space they desire is available. If the space is sold, the computer changes the memory accordingly.

The installation, to be known as the "Magnetronic Reservisor System" will be constructed by Teleregister Corp., Stamford, Conn. The same firm has already constructed similar systems for use in making airline reservations and in warehouse inven-

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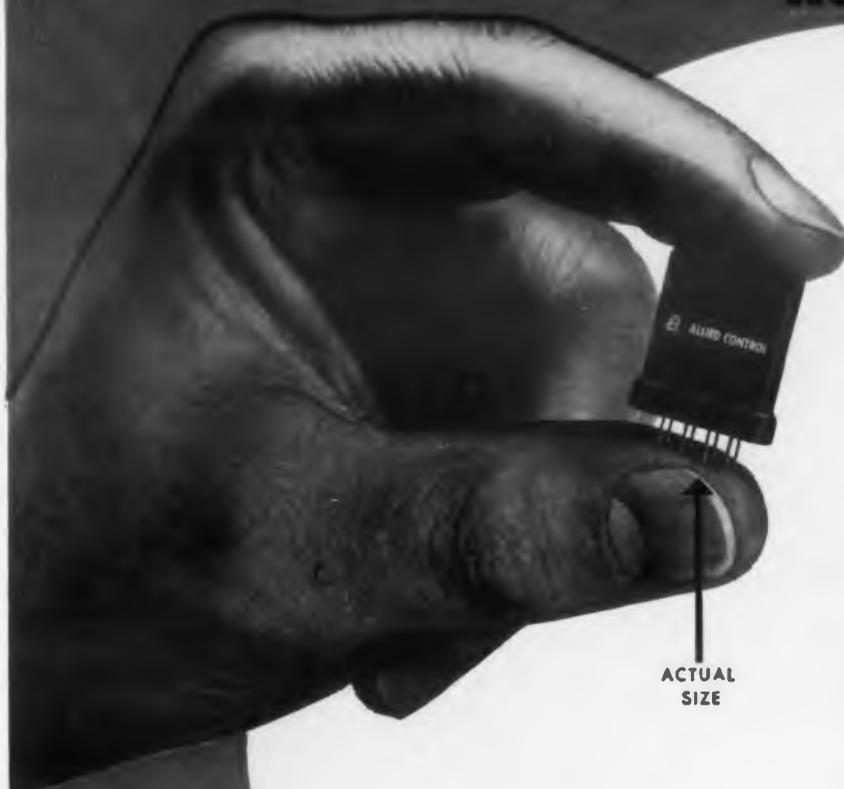
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CIRCLE ED

New Sub-Miniature Relay

Now Double Pole Double Throw
with Increased Ratings



Weights 0.33 oz.—
low capacity for R
switching. Applic
to printed circuit

TYPE KH-6D

ELECTRICAL SPECIFICATIONS

CONTACTS: Double pole double throw rated at
0.5 amperes at 26.5 volts DC or 115 volts AC
resistive

COIL: Sensitivity—nominal 1.0 watts, maximum
0.3 watts
Resistance—up to 1500 ohms standard

TEMPERATURE: Minus 60° C to plus 125° C

VIBRATION: 10 G up to 500 cycles

SHOCK: 100 G plus (operating)

SPEED OF OPERATION: 2 milliseconds at
nominal voltage direct from battery supply
and 1 millisecond with series resistance

ALTITUDE: 350 volts rms at 80,000 feet

TERMINAL TYPES: Printed circuit, solder terminals
and plug-in

CAPACITY: N. O. contact to case 0.6 mmf.

Write for catalog sheet giving complete information



ALLIED CONTROL



CIRCLE ED-8 ON READER-SERVICE CARD ➤



CHIEF PROJECT ENGINEER Harvey J. Brown (seated), Ryan Industries, Inc., Detroit, discusses new G-E motor for Ryan Industries' intervalometer-directed disseminator with G-E Sales Engineer Hugh Folsom.

G.E. develops a versatile new aircraft motor to meet rigid specs of Ryan Industries, Inc.

"Recently we required an aircraft motor of extreme versatility to meet radio-interference, explosion-proof, and other military specifications on an intervalometer-directed disseminator we are developing," says Chief Project Engineer Harvey J. Brown of Ryan Industries, Inc. "We took our problem to General Electric because of their proved ability to produce prototype and production models to meet our tight schedules."

"General Electric engineers developed a new motor which fully met our needs. And the close teamwork between our G-E sales engineer and his factory specialists

enabled us to complete our development on time."

IN SERVING YOU, G-E engineers can draw on unmatched experience gained in solving this and hundreds of similar aircraft-motor problems. And they have at their disposal G.E.'s extensive aircraft-motor development and testing facilities.

To take full advantage of this extensive engineering service, contact your local G-E Apparatus Sales Office *early in your planning*. And for more information, write today to Section 704-31, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

Transistor Auto Radio . . . An experimental auto radio incorporating nine transistors has been developed. Operating directly from a 6v car battery, it drains about one-tenth the power required by a conventional radio. More than one-half the power is drawn by the radio's two pilot lights.

The transistor radio was developed at the David Sarnoff Research Center, Radio Corp. of America, Princeton, N. J., by a research group including Larry A. Freedman, Thomas O. Stanley, and David D. Holmes. If ever placed on the market, such a radio would offer the advantages of lowered battery drain, less heat inside the car, and lessen the danger of battery failure due to the driver forgetting to shut his radio when he parks. This radio has performed satisfactorily at temperatures from -90°F . to 176°F .

Engine Analyzer . . . By connecting only two leads to an auto engine's ignition system, a recently developed electronic device can be used to detect as many as 65 different engine faults. Faults are rapidly identified by interpretation of the display on a built-in oscilloscope.

Since the analyzer can be powered by the car's battery, the engine's performance can be studied while the car is in motion. It can also be connected to a 110v a-c source. A set of blown-up photographs of typical scope displays are supplied with the instrument to enable a mechanic to utilize it with only a little instruction.

Developed in the research laboratories of Socony-Vacuum Oil Co. Inc., 26 Broadway, New York, N. Y., the analyzer will be manufactured and marketed by Allen B. DeMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

In an experiment the analyzer proved that only five out of 25 cars chosen at random were in top running condition. Devices like the analyzer have already been used to study the performance of aircraft engines.

◀ CIRCLE ED-9 ON READER-SERVICE CARD



Newest ELECTRONIC CONCEPT BY
BURROUGHS CORPORATION RESEARCH CENTER

BEAM SWITCHING TUBE...

AVAILABLE NOW IN PRODUCTION QUANTITIES



Cross Section showing
Cathode, Grids,
Spades and Targets for
10 position switching.

The beam switching tube offers a new basic device to the engineer of electronic equipment. Versatility of the basic ten-position tube is such that any desired type of sequential, simultaneous or random switching of any number of positions may be obtained. The simplicity of the tube design and associated required circuitry results in a new standard of reliability. It reduces the total number of tubes required in a circuit, space, weight, and heat in control and switching systems.

Perfected by the Burroughs Research Center... rigidly tested and accepted by key electronic plants and communications labs throughout the world... this revolutionary new tube is now precision-manufactured in production quantities with complete accuracy and dependability by the Haydu tube division, specialists in the electronic industry.

The simplicity and reliability of this new basic building block have been demonstrated in applications performing the following functions:

- DISTRIBUTING
- SAMPLING
- FREQUENCY DIVIDING
- COUNTING
- CODING
- MODULATING
- GATING
- TIMING
- CASCADING
- MULTIPLEXING
- MATRIXING
- OSCILLATING

HAYDU

BROTHERS OF NEW JERSEY

PLAINFIELD, NEW JERSEY

Subsidiary of Burroughs Corporation 



An Applications Engineering Department, offering engineering service and consultation, has been set up to assist you in taking full advantage of this device. For further information, contact:

APPLICATIONS ENGINEERING DEPARTMENT
HAYDU BROTHERS OF NEW JERSEY
c/o BURROUGHS RESEARCH CENTER
PAOLI, PENNSYLVANIA

Crystal Spectrometer . . . In order to overcome the handicap of dealing with a multitude of photon energies with inefficient detectors, the National Bureau of Standards, Washington 25, D. C., has developed a crystal spectrometer having a photon-detection efficiency exceeding 80% and an energy resolution of 11% in the range from 0.5 to 50Mev. The heart of this spectrometer are two large sodium-iodide, thallium-activated crystals 4" long x 5" diam.

The dissipation of the energy of an individual photon in such crystals produces a visible light pulse that is detected and measured by photomultiplier tubes. The total light output is proportional to the total energy absorbed. The development of this spectrometer has provided an approach to many experimental research problems that were formerly considered impossible of attack because of the low detection energy of available instruments.

Computers Aid Plane Design . . .

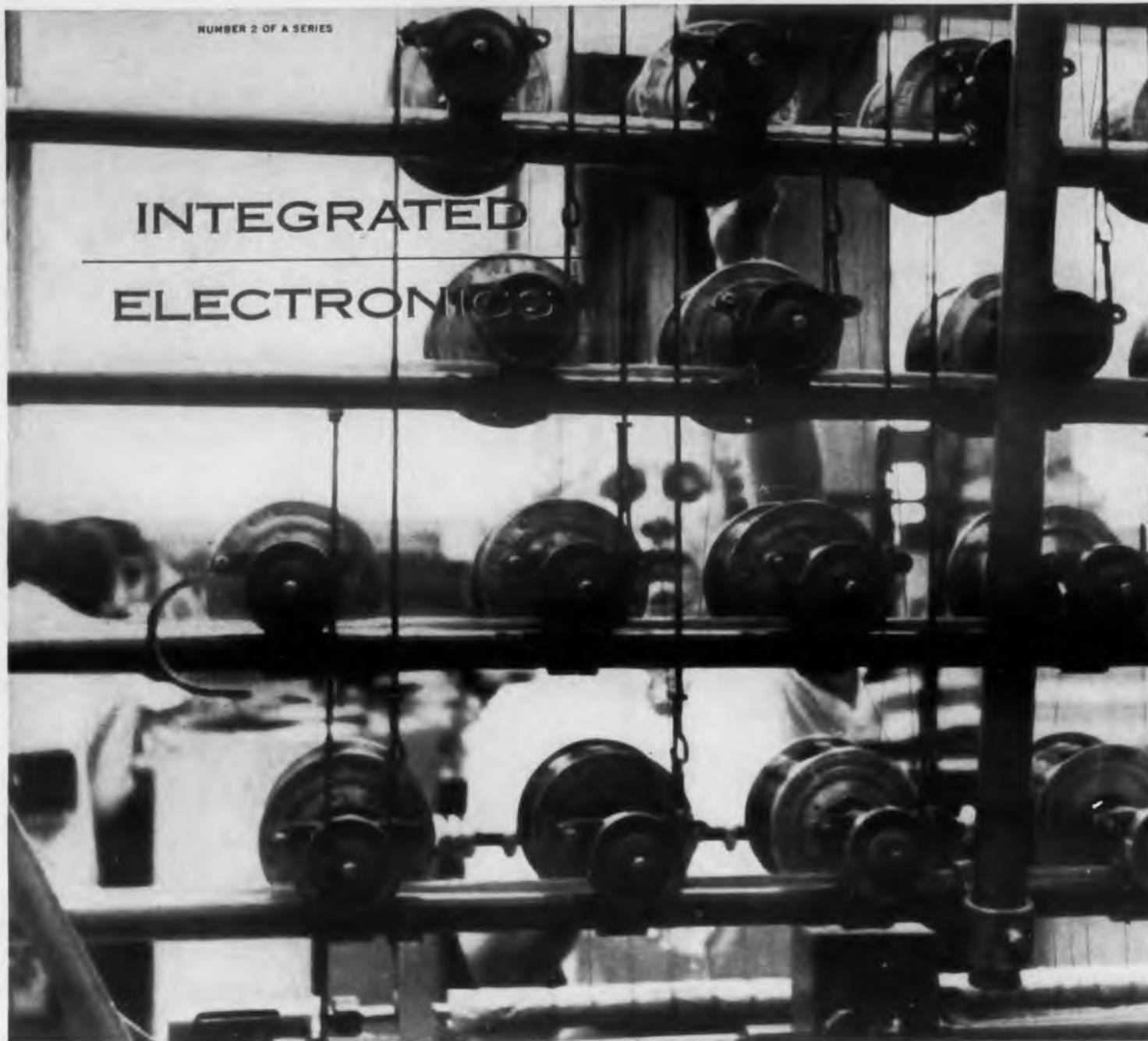
Electronic computers have invaded the aircraft industry on a large scale. Three of the nation's biggest manufacturers of air planes have leased large-size digital computers to aid in the design and evaluation of new types of planes, while a fourth concern has developed its own data-reduction device.

Both Lockheed Aircraft Corp., Marietta, Ga., and Bell Aircraft Corp., Buffalo, N. Y., have leased type 50 Magnetic Drum Data Processing Machines from International Business Machines Corp., 590 Madison Ave., New York 22, N. Y. Convair, San Diego, Calif., has leased a Remington-Band Univac Scientific ERA-1103. Analog Computers are already in service at Convair's San Diego and Pomona, Calif., installations, and another large digital computer had previously been installed at Convair's Fort Worth, Texas, division.

Chance Vought Aircraft, Dallas, Texas, has constructed its own electronic telemetering and automatic data reduction facility. Data from planes under test is recorded on three magnetic tape recorders.

CIRCLE ED-10 ON READER-SERVICE CARD >

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Three complete plants with a total of 240,000 square feet are devoted exclusively to precise military electronics and electro-mechanical production. These facilities are staffed and equipped to design, develop, test, and manufacture equipment ranging in size from miniature transceivers to heavy shipboard fire control weighing more than two tons.

Hoffman Laboratories is equipped with a completely integrated manufacturing operation with sheet metal, machine shop, plating, welding, assembly, and test departments.

Constant quality control and inspection procedures assure the highest equipment efficiency... equipment that meets and exceeds requirements.

Write the Sales Department for your free copy of "Report From Hoffman Laboratories."

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 Noise Reduction
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 Communications
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 Transistor Application



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 WRITE TO DIRECTOR OF ENGINEERING, HOFFMAN LABORATORIES, INC., 3761 SOUTH HILL STREET, LOS ANGELES 7, CALIFORNIA

CIRCLE ED-11 ON READER-SERVICE CARD FOR MORE INFORMATION

Summer Schools

The following courses are being offered during the coming summer. They are all on the advanced or graduate level. Where available, the name of the person to write to for more information and registration and application dates are given.

Columbia Univ., New York, N. Y. Thomas C. Izard, Registration from June 30-July 1.

Engineering s205, Application of the Laplace Transformation to Engineering Problems.
 EE s270, Information Theory.

Manhattan College, Riverdale, New York 71, N. Y. Brother A. Leo. Registration July 6.

July 8-August 19: Mathematics 59.5, Higher Mathematics for Engineers.

Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y. Prof. A. B. Giordano. Registration from May 30-June 3.

June 6-July 27: 4600, Techniques in Microwave Measurements.

Massachusetts Institute of Technology, Cambridge 39, Mass. Prof. Ernest H. Huntress.

June 14-24: 2.439, Industrial Applications of Heat Transfer to Electronics.

June 20-July 1: 2.739, Creative Engineering and Product Design.

6.569, Switching Circuits.
 M419, Numerical Analysis.

July 18-29: 6.628, Noise in Electron Devices

August 22-September 2: 6.601, Numerical Control of Machine Tools.

Univ. of Illinois, College of Engineering, Urbana Ill. Prof. G. H. Fett. Registration deadline June 18.

June 20-August 13:

Servomechanisms and Automatic Control Devices.

Electric and Magnetic Fields.

Electromagnetic Waves and Radiating Systems.

Advanced Communication Networks.

Vacuum Tube Circuit Analysis.

State Univ. of Iowa, Iowa City. Ted H. McCarron. Applications to June 14. Registration begins June 14.

June 15-August 10:

55:100 Elements of Applied Electronics

55:101 Applied Electronics Laboratory.

55:151 Industrial Electronics.

55:213 Advanced Engineering Problems.

55:241 Electrical Research.

Univ. of Texas, Austin 12, Texas. A. W. Straiton.

June 7-August 30: EE 392K, Antenna Theory and Practice.

Univ. of Michigan, College of Engineering, Ann Arbor, Mich. S. S. Attwood.

Regular Summer Session: June 17 to August 13.

EE 100, Circuits II.

EE 121, Radio Communications II.

EE 210, Electromagnetic Field Theory.

EE 283, Physical Electronics.

July 5-29: Transistor Application Symposium.

Registration July 5. Application deadline June 1.

EE 401, Fundamental Physical Properties of Transistors, and Pulse and Switching Applications.

EE 402 Transistor Circuit Principles, and Applications for Continuous-Operation Service.

Special Short Courses

Digital Computation Dept., Willow Run Research Center, Univ. of Michigan, Ypsilanti, Mich. Dr. John W. Carr III, application deadline June 1.

August 1-12: Digital Computers and Data Processors.

At Ann Arbor. Prof. Donald L. Katz, 2028 East Engineering Building, Ann Arbor, Mich.

Automatic Control, Course I: June 13-18. Course II: June 20-22.

Oklahoma Institute of Technology, Oklahoma A & M., Stillwater, Okla. Write to Prof. C. F. Cameron, School of Electrical Engineering.

June 6-August 6. Application deadline June 6.

EE 403, Electrical Transients: Transient behavior of electrical power and communication networks.

EE 510, Seminar: To acquaint students with the literature of electrical engineering, particularly of recent times.

EE 560, Engineering Mathematical Physics, Part II: Basic principles, including switching algebra, governing the intercommunication of two-valued switching elements to form networks and systems for automatic control and digital computers.

EE 570, Advanced Analysis of Electrical Engineering Problems: Study of electromagnetic relays including an introduction to relay design.

(Either EE 560 or EE 570 will be offered, not both. Choice will be governed by demand. A choice of several advanced mathematic courses will also be available).

Pennsylvania State Univ., University Park, Pa. Reed Ferguson, General Extension Building.

June 27-July 2: Creative Engineering.

August 1-12: Technical Report Writing Workshop.

Northwestern Univ., Evanston, Ill. Dr. J. A. M. Lyon, Chairman, Dept. of Electrical Engineering, Application deadline June 4.

June 21-September 3.

EE 550 Nonlinear Electron-Tube Circuits.

EE 612, Operation Circuit Analysis.



YES... 2 OUT OF 3 ELECTRONIC ENGINEERS SPECIFY MOLONEY TRANSFORMERS FOR TRANSMITTERS

Big league designers recognize that the key man on a transmitter team is the dependable transformer. Therefore, it is not surprising that 2 out of every 3 transmitter manufacturers specify Moloney Transformers. That's a .667 batting average and that's good in any league.

With Moloney in the lineup... you aren't fielding a rookie... but a seasoned veteran.

For your transmitter specify a league leader.

- Modulation Transformers
- Modulation Reactors
- Rectifier Transformers
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Write for Bulletin ST3505.



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(Surface Barrier)

TRANSISTOR



under 35 and have baccalaureate degrees in electrical engineering from colleges in the United States and Canada within ten years prior to May 1, 1955. Awards are made on the basis of social and civic accomplishment as well as technical achievements.

Nomination forms may be obtained from A. B. Zerby, executive secretary, Eta Kappa Nu Association, P. O. Drawer C, Dillsburg, Pa. Nominations must be returned to Mr. Zerby not later than May 31, 1955.

TV Receiver Sales Up . . . Retail sales of TV receivers in 1954 increased by nearly one million units from the level of 1953, according to the Radio-Electronics-Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C. For the year, 7,317,034 receivers were sold at retail compared with 6,370,571 sets sold in 1953.

Retail sales of radios, excluding automobile receivers, totaled 6,430,743 units during the year compared with 7,031,293 sets sold in 1953. In addition to the home, clock, and portable radios sold at retail, an additional 4.1 million auto radios were manufactured during the year.

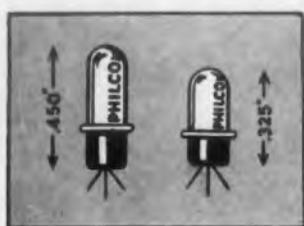
Methods Improvement Competition . . . Entries are now being accepted for the Fifth Annual Methods Improvement Competition sponsored by the Industrial Management Society. The competition is to be in conjunction with the 19th Annual Time and Motion Study and Management Clinic scheduled for Nov. 9-11, 1955 at the Hotel Sherman, Chicago, Ill.

Industrial plants and companies are invited to submit 16mm motion picture films showing the "before" and "after" phases of methods improvements made in their manufacturing, processing, or office operations. The competition is divided into two sections—for companies over 1000 and those under 1000 employees.

Rules and regulations for the contest may be obtained from the Society, 35 E. Wacker Drive, Chicago 1, Ill.

For the First Time...

High Frequency Circuits Can Be COMPLETELY TRANSISTORIZED



Philco SB Transistors are available in the sizes shown here—standard and miniature.

Today, Philco's new SB Transistor opens up a completely new field of commercial, industrial and military applications for the electronics design engineer. With vastly superior performance assured to 50mc and above, many basic circuits can now be *completely transistorized*. Video bandpass amplifiers, wide band low-pass amplifiers, high frequency oscillators and high speed switching are only a few of the innumerable circuits which the design engineer can produce quickly, easily, efficiently with the revolutionary new SB Transistor.

UP TO 10 TIMES BATTERY LIFE

The Philco Surface Barrier Transistor operates efficiently with power consumption of less than *one* milliwatt! This extremely low power drain results in up to *ten* times the battery life obtainable with junction transistors, vastly reducing operating costs. Hermetically sealed, the SB Transistor has greater inherent characteristics of stability, longer life and higher efficiency than any other type of transistor.

HIGHEST UNIFORMITY YET ATTAINED

Due to Philco's unique design and precision production methods, the SB Transistor reaches a degree of uniformity and unvarying quality never before achieved with transistors. This remarkable quality permits design engineers to specify the Philco SB Transistor with full assurance of superior performance.

Now being produced in quantity this new Philco SB Transistor is available for your current projects and immediate shipment can be made to you.

**For complete technical information on the PHILCO SB Transistor
write Dept. ED**

PHILCO CORPORATION
GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44, PENNSYLVANIA

Automatic Zone Melter . . . An automatic zone melting apparatus has been developed at the National Bureau of Standards, Washington 25, D. C. The zone melting process is widely used to purify semiconductor materials or to produce semiconductor compounds (*ED, March, 1954, p. 5*). In the Bureau's device, the induction heating coils are driven by a motor along the length of the melting tube and returned automatically to the starting position for a new run.

The heating coils are not shut off on the return path because the coils move too fast to melt the semiconductor inside the tube. The Bureau's zone melter is now being used to produce a series of intermetallic compounds formed between the metal antimony and the metals indium, gallium, or aluminum.

Another Work-Study Program . . .

Advanced degrees in electronics engineering at Stanford University are available to electrical engineering graduates on a work-study basis through the Honors Cooperative Program of Stanford University in cooperation with Ampex Corp.

Further information and applications may be secured from the Manager, Personnel Dept., Ampex Corp., 934 Charter St., Redwood City, Calif.

Color Wheel Used in Russian Color TV . . .

The discarded field sequential color TV system, which requires a rotating mechanical color wheel, is reported to be in use in Russia. According to the *Du Mont Dispatch*, published by Allen B. Du Mont Laboratories, Inc., New York, N. Y., experimental live and film color TV broadcasts are being transmitted from a studio in Southwest Moscow.

Electronic Inventory Control . . .

An electronic inventory control system will be installed at the B. F. Goodrich Footwear & Flooring Plant, Watertown, Mass. The "Magnetronic" inventory system was made by Tele-register Corp., Stamford, Conn.

← CIRCLE ED-15 ON READER-SERVICE CARD

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62nd St.,

CIRCLE E

Radio Amateur's Course . . . Sales of communication equipment to amateurs should be stimulated by the availability of a new course for amateurs. The Radio - Electronics - Television Manufacturers Association, 777 14th St., N. W., Washington 5, D. C. is offering a course teaching the international code by records, and explaining how to construct a two-way station.

Electronic Doorman . . . A reader has proposed an electronic doorman for apartment houses incorporating a closed-circuit TV system. The system would consist of a TV camera trained on the entrance way with monitors in each apartment. A person desiring to enter the building could be viewed in the monitor by the tenant whose bell he rings.

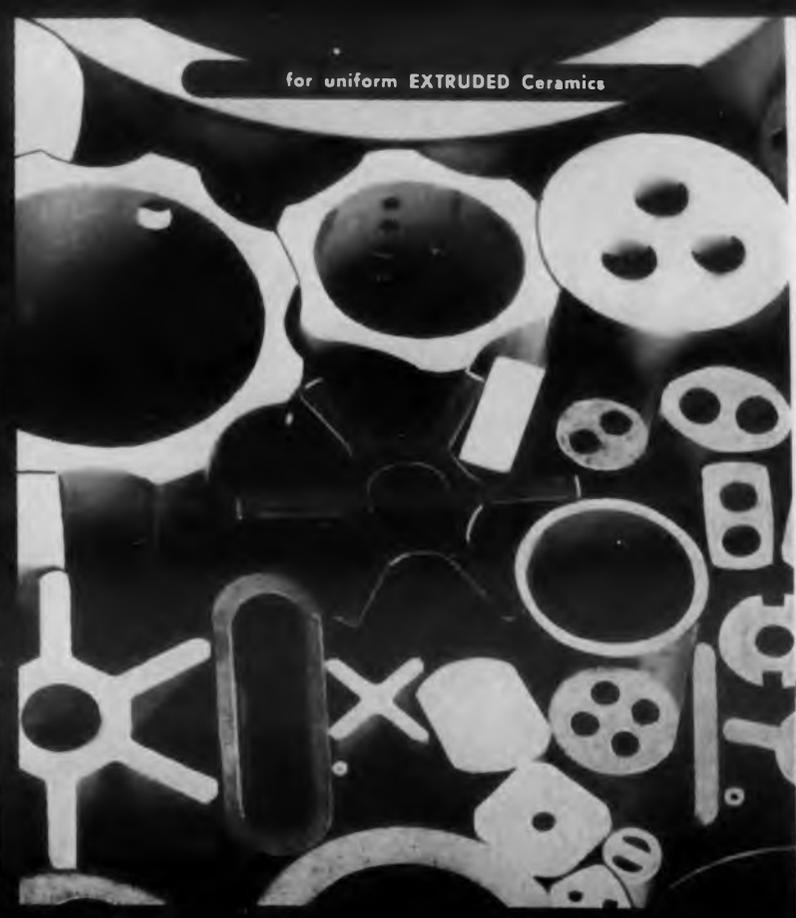
If such a system came into widespread use, it might have an adverse effect on the size of broadcast TV audiences. Housewives might spend all their time at the monitors observing the people visiting their neighbors.

Portable X-ray . . . Another use for radioactive materials has been found in the development of a portable X-ray unit. By using thulium-170 as the source of X-rays, no electrical power source is required. The unit weighs 20 lb.

Known as the "Iso-X", the unit is manufactured by Litton Industries, 336 N. Foothill Rd., Beverly Hills, Calif. The radiation from the unit is low enough to permit an operator to remain near it without exceeding the minimum tolerance dose. Since the half-life of thulium-170 is 129 days, the time needed for producing a negative increases as the source decays.

If you need a special circuit, component, material, send us your request on company letterhead. We will publish it along with your name and address in the earliest issue possible. Interested readers can answer you directly.

Address brief requests to Information Dept., ELECTRONIC DESIGN, 19 E. 62nd St., New York 21, N. Y.



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CIRCLE ED-17 ON READER-SERVICE CARD FOR MORE INFORMATION

Single Tube for 3 Colors . . . A new developmental TV camera tube is able to generate red, green, and blue signals simultaneously. The present color camera required a separate tube for each color, with the three signals combined into a single signal. By generating all the colors simultaneously in one tube, the problem of overlapping or fringing of color signals is eliminated. In addition, the color camera can be more compact.

Known as the "Tricolor Vidicon", the tube is under development at the David Sarnoff Research Center, Radio Corp. of America, Princeton, N. J., by a group including Dr. Paul K. Weimer, Dr. Sidney Gray, Dr. Stefan A. Ochs, Harold Borkan, and Harry C. Thompson. It is the same size as present color camera tubes.

The heart of the tube is an intricate color-sensitive target applied to the face of the tube by an evaporation technique. The target is a rectangle whose diagonal measurement is 1-1/2". It consists of nearly 900 fine vertical strips of alternating red, green, and blue color filters, covered by three sets of semi-transparent, closely spaced, conducting signal strips. The signal strips corresponding to a given color are all connected to a common output terminal and insulated at the same time from the strips of the other two colors.

The target is scanned by a single electron beam. The color-sensitive filters permit the signal strips to produce electrical signals corresponding to the arrangement of light and color in the scene before the camera.

Current research on the Tricolor Vidicon is concentrated on the development of more sensitive photoconductive materials that will permit this tube to operate as efficiently under all lighting conditions as present camera tubes.

Eight-Hour Records . . . Recording on endless reels of vinyl tape, a new European recording system offers up to 8 hr of uninterrupted music. Like ordinary records, the tape is grooved and the pickup is a metal stylus similar to a needle. The 1/2" wide reels are housed in plastic boxes called "sound books". A special playback unit, illustrated above, is required.

Although this recording system has been marketed on the Continent for four years by Teflon, Cologne, Germany, it is being introduced in this country for the first time by Audio-Master Corp., 17 E. 45th St., New York, N. Y. It has been under development for the last 15 years. To play one of the books, it is placed on a spindle projecting from the top of the playback equipment. The spindle mates with grooves in the reel. A little transparent plastic window is then opened in the book and loop vinyl tape is pulled out and slipped over the friction-drive wheels. The drive wheels are turned on and the stylus



A Teflon "sound book" is being mounted on the playback unit. Each book contains up to 600' of vinyl tape for eight hours of uninterrupted playing.

moved into position against the tape. The tape moves at two speeds: 7-1/2"/sec and 3-3/4"/sec.

There are about 82 grooves in the tape. In playing a complete record, the stylus slowly moves down the 1/2" width of the tape. The head mounting the stylus is carefully balanced so that the stylus does not wear hard on the bottom of the groove. The tapes have a long life. They are made in much the same manner as ordinary records.

No rewinding of the tapes is necessary, since they revolve inside the book in a figure-eight manner, automatically rewinding. It is possible to approximately choose the portion of the tape by moving the stylus from one groove to another. The greatest advantage of the Teflon system is in playing long musical pieces or in providing hours of background music. It is not likely to be used for short popular recordings in this country.

Electronic Ranching

By registering the number of times this cow stretches its neck to chew grass, the electronic device strapped to the animal's back will help determine which grasses cattle like best. The unit was developed by Burgess Products, Ltd., Dukes Way, Team Valley, Gateshead, England.



4 FAMOUS *Collins* COMPONENTS ARE READY TO WORK FOR YOU

AUTOTUNES AND AUTOPOSITIONERS

By means of the Collins Autotune, shafts or devices requiring accurate positioning can be automatically reset to any of several variable positions. Auto-positioners are used where up to 20 or more fixed positions are needed. Rotational reset accuracy .05°; Autotune Channels: 8-12 each independently variable over entire range, this may vary from a fraction of one turn to as many as 20 turns. Output torque is available in the range from 1/2-24 pound-inches. Operation time: as low as 1 sec.; System weights: as low as 2 lbs.; Power supply: 28 v dc, 110 v ac 50/60 cycles or other conventional sources.

MECHANICAL FILTERS

The Collins Mechanical Filter is an electro-mechanical bandpass filter, smaller than the usual i-f transformer, but providing better i-f selectivity than several stages of conventional tuned i-f circuits. The Mechanical Filter, readily adaptable to existing or new i-f designs, can be supplied with bandwidths from 500 cps to 12 kc for center frequencies from 100 kc to 500 kc, with -60 db bandwidths less than 3 times the -6 db bandwidths. Response variation within the passband is less than 3 db. Performance is dependable from -40°C to +85°C with relative humidities up to 95%.

PRECISION TUNED OSCILLATORS

Collins Precision Tuned Oscillators are permeability tuned and incorporate a precision lead screw. Mechanically rugged and sealed against atmospheric changes, these accurate R.F. sources are individually compensated for temperature and voltage variations. Fundamental frequencies in the range of 450 kc to 4 mc are covered and frequency multiplication may be employed to attain complete frequency coverage. R.F. output 1-30 v rms depending on model. Output is linear with lead screw rotation making dial design easy. Average short term (24 hr.) stability under specified condition is in the order of .003% after warmup.

HYSTERESIS SYNCHRONOUS MOTORS

Ideal for driving timing mechanisms, magnetic storage drums, recording charts and automatic frequency controls, Collins precision built hysteresis motors feature high starting torques and superior efficiency. Synchronous performance is possible from zero to as high as 1000 cycles per second. Diameter 2", length 2.3", torque up to 2 oz.-in. Some models have split windings for operation directly from plate circuits of 2 phase, direct-coupled push-pull amplifiers thus eliminating output transformers. Other models for 60 cps and 400 cps fixed-frequency operation from conventional power sources.

For complete information on any of these Collins Components contact your nearest Collins office.

COLLINS RADIO COMPANY

CEDAR RAPIDS, IOWA

261 Madison Avenue, NEW YORK 16, NEW YORK
1200 18th Street N.W., WASHINGTON, D. C.
1930 Hi-Line Drive, DALLAS 2, TEXAS
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COLLINS RADIO COMPANY OF CANADA, LTD.
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CIRCLE ED-18 ON READER-SERVICE CARD FOR MORE INFORMATION

with the help of **EPON RESIN...**

Motor stator becomes pump housing as well— in new, ultra-compact, refrigeration motor-compressor



New Compressor (left) takes only 27% of the space of a conventional unit (right). It has only 10% as many parts, weighs 58% less, and will cost much less to produce.

Assembled stator (left). Finished stator (right) has been potted with Epon resin formulation. New compressor was developed by Wetmore Hodges and Associates, Redwood City, California.



Why not combine the pump and the motor? Put a gear pump *inside* the motor stator, encase the stator in plastic, and you can build an entire motor-compressor in the space occupied by a conventional motor alone!

Wetmore Hodges and Associates have done just that. But along the way, they ran into an unexpected problem. With the motor stator doubling as the pump housing, it had to be pressure tight . . . free of voids. This was impossible to achieve with standard potting compounds.

After hundreds of plastic formulations were tried, an Epon resin-based compound solved the problem. The Epon-impregnated stator proved to be pressure tight, stable mechanically and fully resistant to Freon at 350 psi, at temperatures as low as -20° F and as high as 250° F. Important too, Epon resin has excellent dielectric properties; is impervious to air, oil and water.

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May 18-20: National Telemetering Conference, Hotel Morrison, Chicago, Ill. For information, write to IRE, 1 E. 79th St., New York 21, N. Y.

May 19-21: Global Communications Conference, Hotel Commodore, New York, N. Y. Sponsored by the Armed Forces Communication Association.

May 23-25: Ninth Annual Convention of the American Society for Quality Control, Hotels Statler and New Yorker, New York, N. Y. For information, write to W. E. Gaunt, E. R. Squibb and Sons, New Brunswick, N. J.

May 26-27: Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif. For information, write to Dr. Lester M. Field, 8820 Bellanca St., Los Angeles, Calif.

May 31-June 3: Basic Materials Exposition, Convention Hall, Philadelphia, Pa. For information, write to Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

May 31: Symposium on Elementary Particles, Pisa, Italy. Sponsored by the International Union of Pure and Applied Physics. For information, write to Dr. H. A. Barton, Secretary, U. S. National Committee, International Union of Pure and Applied Physics, 57 E. 55th St., New York 22, N. Y.

June 13-18: International Design Conference, Aspen, Colo. For information, write to E. W. Fairfield, Libbey-Owens-Ford Glass Co., Toledo 3, Ohio.

June 14-16: Conference and Exhibit on Magnetism, William Penn Hotel, Pittsburgh, Pa. Sponsored by the AIEE, American Institute of Mining and Metallurgical Engineers, and American Physical Society. For information, write to A. C. Beiler, c/o Westinghouse Electric Corp., 2-F Materials Engineering Dept., E. Pittsburgh, Pa.

June 20-25: International Symposium on Electromagnetic Wave Theory, Univ. of Michigan, Ann Arbor, Mich. Sponsored by Commission VI of URSI. For information, write to J. W. Crispin, Jr., Univ. of Michigan, Ann Arbor, Mich.

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June 27-29: First Annual Nuclear Society Meeting. Pennsylvania State University, State College, Pa. Sponsored by the American Nuclear Society. For information, write to Prof. W. W. Miller, Pennsylvania State University, State College, Pa.

June 27-July 1: AIEE Summer General Meeting, New Ocean House, Swampscott, Mass. For information, write to AIEE, 33 West 39th St., New York 19, N. Y.

June 28-July 9: International Electrotechnical Commission, London, England. For information, write to the U. S. National Committee, c/o American Standards Association, 70 E. 45th St., New York 17, N. Y.

August 22-23: Symposium on Electronics and Automatic Production, San Francisco, Calif. Jointly sponsored by Stanford Research Institute and the National Industrial Conference Board. For information, write to Stanford Research Institute, Palo Alto, Calif., or the National Industrial Conference Board, 247 Park Ave., New York, N. Y.

August 24-26: Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif. Sponsored by the West Coast Electronic Manufacturers' Association and the Seventh Region of the IRE. For information on exhibits, write Mal Mobley, Jr., 344 N. LaBrea Ave., Los Angeles, Calif. Technical papers should be submitted to Dr. W. A. Edson, Applied Electronics Laboratory, Stanford, Calif.

September 12-16: Tenth Annual Instrument-Automation Conference and Exhibit, Shrine Exposition Hall and Shrine Auditorium, Los Angeles, Calif. Sponsored by the Instrument Society of America. Analytical Instrument, Computer, and Maintenance Clinics will be held during the conference. For information, write to Dr. Arnold O. Beckman, 3443 S. Hill St., Los Angeles, Calif.

September 14-16: Annual Meeting of the Association for Computing Machinery, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.

October 3-5: Eleventh Annual National Electronics Conference, Hotel Sherman, Chicago, Ill. For information, write to J. Kocik, c/o Illinois Bell Telephone Co., 208 W. Washington St., Chicago 6, Ill.

October 24-25: First Annual Technical Meeting of the Professional Group on Electron Devices of the IRE, Shoreham Hotel, Washington, D. C. For information, write to IRE, 1 E. 79th St., New York, N. Y.

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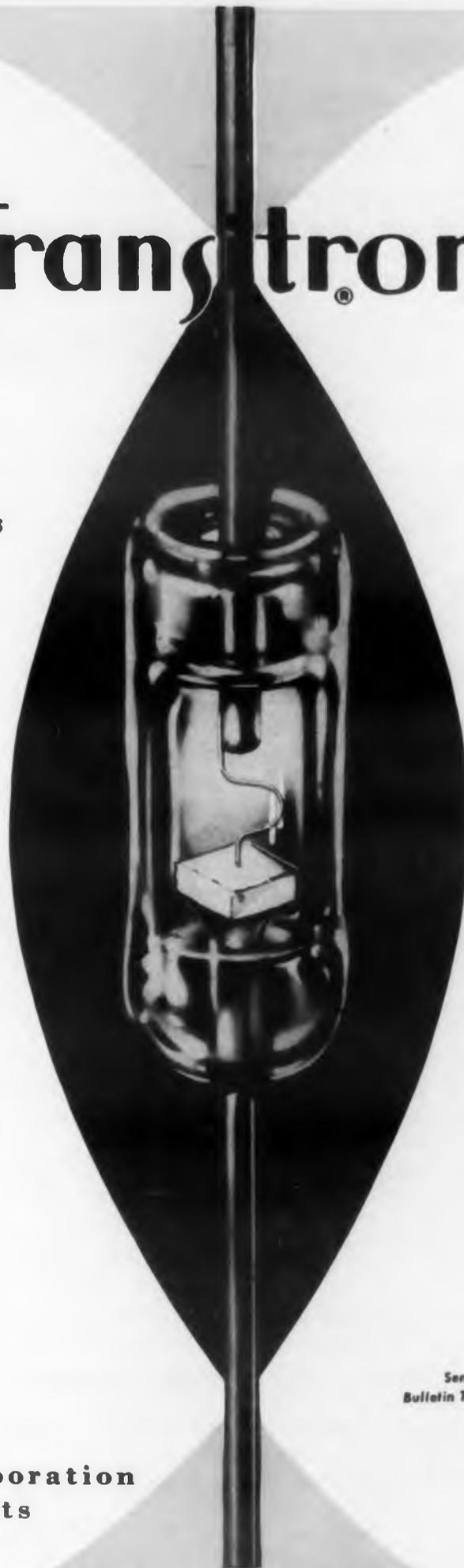
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Design For Automation

By Robert C. White, Staff Engineer

Automation Engineering Laboratory

Greenwich, Conn.

AUTOMATION in the electronics industry has been achieved to a moderate degree, today, by the component manufacturers. Standardized sub-assemblies are being produced in large quantities by automation techniques by a number of component and equipment manufacturers. To a large degree this automation has been made possible by top level decisions to redesign components to product characteristics which, without affecting the desired performance factors, facilitate mechanical feeding to automatic manufacturing machinery and assembly stations.

The electronic engineer contemplating design for automation will find his problems greatly reduced if he can place himself in the position of the mechanical engineer who is given the job of producing a machine for automatic production. In a great many cases the feasibility of automation hinges on the adaptability of the component parts to hopper feed methods. It is the purpose of this article to discuss the design factors which result in ease of feeding and those factors which are to be avoided wherever and whenever possible.

Early efforts to mechanize electronic manufacturing were concentrated on the development of special machinery. These machines, although of great importance in reducing manufacturing costs, were often limited by the necessity of resorting to hand feeding assisted by various jigs, fixtures, and transfer mechanisms. It was soon recognized that human dexterity

and fatigue were the bottleneck in further improvement. As early as 1930 the development of several practical mechanical parts feeders pointed the way to fully automatic operations. In 1948 the introduction of the vibratory parts feeder opened up the possibility of large scale feeding of glass and ceramic parts which were often damaged in earlier mechanical feed units. The important reductions in cost achieved by fully automatic operation were now given a sharp acceleration and the electronic component design engineer found himself faced to an ever-increasing degree with the question from top management, "Will the product lend itself to automation?"

The basic concepts to follow are applicable to all component design where immediate or future automation is to be considered regardless of whether they are made of metal, ceramic, plastic or fibre.

The most common components encountered in electronic assembling, testing or manufacturing operations are vacuum tubes, dry rectifiers, resistors, capacitors, coil forms and terminal posts. It is these components and their elemental parts which will form the largest challenge to the design engineer in maintaining and increasing the rate at which automation is finding its rightful place in the vigorous expanding electronic industry.

The direct results which must be expected from a consistent awareness of the importance of the "design for feeding" concept are higher production rates, lower costs, improved quality control and a general

up-grading of the workers due to elimination of monotonous manual operations and increased need for a larger percentage of technical operator and maintenance personnel.

Hopper Feed

Let us now examine the factors which are of prime importance in designing for automation. The criterion to shoot for is design of parts which can be consistently hopper fed in an oriented position.

Symmetry—In all considerations of symmetrical component design two factors must be emphasized: mass and dimensions.

In most cases it is satisfactory to consider the mass factor simply as the location of the center of gravity of the component. Only in cases where elements of an electronic component are free to change position with respect to one another must a more detailed dynamic study be carried out. The design engineer should establish the location of the center of gravity of each component he develops as a matter of routine if automation methods are to be employed in its application on the production assembly line.

For purposes of this discussion dimensional symmetry shall be defined as symmetry with respect to three axis through the center of gravity. Examples of typical symmetrical components are shown in Fig. 1.

Dissymmetry—If the design of a component requires one or more degrees of dissymmetry it is

Fig. 2. The right are symmetrical more design hopper fed right parts require special indexing.

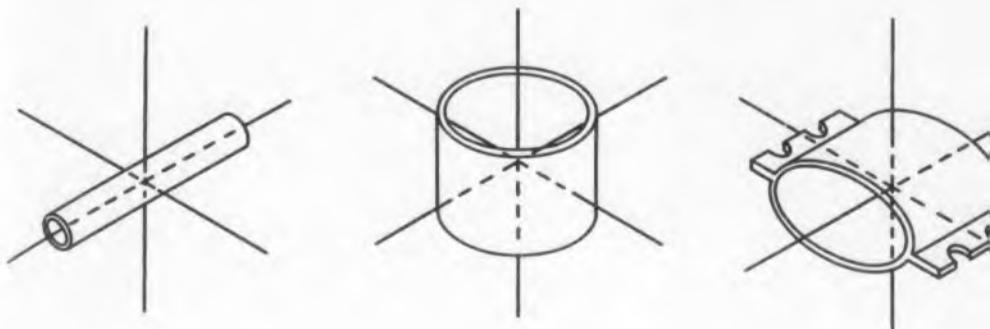


Fig. 2. The parts to the right are externally dissymmetrical in one or more degrees; all can be hopper fed. The extreme right parts, d and e, require special devices for indexing.

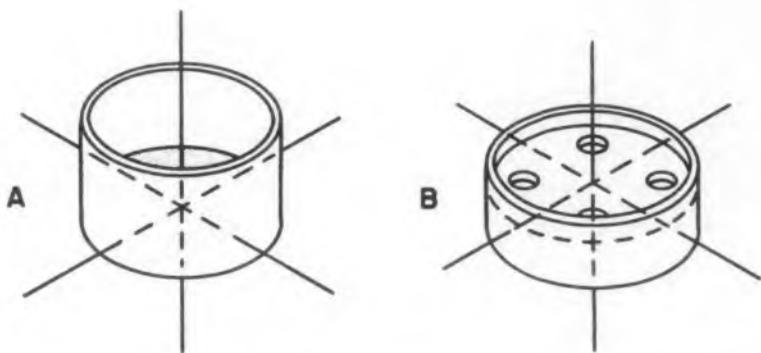
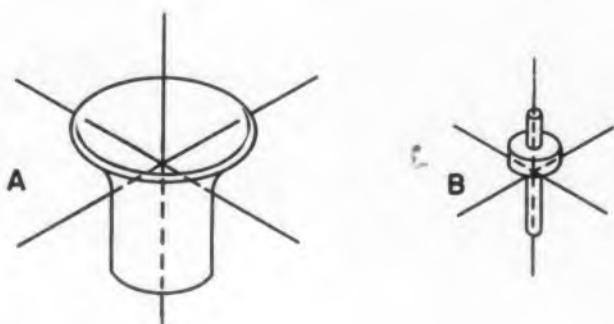


Fig. 4. Parts which are flat and less than 0.020" thick are seldom satisfactory for hopper feed because of difficulty in obtaining single layer feed.

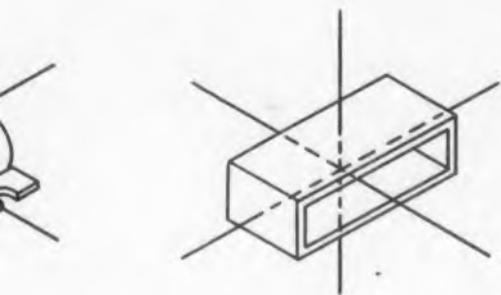


Fig. 1. All of these parts are symmetrical in 3 degrees. They are all simple to hopper feed.

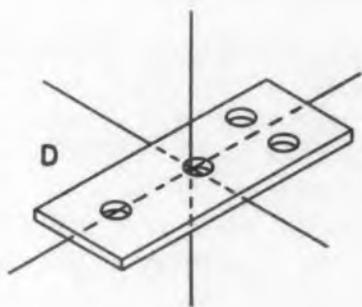
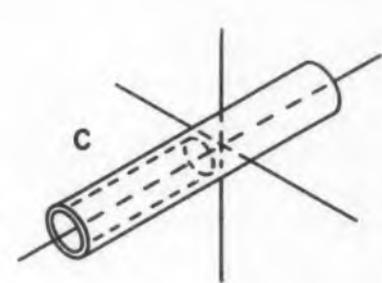
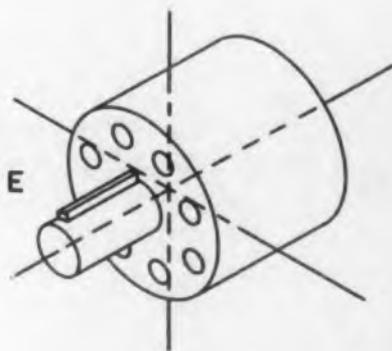
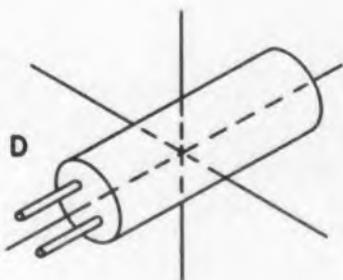
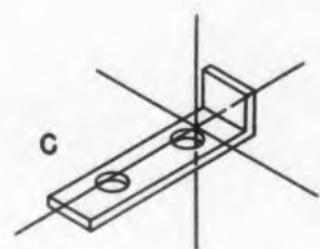
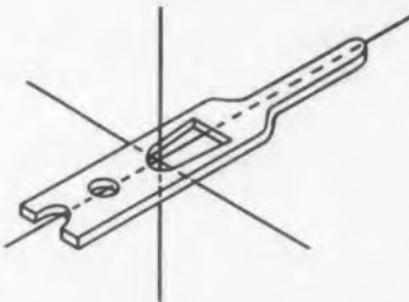
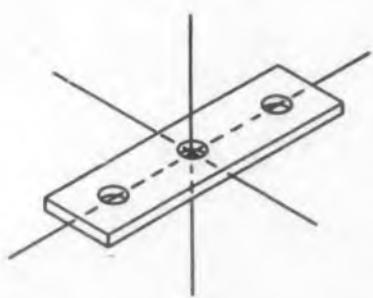


Fig. 3. Internal dissymmetrical parts a and c have a markedly displaced center of gravity and can be readily hopper fed. Parts b and d require mechanical or electric probes or sensing devices.



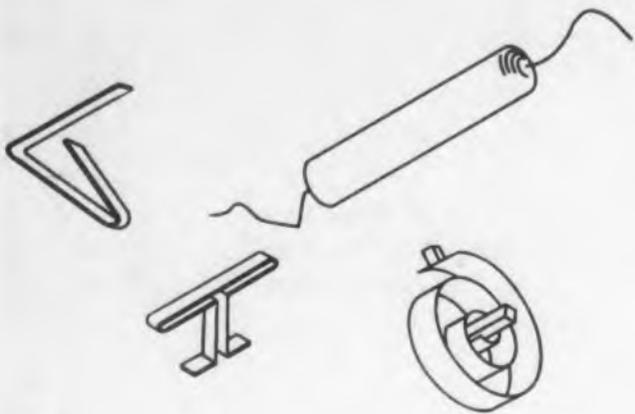
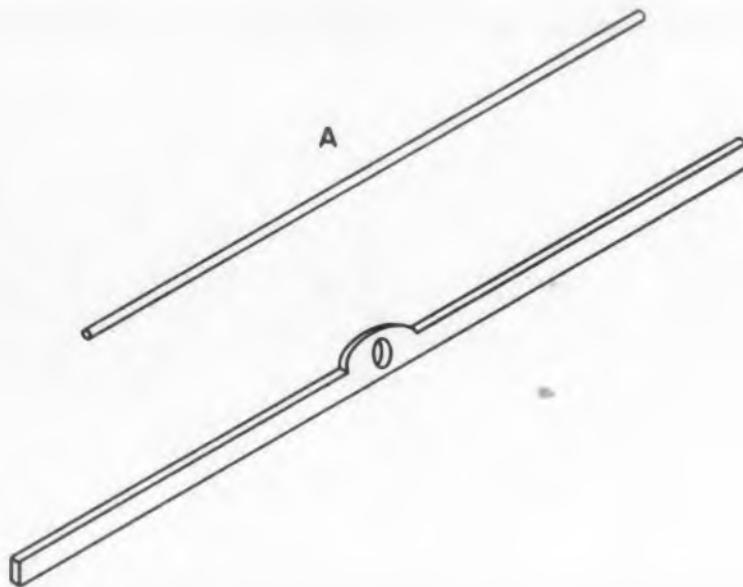


Fig. 5. The parts shown to the left are not adaptable for hopper feed because of interlocking and tangling tendencies.

Fig. 6. Long slender parts such as these do not perform well in hopper feeders and should generally be magazine fed.



important to provide external dissymmetry since automatic feed of such components is generally feasible, Fig. 2.

An electronic component with all degrees of dissymmetry being internal presents a difficult problem for automatic feed. In general mechanical probes or balancing methods of orientation must be employed. Such methods may add tremendously to the complexity and cost of automation. If internal dissymmetry is unavoidable the design engineer should attempt to displace the center of gravity as much as possible from the geometric center. The resulting torque effects may be quite useful in producing oriented feed, Fig. 3.

Shapes to be avoided—The design engineer should constantly be aware of other features which should be avoided whenever possible. For example, do not specify unnecessarily thin cross section of flat pieces. Flat pieces with a thickness of less than 0.020" are difficult to feed mechanically by standard methods.

In cases where thin stock cannot be avoided the engineer should consider incorporation of projections or a rim at right angle to the flat surfaces, Fig. 4.

Parts with shapes that have a strong likelihood of interlocking or tangling into a scrambled mass are Design Enemy No. 1 since more often than not no feasible method of hopper feed can be economically achieved. The standard lead capacitor and resistor falls in this category. It is, however, encouraging that basic redesign of some of these components is now underway, Fig. 5.

Components or elements of components with slenderness ratios greater than 1:50 are usually very difficult to hopper feed. When this factor cannot be avoided it is necessary to resort to other means than hopper feed, Fig. 6. Alternate types of feed are discussed below.

The most aggravating shapes are those which are highly flexible. An example of this class is the coiled coil tungsten filament, Fig. 7. Although some success

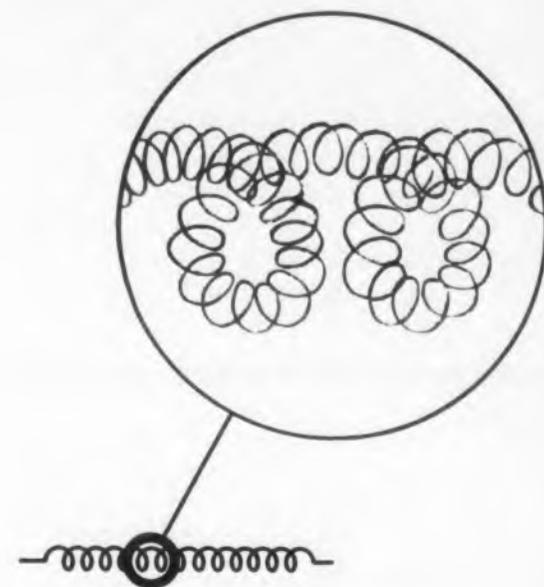


Fig. 7. A coiled filament being extremely flexible is unusually difficult to hopper feed.

has been achieved with vibratory equipment, the feed rate is generally not satisfactory.

Other Types of Feed

Alternate solution if thinness, interlocking, slenderness, and flexibility cannot be avoided are roll, or coil stock, feeding and magazine feeding. In many cases where parts are made from wire or thin flat stock the cut-off or forming operations can be best accomplished by incorporating these operations as an integral part of the assembly operation. Typical cases are the welding of domet and nickel wire for leads, and the production of terminals in strip form followed by roll feeding the strips to terminal board assembly machines.

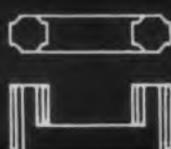
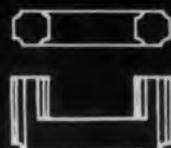
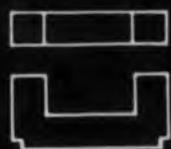
In a number of cases it is feasible to magazine parts at the forming operation and use the loaded magazines to feed to subsequent assembly or processing operations. This method takes advantage of the oriented position of pieces just prior to discharge

Design To Provide

1. Symmetry of shape and weight distribution with respect to three axis.
2. External dissymmetry in preference to internal dissymmetry.
3. Maximum moment effect around one or more axis where internal dissymmetry is unavoidable.
4. Thickness of .020" or more for flat pieces.
5. Freedom from interlocking or tangling in mass.
6. Slenderness ratio below 1:50.
7. Rigidity of parts in scrambled mass or flow.

Design To Avoid

1. Unnecessary dissymmetry of shape and weight distribution.
2. Internal dissymmetry unless resultant movement effect around one or more axis is significant.
3. Thickness less than .020" for flat pieces.
4. Tangling or interlocking characteristics.
5. Slenderness ratio above 1:50.
6. Flexibility of parts in scrambled mass or flow.



from such machines as punch and die presses. The method is particularly applicable to mica parts.

Another example of magazine feeding is the stacking of large plastic terminal boards for slide feed to automatic machines which rivet or stake the terminals in place. In this operation an operator can usually stack the boards in a magazine at 4-5 times the production rate of the terminal staking machine. Hence only 1/4 to 1/5 of the operator's time need be chargeable to the assembly cost. Conversely one operator may service 4 to 5 assembly machines.

Summary

In summary, it is essential to realize that although mechanical design must not subordinate function design, awareness of the points which produce 'automatable' parts may well be the determining factor in the economic success or failure of any electronic component.



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Using Glass in Electronic Designs

I—Properties of Glass

William H. McKnight

Corning Glass Works, Corning, N. Y.

GLASS has had a crucial role in electronic devices since the first vacuum tube was enclosed in a glass bulb. Since designing and working with glass is a highly specialized art, the electronic designer who wishes to utilize glass is simply required to prepare careful specifications for the glass fabricator. The properties of glass of significance to the electronic designer are discussed here. The procedures for specifying glass, including all newer forms of glass such as conductive, photosensitive, metallized, ribbon, and fused silica glass, and parts made by the "Multiform" process are to be given in Part 2.

Properties of Glass

Glasses are fundamentally strong materials. In compression they surpass brick, cast iron, or concrete. (Glasses will withstand pressures that cause most metals to flow.) They never fail in shear, and tensile strengths as high as 2,000,000psi have been recorded.

The absolute strength of a glass is directly related to surface conditions. Thus glasses with extremely high strengths are not usually useable in glass products where the surfaces are scratched or abraded. However, by the proper choice of composition, good

design and added finishing treatments, glass products can be made with excellent mechanical strength. A working stress of 4000psi with adequate safety factors can be attained with tempered commercial glasses. Since glass does not flow before failure, the full working stress up to fracture can be realized.

The elastic modulus of glass varies from a value lower than most metals to a value higher than aluminum. Many glasses now being melted have an elastic modulus approximately one third that of steel.

The hardness of glass is usually measured by scratch tests. Glass has a hardness, depending on its composition, of about 6 on Mohs' scale. In general, the high silica and borosilicate glasses are harder than lime or lead glass.

In thermal properties glasses have a broad range of characteristics. The heat shock endurance of a glass is a function of its thermal expansion coefficient. These coefficients vary from 5.6×10^{-7} per degree centigrade to twenty times that value. For good hermetic seals, it is possible to match the most commonly used metals with one or more glasses with the same temperature coefficient of expansion, as shown in Table 1 on the opposite page.

Glasses are classed as electrical insulators, but here again there is a broad range of characteristics. The best glass has an electrical resistance one hundred million times that of the lowest resistance glass. The dielectric strengths of the glasses are so high, the thickness of the glass necessary for mechanical strength is usually far in excess of that necessary to prevent dielectric breakdown.

The dielectric breakdown voltage of glass usually decreases as frequency and temperature increase. For example, at about 200°C, the dielectric strength of a glass is lowered about 5%. For some glasses, such as the 96%-silica group, the dielectric constant is essentially independent of temperature, while for others there is a marked rise above 200°C. Most of the glasses commonly used for electronic components are essentially independent of frequency, however, there is a considerable variation of power factor with frequency which must be considered when designing tuning circuits to cover a large frequency range. The variation of power factor is constant and reproducible. Slightly more expensive glasses are available which are comparatively independent of frequency and can be used when necessary.

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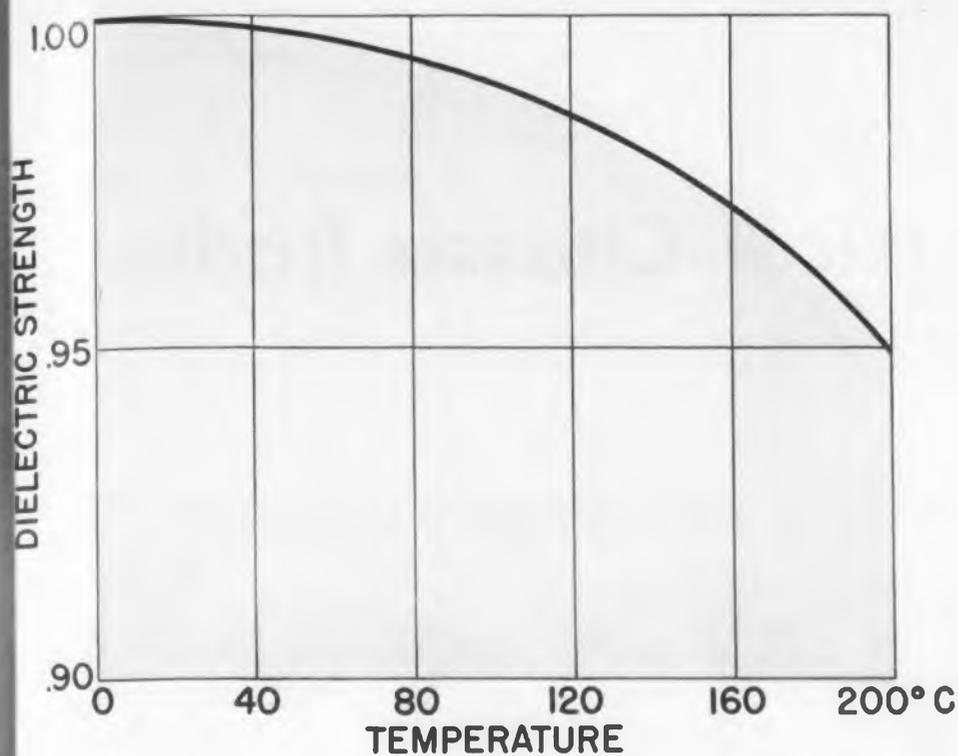


Fig. 1. The dielectric strength of most glasses decreases with temperature, although for some there is a marked rise above 200°C.

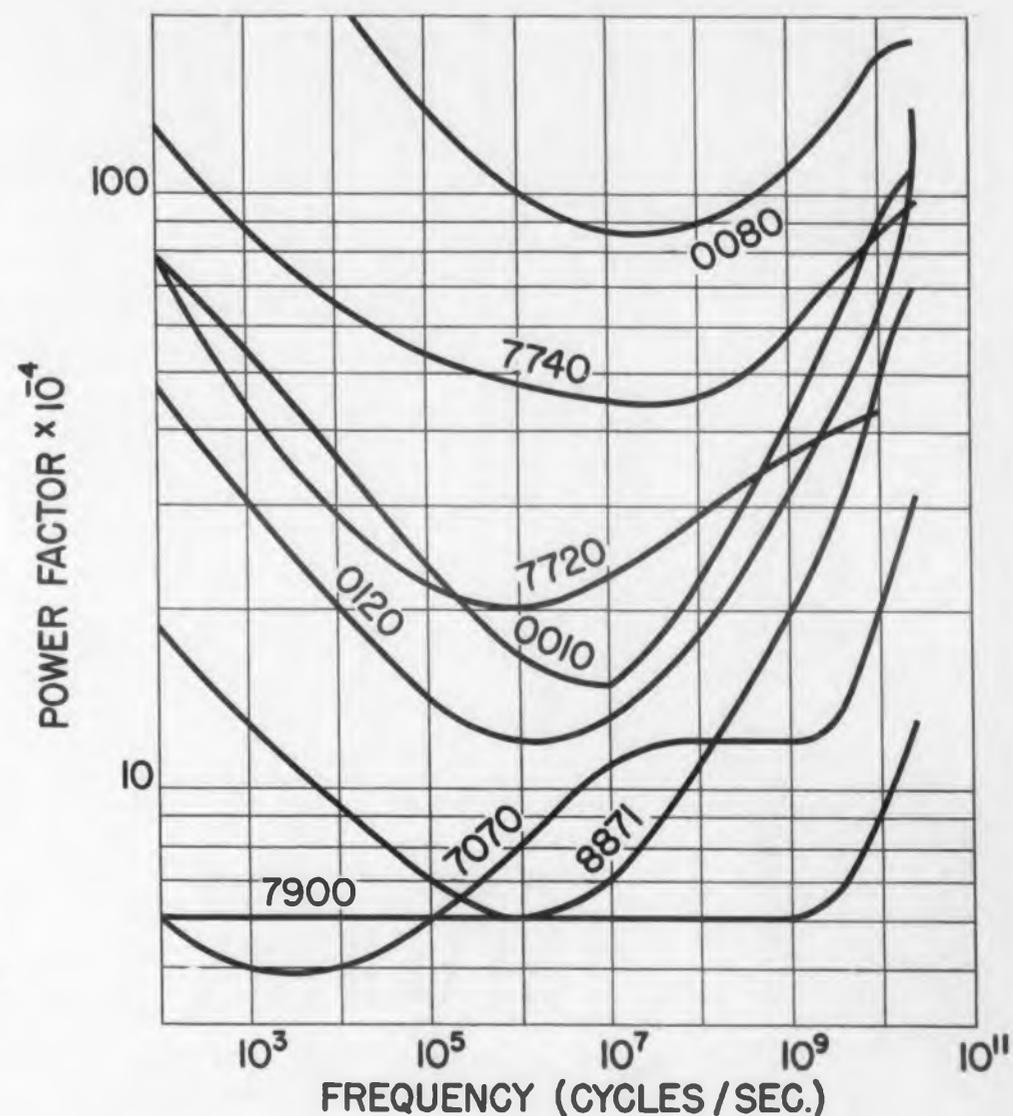


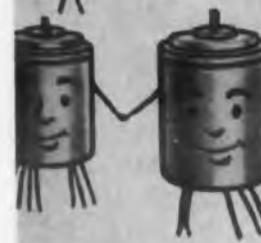
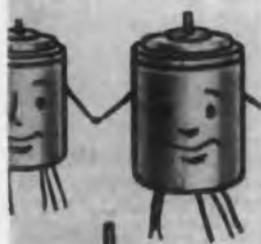
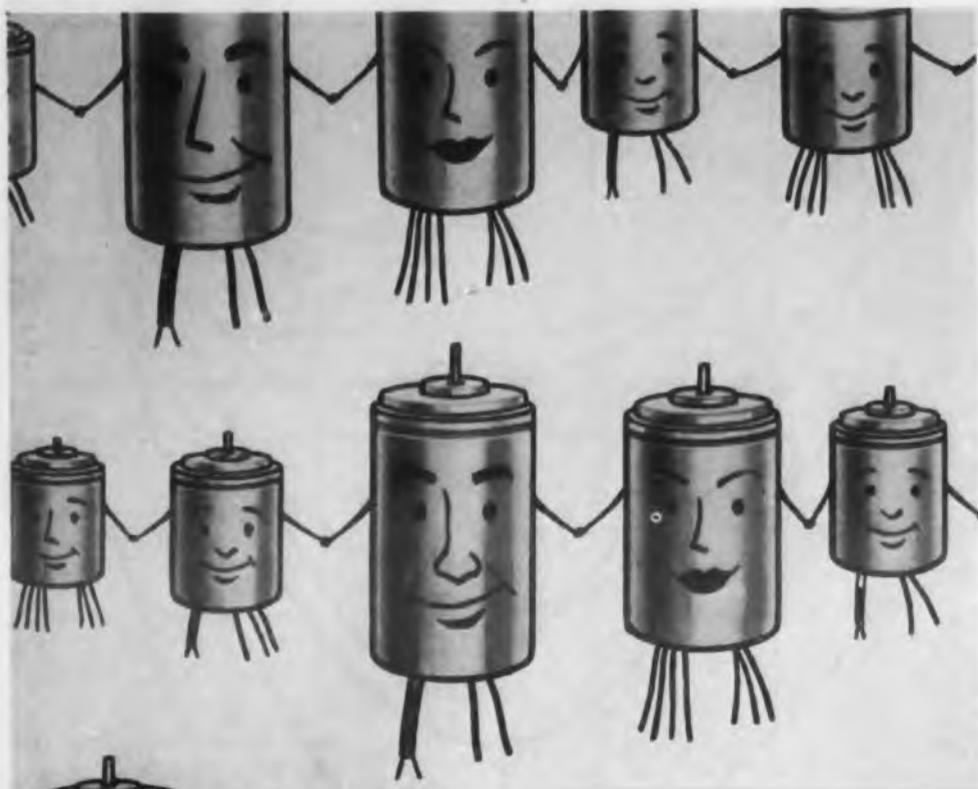
Fig. 2. Additional properties of the glasses charted here are given below.

Table 1. When making glass-to-metal seals, these glasses are commonly sealed to the indicated metal because their thermal coefficient of expansion is the same as that of the metal.

Metal	Glass
Platinum	Potash Soda Lead; Soda Lime, Borosilicate
Tungsten	Borosilicate; 96% Silica; Special sealing glasses
Copper	Any soft glass by special technique
Mica	Special soldering glass
Quartz	96% Silica
Molybdenum	Borosilicate
Dumet	Potash Soda Lead; Soda Lime

Table 2. Selected properties of a representative group of glasses.

Glass Code	Type	Color	Thermal Expansion Coeff.—/°C	Upper Working Temperatures (Mechanical Considerations Only)				Log ₁₀ of Volume Resistivity 25°C	Dielectric Properties at 1Mc and 20°C		
				Annealed		Tempered			Power Factor	Dielectric Const.	Loss Factor
				Normal Service (°C)	Extreme Limit (°C)	Normal Service (°C)	Extreme Limit (°C)				
0010	Potash Soda Lead	Clear	91 x 10 ⁻⁷	110	380	—	—	17+	0.16%	6.6	1.1%
0041	Potash Soda Lead	Clear	84 x 10 ⁻⁷	110	400	—	—	—	—	—	—
0080	Soda Lime	Clear	92 x 10 ⁻⁷	110	460	220	250	12.4	0.9	7.2	6.5
0120	Potash Soda Lead	Clear	89 x 10 ⁻⁷	110	380	—	—	17+	0.16	6.6	1.1
7050	Borosilicate	Clear	46 x 10 ⁻⁷	200	440	235	235	16	0.33	4.9	1.6
7052	Borosilicate	Clear	46 x 10 ⁻⁷	200	420	210	210	17	0.26	5.1	1.3
7070	Borosilicate	Clear	32 x 10 ⁻⁷	230	430	230	230	17+	0.06	4.0	0.24
7250	Borosilicate	Clear	36 x 10 ⁻⁷	230	460	260	260	15	0.28	4.8	1.3
7340	Borosilicate	Clear	67 x 10 ⁻⁷	120	510	240	310	16	—	—	—
7720	Borosilicate	Clear	36 x 10 ⁻⁷	230	460	260	260	16	0.27	4.7	1.3
7740	Borosilicate	Clear	32 x 10 ⁻⁷	230	490	260	290	15	0.46	4.6	2.1
7760	Borosilicate	Clear	34 x 10 ⁻⁷	230	450	250	250	17	0.18	4.5	0.79
7900	96% Silica	Clear	8 x 10 ⁻⁷	800	1090	—	—	17	0.05	3.8	0.19
7900	96% Silica (Multiform)	White	—	—	—	—	—	—	—	—	—
		Opaque	8 x 10 ⁻⁷	800	1090	—	—	17	0.05	3.8	0.19
7910	96% Silica	Clear	8 x 10 ⁻⁷	800	1090	—	—	17+	0.024	3.8	0.091
7911	96% Silica	Clear	8 x 10 ⁻⁷	800	1090	—	—	17+	0.019	3.8	0.072
8871		Clear	103 x 10 ⁻⁷	—	—	—	—	18	0.05	8.4	0.42



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Vertical-Chassis Radio



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The printed-circuit board with sockets added.



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Design Forum

VERTICAL-chassis construction, which has already reached the consumer market in TV receivers (*ED, Jan., '55, pp. 34-35, and May, '54, p. 18*) and audio amplifiers (*ED, Jan., '55, pp. 24-27*), has now been adopted for the most common electronic product for the consumer—the inexpensive table-model radio. The vertical chassis means that tubes can be removed from the back of the enclosure without unscrewing the chassis. The vertical-chassis radio shown on these pages also features printed circuits.

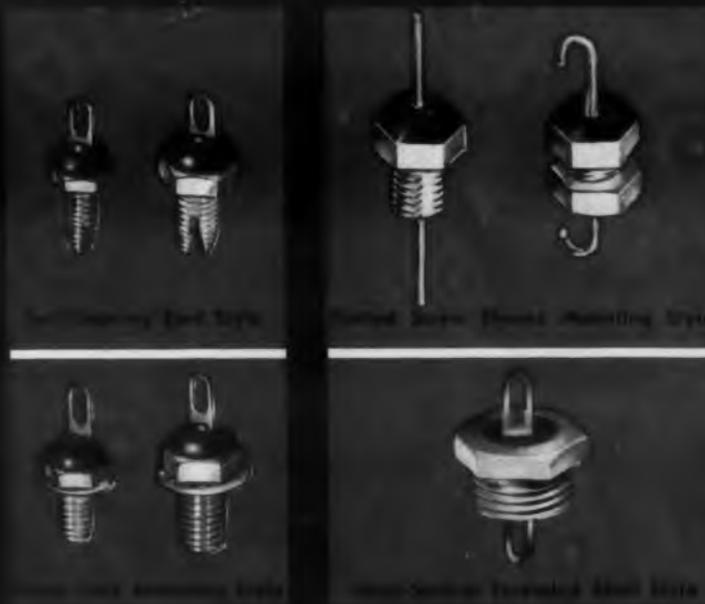
Manufactured by General Electric Co., Syracuse, N. Y., this Model 455 radio has a printed circuit with copper-foil conductors on both sides of the base laminate. Connection between the two sides of the circuit is achieved by plated-through holes (*ED, Sept., '54, p. 17*) rather than eyelets. The tube complement of the set is as follows: converter—12AU6; i-f amplifier—12BA; detector and automatic volume control—12AV6; audio output—50C5; and rectifier—35W4. The antenna is mounted on the inside of the perforated back cover of the enclosure in the form of a large loop.

The feet on which the cabinet stands are an integral part of the plastic cabinet and make for good cooling. There are cooling holes in the bottom of the cabinet. The "Conelrad" stations are indicated on the easily-read tuning dial.

The growing use of the vertical-chassis arrangement means that servicing is made easier. At the same time the concurrent use of printed circuits means that the nation's servicemen must be rapidly trained in the method of repairing printed circuits if this gain in ease of servicing is not to be lost.

new design freedom with

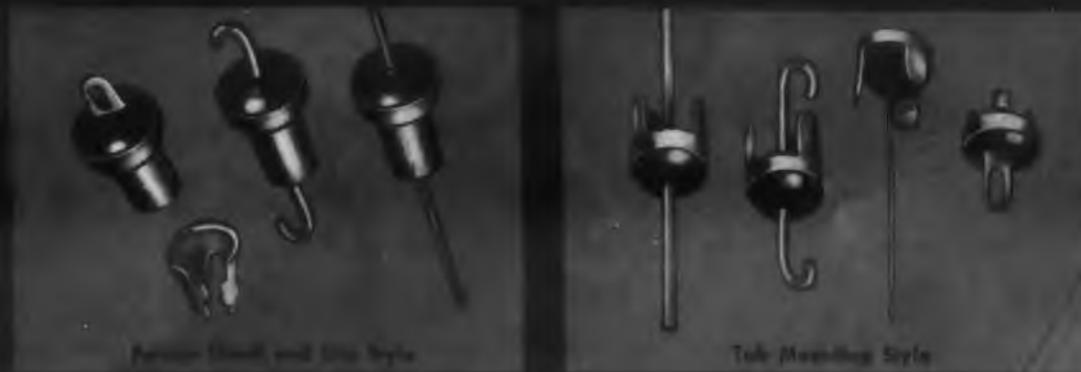
Sprague Button Ceramic Capacitors



Sprague, on request, will provide you with complete engineering service for optimum results in the use of ceramic capacitors—buttons, discs, plates, printed r-c networks, high-voltage moldeds, etc.

WORLD'S LARGEST CAPACITOR MANUFACTURER

SPRAGUE[®]



↓

Sprague button ceramic capacitors offer distinct advantages to designers of ultra-high-frequency TV receivers and electronic equipment. These tiny capacitors are available in many styles for coupling, bypass, and feed-thru applications. Their wafer-dielectric construction makes possible higher self-resonant frequencies than with capacitors using conventional dielectric tubes. Button stand-off types, for example, minimize ground inductance and hold it at a fixed value while providing a short, uniform bypass to ground. They also provide effective shielding of the capacitor element by the outer metal shell. Sprague button capacitors are sealed against moisture by a high temperature resin, and are conservatively rated at 500 volts d-c.

For complete engineering data, write for Bulletin 605A to Technical Literature Section, Sprague Electric Company, 347 Marshall Street, North Adams, Massachusetts.

"Expert for the Americas: Sprague Electric International Ltd., North Adams, Mass. CABLE: SPEXINT"
CIRCLE ED-23 ON READER-SERVICE CARD FOR MORE INFORMATION



After the encapsulated body is inserted into the socket, the screw is turned into the threaded metal insert in the socket, holding the Encapsor securely.



These potted units are made in many standard circuits, facilitating maintenance.

Encapsulated Plug-In Circuits

MODERNIZATION and maintenance costs of industrial control, computer, communications, testing, and telemetering equipment can be greatly reduced by designing with the encapsulated plug-in circuits shown on these pages. Known as "Encapsors", these rugged units are available in more than 20 different standard circuits, or they can be made to order with a specified circuit. Some space-saving can also be achieved in many devices by constructing them with a number of these units linked together.

The modular units consist of three main parts: the potted body, the tube, and a center screw that secures the unit to its socket. Generally, Encapsors are furnished with either a conventional or a printed-circuit-type socket modified with a threaded metal insert to receive the center screw. Either conventional or miniature tube types are used. In addition they can be made to receive tube shields or clamps. Units are also made without tubes or with encapsulated semiconductor diodes or transistors.

To install a unit, the tube is removed, the body is plugged into its socket, the center screw is turned into the mating thread in the socket, and the tube is replaced. When the unit is removed, the screw does not fall out of its hole. The screw also functions as a

heat sink. The screw runs in a threaded metal insert in the center of the body.

The units are constructed around a base form similar to a turret socket. After the components, which are conventional types, are mounted, the body is encapsulated in a modified epoxy resin known as "Alcorite". This opaque resin contains an aluminum oxide filler. The alumina filler improves heat transmission without lowering the insulation quality of the epoxy. It also makes the epoxy mechanically stronger, less brittle, raises softening temperature, affords greater dimensional stability, and reduces exotherm heat produced during curing. The curing temperature is low enough to prevent damage to components. In addition, the metal stud placed inside the body during the molding process carries away exotherm heat. The potting compound is available in different colors and the plug-in base and the top tube socket are made in a number of different colors for color coding purposes.

Among the standard circuits are a flip-flop, six-to-one and ten-to-one dividers, a transfer gate, a pulse-length adjuster, wave shapers, oscillators, power amplifiers, a keyer-modulator, and a differential amplifier. Other standard circuits are clamping, storage,



Components are mounted on a turret socket prior to the encapsulation process.

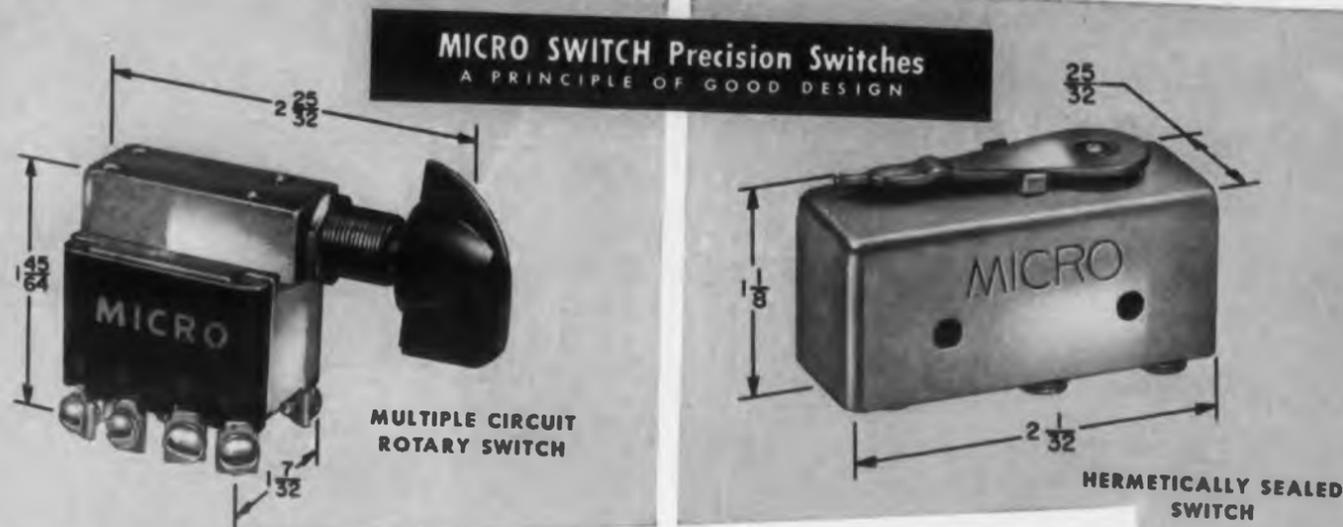


A number of Encapsors are used in this device to greatly simplify manufacture and testing.

memory, resolving, integrating, impedance matching, isolation, coupling, and rectifying circuits. These units are manufactured by Alcor Electronics Corp., 80 Lafayette St., New York 13, N. Y.

These plug-in circuits are of particular interest to designers of equipment for the military. Field maintenance problems are solved by substitution of units, with the only tool required being a screwdriver. Military equipment can be readily modernized by substituting improved circuits. When combined with printed circuits, all components are mounted in the potted body, and the printed-circuit board contains only foil connectors and tube sockets. For more information on these plug-in circuits, turn to the Reader's Service Card and circle **ED-24**.

ELECTRONIC DESIGN • May 1955



New MICRO SWITCH products meet exacting electronic requirements

Keeping pace with the ever-changing needs of the electronics industry has always been an important consideration of MICRO SWITCH engineering development.

New switches and new switch assemblies are always on the drawing boards and on test at MICRO SWITCH. Often designers find these switches fit, without change, the particular service at hand. At other times consultation with MICRO SWITCH engineering results in modification of an old design or development of one entirely new.

Whatever the task, MICRO SWITCH components either are or can be made available to give the utmost in reliable

service performance. Does your current problem involve any switches like these?

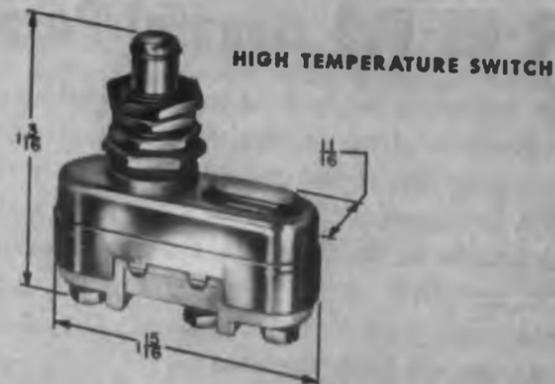
A Multiple Circuit Rotary Switch—Will handle up to 8 circuits at 20 amperes at 115 volts a-c.

New Hermetically Sealed Switch—Provided with split contact circuit arrangement.

Sealed Subminiature Switch—Completely environment-proof, has high electrical capacity and long life.

High Temperature Switch—Designed to operate perfectly in temperatures up to 1000° F.

MICRO SWITCH field engineers are conveniently located at 20 branch offices. Consultation with them involves no cost. It can save you much time and money.



MICRO SWITCH provides a complete line of extremely reliable, small-size, high-capacity, snap-action precision switches and mercury switches. Available in a wide variety of sizes, shapes, weights, actuators and electrical characteristics. For all types of electrical controls.

MICRO SWITCH

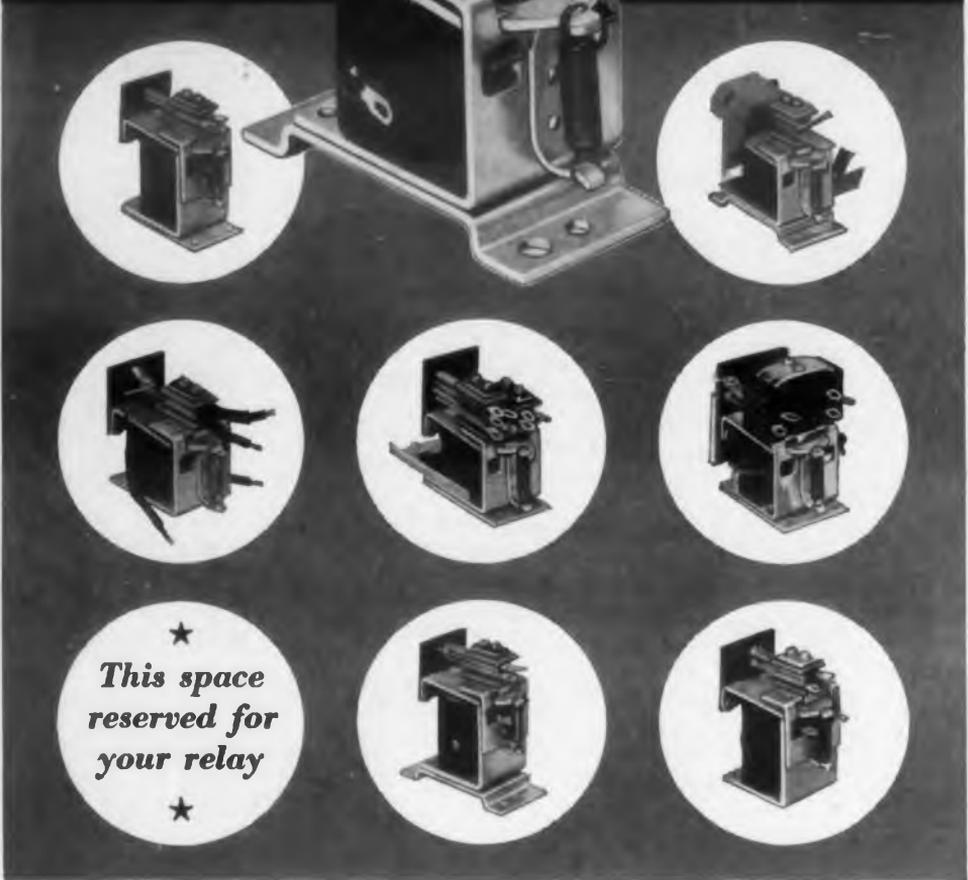
A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS

CIRCLE ED-25 ON READER-SERVICE CARD FOR MORE INFORMATION



What is YOUR RELAY PROBLEM?



★
This space reserved for your relay
 ★

R·B·M General Purpose Relays..

have solved many specific relay problems with no development or tooling cost to the customer. RBM has produced hundreds of thousands of magnetic relays from standard parts—designed and initially produced over seven years ago—to fulfill the need for dependable relays at low cost.

The many variations of contact form and ratings, as well as ter-

minial arrangements and mounting brackets, may well provide just the right relay for you. WRITE FOR BULLETIN 570— or better yet, tell us your requirements. Bulletin 570 shows only a few of the many variations.

Whether a single relay or a relay panel complete with wire assemblies and cord sets, RBM may help you lower your costs.

R-B-M DIVISION
ESSEX WIRE CORPORATION
 Logansport, Indiana

Controls for Electronic, Refrigeration, Industrial, Appliance, Communication and Automotive Industries



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

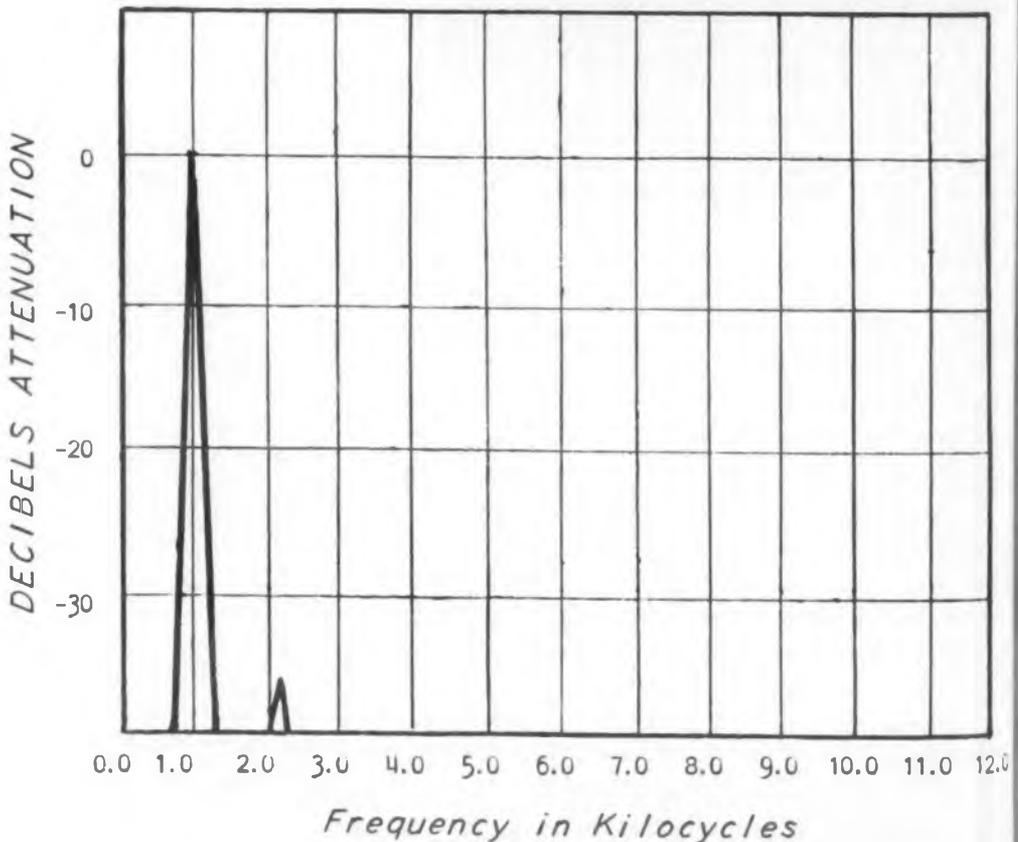
Electro-Mechanical Circuit Elements



Inertia bars are supported in a symmetrical relationship and are insensitive to vibration. Input and output circuits are isolated.



Selectivity curve, right, and spurious response, below.



RESONANCE
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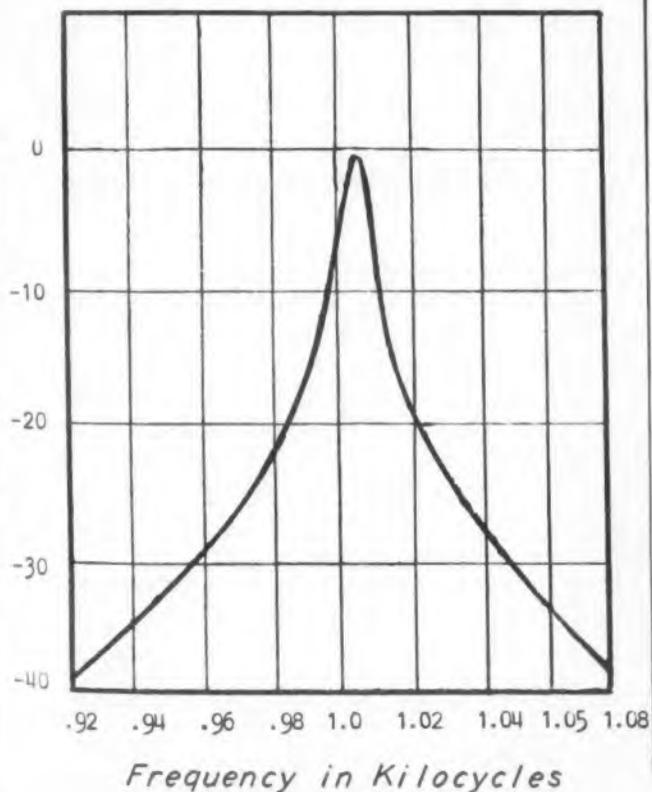
DECIBELS ATTENUATION
0
-10
-20
-30
-40

RESONANCE occurs in two parallel inertia bars instead of the conventional L-C circuit in these transducers. Their small size makes them useful as high-impedance, narrow-band, interstage coupling filter elements, or as low-level oscillator circuits. Standard Q's are as high as 250. In groups these units provide comb filtering, band pass filtering or spectrum analysis. They offer possibilities for simple frequency coding and multiplexing applications in communication and data transmission work. They are convenient to use in analyzing doppler shift, and other signals carrying intelligence.

The construction of these Circuit Element Transducers, manufactured by The Harris Transducer Corp., Woodbury, Conn., is unique. Two stiff parallel inertia bars are connected at the center by a flat flexible cross spring. A driver crystal affixed to the cross spring causes it to expand and contract thereby exciting the inertia bars into oscillations. A second take-off crystal is also attached to the cross spring. A-c signal voltage applied to the driver crystal excites motion at resonance but has little effect off-resonance.

The transducers are now available in a range of frequencies from 100cy to 7kc. Q's of 100 or 250 can be specified. Matched sets with resonant frequencies matched to 0.01% and Q's as high as 500 can be obtained on special order. The transducers are temperature compensated to .001% per degree F. They are operable to 130°F. Input voltages up to 50 rms and d-c voltages up to 100v may be used. Input and output nominal capacitance is .0016 μ fd. Transmission loss at the pass frequency is about 2db; off frequency loss is from 40 to 60db as accompanying graphs show. For more data, turn to the Reader's Service Card and circle **ED-27**.

DECIBELS ATTENUATION



0.0 12.0

Peak performance from every color!

SYLVANIA is your dependable
source of **ALL** picture tube phosphors

Whether you need phosphors for black-and-white or color picture tubes, Sylvania's long experience, highly developed production facilities and exacting quality control add up to *dependability*.

All Sylvania tube phosphors are rigidly inspected for purity, particle size, brightness and uniformity of color. There is a full range of phosphor formulations available to meet your requirements, including special blends for maximum cross-burn resistance. All Sylvania phosphors can be supplied in 1500-lb. lots to eliminate color-matching problems.

To help you secure long-lasting screen brightness and good color, Sylvania also manufactures high-purity *potassium silicate*. Exact control of potassium-to-silica ratio assures maximum wet-screen strength.

For complete information about high-performance Sylvania phosphors and TV Picture Tube components, write to:

SYLVANIA ELECTRIC PRODUCTS INC.,
1740 Broadway, New York 19, N. Y.

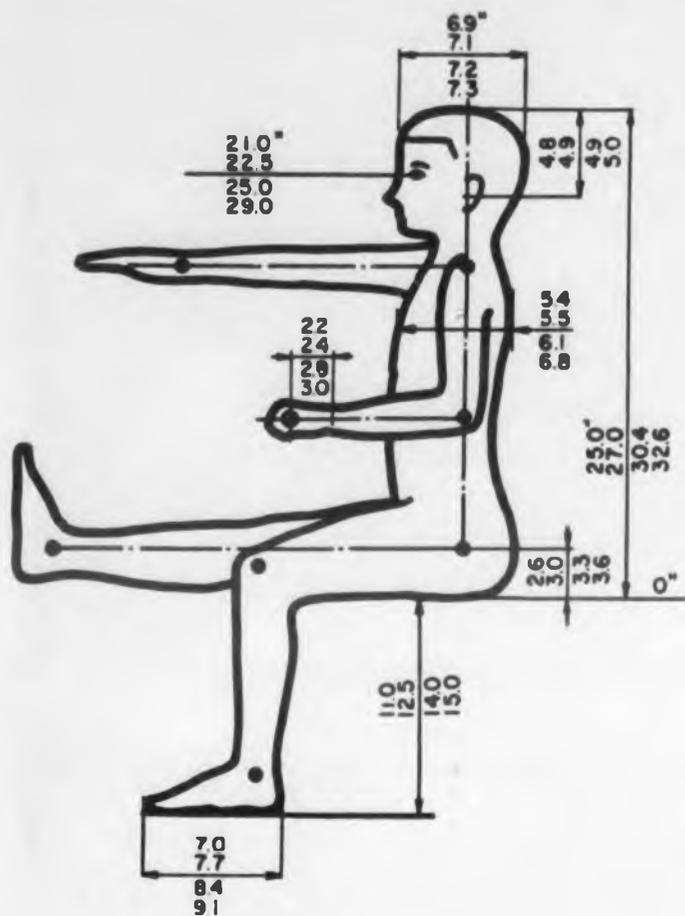
In Canada:

Sylvania Electric (Canada) Ltd.,
University Tower Bldg., St. Catherine St.,
Montreal, P. Q.

SYLVANIA 

Lighting • Radio • Electronics • Television • Atomic Energy

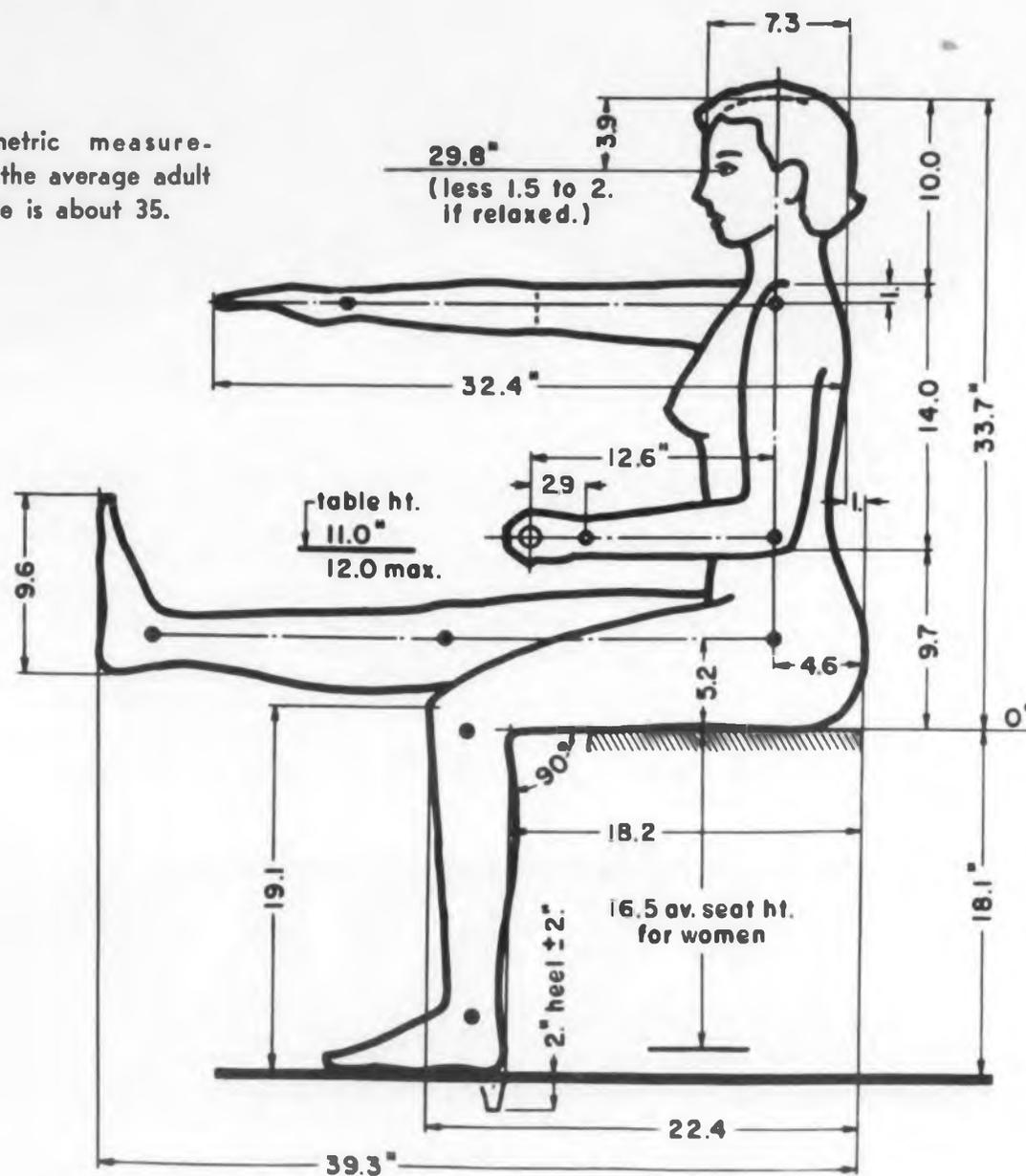
Background
for
Designers



The four values given for each dimension of this child are for average children of 6, 8, 11, and 14 years, respectively.

Human Measurements

Anthropometric measurements for the average adult female. She is about 35.



DESIGNING equipment to fit the human operator is being emphasized so much these days that it should soon become standard operating procedure. Since all electronic equipment, except for a comparatively small number of unattended radio relay and TV booster stations, is meant to be manipulated by humans in some manner, the electronic designer must have accurate data on human measurements and characteristics readily available.

The anthropometric charts, tables, and sources given on these pages contain valuable information for all designers. They were compiled by the Henry Dreyfuss organization, 4 West 58th St., New York 19, N. Y. and are reprinted from Mr. Dreyfuss' recently published book, *Designing For People*.*

Sources for Charts and Table

Adult Male

1. "Human Body Size in Military Aircraft and Personnel Equipment", by F. E. Randal, et al. AAF Tech. Report 556, Air Material Command, Wright Field, Dayton, Ohio, 1945 (several thousand cadets tested).
2. *A Survey in Seating*, by E. A. Hooten, Haywood-Walshfield Co., Gardner, Mass., 1945 (1959 males tested).
3. "Leg and Strength Endurance in Relation to Height, Weight and Other Body Measurements", by E. R. Ellinger, Report 1, Proj. 318, School of Aviation Medicine, U. S. Air Force, Randolph Field, Texas, 1945.

4. "Distance Between Pivot Points", from report by Dr. J. G. Travell, 9 West 19th Street, New York, N. Y. (1952).
5. "Anthropometric Measurements", Bell Telephone Laboratories Report, 1945.
6. "Dimensions of the Human Figure", *Architectural Graphic Standards*, Charles G. Ramsey & Harold R. Sleeper, John Wiley & Sons, New York, 1955.

*Simon and Schuster, New York, 1955.

Human characteristics. The weight of the average man was determined within the range of 202 and 118 lb for the 97.5 and 2.5 percentiles.

	Average Child				Average Man	Average Woman
	6	8	11	14		
Weight (lb)	44.5	55	75.5	98.7	153.1	133.5
Left-handed					6.6%	3.8%
Color blind					3.5%	0.2%
Hard of hearing					4.5%	4.5%
Wear glasses					43.6%	56.4%

Wiley & Sons, Inc., 440 Fourth Ave., New York, 1951.

Anatomy for Interior Designers, by F. de N. Schroeder, Whitney Publications, New York, 1951.

An Introduction to Physical Anthropology, M. F. A. Montague, Thomas Publishing Co., Springfield, Illinois, 1951.

"Faces and Heads" by J. A. Consentino—Report by U. S. Chemical Warfare Service Development Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.—1945.

Adult Female

U. S. Department of Agriculture Misc. Pub. No. 454, "Women Measurements for Garment & Pattern Construction," 1941 (10,042 females measured).

"Handbook of Human Engineering Data for Design Engineers," Tech. Rep. No. SDC 199-1-1 Part II, Tufts College, Institute for Applied Experimental Psychology, Medford, Mass. 1949.

"Anthropometric Nomograph of Army Women" prepared by the Quartermaster, Climatic Research Laboratory (6237 females tested).

"Survey in Seating" conducted by Dr. Ernest Hooton & Staff, Harvard Univ. Dept. of Anthropology, 1945 (4908 females tested).

"Survey of Body Size of Army Personnel Male and Female," Phase 4, Report 1, Office Technical Services (4302 females tested).

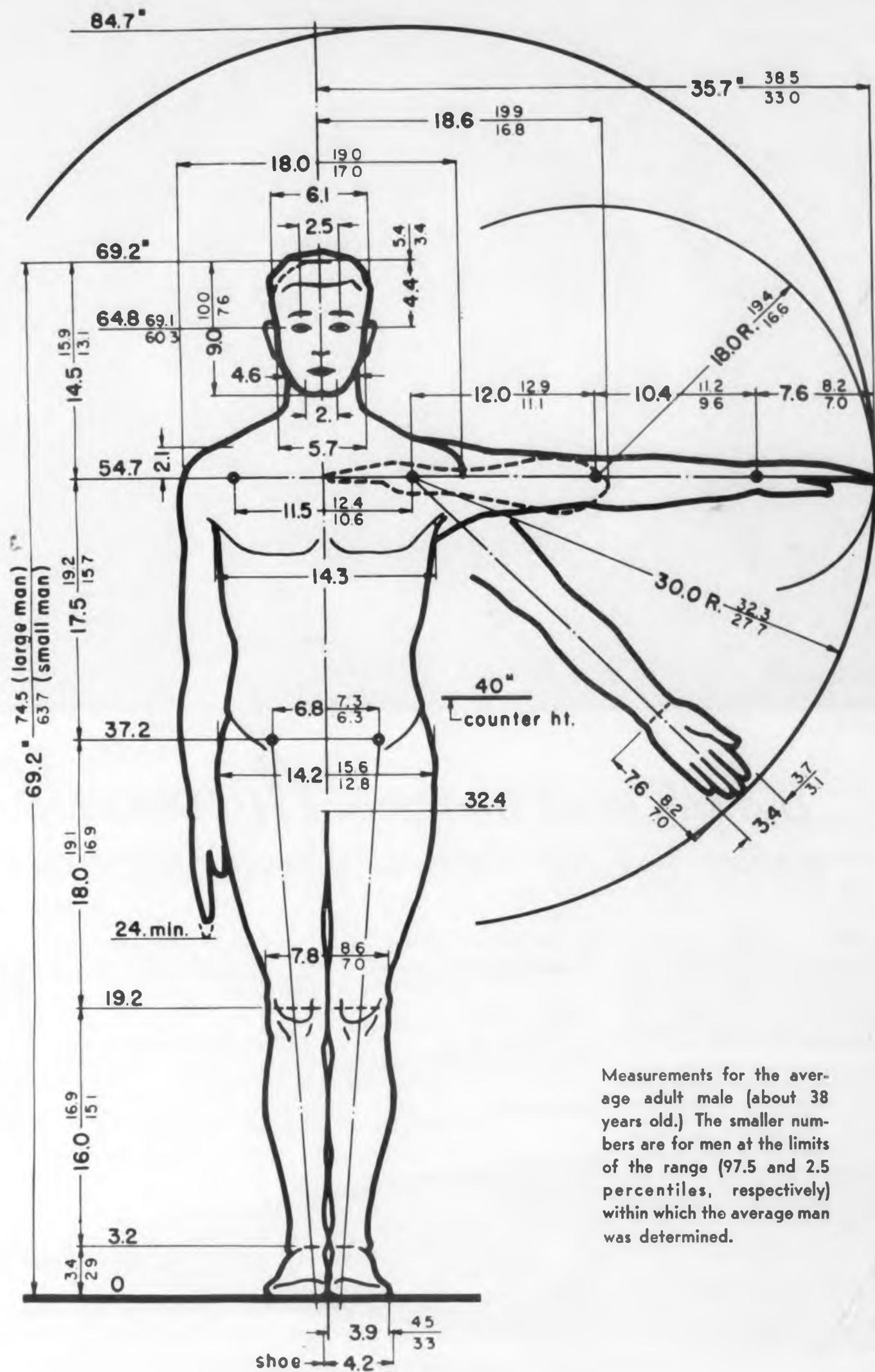
"Body Measurements of Female Flying Personnel" by A. R. Elmer, Report ENG-49-695-32A, USAF-Air Material Command, Wright-Patterson AF Base, 1943.

Children

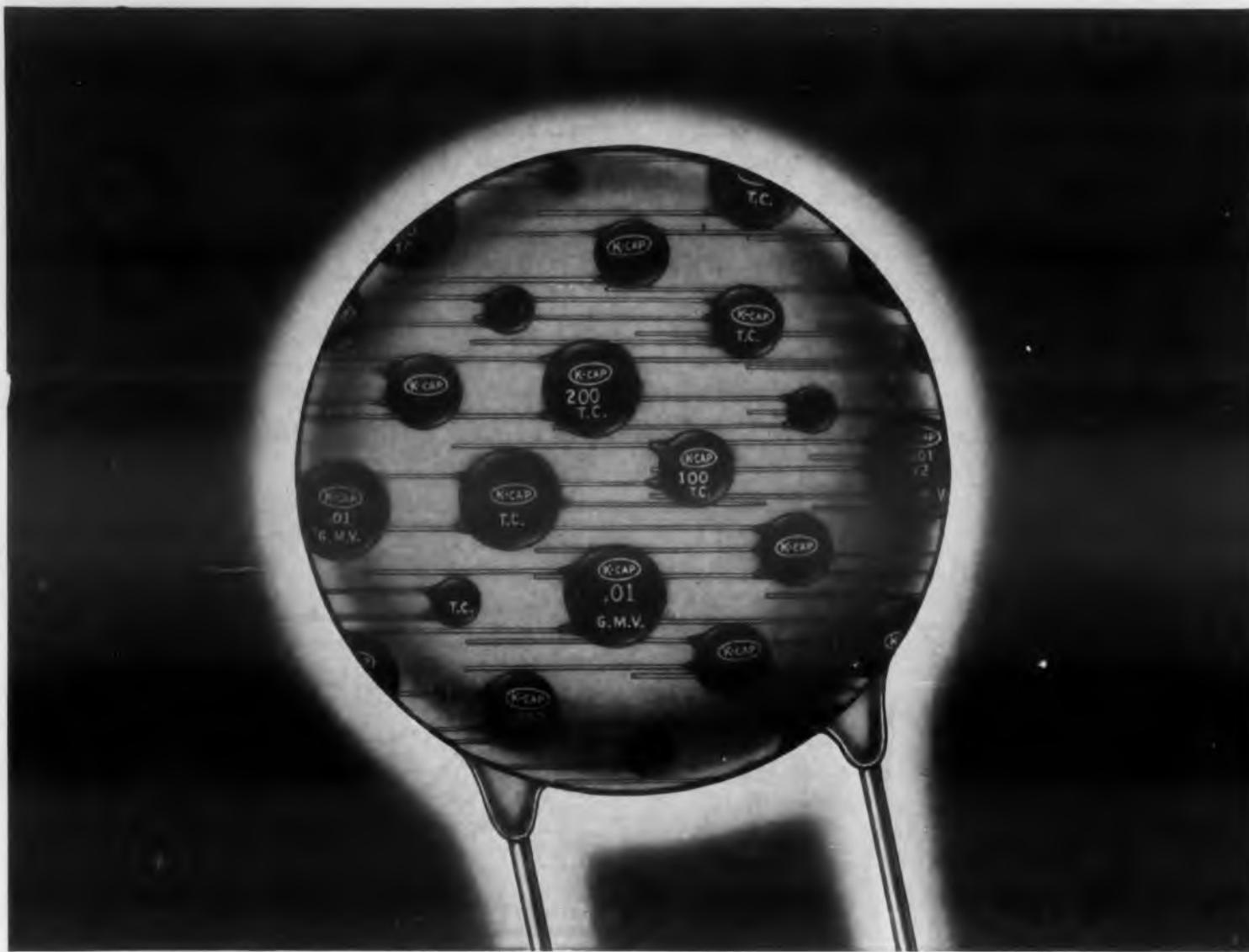
"Pivot Points", Report by Dr. Travell.

"Children's Body Measurements", U. S. Department of Agriculture Misc. Publication No. 365, 1939 (133,807 American boys and girls tested).

"Basic Body Measurements of School Age Children", U. S. Department of Health Education and Welfare, Office of Education, 1953 (152,191 boys and 144,307 girls tested).



Measurements for the average adult male (about 38 years old.) The smaller numbers are for men at the limits of the range (97.5 and 2.5 percentiles, respectively) within which the average man was determined.



Did you know that only **AUTOMATIC** makes K-CAP Ceramic Disc Capacitors?

K-CAP* Ceramic Disc Capacitors are another mass produced electronic product made by Automatic Manufacturing Corporation, originators of the famous K-Tran* and J-Tran* I.F. Transformers...the first standardized I.F.'s in the industry.

K-Cap capacitors, like K-Tran and J-Tran, are manufactured completely within our own plant from the basic powders to the completed capacitor. The high K ceramic bodies are developed in our own modern laboratory and produced under the exacting supervision of our quality control engineers. The silvering process is done by men with more than 20 years experience in silvering trimmers and condensers.

K-Cap Ceramic Capacitors are distinguished by their black, wax impregnated, phenolic coating, stamped with red markings. All bear the registered trade mark K-Cap.

They are made in 4 standard types:

GUARANTEED MINIMUM VALUE
for bypassing, etc.

GENERAL PURPOSE
for coupling, etc.

TEMPERATURE COMPENSATED
in a range of T.C. from N.P.O. through N2200

HIGH STABILITY
for elimination of drift

Available in either single capacitor, dual capacitor unshielded, and dual capacitor shielded, in a range from 2. uuf to .02 uf.

☆ ☆ ☆

For more information about K-Cap, K-Tran and J-Tran, write for a copy of the K-Tran-K-Cap Manual—56 pages of engineering information, most valuable to you in Electronic designing.

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



CIRCLE ED-29 ON READER-SERVICE CARD FOR MORE INFORMATION

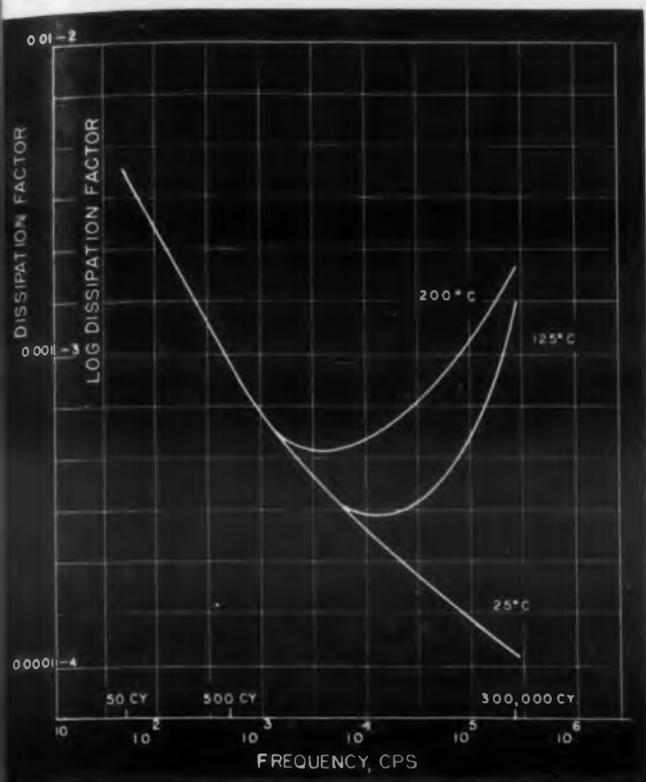
Glass-Teflon Dielectric

EASILY handled and non-stretchable, this stiff thin film, known as Fiberfilm, has all of the excellent electrical properties of Teflon. The non-porous type is especially useful as a dielectric for high-temperature, low-loss capacitors of both the dry and wet type; for interlayer insulation in coils; and for high-temperature rated wire leads and cables. Having desirable adhesive properties, coil wire can be wound to the edge of this insulation without spilling off.

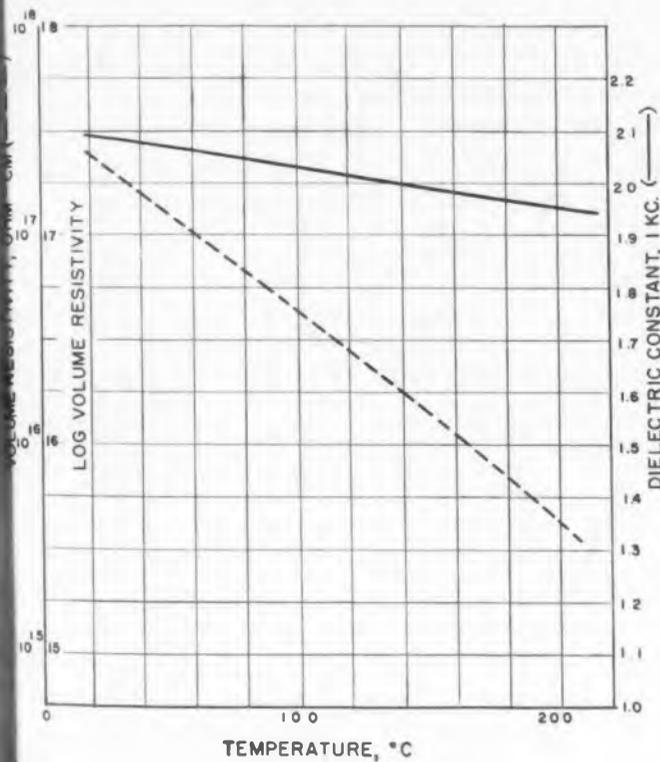
Fiberfilm, manufactured by the New Products Div. of American Machine and Foundry Co., 26 Madison Ave., New York 16, N. Y., is made from glass microfibers and polytetrafluoroethylene. It is available in long continuous rolls up to 40" in width. The non-porous type is currently made in thicknesses ranging from 1 to 1.7 mils. Laminations of greater thicknesses are available. The insulator has a dielectric breakdown strength in the range of 1400 to 4000v/mil, depending on its form and treating. It performs satisfactorily at temperatures of 200 to 250°C. The dissipation factor at 1kc is less than 0.001. Volume resistivity at 25°C is 10^{15} ohm-cm. Dielectric constant at 25°C at 1kc is 2.1. Because the dielectric does not stretch under tension it is well suited for use on winding machines. Dielectric-strength uniformity is, therefore, assured and rejection rate of capacitors, for example, is low.

A porous variety of Fiberfilm is available in different thicknesses and Teflon-to-glass ratios. The porous sheet is useful in high-temperature coils and transformers as interlayer insulation where the entire assembly is impregnated with silicone resin. The material also serves as spacers in tantalum electrolytic capacitors. The sheet also acts as a filter and is especially suitable for corrosive high-temperature applications. The porosity can be closely controlled.

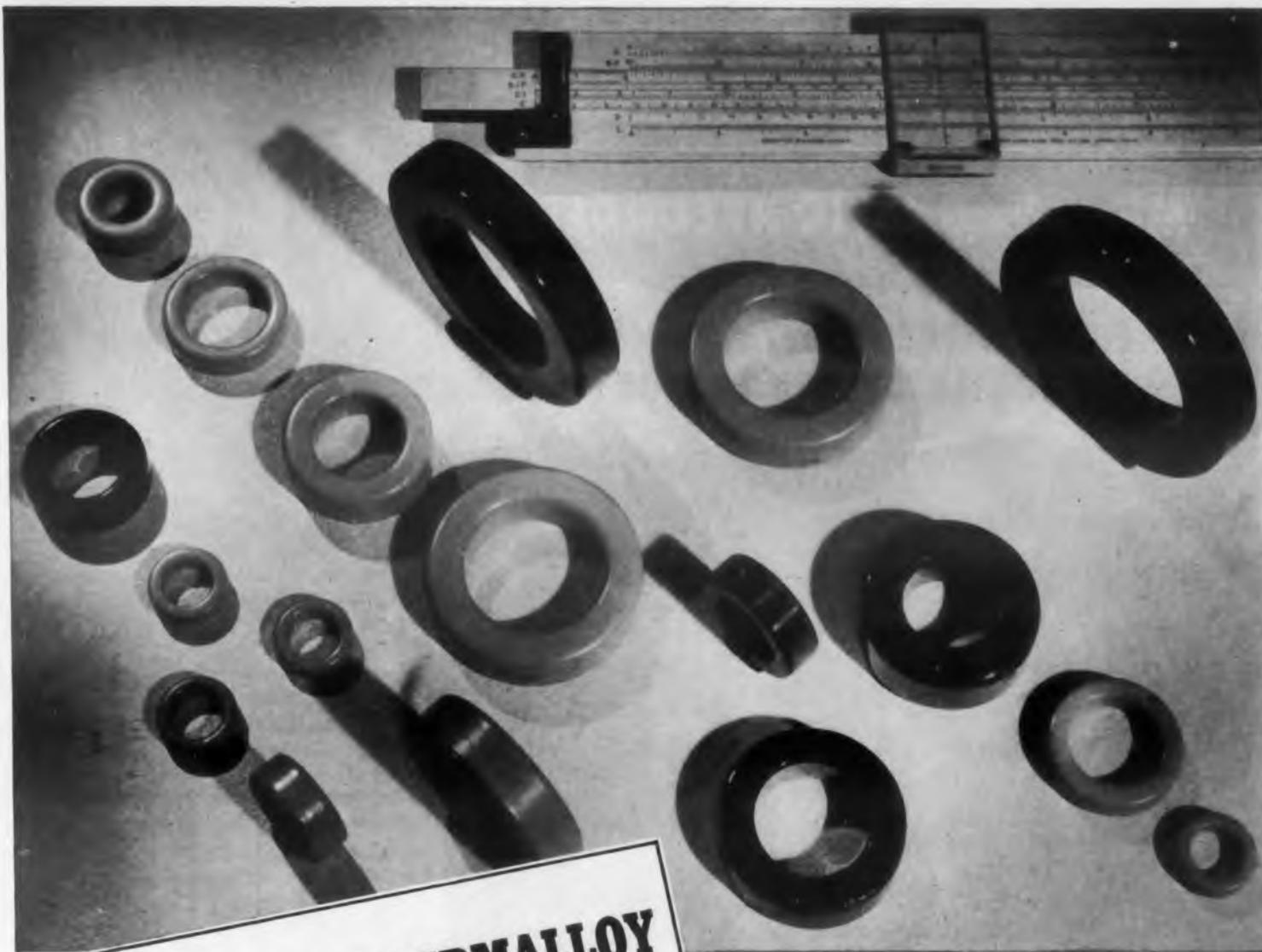
Silicone resin can be used in place of Teflon. The porous vinyl Fiberfilm is moisture repellent, does not breathe. For more information on this dielectric turn to Reader's Service Card and circle ED-30



Dissipation factor vs. frequency for non-porous Fiberfilm sheets.



Dielectric constant and resistivity vs. temperature for non-porous type.



MOLYBDENUM PERMALLOY POWDER CORES*

(New technical data now available)
Write for Bulletin PC-104A, dated March 15, 1955

HIGH Q TOROIDS for use in Loading Coils, Filters, Broadband Carrier Systems and Networks— for frequencies up to 200 K C

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

- ★ **Furnished in four standard permeabilities—125, 60, 26 and 14.**
- ★ **Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.**
- ★ **These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.**

For high Q in a small volume, characterized by low eddy current and hysteresis losses, ARNOLD Moly Permalloy Powder Toroidal Cores are commercially available to meet high standards of physical and electrical requirements. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc, 60 Mu at 10 to 50 kc, 26 Mu at 30 to 75 kc, and 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability ($\pm 0.1\%$) over a specific temperature range.

*Manufactured under license arrangements with Western Electric Company

W&D 4744

THE ARNOLD ENGINEERING COMPANY



SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.

Los Angeles: 3450 Wilshire Blvd.

Boston: 200 Berkeley St.

CIRCLE ED-31 ON READER-SERVICE CARD FOR MORE INFORMATION

SIE

MR-4 MAGNETIC RECORDER

- FOR LOW-FREQUENCY APPLICATIONS
- IN MOBILE OR LABORATORY USE



The SIE MR-4 Magnetic Recorder provides 28 channels for FM recording of low-frequency phenomena from DC to 500 cycles-per-second.

Unique design features, including the SIE Slope Modulator and Length-Time Servo System, result in superior signal-to-noise ratio and timing accuracy characteristics.

SIE's field-proven experience in heavy-duty construction techniques offers assurance of operating reliability under all conditions. Plug-in units and unitized chassis provide ease of maintenance. Advanced circuitry eliminates critical adjustments and complex operating procedures.

CHANNELS: 28

FREQUENCY RESPONSE: DC to 500 cps.

SIGNAL-TO-NOISE RATIO: In excess of 60 db to 100 cps. Better than 54 db at frequencies above 100 cps.

DISTORTION: Less than 1% at any frequency.

REPRODUCIBLE ACCURACY: Within .0005 seconds-per-second.

POWER REQUIREMENTS: 12 Volts DC. 25 amperes standby, 47 amperes recording.

SIE

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.

P.O. Box 13058

2831 Post Oak Rd.

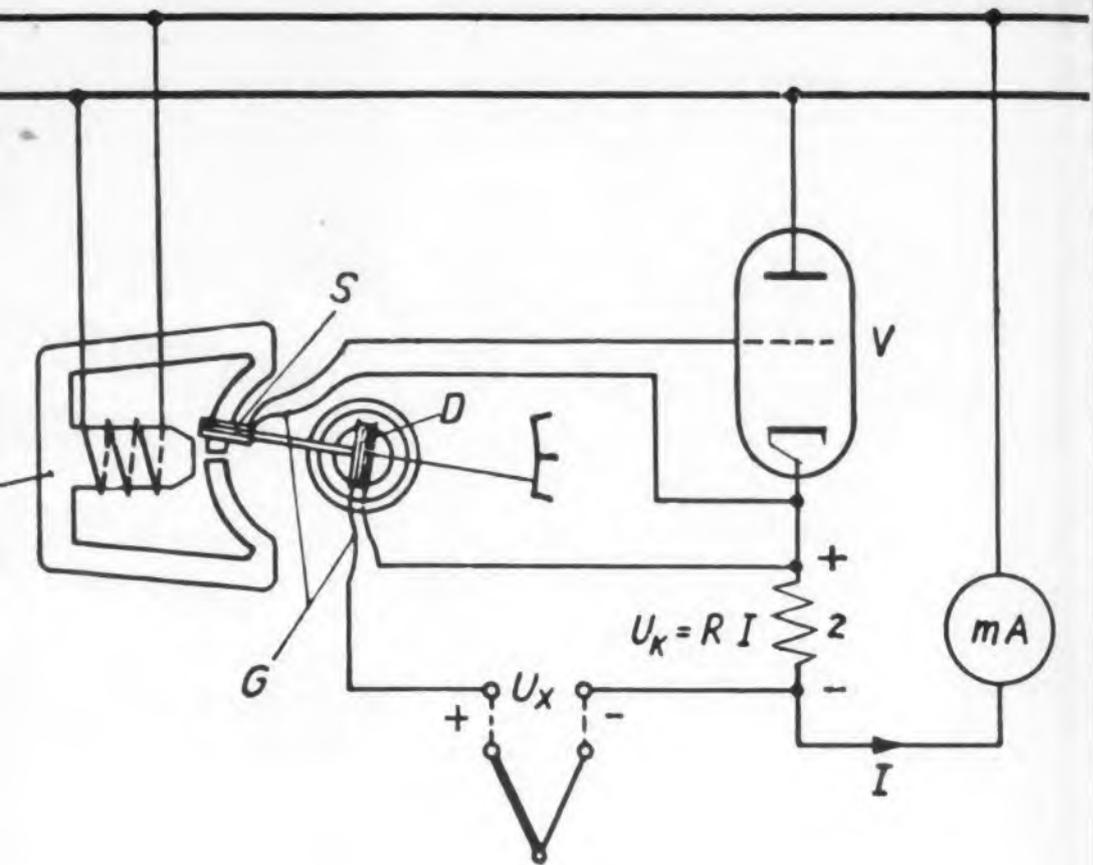
Houston 19, Texas

203 54

REPRESENTATIVES THROUGHOUT THE WORLD

CIRCLE ED-32 ON READER-SERVICE CARD FOR MORE INFORMATION

Swing-Coil Compensator



Swing-coil zero system; amplifier tube only part subject to wear. Swing coil exerts no reaction torque on moving coil.

- D*—moving coil
- S*—swing coil connected to *D*
- E*—a-c energized exciter
- G*—gold tape leads
- R*—compensating resistor
- V*—electron-tube amplifier

RECO
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RECORDING instruments that might ordinarily load such low-voltage devices as thermocouples, measuring bridges and p_h -electrodes can be readily operated from the non-dissipative Swing-Coil Compensator. The Swing-Coil Compensator produces a high current output which can drive, also, large easy-to-read millimeters. Input voltage is compensated in the device by an automatically regulated opposing voltage thus exhibiting closed-loop control. The several milliamperes of current that flows through the resistor in the compensating circuit is proportional to the voltage being measured.

The Swing-Coil Compensator, manufactured by AEG (Allgemeine Elektrizitäts Gesellschaft) of Germany, and distributed by D. C. Seibert, Box 281, Wilmington, Del., consists of a moving coil, a swing coil and E-magnet, an electron-tube amplifier, and a compensating resistor. Unknown voltages are connected to the moving coil. As the moving coil deflects, the unique rigidly-connected swing coil moves out of the zero-field center of its exciter E-magnet into a strong magnetic field. Voltage induced in the swing coil drives the amplifier-tube grid and plate current flows. Plate current causes an IR drop in the compensating resistor. If there is a difference between the measured voltage and the compensating voltage, the swing coil picks up exciter voltage and tube current adjusts until it is proportional to the input voltage.

The swing-coil system operates with practically no time lag and is critically damped. Swing-coil movement of less than one degree produces proper action. For a standardized output current of 5ma and a typical input of 10mv, the calculated accuracy is 0.24%.

Supply voltage variations are automatically balanced by the compensator action. The tube is well operated and life expectation is at least 5000 hours. For more information about this instrument, turn to the Reader's Service Card, and circle ED-33.

New

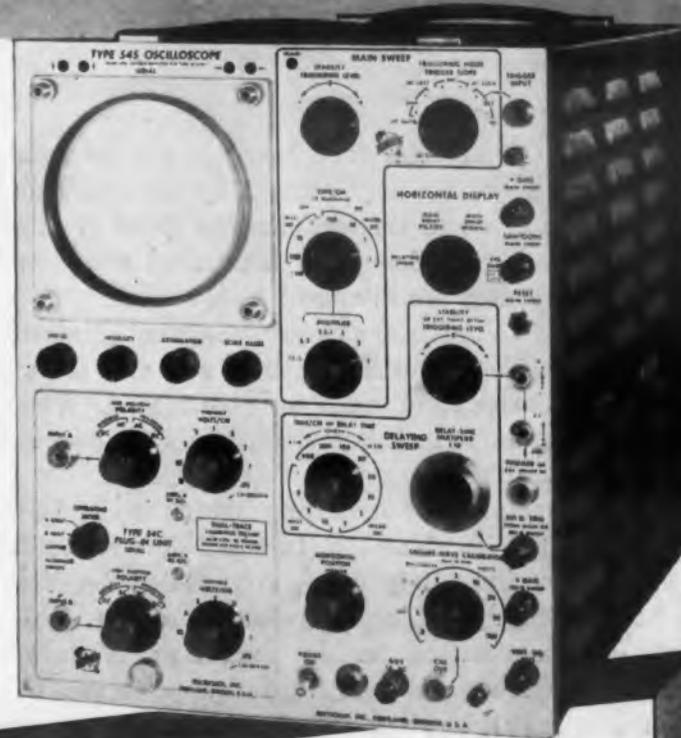
for fast-rise applications

(12 MILLIMICROSECONDS)

Tektronix Type 545 and Type 541 CATHODE-RAY OSCILLOSCOPES

TYPE 545—This new high-speed laboratory oscilloscope, in combination with the new Type 53K/54K Fast-Rise Plug-In Unit... opens the way to quicker, easier analyses of fast-rising waveforms... providing faithful displays and accurate measurement facilities well beyond the range of previous oscilloscopes of its size and cost. The Type 545-Type 53K/54K combination offers a vertical-amplifier passband of dc to 30 mc (12-millimicrosecond risetime) at calibrated sensitivities to 0.05 v/cm, with a full 4-cm linear vertical deflection. A wide range of calibrated sweeps, with calibrated sweep delay from 1 μ sec to 0.1 sec, and high accelerating potential, 10 kv, fully complete this greatly extended vertical-amplifier range.

The Type 545 is the most versatile oscilloscope ever made, for it can be quickly converted to many other applications. By merely plugging in the appropriate Type 53/54 Plug-In Pre-amplifier you are ready for wide-band, wide-band high gain, dual-trace, high-gain differential, microvolt-sensitivity, or wide-band differential applications. It's a rare oscilloscope application that isn't easily handled by this modern method.



Vertical-Amplifier Characteristics with Type 53K/54K Unit Plugged In

Transient Response—Risetime, 12 millimicroseconds.

Frequency Response—Passband, dc to 30 mc. (down 3 db \pm 1/2 db at 30 mc, only 6 db at 45 mc).

Input Impedance 20 μ ohm, 1 megohm.

Sensitivity—0.05 v/cm to 20 v/cm in 9 calibrated steps.

Price—\$125



LOW INPUT CAPACITANCE

With Accessory Probes for Type 53K/54K

Probe	Input Impedance	Maximum Sensitivity
P405	11.5 μ f, 5 megohms	0.25 v/cm
P410	7.5 μ f, 10 megohms	0.5 v/cm
P420	4.5 μ f, 10 megohms	1 v/cm
P450	2.5 μ f, 10 megohms	2.5 v/cm
P4100	2.5 μ f, 10 megohms	5 v/cm

Type 545 Oscilloscope Characteristics

Wide Sweep Range

24 Calibrated sweeps from 0.1 μ sec/cm to 5 sec/cm, accurate within 3%. Accurate 5-x magnifier extends calibrated range to 0.02 μ sec/cm. Continuously variable from 0.02 μ sec/cm to 12 sec/cm.

Wide Sweep-Delay Range

Additional delaying-sweep circuitry provides conventional, or triggered jitter-free delay, 1 μ sec to 0.1 sec in 12 calibrated ranges. Range accuracy within 2%. Incremental accuracy within 0.2% of full scale.

Versatile Triggering

Internal or external, with amplitude-level selection or AUTOMATIC TRIGGERING. High-frequency synchronization up to 30 mc.

Square-Wave Amplitude Calibrator

0.2 mv to 100 v in 18 steps, accurate within 3%.

New Cathode-Ray Tube

Tektronix T54P 5" precision metallized crt provides 4-cm vertical and 10-cm horizontal linear deflection. 10-kv regulated accelerating potential.

Balanced Delay Network

0.15 μ sec vertical signal delay.

DC-Coupled Unblanking

Uniform unblanking at all sweep speeds and repetition rates.

Electronic Voltage Regulation

All voltages affecting calibrations are fully regulated.

CRT Beam Position Indicators

Type 545—\$1450 plus price of desired plug-in units.

Type 541—Same characteristics, less delayed-sweep facility—\$1145 plus price of desired plug-in units.

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CIRCLE ED-34 ON READER-SERVICE CARD FOR MORE INFORMATION

Selecting Miniature Bearings

H. M. Dardani, Chief Process Engineer,
Miniature Precision Bearings, Inc., Keene, N. H.

SELECTION of miniature bearings for electronic devices is greatly implemented by the tables and nomographs given in this article. The types of miniature bearings considered are illustrated above and their relative uses are discussed in the table.

Obviously, radial bearings are designed primarily for radial loads. Nevertheless, they can also sustain a moderate amount of axial or thrust load. Where there is any doubt in this matter, it is best to check with the manufacturer.

Various methods of mounting shafts in bearings are shown in Figs. 1 and 2. In small devices, radial load is often limited by shaft strength rather than by bearing strength. The four most common troubles that designers encounter in mounting miniature shafts involve the following: (1) radial play; (2) axial play; (3) starting torque; and (4) running torque.

A miniature motor with excessive radial play, for example, will not allow the rotor to maintain a uniform air gap. Excessive axial play may cause undue wear or improper functioning of associated equipment. In airborne equipment, starting and running torque characteristics of ball bearings remain almost constant regardless of shaft position.

Sample Problem

A typical problem might concern a tape printer mechanism that records data from an electronic computer. For such an installation the design may require high speed, low torque, and a very small amount of inertia. Since the printer is not intended for mobile use, the loadings are fixed. Thus, it is merely necessary to know whether load is radial, axial (thrust) or a combination of both.

Assume that the printer has a miniature shaft that must sustain 5 lb of radial load at a speed of 8000-rpm. Referring to Table 1, it is clear that out of 13 available bearing designs, several can be considered for this application. Since the load is only 5 lb (light) and the speed 8000rpm (medium), the radial retainer series (No. 3 in the table) may be selected tentatively because of its low starting torque.

Fig. 3 is a set of curves showing the relationship

between radial load (lbs) to speed (rpm) for eight sizes of radial retainer bearings. The curves were developed from the equation:

$$P = C / \sqrt[3]{L_H \times rpm \times 60 \times 10^{-6}}$$

where P is the radial load that can be handled in pounds, L_H is the average life in hours, rpm is the speed of the shaft, and C is an empirical factor that depends on bearing design. Actual values of C are found by tests and are listed in makers' catalogs.

The formula gives bearing load rating in pounds for SAE 52100 steel. For stainless steel, the formula result must be multiplied by 0.85 and in the case of beryllium copper by 0.25. An additional factor (0.7) must be applied when the outer bearing race rotates while the inner race is stationary.

Let us assume that the value of P is calculated by means of the equation, to be 10 lb for a bearing of SAE 52100 steel. If the bearing is made of beryllium copper, outer race rotates, inner race stationary, then $10 \times 0.25 \times 0.7$ equals 1.75 lb. Under the changed conditions, the radial load for the bearing is reduced from 10 to 1.75 lb.

Again referring to Fig. 3 and the specific bearing design problem, it is now necessary merely to choose the proper size. Since the intersection of the 5-lb radial load line and the 8000rpm line falls below the three top curves, bearings C , D , F , G , or H will meet the requirements for load and speed. If the designer must hold OD to a minimum, he probably would select bearing C since it has an OD of 0.2500" as compared to 0.3125" for the other sizes.

In case bearing C has too small a bore (0.0781") to accommodate a shaft of sufficient strength for the job, it then may be necessary to consider super-light bearings, which are covered by Fig. 6. Super-light bearing A has an OD of 0.2500", but its bore is 0.1250", which is appreciably larger than the bore of radial bearing C .

In a mechanism having a shaft that is subjected to high axial loads, a thrust bearing is recommended. To select the proper thrust bearing for a specific case, the curves of Fig. 4 are used. The broken lines indicate conditions where thrust load requirement is 15 lb and speed is 6000rpm. It is easy to see that

thrust bearings C , D , or E would be satisfactory for this situation. Of the three, bearing C has the smallest OD and bearing D accommodates the largest shaft

Combined Loads

If the electronic engineer is concerned with a mechanism that must withstand sizable radial and thrust loads, which often occur in airborne units, there are several solutions to the problem. He can use two sets of bearings on the shaft, one pair for thrust, the other for radial load. Angular contact bearings may be employed as shown in Fig. 2. Then again, pivot bearings can be used on one or both ends of the shaft as shown in Fig. 1.

If separate radial and thrust bearings are employed, the correct size for each pair can be determined from Figs. 3, 4, and 6 by the method explained previously. The procedure for selecting angular contact and pivot bearings is somewhat different from the above but equally simple.

For example, the case may involve a radial load of 6 lb, an axial load of 3 lb and a speed of 4000rpm. Fig. 5 deals with angular contact bearings. The equivalent radial load from the expected thrust load of 3 lb equals thrust load times $\tan 60^\circ$ (cone angle)

$$3 \times 1.732 = 5.20 \text{ lb.}$$

A bearing selected to carry a radial load of 6 lb (bearings C , D or E , Fig. 5) can then support the specified thrust load of 3 lb. If, however, the equivalent radial load produced by the thrust component had exceeded 6 lb, the bearing would have had to be selected on the basis of the higher equivalent radial load.

In a similar manner, Fig. 7 is used to select the proper pivot bearing for a specific design. Here, bearings D , E , or F meet the requirements for the last problem. It should be noted that the smallest angular contact bearing (C) that can be used for the problem has a larger OD (0.2500") than the comparable pivot bearing (D) which has an OD of 0.1968". However, the width (W) of the angular-contact bearing (0.0938") is less than that of the pivot bearing (0.1181").

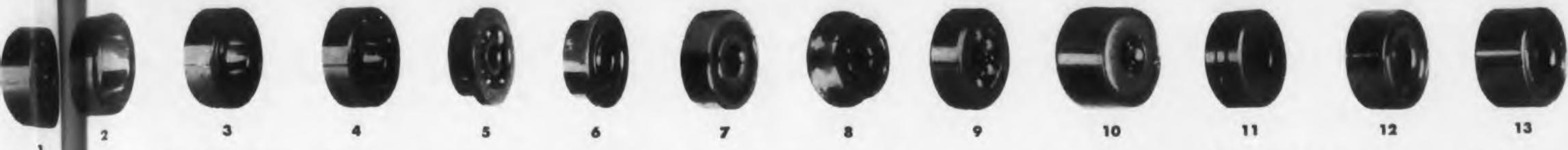


Table 1. This compilation of information for the bearings illustrated above should help the designer to select the proper type of bearing for a particular application.

Bearing Type Name	Load Conditions	Size Range			Weight Range (grams)	Balls	"C" Factor Range
		O D	Bore	Width			
Radial	High radial loads, moderate speeds, moderate thrust loads.	1/10" - 5/16"	1/32" - 3/32"	1/32" - 7/64"	0.02 - 0.69	7 - 10	15 - 106
Super Light Radial	Same as radial—for larger shafts with small OD of bearing.	1/4" - 3/8"	1/8" - 1/4"	3/32" - 1/8"	0.28 - 0.62	11 - 25	61 - 118
Radial Retainer	Moderate or medium speeds, moderate radial and thrust loads, low starting torque.	5/32" - 5/16"	3/64" - 3/16"	1/16" - 7/64"	0.08 - 0.64	5 - 7	24 - 97
Spring Separator	Low starting torque, oscillating motion, low speeds (up to 5000rpm).	5/16"	3/32" - 3/16"	7/64"	0.39 - 0.62	5 - 7	68 - 87
Flanged Radial	Convenience in mounting eliminates need for seat in housing or special retaining devices. Aids squareness in mounting. Saves axial space in gear trains.	5/32" - 5/16"	3/64" - 3/16"	1/16" - 7/64"	0.12 - 0.78	8 - 16	32 - 118
Flanged Radial Retainer	Combines advantages of flanged design with radial-retainer bearing.	5/32" - 5/16"	3/64" - 3/16"	1/16" - 7/64"	0.10 - 0.78	5 - 7	24 - 97
Separable	Well adapted to very high speeds, combined radial and thrust loads. Mounted in opposition, bearings permit axial adjustment of internal bearing clearances.	3/16" - 5/16"	3/64" - 1/8"	5/64" - 7/64"	0.15 - 0.69	5 - 8	48 - 113
Flanged Separable	Combines advantages of flanged and separable types.	3/16" - 5/16"	3/64" - 1/8"	5/64" - 7/64"	0.20 - 0.83	5 - 8	48 - 113
Angular Contact Pivot	Receives combined loads on conical 60° pivot point; self-contained.	1/8" - 3/8"		3/64" - 9/64"	0.05 - 1.49	6 - 7	18 - 170
Pivot (spherical seat or race types)	Designed for high loads, severe shock. Used with 60° pivot points. Shaft misalignment: 4° for spherical types, 2° for race type.	1/16" - 25/64"		3/64" - 15/64"	0.02 - 2.56	4	3.4 - 205
Thrust	Heavy thrust loads, medium speed, minimum space.	1/8" - 7/16"	3/64" - 1/8"	1/16" - 3/16"	0.06 - 3.1	6 - 8	52 - 406
Shielded	Protects bearing against foreign matter—retains lubricant—no increase in width.	1/4" - 3/8"	5/64" - 1/4"	1/32" - 7/64"	0.022 - 0.759	7 - 10	15 - 106
Shielded Retainer	Same as shielded bearing plus advantages of radial retainer—minimum width.	5/32" - 3/8"	3/64" - 1/4"	1/16" - 7/64"	0.088 - 0.704	5 - 7	24 - 97

Fig. 1. Two methods of mounting shafts with pivot bearings.

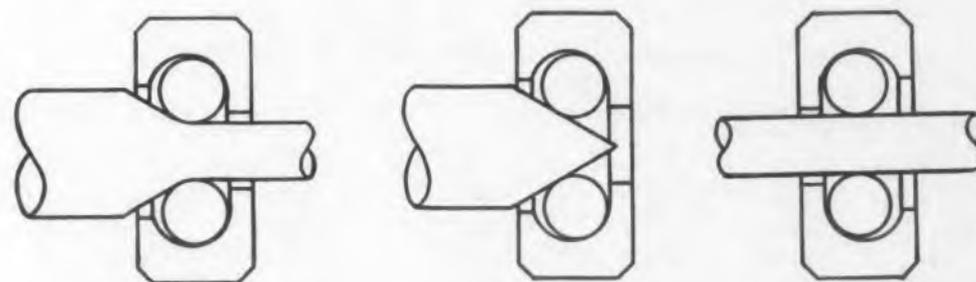
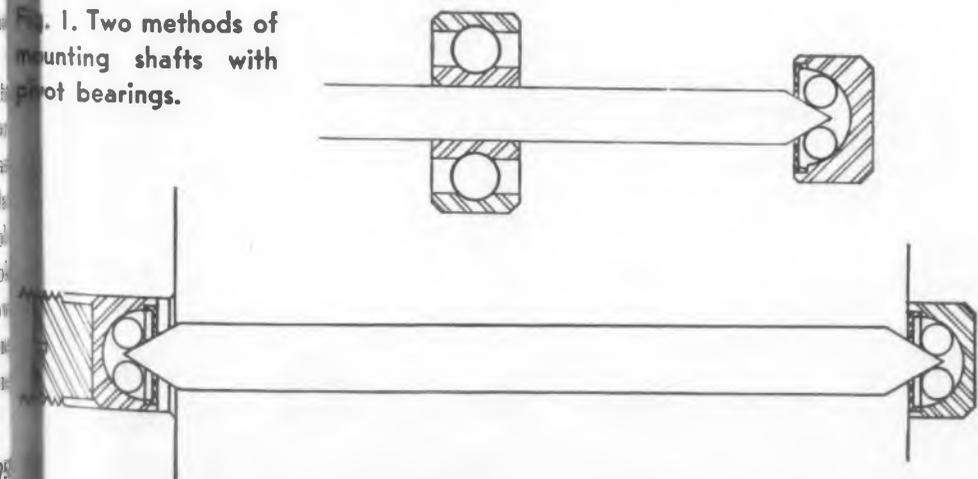


Fig. 2. Three types of shafts that can be mounted with angular-contact bearings.

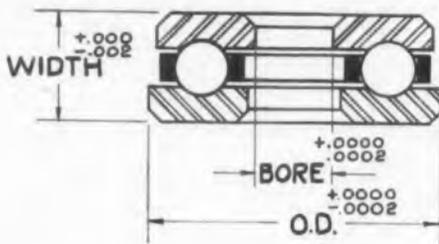
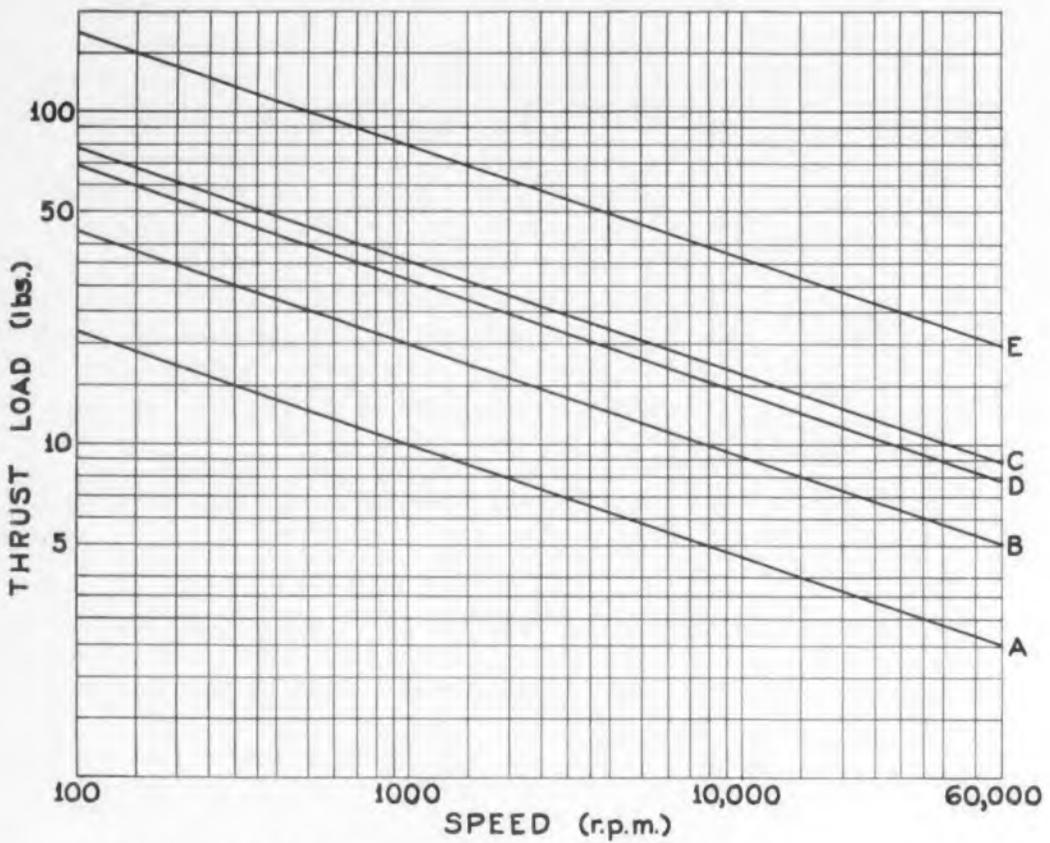
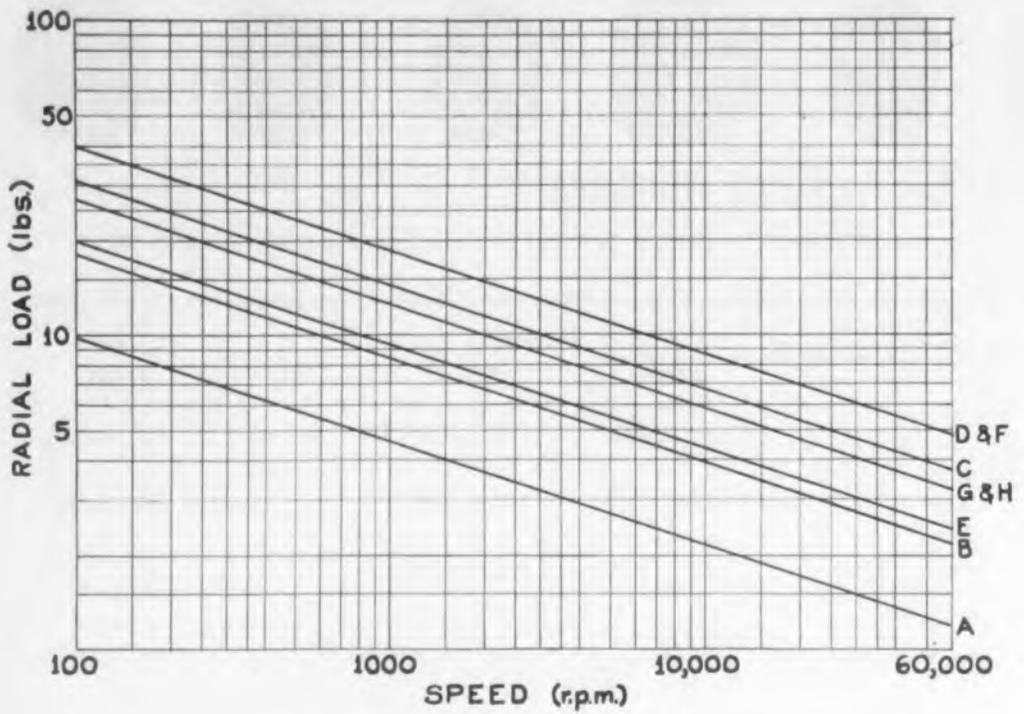


Fig. 4. Thrust bearing selection chart above. All bearing dimensions are in inches.

	A	B	C	D	E
Bore	0.0400	0.0938	0.1250	0.1875	0.1250
OD	0.1250	0.2500	0.3125	0.3750	0.4375
Width	0.0625	0.0938	0.1250	0.1500	0.1875



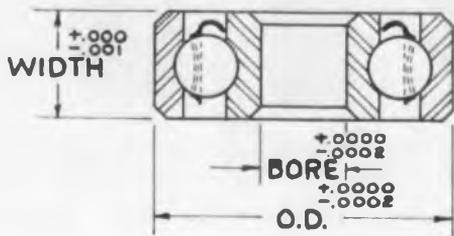


Fig. 3. Radial retainer type bearing selection chart at the left. All bearing dimensions below are in inches.

	A	B	C	D	E	F	G	H
Bore	0.0469	0.0550	0.0781	0.09375	0.1250	0.1250	0.15625	0.1875
OD	0.15625	0.1875	0.2500	0.3125	0.2500	0.3125	0.3125	0.3125
Width	0.0625	0.0781	0.0938	0.1094	0.0938	0.1094	0.1094	0.1094

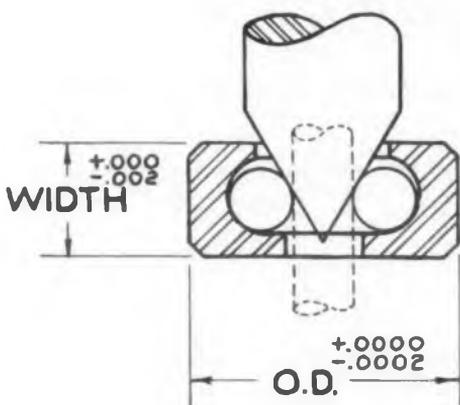
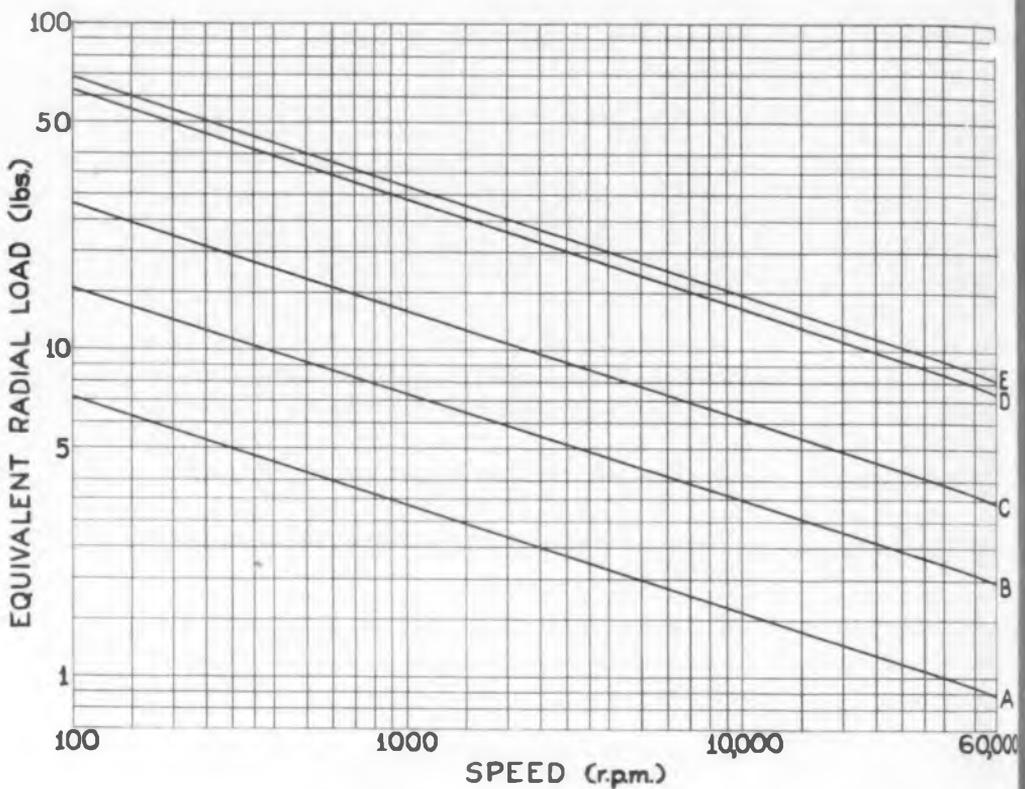


Fig. 5. Angular contact bearing selection chart, above. All bearing dimensions in inches. S stands for shaft diameter, and SE is the diameter of the shaft extension (broken lines).

	A	B	C	D	E
OD	0.1250	0.1875	0.2500	0.3750	0.3750
Width	0.0469	0.0700	0.0938	0.1406	0.1406
min S	0.042	0.062	0.085	0.124	0.150
max SE	0.032	0.048	0.063	0.094	0.125



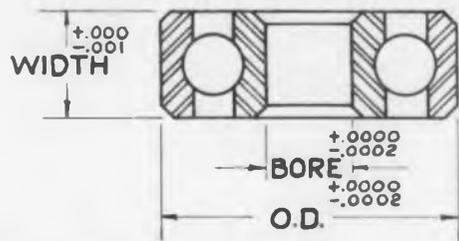


Fig. 6. Super-light radial bearing selection chart.

(All bearing dimensions in inches.)

	A	B	C	D	E	F
Bore	0.1250	0.1250	0.15625	0.1875	0.21875	0.2500
OD	0.2500	0.3125	0.3125	0.3125	0.3125	0.3750
Width	0.0938	0.1094	0.1094	0.1094	0.1094	0.1250

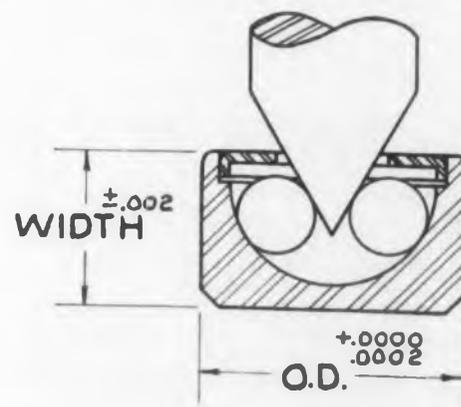
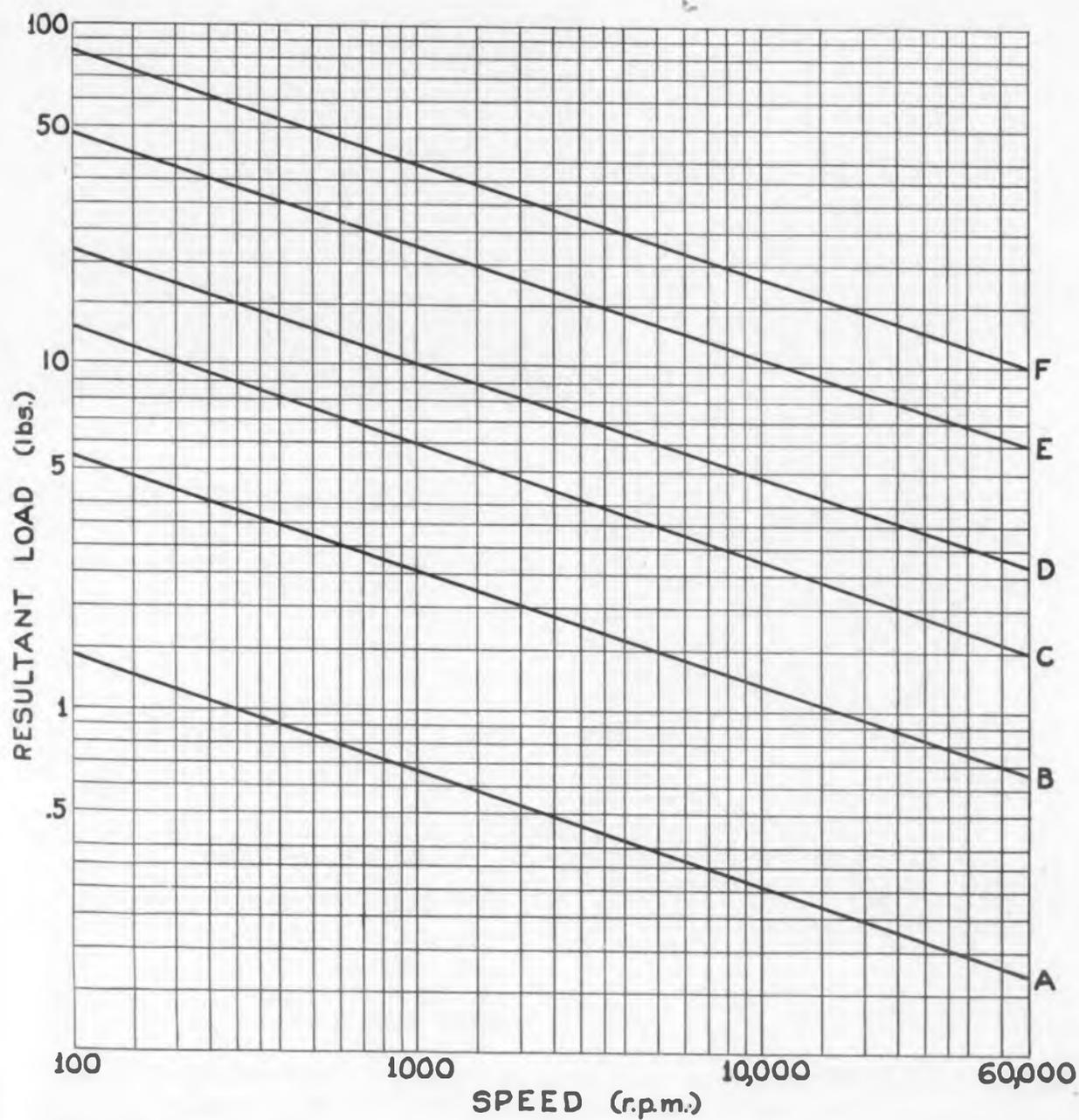
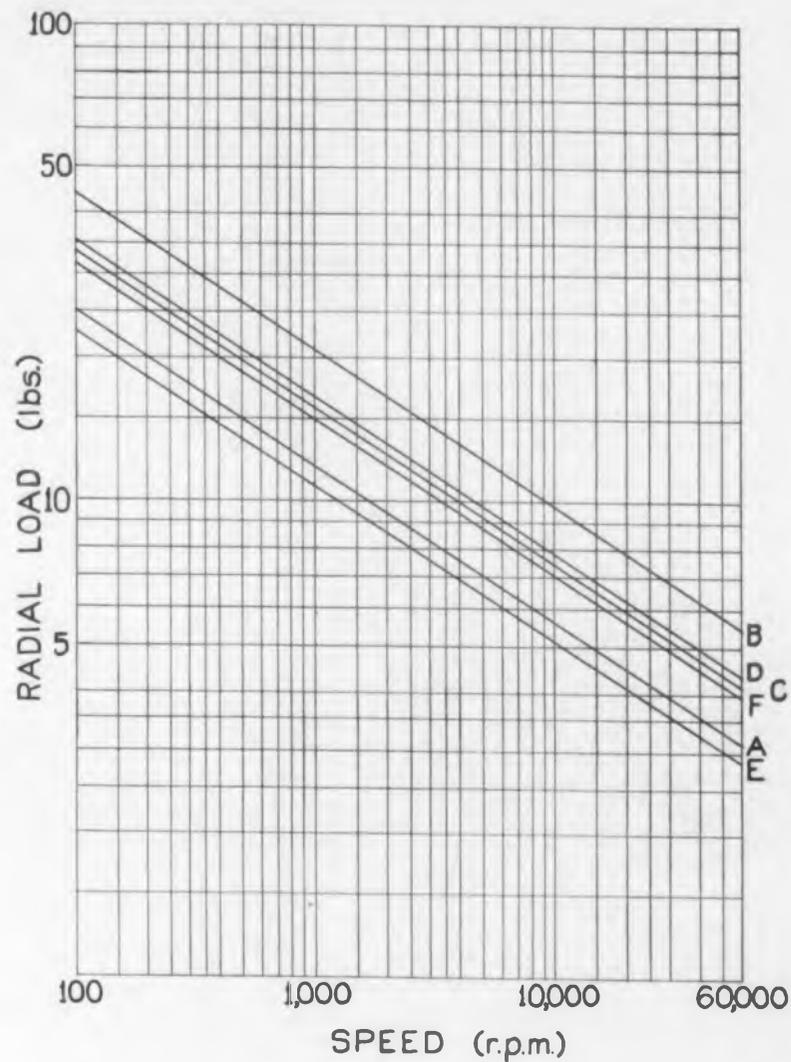


Fig. 7. Pivot bearing selection chart. S stands for shaft diameter.

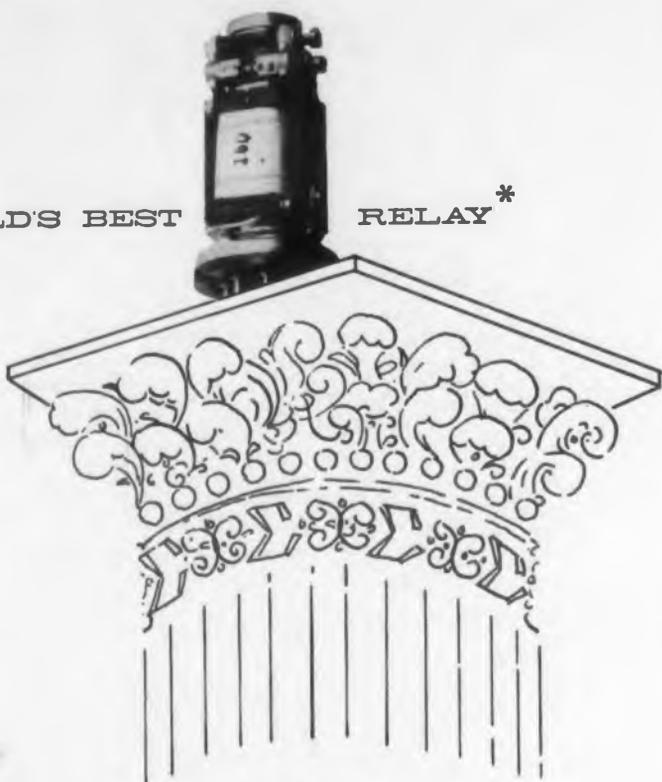
(All bearing dimensions in inches.)

	A	B	C	D	E	F
OD	0.0590	0.1181	0.1575	0.1968	0.2953	0.3937
Width	0.0472	0.0709	0.0945	0.1181	0.1772	0.2362
min S	0.020	0.030	0.040	0.050	0.075	0.100



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While hair is down it may be admitted that this little wonder* is Sigma's first serious challenge to European relays. In fact, it is alleged by certain "independent laboratories" to excel them, particularly for high speed transmission. If so, we're in, because in addition the 72 has provision for maintenance and adjustment that combines features of the old fashioned phonograph needle and the timeless water faucet. Bias and sensitivity are "micrometer" adjustable; contact screws and armature are easily replaceable.

We are now in a position to sell these paragons in fair quantity. If you buy them for the type of application for which they are designed, we won't even cross our fingers — hardly.

**We can't prove this, but it is the opinion of the man who designed it.*

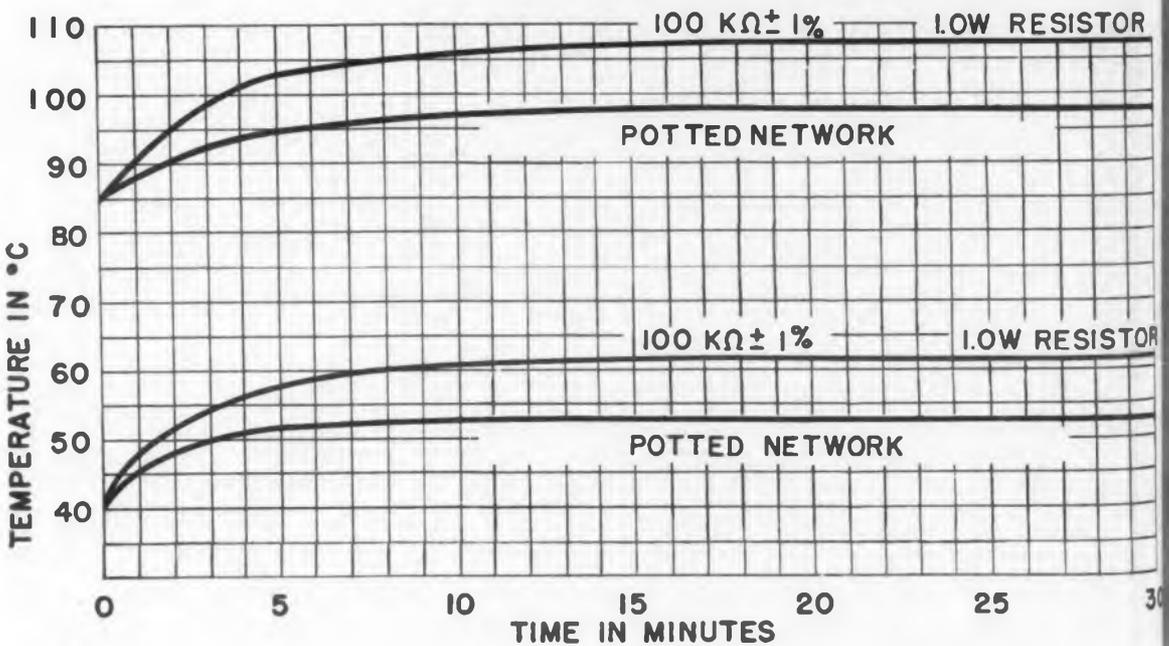
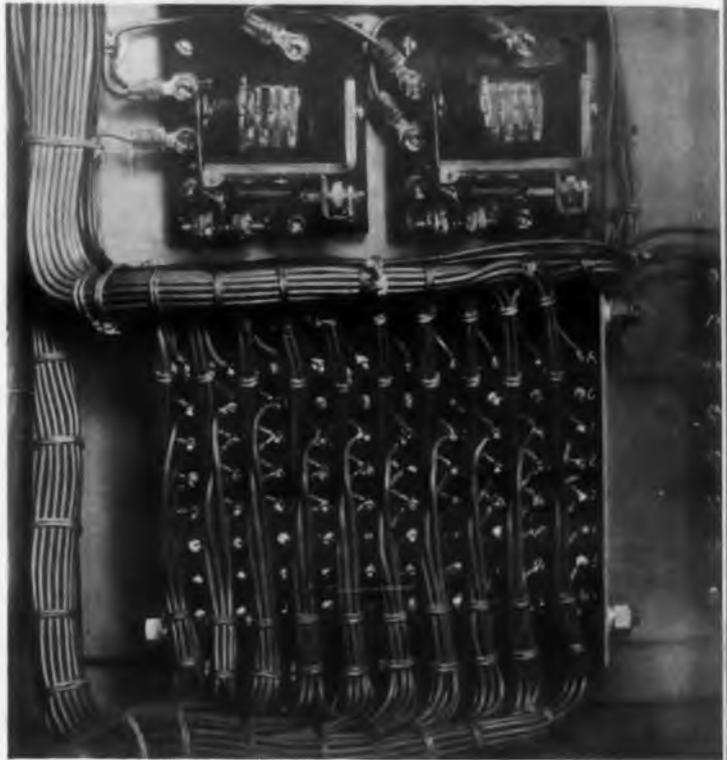
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Rear view of console showing ten potted resistor networks. Each network contains seven, 1w resistors.



Differential between standard resistor normally mounted and potted network mounted to metal chassis in 40°C and 85°C ambients.

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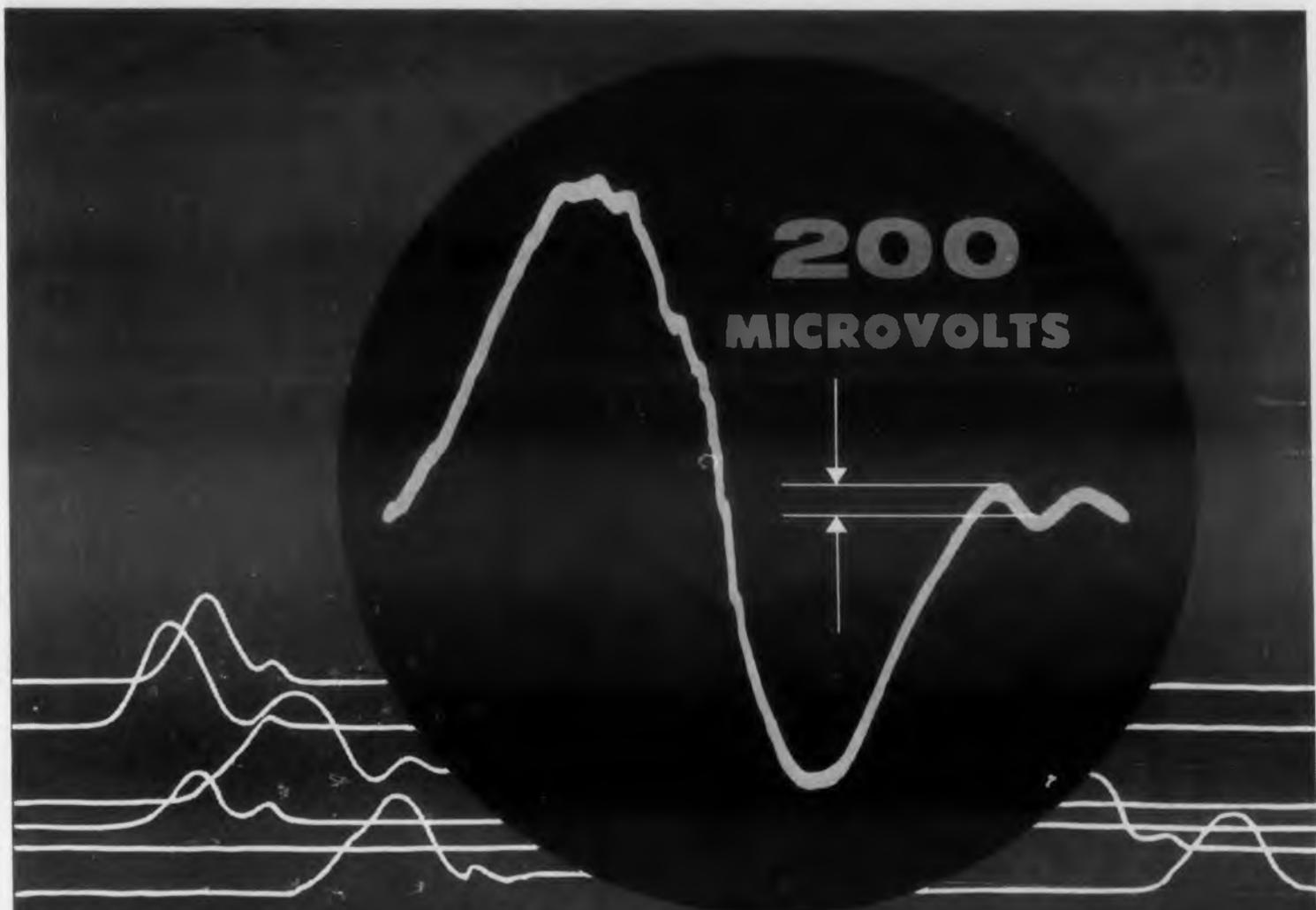


Five precision resistors attached to octal tube socket.

ENCAPSULATION of precision wire wound resistors in one compact space-saving unit not only offers the advantage of miniaturization and hermetic sealing but cuts assembly time. Resistors can be potted in almost any size or shape providing maximum efficiency and ambient operating temperatures up to 150°C. Sealed units are, of course, fungus proof, non-inductive, and non-corrosive.

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The automatic range feature does not make the meter larger than comparable VTVM's.



Range-Finding VTVM

WHEN the probe of the vtvm shown at the left is applied to a potential, the range switch in this instrument automatically turns to the proper range and the reading appears on the meter. The range-finding feature on the unit, which is known as the "Volt-Ohmatic" Automatic Range Switching Vacuum Tube Voltmeter, is a discrete position servomechanism. It is available as a packaged component for incorporation in other equipment such as oscilloscopes, automatic parts sorters, comparison bridges, and automatic controls.

The automatic switching feature means that the meter is always reading on the lowest possible scale for greater accuracy. During the switching action, the meter movement is disconnected from the circuit, thus protecting the instrument. The range switch can also be operated manually. When automatic switching is desired, the "automatic" button in the probe is depressed. Only one probe is employed for a-c, d-c, and resistance measurements. The instrument is manufactured by Bergen Laboratories, 11 Godwin Ave., Fair Lawn, N. J.

When used as a d-c meter, the vtvm has an accuracy within $\pm 3\%$ full scale. Voltage ranges are from 1.5v to 1500v full scale. Frequency response is 30cy to 3Mc. The circuit is a twin-triode meter bridge. The dimensions of the unit are 5-1/4" x 4-1/2", and it weighs 5 lb. The dimensions of the packaged switching feature alone are about 3" x 3" x 4". For more information on this instrument or the packaged servo switching device, turn to the Reader's Service Card and circle **ED-39**.

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in 6 years



revolutionary ALUMINUM CORE BOX[†] construction

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[†]PATENT PENDING

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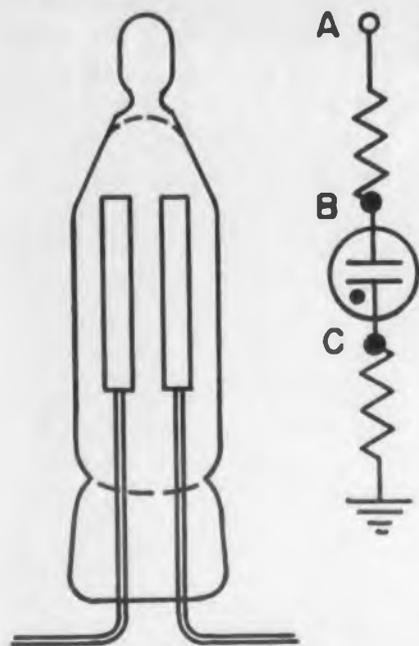


Fig. 1. The basic single-tube gas-diode circuit.

Gas-Diode Memories

COLD-CATHODE gas diodes such as the simple neon glow lamp offer possibilities for low-cost high-speed memories, once the inherent disadvantages of the tubes are overcome. A study of these tubes for memory and indicator purposes has resulted in a number of circuits that provide an approach to reducing the cost of digital computer memories from the present dollar per bit to about 10 cents. Indication is also possible since in most of the circuits the lamp will flash in only one of the two stored states. This study was made by A. W. Holt and D. C. Friedman of the data processing systems laboratories, National Bureau of Standards, Washington 25, D. C.

Cold-cathode gas diodes as computer elements have a number of advantages: smallness of size, ruggedness, cheapness, cool operation, low power requirements, high possible pulse power, visual indication and several types of possible binary states of electrical operation. However, they also have a number of disadvantages that tend to limit their use. Among these are: a wide range of characteristic potentials; variability of these potentials with use, ambient light, and temperature; long deionization time; and difficulty in obtaining access to a single bit when used in a matrix. Recent efforts at the Bureau have been directed toward developing circuits to overcome the

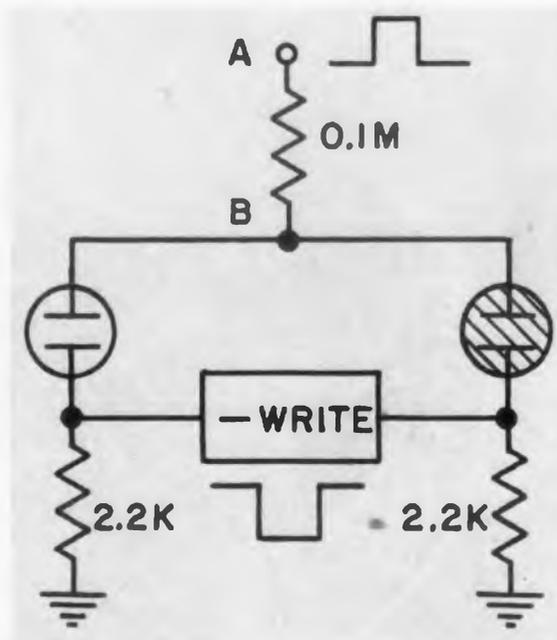


Fig. 2. This double-diode circuit affords high writing speed.

latter two difficulties to obtain indicator memories.

The basic memory circuit consists simply of a gas diode connected in series between two resistors as shown in Fig. 1. Power is applied to one resistor at point A. This resistor is connected to the diode at point B. The other terminal of the diode is tied, at point C, to the second resistor which is returned to ground. This circuit may be a pilot lamp, an oscillator, a flip-flop, an or-gate, an and-gate, a memory bit, or even a photo-flash. How it is used depends upon the voltages applied to points A, B, and C, the values of the resistors, and whether the output is electrical, photoelectrical, or optical.

When used as a d-c indicator memory bit, the total resistance exclusive of the diode is of the order of 0.1 megohm. A potential somewhere between the firing voltage and the holding voltage is applied at point A. If the tube is unfired, this potential is not enough to cause conduction, and the bulb will be dark. This condition may be taken as the binary "zero". B is at the supply voltage; C is at ground. If now a positive potential is applied momentarily at A or B, or a negative potential is applied at C, the tube may be caused to conduct. This conduction makes it glow. Point B drops in potential while point C rises. The new levels will be maintained as long as the potential

Ideas for Design

at A is above the minimum holding potential for the tube. This condition may be considered as the binary "one". To return to the binary zero state, it is necessary to interrupt the holding potential until the tube deionizes fully. This interruption is one disadvantage of the circuit; another is that a continuous path is necessary to maintain the tube in the binary-one state, making it difficult to obtain access to one bit without disturbing others.

Memory Access Circuits

The first innovation was an attempt to overcome the access difficulties. It consisted of turning from the static bit just described to a dynamic type of storage. In this system, a binary one is stored if a tube has "recently" been fired. "Recently," in this sense, means within the last $100\mu\text{sec}$. A binary zero is stored if the tube has not been fired in this time. Since a continuous path need not be maintained for storage, an access scheme of matrix access circuitry may be employed. In the experiments with gas diodes the diode-transistor former and-gate developed for the NBS diode-capacitor memory was used.

In using such an access matrix, the d-c holding potential at A is replaced by a $5\mu\text{sec}$ 100v pulse occurring every $100\mu\text{sec}$ (called a "hold" pulse) on a word bus simultaneously. This pulse will not fire a tube storing a zero, but will reionize a tube storing a one. In order to write a binary one, a positive pulse is applied to the proper word bus, and a negative pulse is applied to the proper bit bus. Neither pulse alone is sufficient to fire the tube; the simultaneous presence of both is required. Since this condition occurs only at the intersection of the selected buses, only the desired bits are written as ones.

In order to examine the stored words, a positive "read" pulse is applied to the proper word bus. If the tube has been ionized recently, this pulse is sufficient to cause conduction, and a signal will be sensed at the "read repeater". During the holding pulse, the logical sum of the memory appears at the read repeaters if this information is desired.

This is a one-way memory: that is, information that has been read into the memory must be completely erased before new information can be read in. In order to write a zero, it is necessary to inhibit the "hold" pulse until the tube will no longer reionize when it is applied, and no provision has been made to make this occur on a single bit. However, because it is a high-speed one-way member, it has several possible applications. For example, it may be used as a buffer between the internal memory of a computer and a high-speed printer. In it would be stored the information for a long print-out. While the printing operation is going on, the computer may be calculating the next set of data. An erasing time of about one millisecond may be economically allowed at the end of a printing cycle in this application. The memory may also be used as a visual tally board for a high-speed computer. In this case, erasure will

controlled by the operator at any suitable intervals.

Double-Diode Memory Circuits

The second innovation was made to provide high writing speed in both directions, using a double-diode bit (Fig. 2). In this circuit, two gas diodes, three resistors, and a negative "write" source are employed. Both tubes are fed from the power source through a common resistor. The power source is at the *A* end of the common resistor, and the anodes of both diodes are tied to the *B* end of the resistor. The cathodes of the diodes are returned to ground through separate resistors. The cathodes are also connected to the outputs of the negative "write" source.

In the operation of this circuit, a d-c potential above the firing potential is applied to *A*. One of the bulbs will thus always be on. To write-in the opposite digit, the cathode of the "off" tube is pulled down with a negative "write" pulse, which causes it to fire. Firing causes the common point *B* to drop to near ground potential, so that the "on" bulb now has less than holding voltage across it. It goes out and starts to deionize. At the end of the "write" pulse the point *B* rises again to holding potential, but all the current goes through the newly "on" bulb while the other continues toward its fully deionized state. Since the system is symmetrical, fast writing is possible in either direction.

Laboratory studies show that changing from a one to a zero, or vice versa, may be accomplished in $5\mu\text{sec}$ or less. However, it takes some time to reach steady-state conditions; so that as the repetition rate of changing from a one to a zero and back again increases, it becomes more difficult to determine whether switching has taken place. At the limiting rate, the "off" and "on" tubes have the same conduction state.

This type of memory may be used generally as a high-speed memory, provided the rapidity of change of any one datum is limited to the speed of changing from one binary state to the other. It is an indicating type of memory which may be read out visually by lighting one bulb of each pair or read-out by photo cells with either push-pull or on-off input to them.

Gas Diode-Capacitor Memory

Another memory which operates more slowly in one direction than the other has been the subject of limited study. Here, a gas diode is connected in series with a capacitor. Bipolar pulses are applied to the other side of the diode, and "read-write" pulses are applied to the other end of the capacitor. Suppose that the capacitor has been charged to -15v . When the first half of a bipolar pulse is applied to the top terminal of the diode, there is sufficient voltage across the diode to fire it. Conduction takes place and the capacitor tries to charge toward $+15\text{v}$. Whether it reaches this potential is immaterial, since during the second portion of the bipolar pulse the tube conducts in the opposite direction and charging is toward -15v . At the end of charging, the capacitor is left

with the original charge. Thus a binary "one" (since the tube flashed) has been read and restored. If, however, the capacitor had been uncharged, the bipolar pulse would not have fired the bulb, the tube would have remained dark, and the capacitor charge would have remained unchanged. Since in this case all leakage would be toward ground, there is no chance of losing a zero. However, a binary one would tend to leak toward zero and therefore must be regenerated by the process of reading.

In order to write a binary one, it is necessary only to fire the tube during the bipolar pulse. This may be done by a negative bottom "write" pulse applied during the first half of the bipolar operating pulse. The regular regeneration cycle then holds this new information. To write a binary zero, the tube is fired during the first portion of the bipolar pulse; then, when the pulse starts down to charge the capacitor in the opposite direction, a bottom pulse is applied which holds the lower plate of the capacitor at -15v . This does not prevent the normal cycle of charging the upper plate to -15v , since this potential is set by the operating pulse amplitude and the drop across the diode. The bottom pulse is maintained until the upper pulse is over. At this time the upper plate of the capacitor is disconnected so that when the bottom is returned to ground, the top also rises to ground potential. Deionization must have progressed sufficiently before the next operating pulse to prevent refiring.

Other Memory Circuits

A variation of the NBS diode-capacitor memory can be achieved by replacing the semiconductor diodes with gas diodes. Here the diodes are used only to clamp one side of the storage capacitor or to discon-

nect it. This arrangement makes the requirements concerning the characteristics of the diodes much less stringent. In the operation of this circuit, the capacitor is charged a few volts positive for a binary one and a few volts negative for a binary zero. To write a one, the diodes are fired, clamping the top of the capacitor to approximately ground, and the bottom is pulled downward to -25v . When the clamping pulses are terminated, the diodes deionize, disconnecting the top of the capacitor. The bottom pulse is then released, raising the top of the capacitor to $+25\text{v}$. Similarly, to write a zero, a positive bottom write pulse is used. This circuit is shown in Fig. 3.

Reading is accomplished by clamping the top of the capacitor and noting the polarity of the pulse at the input to the read amplifier. To restore the information, the bottom pulse is applied in the same polarity as the pulse obtained upon clamping. Regeneration is necessary because of the destructive reading operation as well as leakage. Since the bit amplifiers are used in common, regeneration must be done word by word.

Although this is not primarily an indicator type of memory, it is possible to make it one. When operated in the mode just described, one diode carries more current than the other during rewriting, depending upon the polarity of rewriting, and this may be noted photoelectrically. In another mode of operation, regeneration is accomplished by releasing one clamping diode immediately after sensing. This action probably would be noticeable even visually. Writing may be accomplished in 10 to $50\mu\text{sec}$.

High firing voltages across the diode may be dispensed with by supplying only low voltage to the diodes for charging purposes and a radio-frequency voltage to a shield about the tube to fire it.

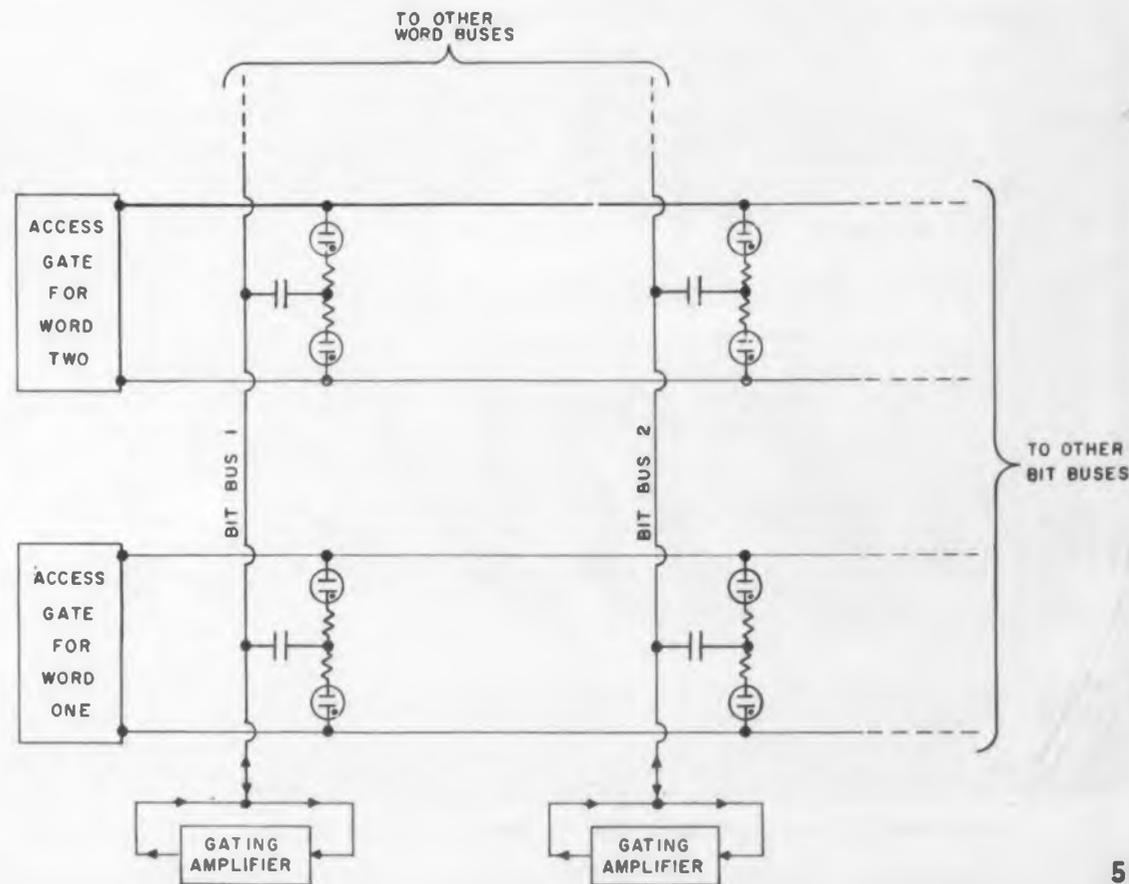


Fig. 3. The organization of a double-diode-capacitor memory.



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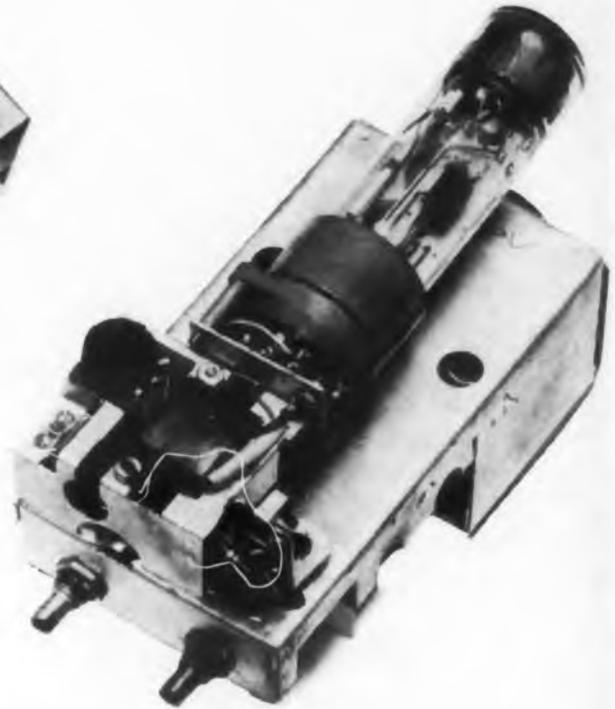
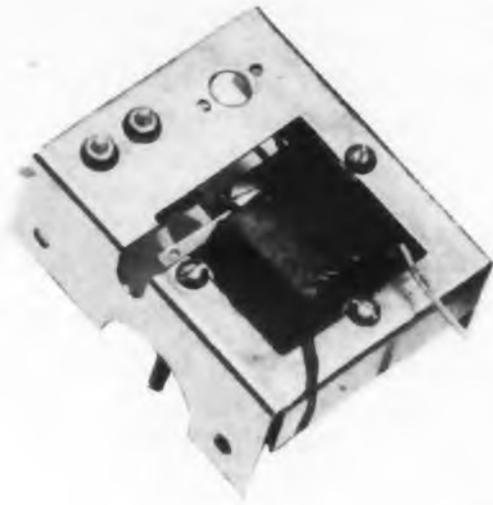
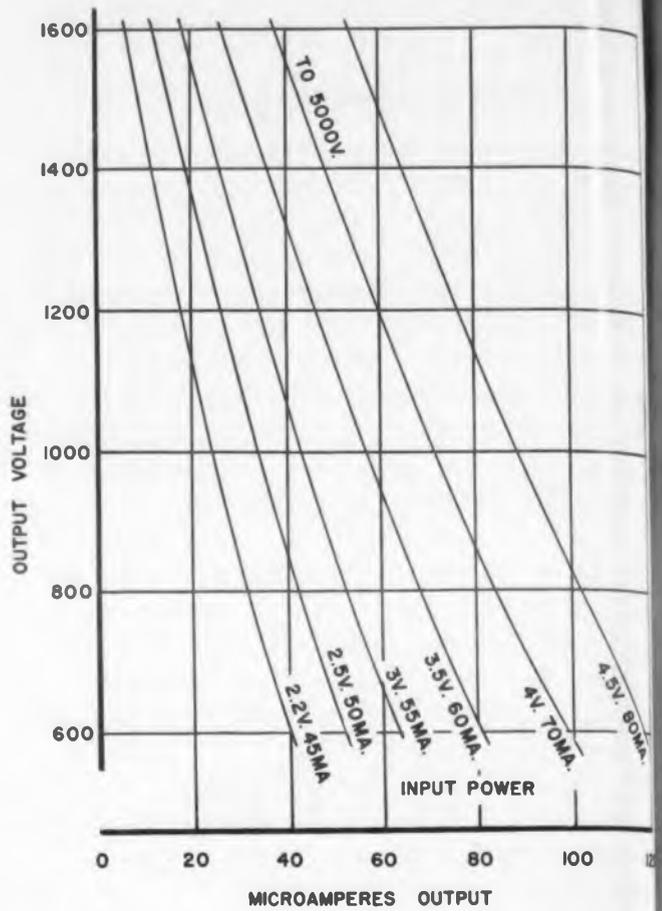
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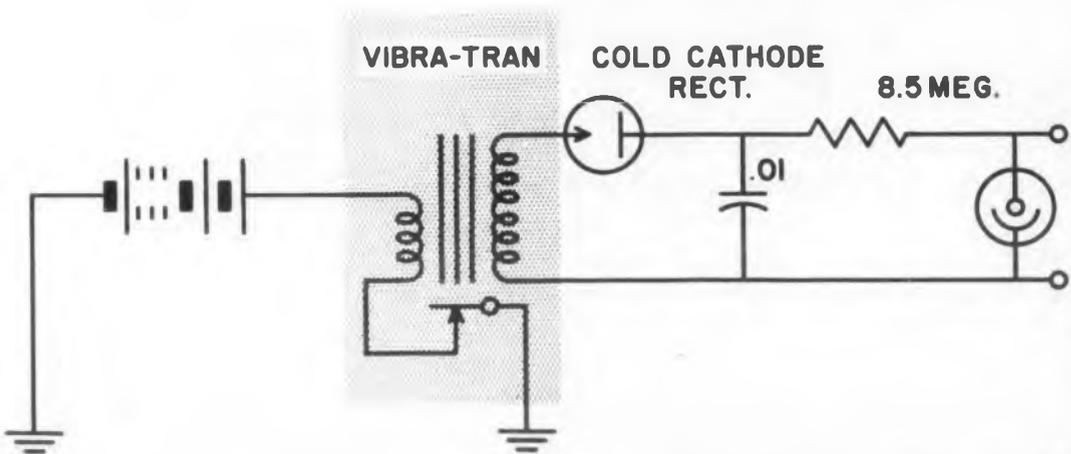
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Miniature Step-Up Vibrator



Transformer and reed are mounted in the chassis above. Photomultiplier device using a Vibra-Tran is shown at right. Circuit for producing graph data shown below.



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COMBINING the functions of a vibrator and transformer, this flashlight-cell operated component is ideal for miniature portable high-voltage power supplies. Known as the Vibra-Tran, the device was initially developed by the AEC for miniaturizing a Geiger Counter. It is now available commercially for supplying high voltage to photomultiplier tubes, ionization chambers, proportional counters, electrostatic precipitators, and photoflash equipment. Since low-power drain transistor circuits are feasible and practical, this device conceivably aids test-equipment manufacturers produce simple, battery-operated portable equipment such as oscilloscopes and megohmmeters.

The output voltage of the Vibra-Tran, manufactured by Edko Electronics Engineering Co., 202 Grand St., Brooklyn 11, N. Y., is governed by the secondary turns and the rate of change of flux. As the reed breaks contact, the magnetic flux in the core suddenly collapses generating a large, sharp, voltage spike in the secondary. The flux rate at break is much greater than at the reed contact instant, because the primary circuit has a larger LR factor.

A cold cathode rectifier can be used for rectification. Because of the very high harmonics in the secondary voltage, the filter is extremely simple. Coupled with simple electro static shielding normally used for h-f radiation, a 0.01mfd capacitor, and a 1 megohm resistor, the ripple for a 700v d-c regulated output is less than 1mv. The unit's core and reed are mounted on a shielding chassis which also readily accommodates the rectifier, filter, and regulator circuit elements. The platinum ruthenium reed is adjustable by a set screw. The reed has a minimum life of 500 hours. The high efficiency of the circuit permits a battery life as long as 50 hours (two D cells in series).

The unit starts over a wide range of temperature, and battery voltage. No orientation is necessary. Because windings are not grounded, a tapped bleeder may be used to get bias voltage. The unit is not affected by moisture. A typical unit weighs 6-1/2 oz. For more information, turn to the Reader's Service Card and circle **ED-42**.

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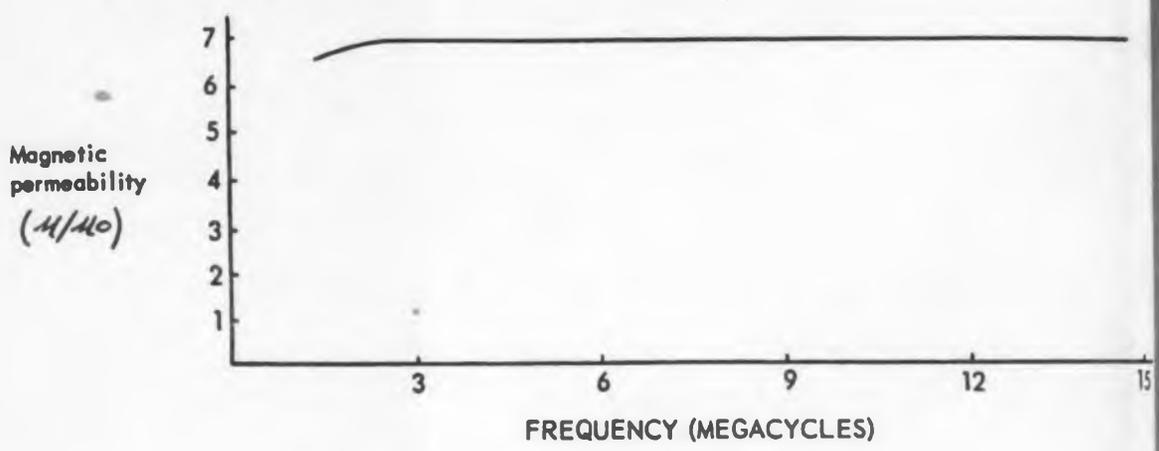
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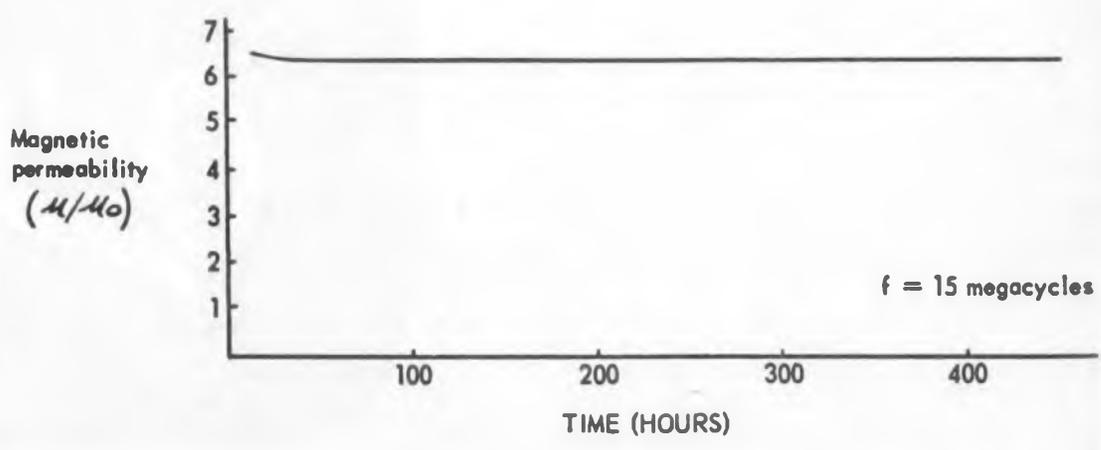
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Magnetic Plastic Core



Magnetic permeability versus frequency at room temperature.



Magnetic permeability versus time after heat aging at 200° C.

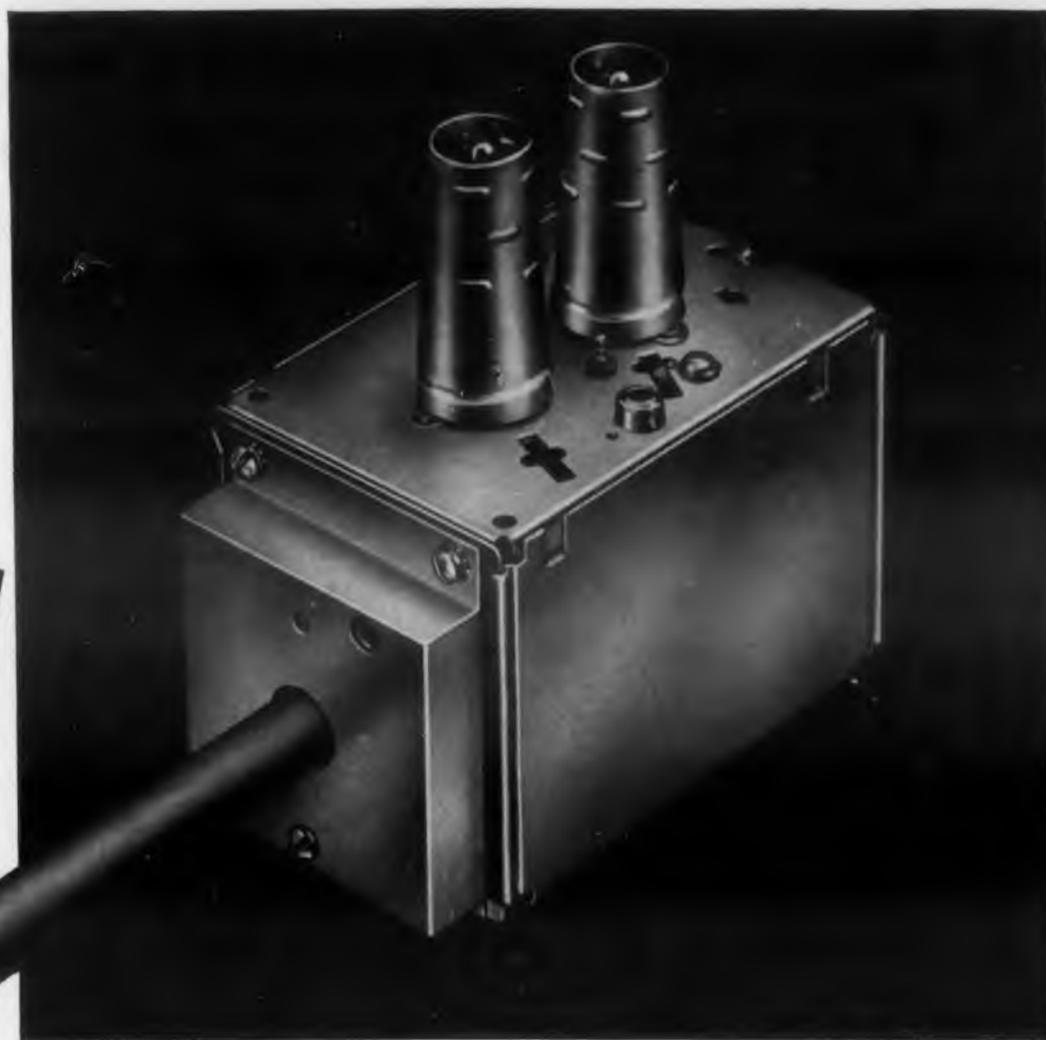
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These assorted plastic cores are typical of shapes and sizes that can be made.



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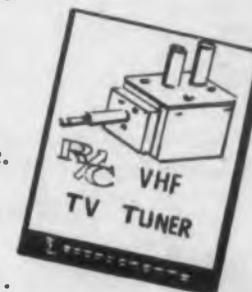


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UNUSUALLY high temperature stability, imperviousness to humidity, and low magnetic losses at 20Mc and higher frequencies, make this magnetic plastic core eminently suited for high-frequency coils, filters, and attenuators. Employing a binding resin that has outstanding properties at high frequency and high temperatures, this core offers coil designers new performance standards. Additionally, the core has an impact strength up to 40 times greater than other commercially available high frequency core materials. The material maintains a high impact strength at temperatures as low as -100°C . It is easily machined.

Known as Ferrotron, the core is manufactured by the Polymer Corp., Reading, Pa. It is heat resistant up to 200°C . Permeability is constant over wide ranges of frequency and temperature. It has an extremely low magnetic loss tangent. The material does not change properties due to humidity; it does not require a sealer.

An outstanding property of a coil wound on a Ferrotron slug is a positive coefficient of Q with temperature. Expressed as a percentage, the coefficient is $+0.10\% \Delta Q / ^{\circ}\text{C}$. This means that the power loss at elevated temperatures is less than that at ambient temperatures. It also suggests that sharper tuning of resonant circuits is possible. The temperature coefficient of permeability is $+0.002\% \Delta \mu / ^{\circ}\text{C}$.

Graph data was obtained for toroidal specimens measured with a Radio Frequency Permeameter (ED, p. 44, March, 1955). Uniformity of values from batch to batch is within the accuracy of the best equipment. Slugs are now available in sizes ranging from $1/2''$ to $2''$ OD by $1''$ lg. For more data, turn to the Reader's Service Card and circle ED-45.

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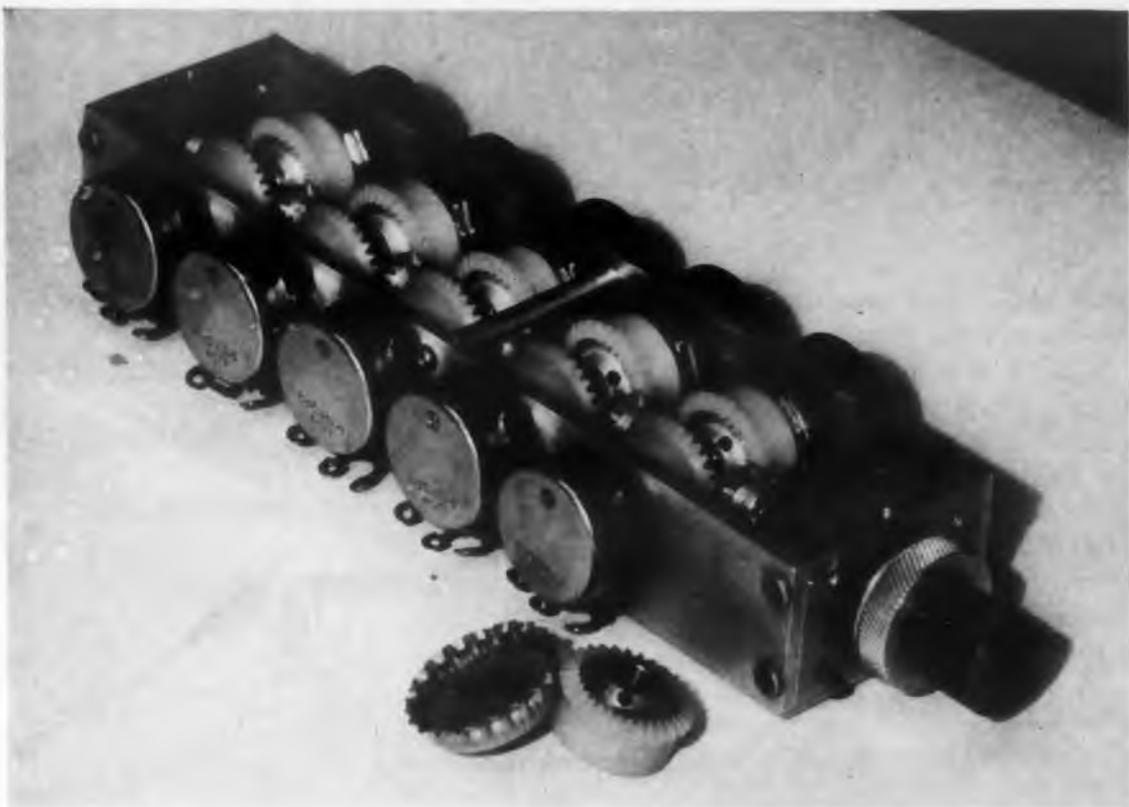
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Ten potentiometers are adjusted by only two knobs. All gears revolve simultaneously but switch energizes one clutch at a time.



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VARIOUS clutching and drive combinations can be assembled from a single clutch body common to all units described on these pages. By using a standard common body, costs have been reduced so that designers can specify clutches whenever such features are desirable. Two knobs can be used to control ten shafts as shown by the typical potentiometer drive assembly illustrated on the opposite page. This design conserves front panel space and eliminates the confusion of numerous knobs. Gear, cable, or direct in-line drive shells can be mated with the standard clutch body.

Some of the applications for the miniature clutches made by Electronic Manufacturing Engineers Co., 2410 Beacon Ave., Seattle 44, Wash., include controlling remote positioning devices, differential drives, and groups of devices as mentioned earlier. Their small size permits them to be built into speed changer gear boxes for selecting alternate gear ratios. The cable drive type not only allows a large degree of flexibility in hand-drive positioning but is a simple, low cost, anti-backlash servo drive. The direct in-line drives also have servomotor positioning applications.

The clutch assembly weighs less than an ounce and units may be ordered to operate from 6 to 30v ac; power consumption is less than one watt. The various drive shells run approximately 1" in diameter. The depth of the units depends on whether it is a continuous rotation or single turn model; the maximum depth is 1". The clutch is a positive on-off type. The drag torque is 0.5oz-in and engaged torque is 15oz-in. There is zero clutch slip when operated within rated conditions. For maximum clutch life, it is not advisable to operate the clutch when speeds exceed 200rpm.

There are a variety of clutch accessories available permitting the clutches to be adapted to many applications. For more application data, turn to the Reader's Service Card and circle **ED-48**.

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Silicone News

FOR DESIGN ENGINEERS

New Silicone Insulated Generator Produces 300% More Power/Pound

Designed to service aircraft aboard ship, the new 400 cycle, Class H generator built by Westinghouse is rated at 600 kw at 12,000 rpm; weighs only 2100 pounds compared with 7500 pounds for a comparable machine of conventional design. The rotor of this new 4-pole unit measures only 9½ inches in diameter.

This 300% increase in power per pound ratio was accomplished by skillful design, high speed operation and the use of Silicone insulating materials with a conservative AIEE hottest spot temperature rating of 180 C. Built for rugged shipboard service the generator will withstand an impact shock in the order of 20 "G's" in the direction of the shaft and 10 "G's" across the shaft. It was first used aboard the U.S.S. Timmerman.



That's another example of how the extraordinary stability of insulating materials made with Dow Corning silicones is being employed to accomplish radical improvements in the performance and capacity of electric machines. If you are designing electric machines, you can forget the old limitations imposed by the relative instability of organic varnishes and insulating materials. If you are designing new electrically energized machines, you can't afford to settle for heavy, old fashioned electrical components with limited reliability. For more data write for Reference No 38.



RTV SILASTIC PROTECTS AUTOPILOT IN BELL HSL-1 NAVY HELICOPTER

Electrical components in the autopilot system of the new HSL-1 tandem-rotor anti-submarine helicopter built by Bell Aircraft are encapsulated in Room Temperature Vulcanizing Silastic.

Why was RTV specified? Here's what Bell engineers say:

"The decision to provide a protective coating was based on the stringent environmental and test conditions, including sand and dust, high humidity, salt spray and wide temperature variations, to which the autopilot was subjected.

"Of the many coatings tested, only the silicone compounds provided adequate protection. They withstood extreme temperatures without embrittlement or softening. They exhibited low water absorption, and they have good thermal conductivity so that the heat transfer characteristics of coated components are not adversely affected.

"However, in most silicone rubbers, these optimum qualities are realized only after a controlled cure at elevated temperatures—temperatures higher than certain other autopilot components can withstand. This disadvantage was eliminated with the advent of Dow Corning RTV Silastic. RTV can be applied and cured under room temperature conditions or even in the field. Valuable time is saved and no extra equipment is needed either to apply initially or to repair this protective coating." No. 39

Excellent Design Plus Silicones Builds Business for Transit Maker

Although they built their first unit only a year ago, the Brunson Instrument Co. of Kansas City, Mo., is already the second largest producer of surveyor's transits in the world. One reason: the Brunson is the only transit on the market which is completely mounted on ball bearings. Another reason: the bearings, accurate to within 5-millionths of an inch, are all permanently lubricated with Dow Corning 33 Grease. The instrument is therefore designed to meet the requirements of Federal Specification GG-T-621A, including operation at -80 to 160 F. Thousands of Brunson transits are already in government service in the Arctic. No. 40

Design Edition 9

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Precision Phase Shift Measurements

By Raymond Rothschild

Industrial Test Equipment Co., New York 3, N. Y.

ACCURACY of equipment used for computing or control purposes is often determined by the phase shift occurring in transformer components. Small phase angles are exceptionally important in computer transformers, current transformers, potential transformers, computing amplifiers, resolver systems and the like. Hence, it is necessary to be able to make precise phase shift measurements.

Despite the need there are few instruments that can perform the measurements accurately. Some instruments employ the principle of measuring phase by noting the respective zero axis crossings of the reference signal and the signal of unknown phase. Considerable error can be introduced by this method if one of the signals contains noise and harmonic components and this is especially true if the noise or harmonic peak occurs in the vicinity of a zero axis crossing. Ambiguities that can arise are illustrated by the accompanying oscilloscope-type displays.

In order to measure phase, two voltages are required: a reference voltage and a voltage whose phase is to be measured with respect to this reference. The voltage of unknown phase can be resolved into two basic components at right angles to each other. For convenience we may think of these components as an in-phase component (in-phase with the reference) and a quadrature component (90 degrees with respect to the reference). Any instrument that could separate these components in this manner could then be effectively used to measure phase.

The principle of operation of the Phazor Phase Meter Model 200A is based on a precision multiplying device and can be used to measure these components. At the same time it eliminates the effect of noise and harmonics. The multiplier output is proportional to the time average of the instantaneous product of the input signal and the reference signal. The multiplier output is fed to a d-c meter and the deflection of the meter is:

$$D_m = kAB\cos\theta \text{—the in-phase component}$$



$$D_m = \frac{k}{T} \int_0^T V_s \cdot V_r dt$$

where

D_m = meter deflection
 V_s = input signal
 V_r = reference signal
 k = a constant

if

$$V_s = A \sin(\omega t + \theta)$$

$$V_r = B \sin \omega t$$

then

$$D_m = k \frac{\omega}{2\pi} \int_0^{2\pi/\omega} A \sin(\omega t + \theta) \cdot B \sin \omega t dt$$

and

$$D_m = k'AB \cos \theta \text{ (in-phase component)}$$

where

$$k' = \text{new constant}$$

Employing the built-in phase shifter, the input signal may be shifted 90 degrees or

$$D'_m = k'AB \cos(\theta - 90)$$

$$= k'AB \sin \theta \text{ (quadrature component)}$$

This then is similar in operation to an ordinary electro-dynamometer type wattmeter for which there is a current coil and a potential coil. In the wattmeter the meter deflection is proportional to the product of the voltage and the current and the cosine of the phase angle between them. Also in the wattmeter if the current coil were excited with one frequency and the potential coil with a different frequency there would be instantaneous power but no average power so that the meter reading would indicate zero. It can be shown from the multiplier equations that there will be no meter deflection if V_s and V_r are not of the same frequency. Consequently the instrument eliminates errors due to noise or harmonics of the signal voltage if the voltage applied to the reference channel is a distortionless sine wave.

By using a built-in phase shifter which is capable of shifting the input signal 90° the phase between the signals can be measured irrespective of the magnitude of the signal. With an input phase shift of 90° the meter deflection would be proportional to the sine of the phase angle between the reference and the input voltage (quadrature component).

Hence

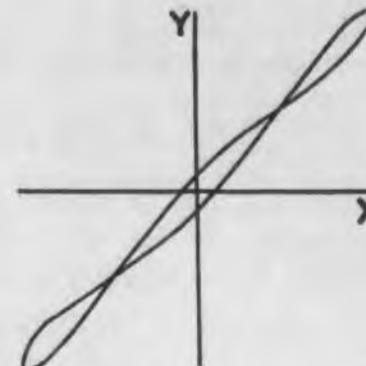
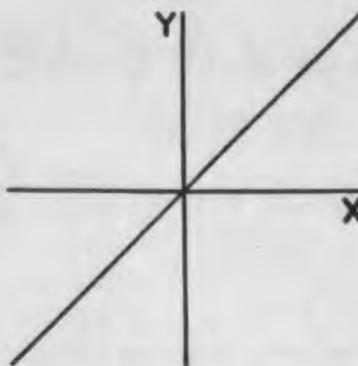
$$\frac{D'_m}{D_m} = \frac{k'AB\sin\theta}{k'AB\cos\theta} = \tan\theta$$

Measurement of Small Phase Shifts

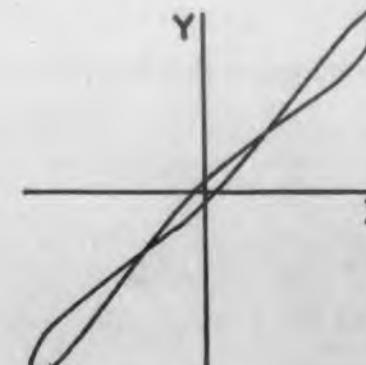
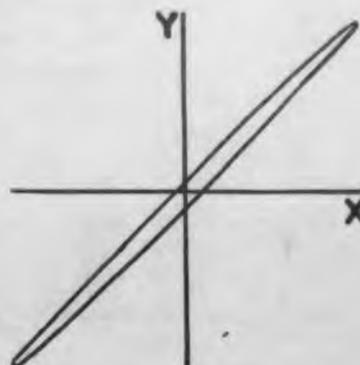
To measure small phase shifts accurately a different method may be employed. That is, a voltage of unknown phase is bucked against the reference voltage. If both voltages are equal in magnitude, then the quadrature component of the difference voltage is proportional to the phase shift.

Let us consider a transformer with a 1:1 ratio transformation. For this condition the circuit conditions shown in the diagram to the right would

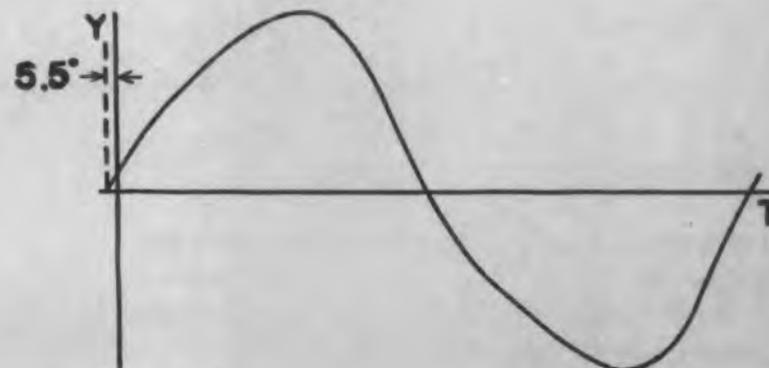
Two voltages at zero phase shift, left, $y = \sin \omega t$ and $x = \sin \omega t$. At the right, third harmonic has been added and $y = \sin \omega t + 0.1 \cos 3\omega t$.



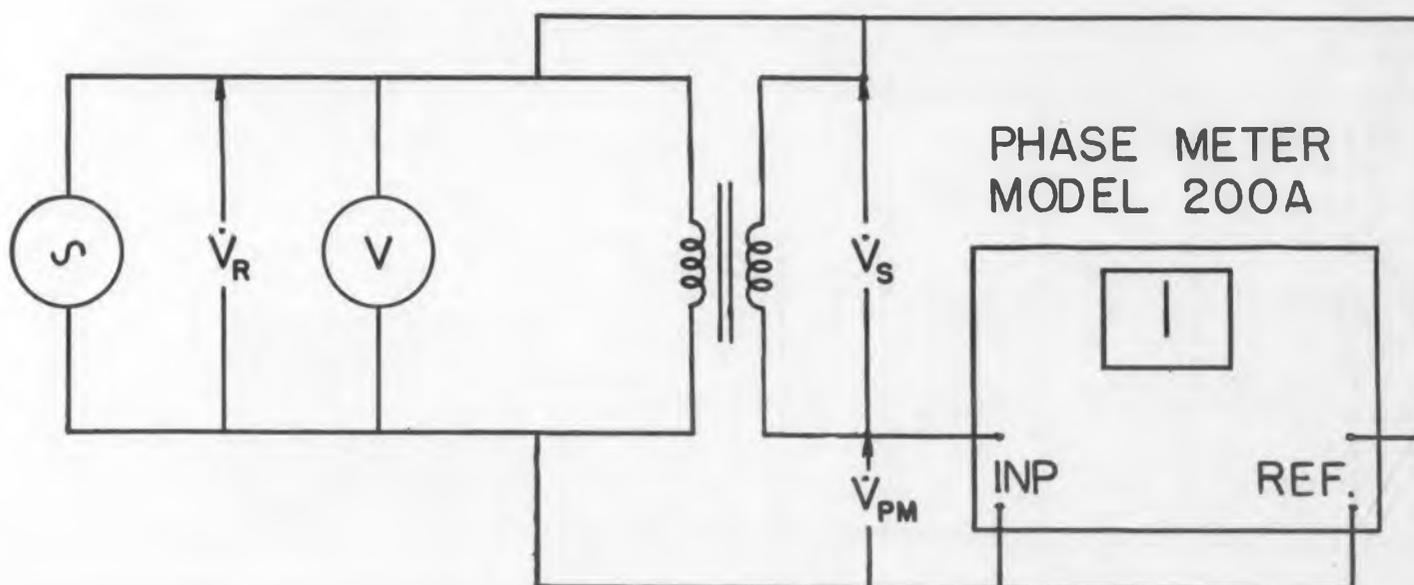
Three degrees phase shift has been added to y signal, left, making $y = \sin(\omega t - 3^\circ)$. At the right, y signal contains both 3° phase shift and 10% 3rd harmonic distortion. Note phase shift for this distorted signal is ambiguous.



Plotting $y = \sin \omega t + 0.1 \cos 3\omega t$, note that the fundamental has zero phase shift but does not pass through zero at zero degrees.



Connections for measuring small phase shifts with Phase Meter.



applicable. The symbols of the diagram represent specific voltages as indicated in the legend below:

\dot{V}_r = transformer primary voltage (as vector)
= reference voltage

\dot{V}_s = transformer secondary voltage (as vector)

\dot{V}_{pm} = voltage across Phase Meter (as vector)

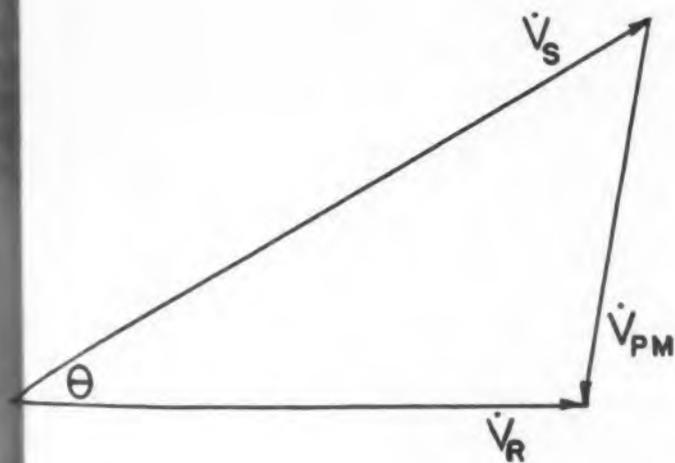
V_r = magnitude of \dot{V}_r

V_s = magnitude of \dot{V}_s

The voltage across the input terminals of the phase meter would be

$$\dot{V}_{pm} = \dot{V}_r - \dot{V}_s \quad (1)$$

A vector representation of each of the voltages is shown below.



$$\dot{V}_{pm} = \dot{V}_r - (V_s \cos \theta + jV_s \sin \theta) \quad (2)$$

\dot{V}_{pm} can be broken up into two components V_o (an in-phase component) and V_{90} (a quadrature component) as follows:

$$V_o = (V_r + V_s \cos \theta) \quad (3)$$

$$V_{90} = V_s \sin \theta \quad (4)$$

When θ is small, which, of course, is the case in this procedure for measuring small phase shifts that might occur in a transformer

$$\begin{aligned} \cos \theta &\approx 1 \\ \text{and } \sin \theta &\approx \theta \text{ in radians} \end{aligned}$$

In accordance with these approximations, equations (3) and (4) can be rewritten as follows:

$$V_o \approx V_r - V_s \quad (5)$$

$$V_{90} \approx V_s \theta \quad (6)$$

But for a nominal 1:1 ratio of transformation V_r (primary voltage) is approximately equal to V_s (secondary voltage) therefore

$$V_{90} \approx \theta V_r \quad (7)$$

and dividing thru equation (5) by V_r

$$V_o/V_r \approx (V_r - V_s)/V_r = 1 - V_s/V_r = e_t \quad (8)$$

which represents the error in the nominal ratio of transformation

or

$$V_o \approx e_t V_r \quad (9)$$

Phase Meter Model 200A produces a deflection proportional to the in-phase component of \dot{V}_{pm} (or V_o) when its phase shift switch is in the "0" position and a deflection proportional to the quadrature component of \dot{V}_{pm} (or V_{90}) when in the "90" position. Therefore, by utilizing equation (7) it is possible to calibrate this Phase Meter to read phase angle directly when the instrument is set to read quadrature voltage. Furthermore, by utilizing equation (9) it is possible to read error in ratio of transformation when the instrument is set to read in-phase voltage.

Let us consider a specific example. Suppose we had a transformer with a transformation ratio of 1.000 \pm .001 and an allowable phase shift of \pm 1 milliradian

at a primary voltage of 10.0 volts. Collecting this data in a form to be substituted in our equations

$$V_r = 10 \text{ volts}$$

For the worst condition, the respective maximum phase shift and error in transformation ratio would be

$$\theta = 0.001 \text{ radians}$$

$$e_t = 0.001$$

From equation (9)

$$V_o \approx e_t V_r = 0.001 (10) = 10 \text{ millivolts}$$

and using equation (7)

$$V_{90} \approx (0.001) (10) = 10 \text{ millivolts}$$

Hence, when using the foregoing method, a quadrature voltage of 10 millivolts represents 1 milliradian and an in-phase voltage of 10 millivolts represents an error in ratio of transformation of 0.1%. It would now be necessary to set the input gain control of the Phase Meter so that a signal of 10 millivolts would produce a full scale deflection.

Sources of Error

The major sources of error will originate from the following factors:

- a Error in approximations of equations (7) and (9)
- b Error in calibration of Phase Meter.
- c Possible errors in Phase Meter.

For the example under consideration

$$V_r = 10 \text{ volts}$$

$$\theta = 1 \text{ milliradian}$$

$$e_t = \pm .001$$

$$\sin \theta = 0.00100$$

$$\cos \theta = .99999$$

This means that the error of assuming $\sin \theta = \theta$ is negligible and the error of assuming $\cos \theta = 1$ is also negligible.

There is another approximation that was made in equation (7); that is, the assumption that V_r is approximately equal to V_s . For this case, the worst condition will occur when the error in transformation ratio is at its maximum

or

$$e_t = 0.001$$

then

$$e_t = 1 - V_s/V_r = 0.001$$

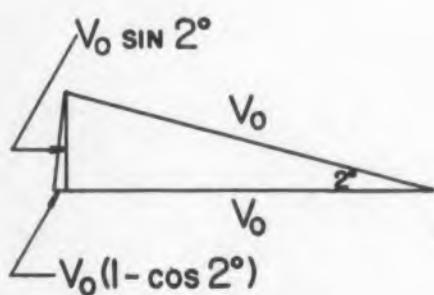
or

$$V_s/V_r = 0.999$$

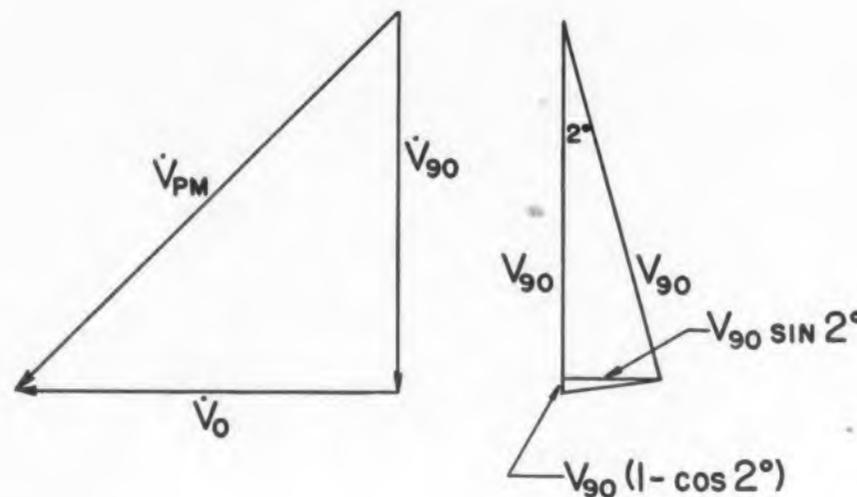
But according to equation (6), θ is inversely proportional to V_s . This means that in the worst case this approximation in equation (7) will introduce an error of 0.1% full scale in the measurement of θ .

Assume that the instruments which are employed in the calibration of the Phazor Phase Meter are possibly be in total error by \pm 3%. This would introduce a maximum error in the reading of the Phase Meter of \pm 3% of full scale.

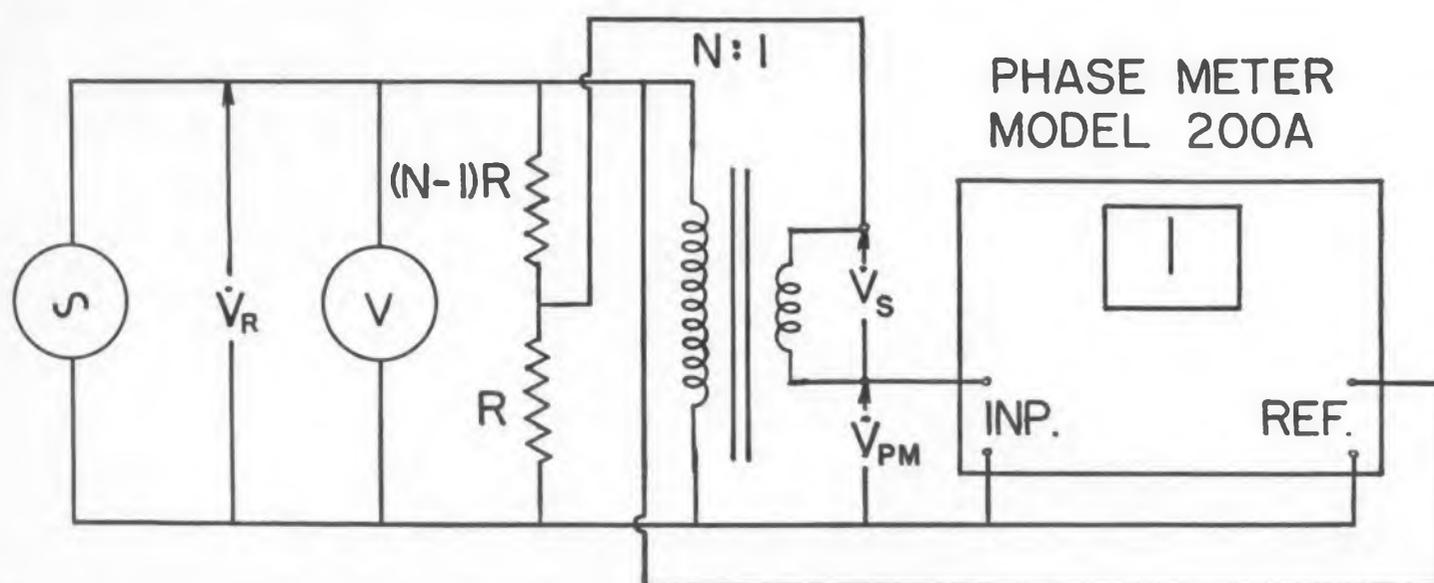
The specified accuracy of Phase Meter Model 200A is \pm 2 degrees. Assume then that either the in-phase or quadrature component of the difference voltage (V_r) might be shifted \pm 2 degrees due to internal errors in the Phase Meter. To examine the effect of this type



Effect of a 2° error on the in-phase, V_o , and quadrature, V_{90} , components, left and right respectively, of the phase meter vector voltage, V_{pm} , center. See extreme right-hand column text for numerical results.



Connections for measuring small phase shift in transformers not having 1:1 ratio.



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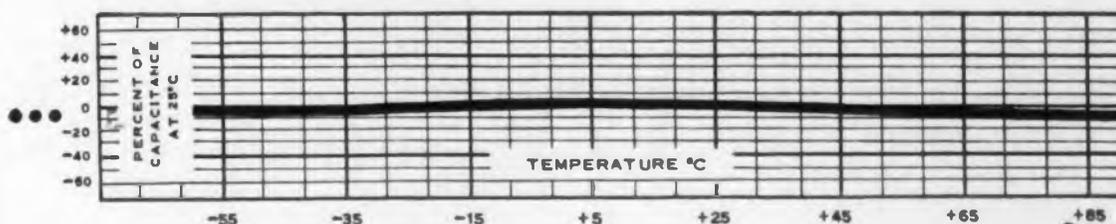
Mechanically accurate. Thickness, diameter, and lead spacing are always exact. And leads are always on perfect center line—never offset. The answer for automatic assembly.

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Easiest identification. Clearly labeled to avoid confusion and mistakes. Stamped with capacity, voltage rating, and tolerance.

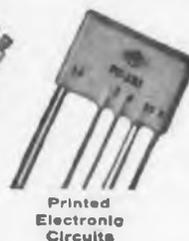
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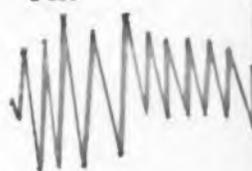
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error, consider the vector V_{pm} and its component parts V_o and V_{90} as shown on the opposite page.

If V_o were shifted 2 degrees, it would introduce an error of

$$V_o (1 - \cos 2^\circ) = V_o (0.00061)$$

in the reading of the in-phase component and an error of

$$V_o \sin 2^\circ = 0.0349 V_o$$

in the reading of the quadrature component.

Similarly, if V_{90} were shifted 2 degrees it would introduce an error of

$$V_{90} \sin 2^\circ = 0.0349 V_{90}$$

in the reading of the in-phase component.

This would then introduce a maximum error in the reading of the in-phase component of

$$(0.00061) (10) = 0.006 \text{ mv.}$$

$$+ (0.0349) (10) = 0.349 \text{ mv.}$$

$$\text{Total } 0.355 \text{ mv.}$$

But full scale equals 10 mv., hence this contribution will yield a maximum error of 3.55% of full scale in the reading of the error in ratio of transformation.

For the quadrature component, the maximum error would be

$$(0.00061) (10) = 0.006$$

$$+ (0.0349) (10) = 0.349$$

$$\text{Total } 0.355$$

But full scale equals 10 mv hence this contribution will yield a maximum error of 3.55% of full scale in the reading of the phase shift.

To summarize, the total maximum error in the reading of ratio of transformation due to sources a, b, and c is

$$0.0 + 3.0 + 3.55 = 6.6\% \text{ of full scale.}$$

Since full scale represents $\pm 1\%$, the actual maximum total error is only

$$0.0066\%$$

The total maximum error in the reading of phase shift due to sources a, b, and c is

$$0.1\% + 3.0 + 3.55 = 6.7\%$$

Since full scale represents ± 1 milliradian, the actual maximum total error is only

$$0.067 \text{ milliradians}$$

It should be stated that Phase Meter Model 200A may be employed with equal effectiveness on transformers with other than 1:1 ratio. For a transformer with ratio "n", the circuit shown on having a compensating voltage divider as illustrated may be employed. The corresponding solutions for this condition are

$$V_{90} \approx (\theta V_r)/n \quad (10)$$

$$V_o \approx (e_i V_r)/n \quad (11)$$

Thus we see equations (10) and (11) are similar to equations (7) and (9) except for the additional factor $1/n$.

Calibration procedure and sources of error can be readily deduced by referring to the previous discussion of the transformer with a ratio of 1:1.

New Products...

Potentiometer

Variable and Fixed Sections



The "Esipot" offers the equivalent of a 10-turn potentiometer, although any setting can be made within less than two revolutions of the single control shaft. It consists of

a high-resolution single-turn potentiometer which actuates a 10-position attenuator switch as the potentiometer reaches the end of its travel in either direction. This switch transfers the single-turn potentiometer to any one of the 10 voltage positions provided on a 10-step attenuator switch.

Because the "Esipot" uses precision fixed resistors in the initial attenuator section, a wide range of resistance values can be made available, having excellent frequency response and power dissipation characteristics. The unit can often replace a pair of controls where both "course" and "fine" adjustment steps are desired. Its high resolution makes it valuable as a "zero adjust" or precision gain control.

The assembly is only 1-3/4" diam x 1-3/4" long behind panel, and mounts in a single 7/16" panel hole. A standard 1/4" diam operating shaft is provided. Electro-Measurements, Inc., Dept. ED, 4312 S. E. Stark St., Portland 15, Ore.

CIRCLE ED-52 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Power Rectifiers

Up to 15amp



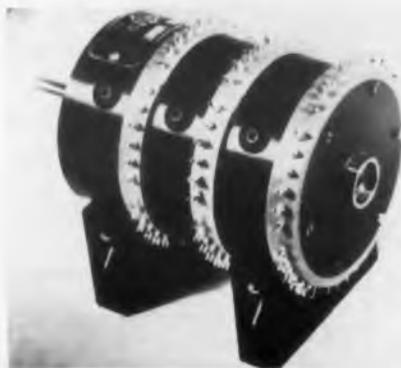
Silicon power rectifiers, Types CK775 and CK776, are capable of handling up to 15amp and 200v peak. Operation at 5amp and 170°

is permissible. The ratio of reverse to forward resistance is over 100,000. The rectifiers are small (about 0.6 cu in), hermetically sealed, and usable to over 100,000cy. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE ED-53 ON READER-SERVICE CARD FOR MORE INFORMATION

Sampling Switch

Has Three Synchronized Poles



The Model 6300 is a high-speed sampling switch with three synchronized poles. This compact, precision unit is available with from one to six poles, each pole being capable of sampling up to

30 non-shorting channels. The switches feature this firm's new "Perma-Brush" to provide longer service life and more predictable, uniform performance.

Standard features include semi-molded contact plate construction and individual phasing provisions. The unit is available in a wide range of variations of number of contacts and terminals. Length, including shaft, is 3", and diameter, minus base, is 2-5/8". General Devices, Inc., Dept. SPED, P. O. Box 253, Princeton, N. J.

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

Silicon Crystal Diode

Covers 10,000-20,000Mc Band



The 1N286, a broad-band, coaxial, point-contact type crystal diode, is designed for use as a crystal mixer. Its unique internal

geometry makes it possible to cover the band of frequencies from 10,000Mc to 20,000Mc.

With the crystal holder made in WR-75 waveguide the 10,000-15,000Mc band can be covered, and with the holder made in WR-51 waveguide the 15,000-20,000Mc band can be covered. Because of its broad-band characteristics, the diode is particularly useful in such applications as tunable frequency radar systems and counter-measure devices. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

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

Spectrum Selector

For Gating Pulses



The Model SD Multi-pulse Spectrum Selector displays and selects for spectrum analysis, a specific train of microwave pulses, as well as any one pulse in a train. Designed to work

with spectrum analyzers, it will select and gate a group of pulses up to 100µsec in length. It will work with fast, narrow pulses, and can be adjusted to gate any pulse including the first, at zero time. Special circuitry discriminates automatically once pulses have been selected.

The unit operates at all microwave frequencies that can be accepted by Polarad spectrum analyzers. Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.

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

Slip Ring Assemblies

Low Friction, High Precision Units



Miniature slip ring and brush assemblies matched to specific project requirements are now being manufactured by this firm. The units are designed to transmit electrical energy to and from rotating elements in various kinds of electromechanical devices. Many uses are found in computers, telemeters, and other

types of control and indicating systems. They are particularly suitable for applications such as gyroscopes, where low friction and high precision are required.

Prototype samples can be supplied within a short time and at low cost. Iron Fireman Electronics Div., Dept. ED, 2839 S. E. 9th Ave., Portland, Ore.

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

Transducer For Underwater Work

The Model PS-23 transducer is designed for use in the 22 to 28kc band or at lower frequencies, where pressures and temperatures are severe. It is serviceable at static pressures up to 2,000lb square inch and at temperatures up to 300°F.

This model has an impedance of 16 + j56 ohms at 24kc, and a receiving sensitivity of -102 to -104db vs 1v per microbar in the 22 to 28kc band. Its electroacoustic efficiency is approximately 20% for transmitting or receiving in water.

The transducer measures 3-1/2" in length and 3-1/4" in diam. It may be applied with nonfloodable cable, or with leads and provisions for sealing to an instrument case or cable leader. The Harris Transducer Corp., Dept. ED, Southbury, Conn.

CIRCLE ED-58 ON READER-SERVICE CARD

Potentiometer Low Operating Torque

Extremely compact and sturdy 4-section precision potentiometers made in Switzerland are available in the United States. The microfriction units have a starting torque of 0.003 to 0.006oz-in per section. Resistance range is 100 to 100,000 ohms. Maximum resistance tolerance is ±0.2%. Special linearity tolerance is ±0.15%. Electrical rotation is 355°±2°; maximum operating speed is 700 rpm. Power rating is 1/2w. Diameter of case is 1.18"; length of 4 sections is 1.86". F. H. Paul & Stein Bros. Inc., Dept. ED, 235 Fifth Ave., New York 16, N. Y.

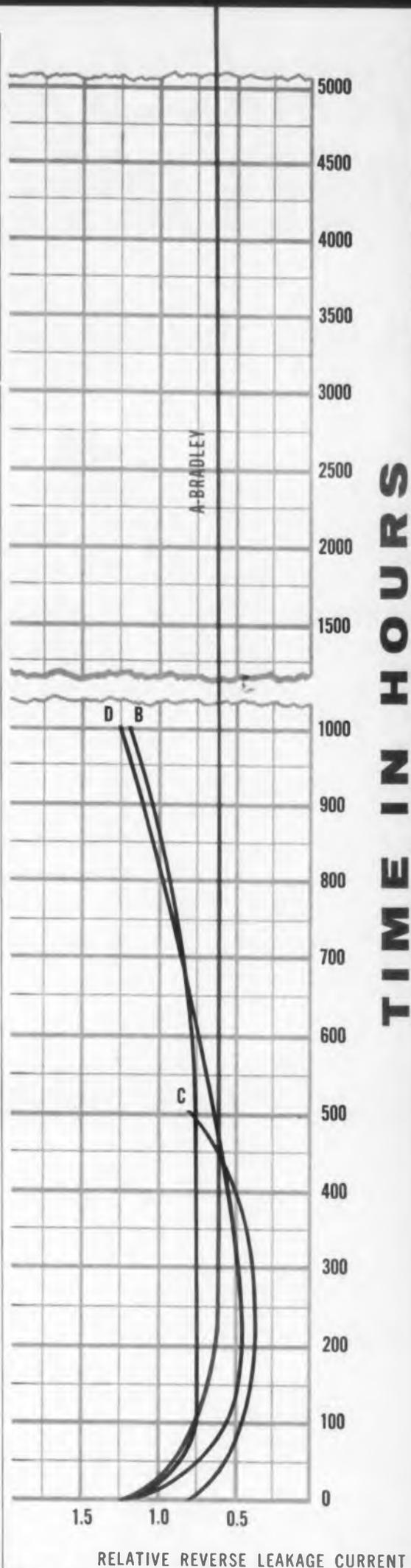
CIRCLE ED-59 ON READER-SERVICE CARD

Fast Etching Solution For Printed Circuits

A new etching solution for making etched printed circuits is trade named Hunt RCE Solution. It gives controlled rapid etching speed, permitting standardization of a high production etching schedule; and instant and uniform etching over the entire circuit. Philip A. Hunt Co., Dept. ED, Palisades Park, N. J.

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CIRCLE ED-61 ON READER-SERVICE CARD ➤



RELATIVE REVERSE LEAKAGE CURRENT



Life test curves comparing reverse leakage of Bradley vacuum processed selenium rectifiers with units produced by different processes by other manufacturers.

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Oscillographic Systems

In Six and Eight Record Channels

Six and eight-channel models have been added to this firm's line of oscillographic recording systems. The complete "150" line now includes single, two, four, six, and eight-channel systems, adaptable to numerous recording requirements by means of interchangeable, plug-in preamplifiers or "front ends."

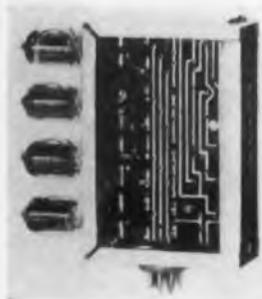


The eight-channel system is comprised of two units: a mobile cabinet containing an eight-channel recorder, control panel, and four driver amplifiers with power supplies; and a second mobile cabinet containing four additional driver amplifiers with power supplies, a sliding shelf, and cabinet space. The six-channel system is similar to the eight, but with fewer galvanometers, driver amplifiers, and power supplies. Sanborn Co., Industrial Div., Dept. ED, 195 Massachusetts Ave., Cambridge, Mass.

CIRCLE ED-62 ON READER'S SERVICE CARD FOR MORE DATA

120kc Decade Counter

For Indication and Recording



Model AC-4A Decade Counters provide a 120-ke counting rate and have an output voltage suitable for recorder operation. They feature etched circuits in which every circuit segment is fully visible, clearly labeled, and arranged

diagrammatically for simple servicing. The mechanical layout improves ventilation, making possible lower operating temperatures and longer service life. Illuminated numerals have reflectors for maximum brilliance and easy readability under all light conditions.

The counters are engineered to fit all standard electronic counters, regardless of make, and also may be used separately in experimental or special setups. Resistors are premium quality 5% tolerance units, coupling capacitors are silver mica. Four electronic tubes are employed. Hewlett-Packard Co., Dept. ED, 395 Page Mill Rd., Palo Alto, Calif.

CIRCLE ED-63 ON READER'S SERVICE CARD FOR MORE DATA

G. E. MECHANIZED PRODUCTION AT LOWER COST...ASSURES

Both types offer high reliability at temperatures

Take a close look at the transistor values G.E. now offers. Because production lines are now mechanized, these transistors are made in *less time* at *reduced cost*. Machine methods today assure strictest adherence to the top quality standards demanded of all

General Electric Germanium Products.

Mechanization results in CONTROLLED CHARACTERISTICS, removing any inaccuracy on the part of the operator. Narrow limits are built into production transistors giving



TYPE 2N43A

a more uniform product.

In military and commercial applications these G-E transistors offer precision quality, topmost reliability at mass-volume prices!

General Electric's P-N-P junction transistor, 2N43A, is the first to be written into Air

Force specifications! MIL-T-25096 (USAF) was actually written around this G-E product which was developed for the military. Now it serves an ever-increasing number of commercial as well as military applications.

APPLICATIONS AND SPECIFICATIONS

TYPICAL USES: Audio and Intercom Amplifiers, Servo Amplifiers, Carrier Current Amplifiers, Test Equipment, Fuel Gauges.

SPECIFICATIONS OF THE 2N43A and USAF 2N43A

Absolute Maximum Ratings:

Collector Voltage (Referred to base)	-45 volts
Collector Current	-50 ma
Collector Dissipation	150 mw
Storage Temperature	100° C
Collector Cutoff Current (-45 volts)	-10 microamps

DESIGN FEATURES:

STURDY CONSTRUCTION...meets critical military tests for shock, vibration, humidity, life.

SEALED JUNCTION...contamination gases permanently eliminated!

HIGH POWER OUTPUT...case design makes possible a collector dissipation of 150 mw.

HERMETIC SEAL...unaffected by moisture.

LONG LIFE...no change in characteristics during life of equipment.

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ON MAKES TRANSISTORS AVAILABLE ES CONTROLLED CHARACTERISTICS

atures up to 100°C...are now available in production lots!

HIGH FREQUENCY TRANSISTOR

A new, revolutionary manufacturing technique, the exclusive G-E rate-growing process, coupled with the all-welded hermetic seal, now makes possible extra long life, and noticeably-reduced manufacturing costs by—

- Making 2000 or more transistors from one rate-grown crystal.
- Achieving uniform characteristics in all 2000 transistors—eliminating wasteful rejects.



TYPE 2N78



Billet of germanium is removed from furnace, prior to cutting into enough tiny pellets for 2000 transistors.

APPLICATIONS

For pulse and switching circuits, RF and IF amplifiers; high-frequency test equipment; telephone repeaters.

SPECIFICATIONS

Collector Voltage (Referred to Base)	15 V
Collector Current	20 ma
Emitter Current	-20 ma
Storage Temperature	100° C.
High Frequency Gain at 2 mc	13 db

For further details on specifications and prices, write General Electric Co., Section X7455, Germanium Products, Electronics Park, Syracuse, N. Y.

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Coaxial Triodes

For 20-25kw Equipments



The ML-6424 and ML-6425 coaxial-terminal triodes, employing thoriated-tungsten filaments, are for industrial and broadcast equipments of 20-25kw power output. As replacements for types 5619 and 5604, the new triodes provide improved performance ratings, safety margins, and strength. New thoriated-tungsten filaments greatly reduce power requirements while offering life increases to 100%. Plate current ratings are increased by over 15%, grid current ratings by

over 10%. Terminal inductances are very low. High transconductance characteristics, up to 25%, assure stable operation, low grid drive, and high plate efficiency.

ML-6424 uses the company's standard water jacket and is rated for 40kw input, 20kw anode dissipation. ML-6425 employs an aluminum radiator to reduce weight to 16 lb as compared with 45 lb for conventional type; it is rated for 40kw input, 12.5kw anode dissipation. Full ratings on both tubes obtain to 30Mc; reduced ratings to 90Mc. Machlett Laboratories, Inc., Dept. ED, Springdale, Conn.

CIRCLE ED-65 ON READER'S SERVICE CARD FOR MORE DATA

Sleeve Bearing Motor

Has 2-9/16" diam



A vertically-mounted sleeve bearing motor, Model RCS-65, built in this firm's RWC-2514 frame, is primarily intended for tape recorder duty. It is a permanent, split-capacitor type motor with a 2-9/16" diam. It has relatively high output torque when provided with a small

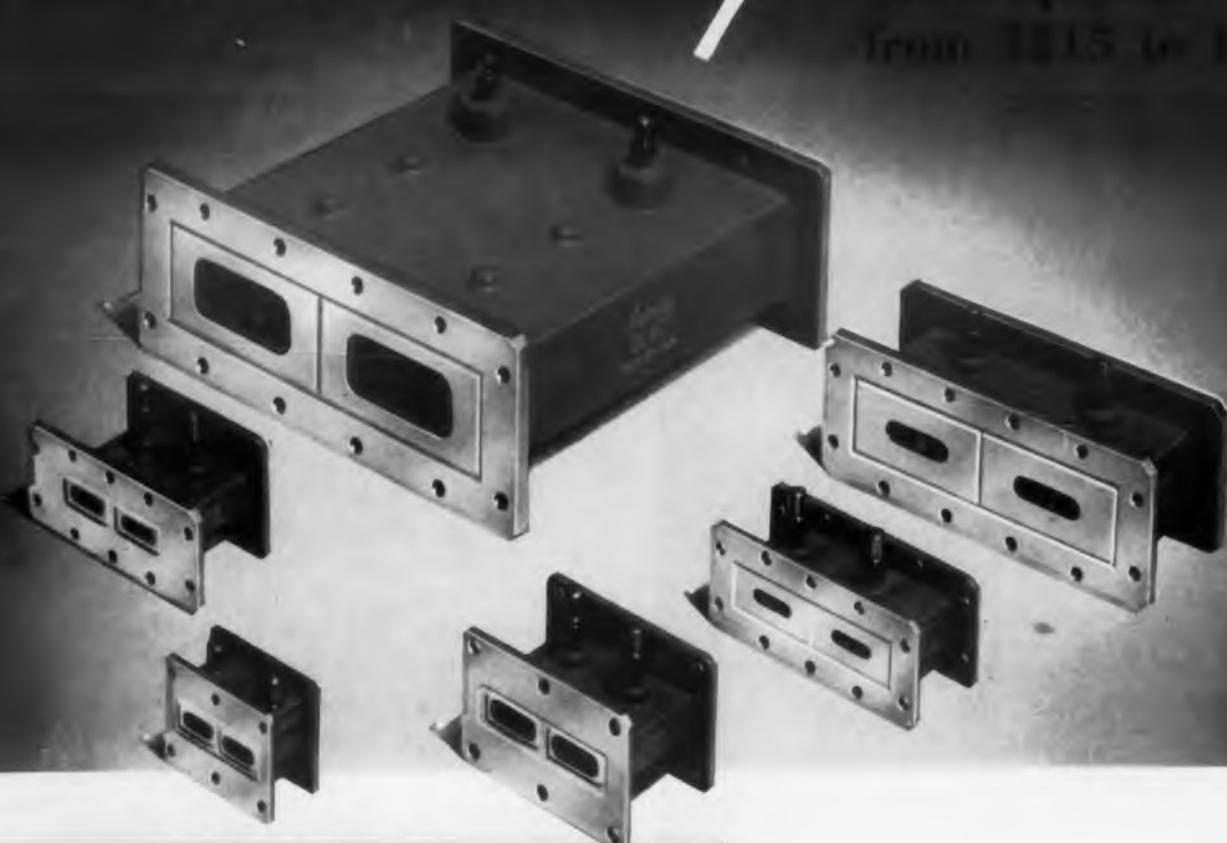
fan for cooling opposite the drive end.

Torque rating is 4 oz-in at approximately 165-rpm on 115v 60cy, continuous duty. The stray magnetic leakage field is low. Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., Dept. ED, 125 Armory St., Boston 19, Mass.

CIRCLE ED-66 ON READER'S SERVICE CARD FOR MORE DATA

NOW...

MICROWAVE



PAT. APPLIED FOR

Band	Frequency	Center Frequency	Power Level (KW Max.)	Type	Description	Tube Designation
L	1215-1355	1285	2000	TR	Dual, Band Pass	6634/BL90
S	2600-3000	2800	750	TR	Dual, Band Pass	6636/BL87
S	2650-2950	2800	750	ATR	Dual	BL92
C	5400-5900	5650	700	TR	Dual 5865	6640/BL60
C	5400-5900	5650	3000	TR	Dual 6568, Band Pass	BL613
C	5400-5900	5640	300	ATR	Dual, Fixed-Tuned, Contact Mount	BL63
X	8490-9578	9000	200	TR	Dual 1B63A	6334/BL27
X	8490-9578	9000	200	TR	6334 tapped Flanges Both Ends	BL78
X	8490-9578	9000	200	TR	6334 plus Separate Channel 1B63A	BL81
X	8490-9578	9000	200	TR	6334 with Recovery Time 1 μ sec at 1 db	6643/BL84
X	8490-9578	9000	200	TR	BL84 with Heater	BL84H
X	8490-9578	9000	200	TR	6334 with Large X Flange Input and Small X Flange Output	6642/BL600
X	8490-9578	9000	200	TR	Dual 1B63A, 2 μ sec Recovery Time	6646/BL604
X	8490-9578	9000	200	TR	BL604 with Heater	6647/BL604H
X	8490-9578	9000	200	TR	6334 with Special Hole Dimensions for Aluminum Flanges	BL607
X	8490-9578	9000	200	TR	6334 with Special Saddle Type Flange	6648/BL615
X	8500-9600	9050	250	TR	Large X Guide	6501
X	8500-9600	9050	250	TR	Four-Element Tube for Large X Guide	6564/BL71
X	8490-9578	9000	250	—	Integral 6334 Hybrid Duplexer	BL507
Ku	15000-17000	16000	100	TR	Dual, Band Pass	6560/BL35

Unlimited design possibilities are now afforded the systems engineers with BOMAC's complete line of dual TR tubes.

BOMAC dual tubes are designed for use with suitable short-slot hybrid junctions to provide balanced duplexers of utmost simplicity.

In operation, the balanced duplexer is similar to magic-T or rat race duplexers. The very low coupling between the transmitter and antenna eliminates the necessity of employing one or more ATR tubes and reduces the losses introduced in radar systems by these tubes. The features of compactness, weight and excellent performance with respect to both transmission and reception characteristics offered by these dual tubes hold many advantages for microwave systems designers and engineers.

BOMAC offers a complete line of hybrids to be used in conjunction with these dual tubes — the tubes can be supplied with integral shutters, offering continuous crystal protection.

We invite your inquiries regarding

- ENGINEERING
- DEVELOPMENT
- PRODUCTION

BOMAC Laboratories, Inc.

BEVERLY, MASSACHUSETTS

GAS SWITCHING TUBES · DIODES · HYDROGEN THYRATRONS · DUPLEXERS · MAGNETRONS · MODULATORS · CAVITIES

Catalog on request. Write (on your company letterhead) Dept. D-5 BOMAC Laboratories, Inc. Beverly, Mass.

Epoxide Resin For Casting Purposes

A flexible, high impact strength epoxide casting resin which is very simple to use is known as Styecast 2340M. It has excellent electrical and physical properties. It is supplied with two components which are mixed together and cured readily to a tack free, opaque material. Adhesion to metals, plastics, glass, etc., is exceptional. Styecast 2340M is easily machined and is usable over a temperature range from -100°F to -400°F . Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE ED-67 ON READER-SERVICE CARD

Silicone Polymer Improves Rubber

Rubbery parts with properties intermediate between those of silicone rubber and organic rubbers can be produced by compounding a new silicone polymer with sulfur vulcanizers and organic rubbers.

Identified as 410 Gum, this polymer can be blended with or applied as a protective coating to extend the serviceable temperature limits and the weather resistance of organic rubbers. Brittle points in the range of -70°F and usefulness at temperatures up to 400°F can be realized by proper blending. Experimental samples are available to designers. Dow Corning Corp., Dept. ED, Midland, Mich.

CIRCLE ED-68 ON READER-SERVICE CARD

Vibration Platform 25cy Harmonic Motion

The type 25 Vibration Platform provides simple harmonic vibration of 25cy for loads as large as 25 lbs. Maximum and minimum amplitude adjustment corresponding to load readily made by an adjustable eccentric weight. Power requirement 1.1amp at 115v, 60cy. Servo Development Corp., Dept. ED, 1440 Broadway, New York 18, N. Y.

CIRCLE ED-69 ON READER-SERVICE CARD

CIRCLE ED-70 ON READER-SERVICE CARD

Set Screw

For Double-Screw Applications

The "Pivot-Lok" Set Screw, with a pivot shaft point, is for use as a locking or adjusting screw in double-screw installations. It provides the advantages of elimination of damage to the second screw, and prevention of loosening due to the turning of the engaged screws as one.

The pivot screw has a shaft protruding from the end. This shaft is pointed and fits into the socket of the screw ahead of it which is to be locked or held in adjustment. Thus, the point on which the top screws turn provides the only contact between the two screws. In spite of the positive holding action, both screws can be easily removed when desired. Set Screw & Mfg. Co., Dept. ED, 265 Main St., Bartlett, Ill.

CIRCLE ED-71 ON READER-SERVICE CARD

Frequency Meters

Nominal 25 to 400cy Types

"Standco" 3-1/2" vibrating reed panel frequency meters are available in 3 styles of cases: molded bakelite case, metal case, and hermetically sealed case. They come with 5, 7, 9, 11, 21, 36, or 41 reeds for normal frequencies of 25, 50, 60, and 400cy. Other ranges from 15-1500cy per second can be supplied. Accuracy of calibration is $\pm 0.5\%$. Herman H. Sticht Co., Inc., Dept. ED, 27 Park Place, New York, N. Y.

CIRCLE ED-72 ON READER-SERVICE CARD

Antenna Cores

Offer Maximum Economy

New components are available offering maximum economy, and great uniformity of quality.

Made of Ferramic "Q" they are available in 1/4, 1/3, 3/4" lengths and in rods and plates from 4 to 1/2" lengths. Ferramic "Q" provides complete stability in respect to size, shock, vibration, and temperature. Additional advantages are high "Q" and lower losses at all frequencies up to 30Mc. General Ceramics Corp., Dept. ED, Keasbey, N. J.

CIRCLE ED-73 ON READER-SERVICE CARD

CIRCLE ED-74 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1955

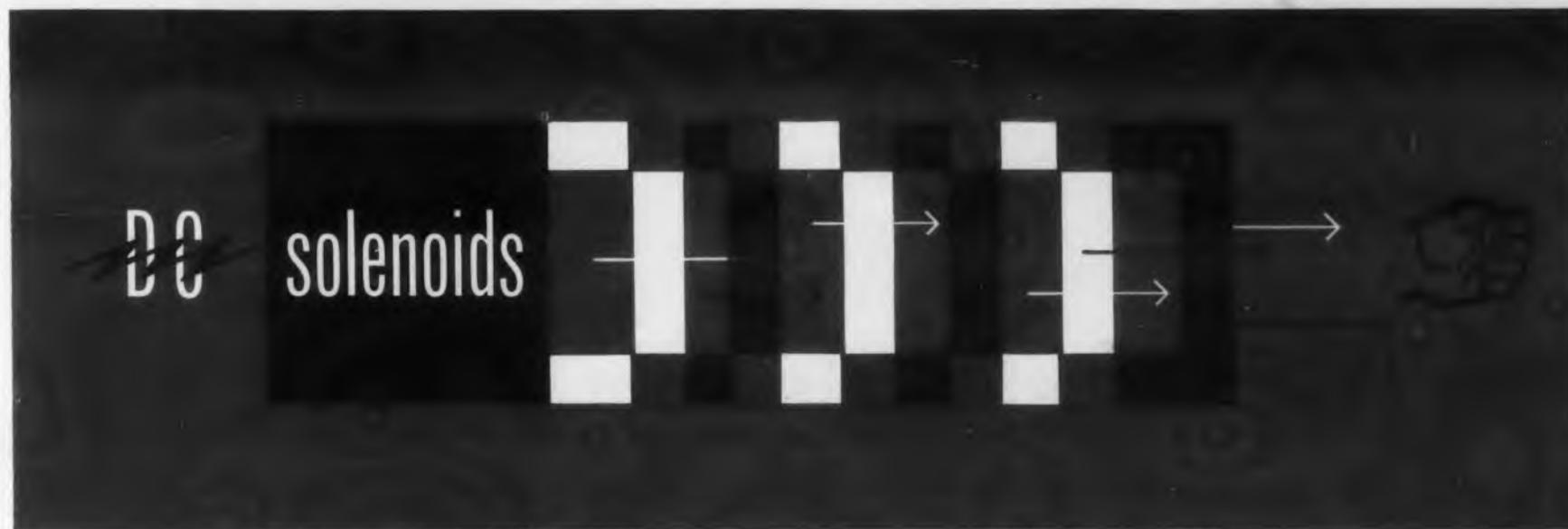


true hermetically sealed solenoids

Just like a sealed vacuum tube! True hermetic sealing around a solenoid... glass seal terminals, lugs, and connectors. All welded and brazed construction. Completely plated after assembly. Exceed most requirements of military specification MIL-S-4040 (USAF). Priced at approximately the same level as conventional types.

high-temperature solenoids

These modern new solenoids give you a reasonable life expectancy at temperatures as high as 350° C. A by-product of hermetic sealing. Class H insulation combined with inert gas filling add those necessary extra few degrees needed in your temperature limits... make these solenoids exceptional high-quality, high-temperature units.



... and those unusual specialties you look for!

Having trouble finding solenoid specialties? Here at Cannon, we'd like to help you. Standard production now includes multiple-strip solenoids for keyboard operation, locking types requiring no holding current, and miniatures and sub-miniatures 1/2" diameter. In addition, our expanded solenoid engineering department is ready to serve you at any time.

CANNON PLUGS



CANNON ELECTRIC CO., 3209 Humboldt St., Los Angeles 31, Calif.

Please refer to Dept. 143

Factories in Los Angeles; East Haven; Toronto, Canada; London, England.

Representatives and distributors in all principal cities

Please ask for latest SR-S releases and/or Solenoid Bulletin.



Photo Courtesy American Gyro

How to keep a missile on target

Genisco Rate-of-Turn Tables provide a fast, precise means of calibrating and evaluating rate gyros

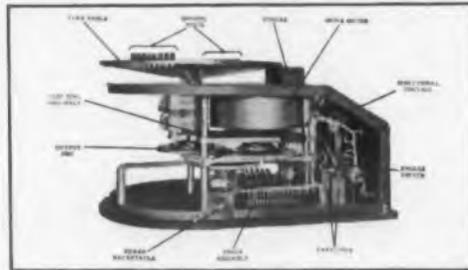
It is imperative that components used in missile guidance systems perform to precise specifications. The Genisco Rate-of-Turn Table is a precision test machine used to calibrate and evaluate rate gyroscopes, vital components in missile guidance systems. Almost all major gyro manufacturers are now using these precision turntables in their test programs.

SMOOTH, CONSTANT ROTATION—Rotation of the table is infinitely-variable from 0.01° to 1200° per second. Constancy of angular velocity is within 0.1% , including drift and wow errors. This accuracy is due in large measure to a unique 60-cycle, 180 r.p.m. synchronous motor and a ball-disc integrator drive system. Absence of gears, belts, pulleys, etc., eliminates rotational irregularities inherent in gear-driven machines.

SPECIALLY SUITED FOR TESTING LARGE QUANTITIES—Operation of

the machine is extremely simple. Precise rates can be set quickly and easily, using only a single hand-wheel, and without "hunting" or having to read complicated scales. These features enable inexperienced personnel to become proficient in the operation of the machine after a few minutes' instruction.

The machine is unusually rugged and operates for long periods with a minimum amount of maintenance.



Interior view of the Genisco Rate-of-Turn Table, Model C181, shows the neat, compact design. More than 100 of these precision machines are now in use.

Several instruments (total weight 100 lbs.) can be tested simultaneously without affecting accuracy.

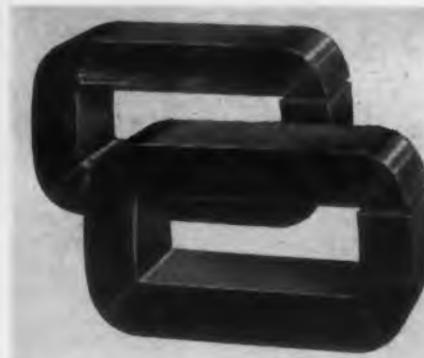
LOW ELECTRICAL NOISE LEVEL—Sixteen slip rings in the machine provide electrical connections from the rotating objects to the control panel. Copper graphite brushes and coin silver slip rings reduce electrical and AC pickup noise below two millivolts per slip ring.

If your problem is development of a single laboratory prototype or production-line calibration and evaluation of rate gyros, write for complete technical data. Address your inquiry to: Contracts Manager, Genisco, Incorporated, 2233 Federal Avenue, Los Angeles 64, Calif.

Genisco
INCORPORATED

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

One-Piece Cores For Large Transformers



Designed to be used as cores for large transformers, these one-piece magnetic cores feature improved magnetic performance because they have only one air gap. The coils are slipped on the core

by pulling the flexible core apart at the gap. These cores are produced in the same manner as "C" cores, that is, a strip of metal is wound around a form and then annealed. Instead of being cut into two "C" parts, only one cut is made.

The single air gap also means that the problem of keeping the two halves of a "C" core together is eliminated. The new cores are available in sizes ranging in weight from 11.75 to 51 lb. Other sizes can be ordered.

The cores are made of high-quality, grain-oriented silicon steel. Since these cores are treated only with varnish on the sides, there is no loss in electrical properties due to vacuum impregnating with a plastic. Indiana Steel Products Co., Inc., Dept. ED, Valparaiso, Ind.

CIRCLE ED-76 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Attenuator For Use in Coaxial Lines



This "Tri-Plate" Variable Attenuator is for use in coaxial lines. The "Tri-Plate" construction makes use of a movable resistive card sandwiched within a new type of printed circuit transmission line.

The attenuator is designed for use as an uncalibrated pad in the frequency range of 1000Mc to 6000Mc. For convenience, the dial carries an approximate calibration reading directly in db at 3, 4, and 5kMc, with accuracy within ± 2 db.

The unit is extremely light in weight and compact. It offers broadband performance, is direct reading and low-priced. It may be used at the bench or panel mounted, and is equipped with two female type connectors mounted on the upper rear. Sanderson Assoc., Inc., Dept. ED, Nashua, N. H.

CIRCLE ED-77 ON READER-SERVICE CARD FOR MORE INFORMATION

Plastic Coating Temperature Resistant

Plastic Dispersions—chemically inert, high temperature - resistant (400°F) materials may be applied by spraying, dipping, or spreading to a broad variety of metallic and non-metallic surfaces providing maximum protection under high temperature and corrosive service conditions.

The Dispersions consist of finely divided particles, 1-20microns, of KEL-F Plastic suspended in volatile organic liquids, similar to those employed in normal paint and lacquer systems. The organic media has been carefully selected for proper viscosity and volatility characteristics to permit the rapid spray application of non-sagging, non-running, smooth, wet films which fuse to a film thickness of approximately 2-2.5 mils. They have a shelf-life of at least 3 years. M. W. Kellogg Co., P. O. Box 69, Jersey City, N. J.

CIRCLE ED-78 ON READER-SERVICE CARD

Micaceous Insulator Bonded with Epoxy Resins

This micaceous insulating material bonded with epoxy resins makes possible extensive improvements in the performance of insulation in generators, motors, transformers, and many other types of electrical equipment. In application, Isomica has outperformed other presently available types of insulation and, because of superior thermal, chemical, and mechanical properties, is giving longer service life.

The new materials come in both flexible and rigid forms—flexible plate, molding plate, segment plate, tapes and tubes. The insulation is homogeneous, with extremely low volatile content—only 1% to 2%. The material can be thermoset on coils and does not crack or break down because of different coefficients of expansion between copper and the insulation. Isomica has good adhesive properties toward copper and other metals. Mica Insulator Co., Dept. ED, Shenectady, N. Y.

CIRCLE ED-79 ON READER-SERVICE CARD

CIRCLE ED-80 ON READER-SERVICE CARD >

ELECTRONIC DESIGN • May 1955



presents

LINE OF HERMETICALLY SEALED

COMPRESSION TYPE END SEALS

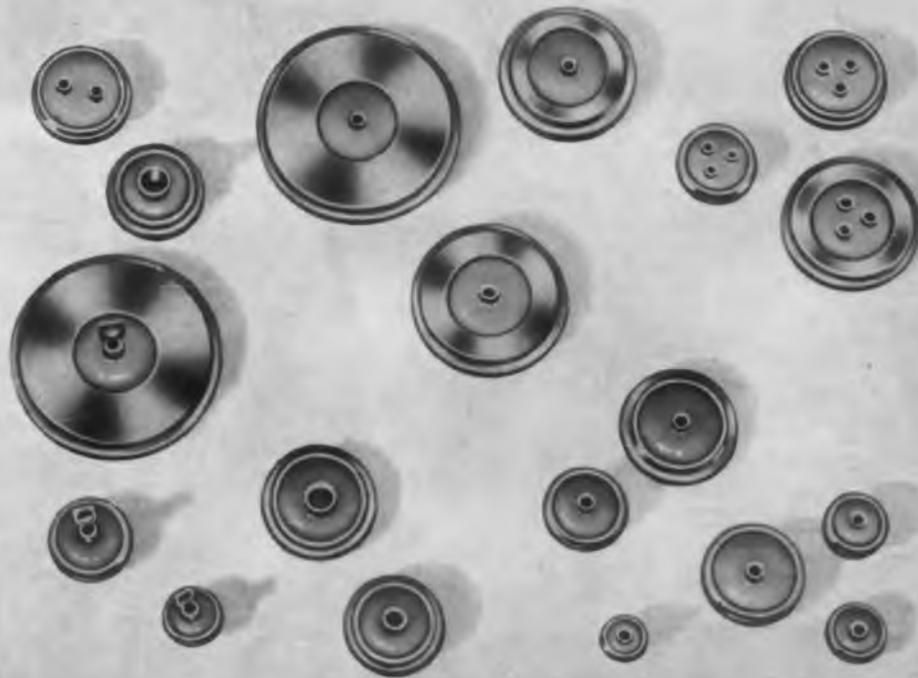
FOR HERMETICALLY SEALING
CONDENSERS, RESISTORS AND
OTHER TUBULAR COMPONENTS

E-1 standardization now makes it possible to offer designers and engineers the economy of standard components in a wide selection of types and sizes. These rugged compression type end seals are available in a broad range of dimensions, in either flared tube or pierced terminals, with single or multiple lead terminations. Inquiries invited.

-here's how

COMPRESSION CONSTRUCTION PROVIDES THE TIME-PROVEN LASTING SEALS

In this exclusive E-I compression construction, the glass remains under constant compression and is therefore extremely strong. These seals possess extraordinary immunity to shock, vibration and pressure changes. For all practical purposes E-1 Compression Seals are indestructible. No special skill is required to apply and assembly is rapid as all metal parts are tin dipped for easy soldering.



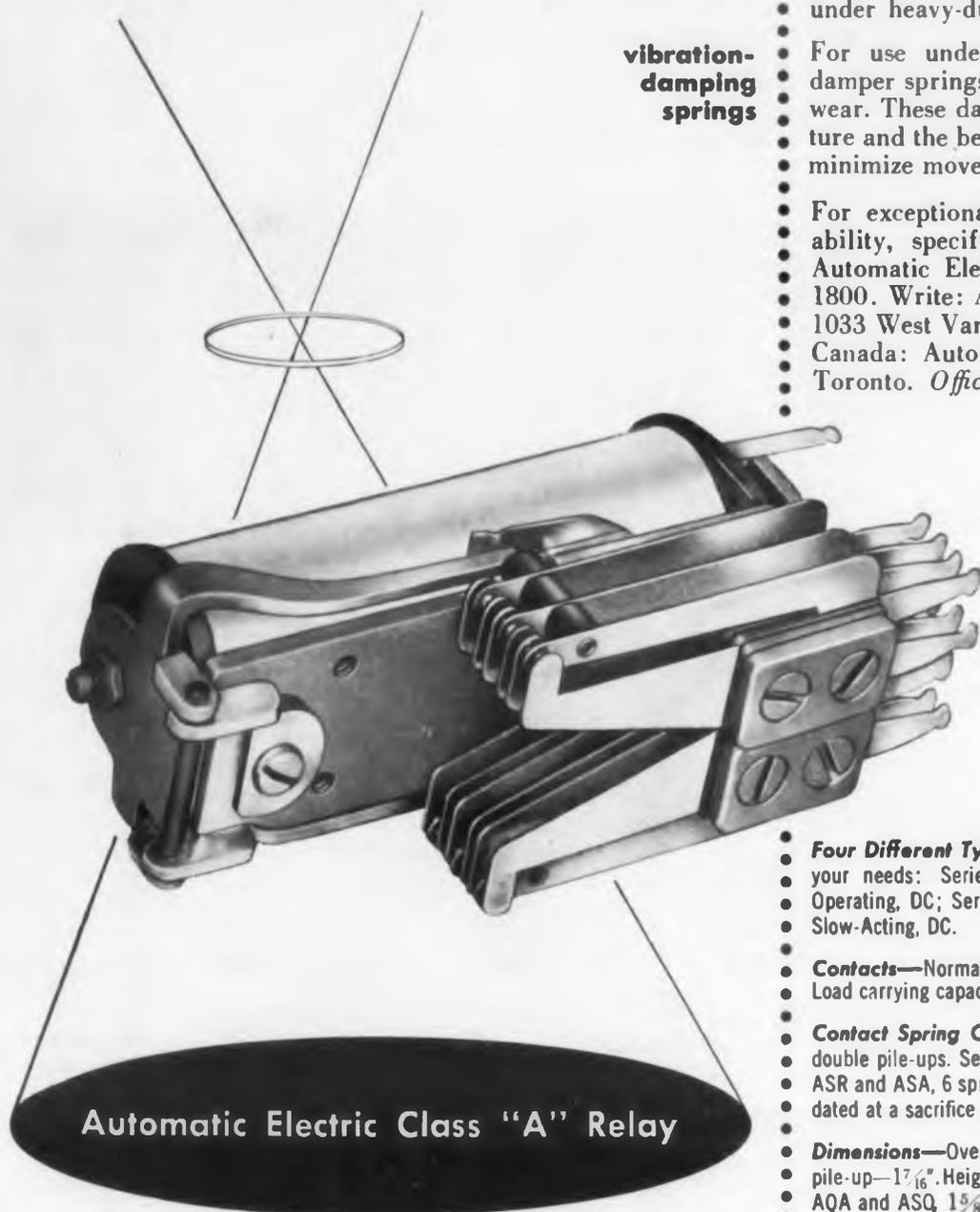
E-I Leadership—in the field of hermetic sealing assures dependability, economy and fast delivery . . . specify E-I for multiple headers, octal plug-ins, transistor bases and closures, sealed terminals, end seals and color coded terminals.



ELECTRICAL INDUSTRIES

Division of Ampere Electronics Corporation • 44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

Critical inspection welcomed...



permanently
attached
contact
points

exclusive
backstop
design

both types
of
armatures

vibration-
damping
springs

• Here's the "workhorse" of the relay industry. Class "A" is a low-cost rugged relay that stands up under critical inspection . . . even after 25 to 50 million operations!

• Contact points are resistance-welded—permanently anchored to the spring for the life of the relay. Continual quality checks on the manufacture of the springs assure lifetime service.

• Backstop is specially formed to prevent armature freezing and to increase life. A "heavy-duty" armature bearing can be supplied for heavy spring loads or constant high-speed operations; its oversized, hard-metal pin turns in precision, long-wearing bearings.

• A choice of "long" or "short" levers gives you the lever ratio required for normal operating and release speeds, or for a residual gap that doesn't vary under heavy-duty conditions.

• For use under conditions of extreme vibration, damper springs can be supplied to prevent excessive wear. These damper springs bear against the armature and the bearing pin with considerable pressure, minimize movement due to external forces.

• For exceptional performance, sensitivity and durability, specify this outstanding member of the Automatic Electric relay family. Ask for Circular 1800. Write: Automatic Electric Sales Corporation, 1033 West Van Buren Street, Chicago 7, Illinois, U.S.A. Canada: Automatic Electric Sales (Canada) Ltd., Toronto. Offices in principal cities.

class "A"
specifications

• **Four Different Types** of Class "A" Relays are available to meet your needs: Series AQA—Quick-Acting, DC; Series ASO—Slow-Operating, DC; Series ASR—Slow-Releasing, DC; and Series ASA—Slow-Acting, DC.

• **Contacts**—Normally single, but can be supplied with twin contacts. Load carrying capacity, 150 watts (maximum 3 amps., non-inductive).

• **Contact Spring Capacity**—Can be supplied with single or double pile-ups. Series AQA and ASO, 13 springs per pile-up; Series ASR and ASA, 6 springs per pile-up. (More contacts can be accommodated at a sacrifice of operating speed and release time delay.)

• **Dimensions**—Overall length, 4". Width, single pile-up—1 1/4", double pile-up—1 7/16". Height (depending upon the number of springs), Series AQA and ASQ, 1 5/8"-2 3/16"; Series ASR and ASA, 1 5/8"-2".

• For more detailed information, ask for Circular 1800.

RELAYS SWITCHES
PRODUCTS OF THE INDUSTRIAL DEPARTMENT OF
AUTOMATIC ELECTRIC
CHICAGO

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

Dual Power Supply With Four Modes of Operation



This low-cost unit, the Model S-2300, consists of two heavy-duty power supplies, each capable of 200v to 300v at 0-300ma. A new switching principle permits front panel selection of four modes of operation: Series

Aiding, 400-1000v, 0-300ma, grounded either polarity or anywhere between the two ends; Parallel, 200-500v, 0-600ma, grounded either polarity with a special internal connection automatically made to control all pass-tube grids from one of the two error amplifiers, ensuring accurate load division up to full rating; Series Bucking, 0-300v at 0-300ma, grounded either polarity, with a factory-adjusted load resistor drawing full rating from one supply, to permit full pump-back and efficient hum cancellation; Isolated, two, completely independent, identical, 200-500v supplies which may be operated in any polarity, up to 1500v apart.

The instrument is available in rack or cabinet style with or without four 4-1/2" rectangular 2% meters to indicate output voltage and current from each supply. New Jersey Electronics Corp., Dept. ED, 341 Carnegie Ave., Kenilworth, N. J.

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

Sealing Boot Replaces Cable Clamp Adapters

This sealing boot is designed to replace AN 3057 cable clamp adapters. It is used on jacketed cables and on wires covered by sleeving to furnish support at the plug or connector and to relieve strain on the connections.



Made of oil-resistant Neoprene with a threaded ring of aluminum, the boot is self-centering. An aircraft-type hose clamp supplies positive sealing action. It is light in weight and has fewer pieces than the conventional-type cable clamp adapter. There are no loose washers or screws.

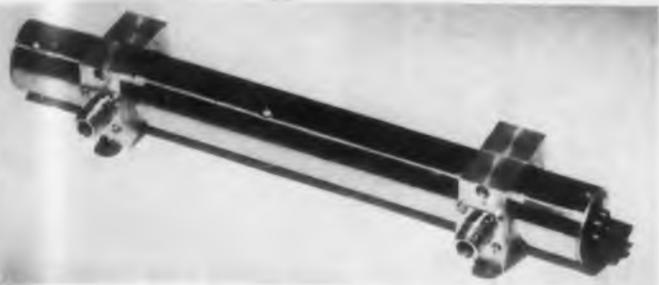
Boots are now available for Army-Navy connector sizes 10SL, 12S, 12, 14S, 14, 18, 20, 22, and 36. Other sizes will be available. The boot is available without the hose clamp if desired. Electronics Div., Whitcomb Blake Co., Dept. ED, New Haven 14, Conn.

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

ELECTRONIC DESIGN • May 1958

Traveling-Wave Tube

Weights only 4 lb



Based on several design innovations, the Model SJ-24-10M S-Band Traveling-Wave Tube is housed in a reduced-size package of 1-1/2" diam x 13" long, including the solenoid, and weighing approximately 4 lb. Both dispersive and non-dispersive low-level tubes are currently being produced for S-band operation, 2-4kMc.

Features also include five-point suspension of the tube stem to provide improved capabilities for rugged-service applications; coaxial input and output terminals conveniently positioned on solid rectangular mounting and heat-dissipation blocks; supply-voltage terminations brought to a convenient end-mounted plug; and an attractive corrosion-resistant chromium finish. Gain is 35db; and output is 19mw. Stanford Laboratories Co., Dept. ED, 1617 Broadway, Redwood City, Calif.

CIRCLE ED-84 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor-Tachometers

Compact D-C Units



A line of d-c motor and d-c tachometer combinations is available, featuring high performance with unusual compactness. Units measure only 2-3/8" diam and

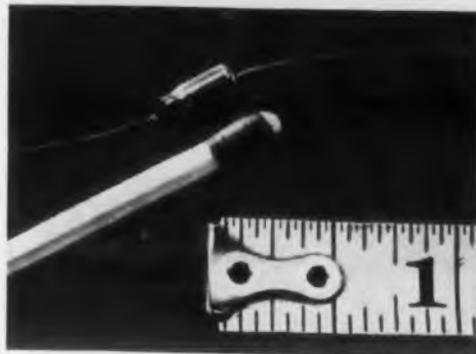
up to 5-1/2" long. All combinations are supplied with auto-reset thermal overload protectors built into the motors, with capacitor filters for both motor and generator optionally available.

The new line includes units with standard motor outputs of 5w to 100w for speeds to 10,000rpm, with an operating voltage range of 6v to 220v. Both permanent-magnet and wound-field types are available, and units for any combination of field and armature voltages can be supplied.

Standard tachometer output is 6v per 1000rpm, $\pm 10\%$. Units with other voltage gradients can also be specified. Linearity of all units is guaranteed within $\pm 1\%$, and maximum ripple, 4% or less, without filtering. Electric Indicator Co., Inc., Dept. ED, Springdale, Conn.

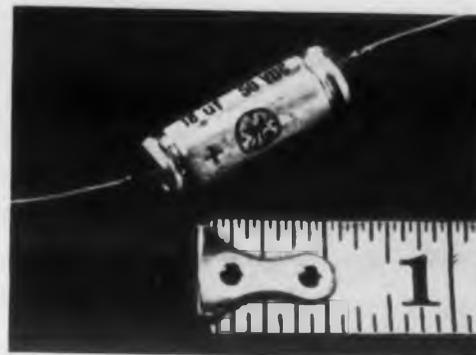
CIRCLE ED-85 ON READER-SERVICE CARD FOR MORE INFORMATION

CAPACITORS by General Electric



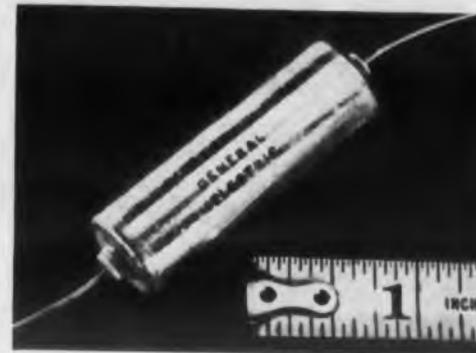
MICRO-MINIATURE

For low voltage d-c miniaturized electronic equipment (hearing aids, walkie-talkies, paging systems). Ideal for transistorized assemblies. Ratings 1-8 uf at 4 v. d-c, 1 uf at 8 v. d-c, 0.5 uf at 16 v. d-c. Tolerance ± 0 to $\pm 200\%$. Temp. range -20 to $+50^\circ$ C. BULLETIN GEA-6065.



TANTALYTIC*

For electronic equipment requiring small size, low leakage current, long shelf life, wide temperature range. Plain or etched foil, and polar or non-polar types, suitable for a-c or d-c. Ratings 0.25-580 uf, 3.75-150 v. Tolerance $\pm 20\%$ (plain foil), -15 to $+75\%$ (etched). Temp. range -55 to $+85^\circ$ C. BULLETIN GEC-808.



METAL-CLAD TUBULAR

For d-c uses where reliability under severe operating conditions is required (military electronic equipment). Ratings 0.001-1 uf at 100, 200, 300, 400 and 600 working v. d-c. (Can be applied to a-c circuits with adequate derating.) Tolerances ± 5 , ± 10 , or $\pm 20\%$. Temp. range -55 to $+125^\circ$ C. BULLETIN GEC-987.



PERMAFIL-IMPREGNATED

Designed to meet requirements of MIL-C-25A, characteristic K specifications, and are suitable for high-temperature operation. Ratings 0.05-1 uf at 400 v. d-c. Tolerance $\pm 10\%$. Temp. range -55 to $+125^\circ$ C. BULLETIN GEC-811.



STANDARD COMMERCIAL

For motors, filters, communication equipment, luminous-tube transformers, industrial control. Ratings dual rated units (a-c or d-c) rated at 0.01-50 uf, at 236-660 v. a-c, 400-1500 v. d-c. Single rated units also available. Tolerance $\pm 10\%$. Temp. range -55 to $+85^\circ$ C. BULLETIN GEC-809.



DRAWN-OVAL

For air conditioning and refrigeration equipment, fluorescent lamp ballasts, business machines, voltage stabilizers. Single, dual or triple-section types. Ratings 1-20 uf at 236-660 v. a-c, and 1-15 uf at 600-1500 v. d-c. Tolerance $\pm 10\%$. Temp. range -30 to $+70^\circ$ C. BULLETIN GEA-5777.

*Reg. trademark of General Electric Company.



ENERGY STORAGE

For use in high magnetic fields and high intensity arc discharge. Ratings: may be built as high as 2000 joules (watt-seconds). Tolerance $\pm 10\%$. BULLETIN GEA-4646.



NETWORK

For guided missiles, aircraft, radar equipment. Ratings: built to user specifications. Temp. range -55 to $+125^\circ$ C, or to user specifications. BULLETIN GEA-4996.

NOTE: All capacitance tolerances are given at $+25^\circ$ C.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

CIRCLE ED-86 ON READER-SERVICE CARD FOR MORE INFORMATION

SEND COUPON BELOW for complete information about G-E capacitors.

General Electric Co.
Section J 442-25
Schenectady 5, N. Y.

Please send me capacitor bulletins checked below.

- | | |
|-----------------------------------|----------------------------------|
| <input type="checkbox"/> GEA-4646 | <input type="checkbox"/> GEC-808 |
| <input type="checkbox"/> GEA-4996 | <input type="checkbox"/> GEC-809 |
| <input type="checkbox"/> GEA-5777 | <input type="checkbox"/> GEC-811 |
| <input type="checkbox"/> GEA-6065 | <input type="checkbox"/> GEC-987 |

Name.....

Position.....

Company.....

Address.....

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

CIRCLE ED-85 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1955

what are
your
diode
requirements?



Check these
PSI features...

- Versatile lead configurations
- Glass-to-metal fusion seal
- Welded construction

Below, we've listed typical types from PSI's broad standard diode line. We also make many special diodes... and if your needs cannot be met by standard types, PSI engineers will be glad to investigate your specific problem promptly. Write us for complete product information.

GERMANIUM GOLD BONDED DIODE SPECIFICATIONS (@ 25°C)

RETMA TYPE	PSI TYPE	OUTLINE 1	MAXIMUM INVERSE WORKING VOLTAGE (v)	MINIMUM FORWARD CURRENT @ +1v (ma)	MAXIMUM INVERSE CURRENT @ SPECIFIED VOLTAGE (ma)
HIGH VOLTAGE TYPES					
	PS200	A/B/C	200	20	0.05 (-50v) 0.2 (-200v)
1N39A		B	200	3	0.2 (-100v) 0.8 (-200v)
1N55B		A	150	5	0.5 (-150v)
HIGH CONDUCTANCE TYPES					
	PS201	A/B/C	90	150	0.02 (-10v) 0.18 (-90v) After switching from 5 ma 1μsec forward pulse to -40v, back resistance must equal or exceed 25K in 0.3μsec. Loop resistance = 2000 ohms min.
	PS202	A/B/C	30	100	0.02 (-20v)
	PS203	A/B/C	30	100	0.1 (-20v)
GENERAL PURPOSE — MEDIUM CONDUCTANCE					
	PS205	A/B/C	80	75	0.05 (-50v)
	PS206	A/B/C	60	75	0.1 (-50v)
1N143		B	100	40	0.1 (-100v)
	PS207	A/B/C	80	40	0.05 (-50v)
	PS208	A/B/C	60	(Note 2)	0.02 (-10v) 0.12 (-60v) After switching from 5 ma 1μsec forward pulse to -40v, back resistance must equal or exceed 80K in 0.3μsec. Loop resistance = 2000 ohms min.
GENERAL PURPOSE					
	PS210	A/B/C	100	15	0.02 (-20v) 0.1 (-100v) 0.15 (-20v) 0.3 (-100v) @55°C
	PS211	A/B/C	60	30	0.05 (-50v) 0.2 (-50v) @55°C
1N63		B	100	4	0.05 (-50v)
1N67A		A	80	4	0.005 (-5v) 0.05 (-50v)

SILICON JUNCTION DIODE SPECIFICATIONS (@ 25°C) 6

PSI TYPE 3	OUTLINE	MINIMUM SATURATION VOLTAGE 4 -E _s (v)	TRANSITION VOLTAGE RATIO 5 E _t /E _s (%)	MINIMUM FORWARD CURRENT @ +1v (ma)	MAXIMUM INVERSE CURRENT @ SPECIFIED VOLTAGE	
					(μa) @ 25°C	(μa) @ 150°C
(D) PS500	A/B/C	300	90	3	0.01 (-150v)	5.0 (-150v)
(D) PS501	A/B/C	150	90	10	0.01 (-75v)	5.0 (-75v)
(D) PS502	A/B/C	55	95	30	0.01 (-30v)	5.0 (-30v)
(D) PS503	A/B/C	30	95	60	0.01 (-15v)	5.0 (-15v)

1. Diodes may be obtained with other configurations to meet special needs.
2. During 0.1μsec 50 ma peak half-sine forward pulse (Maximum PRF = 100 KC), forward voltage ≤ 3v.
3. (D) denotes Developmental Specification.
4. Saturation Voltage (E_s) is measured at 500μa.
5. Transition Voltage (E_t) is measured at 50μa.

A high ratio of E_t/E_s indicates a sharp voltage saturation which in turn correlates with reliability of the unit. This ratio is measured for each diode with respect to its E_s.

6. Recovery time: After switching from 5 ma forward current to two-thirds of the minimum E_s, typically each of the diode types reaches a back resistance of 50K in less than 1μsec.

PACIFIC



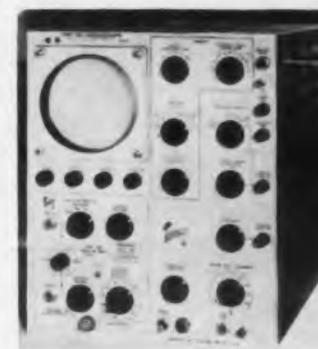
SEMICONDUCTORS, INC.

10451 West Jefferson Boulevard
Culver City, California
3959 Lincoln Avenue
Chicago, Illinois
2079 Wantagh Avenue,
Wantagh, Long Island, New York

THREE SALES OFFICES:

CIRCLE ED-87 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope
Incorporated Plug-In Units



The Type 532 Oscilloscope offers the advantages of all of this firm's Type 53 and Type 53/54 plug-in units, except that the wide band units are limited to a passband of d-c to 5Mc and rise time of 0.07μsec by the characteristics of the main amplifier. The Type 532 is designed for users

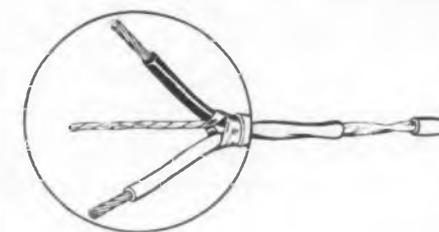
who do not need the high-speed sweeps, high writing rate, and wide passband of the Type 531.

Simplified circuitry eases vacuum-tube loading; a lower accelerating potential reduces possibility of screen damage at very slow speeds and makes possible greater linear vertical deflection. Sweep range 1μsec/cm to 12sec/cm, continuously variable, with 21 calibrated steps from 1μsec/cm to 5sec/cm, accurate within 3%. An accurate 5x magnifier extends calibrated range to 0.2μsec/cm.

The trigger circuitry includes automatic triggering. The unit has a 4kv accelerating potential. A new precision CRT provides 8cm vertical deflection. Horizontal input amplifier sensitivity is 0.2v/cm; 20v/cm; the square-wave amplitude calibrator (approx) 1kc, 0.2mv to 100v in 18 steps, accurate within 3%. D-c-coupled unblanking, electronically regulated power supply, and vertical beam-position indicators are provided. Weight is 52 lb. Tektronix Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

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

Sound System Cable
Features Spiral Copper Shield



The No. 87 P. A. and Sound System Cable, a balanced twisted pair, features a spiral-wrapped copper shield. The wrap offers greater coverage than an average braided shield, and also eliminates time-consuming terminations. It is easily unwrapped, twisted or soldered.

The color-coded twisted pair is accurately produced to provide line balance and eliminate cross-talk. A tough waterproof overall chrome vinyl plastic jacket offers full protection for the shield and inner conductors. Due to its smooth surface and small size (0.225" OD), it is easily pulled through conduit. Belden Manufacturing Co., Dept. ED, Chicago, Ill.

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

ELECTRONIC DESIGN • May 1964

Delay Line

Has 0.4db for 36 μ sec Delay



The Model No. DL 0600 - 03/120 Attenuation Delay Line has a d-c attenuation of 0.4db for a delay of 36 μ sec and rise time of 0.36 μ sec. It is a general-purpose line which has found wide appli-

cation in pulse communication systems.

The unit is a 120-section lumped-constant line which can be supplied with taps every 0.3 μ sec. Delay tolerance is $\pm 3\%$, characteristics impedance 600 ohms, tap capacity 400mmfd, and spurious reflections less than 3%. Size is 13-1/4" x 3" x 1-1/2".

The line is designed for use over a temperature range of -55° to $+125^\circ\text{C}$ and can withstand severe environmental conditions. Delay lines with the same electrical characteristics can also be supplied with a delay drift of less than 20ppm/ $^\circ\text{C}$, working over a temperature range of -65° to $+150^\circ\text{C}$. Epsco, Inc., Dept. ED, 588 Commonwealth Ave., Boston 15, Mass. **CIRCLE ED-90 ON READER-SERVICE CARD FOR MORE INFORMATION**

Pre-Fab Rooms

Provide Microwave-Free Areas

These self-contained "free space" rooms for microwave antenna testing are prefabricated units which can be easily assembled for either indoor or outdoor installation. They can be used as boresight tunnels or test ranges as well as for pattern or other measurements where microwave energy

absorption is required. Each unit is completely self-supporting and needs no other structural members. It consists of a metal framework and plywood panels with microwave absorbing material permanently attached. Standard panel sizes are 4' x 6' x 8' but any panel can be built for a particular installation.

The microwave absorbing material can be of any type, including plastic foam, hairflex, or thin flexible material. To prevent disturbance from outside reflections, the absorber material is backed with a copper screen. An ordinary room can be easily assembled by a few men in one day, with the use of a minimum of standard tools. McMillan Industrial Corp., Dept. ED, Townsville Ave., Ipswich, Mass.

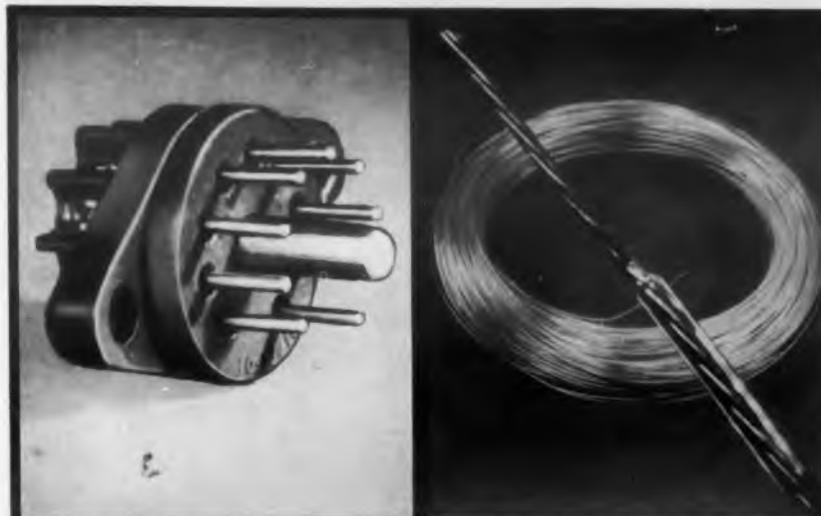
CIRCLE D-91 ON READER-SERVICE CARD FOR MORE INFORMATION

BAKELITE FLUOROTHENE

BRAND

(GENERIC TERM FOR POLYMERS OF MONOCHLOROTRIFLUOROETHYLENE)

A major advance in fluorocarbons that benefits electrical industries **6 WAYS**



Intricately shaped electronic parts are readily molded from BAKELITE Fluorothene. They have excellent dielectric properties, zero moisture absorption, and high resistance to chemical attack. This male connector used in aviation electronic equipment has pins and center post molded in place.

Extruded wire covering of BAKELITE Fluorothene protects against corrosion, fungus, weathering, and impact, in addition to providing good dielectric properties over a broad temperature range. It is excellent for instrumentation control in chemical plants or wherever corrosive atmospheres are encountered.



Superior dielectric properties of BAKELITE Fluorothene at elevated temperatures make it an ideal material for these insulators and other parts used in high-frequency radio circuits. Excellent molding properties make it possible to produce these variously shaped parts to close tolerances.

Film made from BAKELITE Fluorothene, used as a wrapping for wire and electrical parts, provides excellent dielectric properties in combination with toughness and chemical resistance over a broad temperature range. It is also resistant to weather and corrosive atmospheres and will not absorb moisture.

Manufacturers of electrical and electronics equipment are discovering many benefits among the exceptional service properties of BAKELITE Brand Fluorothene. This rigid thermoplastic polymer offers such a combination of good dielectric properties, corrosion resistance, and physical toughness over a wide temperature range that it can function successfully where most other materials fail.

- 1 BAKELITE Fluorothene's electrical properties** include outstanding volume resistivity that remains over 10^{14} ohm-cm. even at 390 deg. F. The material also has a low dielectric constant and high dielectric strength.
- 2 BAKELITE Fluorothene shows no measurable moisture absorption** after long periods of submersion. This factor is instrumental in maintaining its high electrical values, even under extremely humid conditions.
- 3 BAKELITE Fluorothene's working temperature range** extends over 710 deg. F.—from -320 to $+390$ degrees.
- 4 BAKELITE Fluorothene has high compressive strength**, making it excellent for strong, tough parts. Hammer blows on a solid piece seldom scar the surface.
- 5 BAKELITE Fluorothene has outstanding chemical resistance**, enabling it to function in extremely corrosive atmospheres. Furthermore, fuming nitric acid can be piped through fluorothene tubing.
- 6 BAKELITE Fluorothene will not support combustion.**

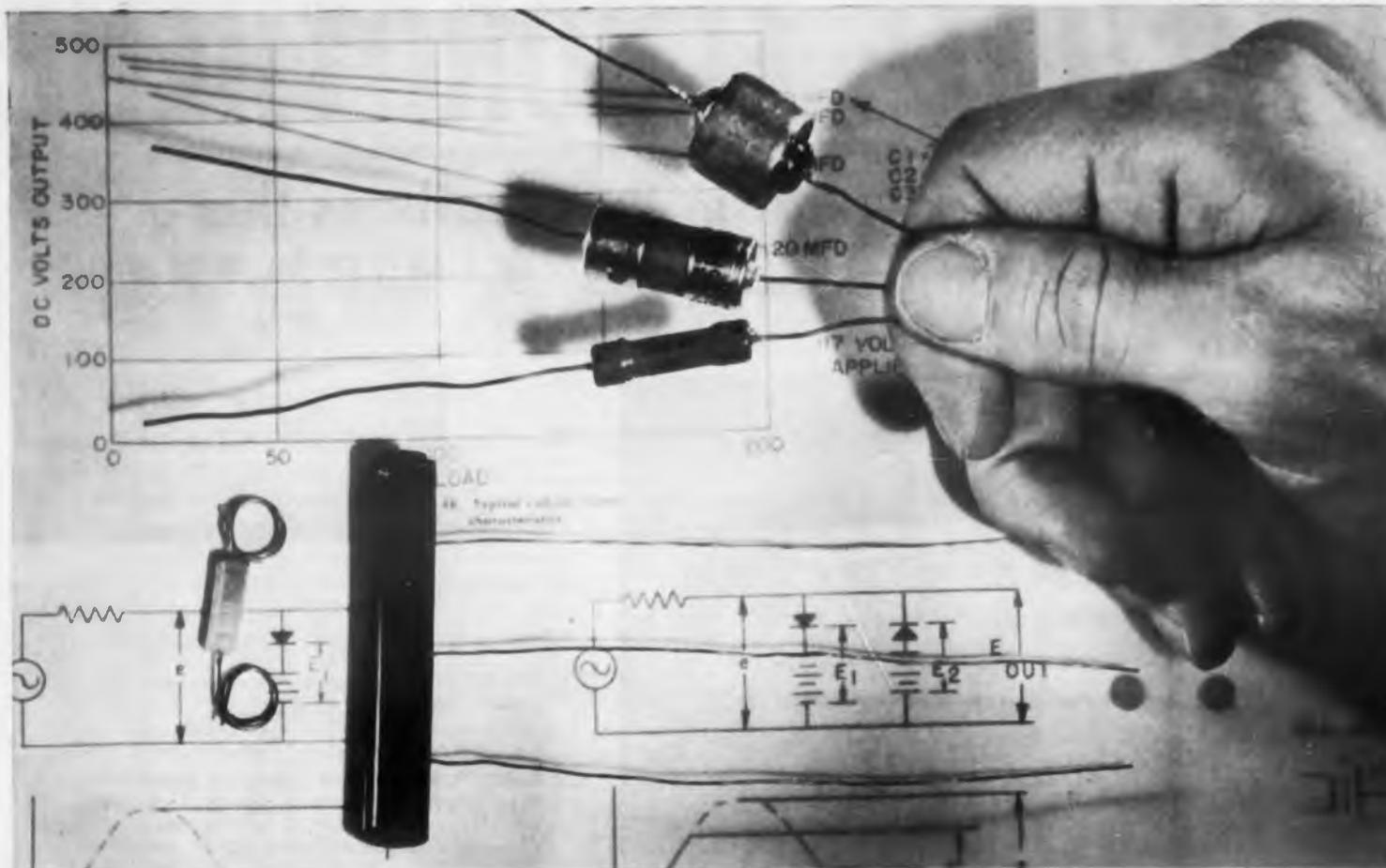
BAKELITE Fluorothene can be fabricated by compression or injection molding or by extrusion, with conventional plastics forming equipment. Typical products include tubing and rod stock, seals, gaskets, and insulation for printed circuits. Film and sheeting produced from BAKELITE Fluorothene is strong and tough and possesses excellent clarity. For information on the forms, properties, and applications of BAKELITE Fluorothene, write Dept. HC-56.



BAKELITE COMPANY, A Division of Union Carbide and Carbon Corporation **UCC** 30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC

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



G-E Miniature *Vac-u-Sel** Rectifiers Provide 60,000 Hours Life; -65 C to 130 C Ambient Range

General Electric miniature Vac-u-Sel rectifier stacks provide outstanding advantages in the areas of:

- Long life expectancy—60,000 hours at 35 C
- Broad ambient temperature range—-65 C to 130 C
- Wide adaptability—variety of stack ratings to 9250 volts peak inverse.

Vac-u-Sel is the G-E trade-mark for a new line of metallic rectifiers with outstanding electrical characteristics.

LONG LIFE EXPECTANCY—Applications requiring 60,000 hours of life and more can be handled with assurance of highly dependable performance with these top-quality rectifier stacks. Long life is an inherent characteristic of these rectifiers. Aging (increase in forward drop) is exceptionally low.

BROAD AMBIENT TEMPERATURE RANGE—All G-E miniature Vac-u-Sel rectifier

cells are specially processed to maintain a high stability of characteristics over an ambient temperature range from -65 to 130 C. Full voltage ratings may be used in all high-temperature applications, and current need not be derated in cases where shorter life is acceptable.

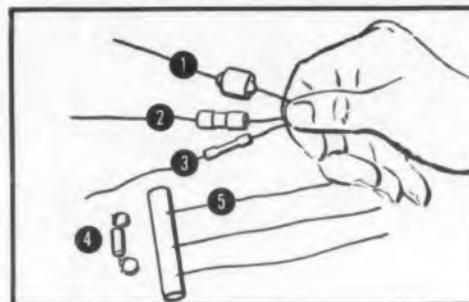
WIDE ADAPTABILITY—Miniature Vac-u-Sel rectifiers are available in individual stacks rated up to 9250 volts peak inverse (6500 volts RMS). Higher voltages may be obtained by using two or more stacks in series. Basic cell ratings are 2.5 ma, 8 ma, and 25 ma (half wave).

Vac-u-Sel rectifiers are available in a variety of housings. The ceramic-tube and metal-tube housings are hermetically sealed. Military specifications on protective coatings are met by applying a special finish to the Textolite* tube stacks at additional cost, and by potting (seal-

ing). Special housings can be offered for large-quantity applications.

PROMPT SERVICE—Immediate attention to any proposition can be obtained by contacting your nearest G-E Apparatus Sales Office, or by writing Section 461-37, General Electric Co., Schenectady 5, N. Y.

*Reg. Trade-mark of the General Electric Co.



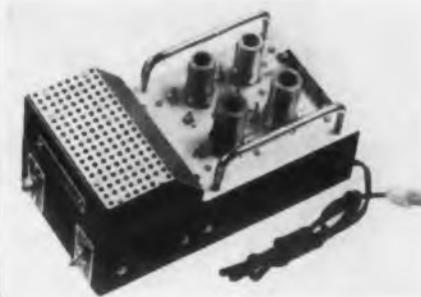
VARIETY OF HOUSINGS available for Vac-u-Sel rectifiers. 1) Metal-clad casing, 2) Textolite tube, 3) Ceramic tube, 4) Nylon tube, 5) Slotted Textolite tube.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

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

Crystal Converters Employ Modular Construction



These converters are constructed on the modular principle of employing plug-in r-f sections to cover the v-h-f spectrum from 20 Mc to 300 Mc. Noise figure at 150 Mc

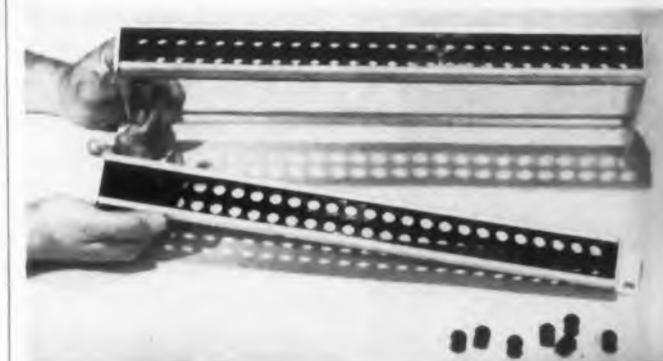
is 3 db and only 4 db at 390 Mc. Overall sensitivity is in excess of 0.1 db. An unusual feature is the universal input which permits matching the unit to any antenna feed line within the impedance range of 20 ohms to 300 ohms.

The base unit incorporates a built-in power supply and a stage of i-f amplification. Plug-in r-f sections in 6 Mc segments, are available for any of the commercial or amateur services in the v-h-f range. Output ranges are available to match any existing receiver installation.

The modified modular construction permits low cost coverage of the entire v-h-f spectrum with one basic unit. Overall dimensions are only 5" x 5" x 1 1/2". Mohawk Electronic Research Laboratories, Inc., Dept. ED, R.D. 4, Box 126-A, Amsterdam, N. Y.

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

Jack Strips Of Molded Phenolic



Molded rather than machined construction is an outstanding feature of this improved telephone-type phenolic jack strip. The construction reduces cost and has a neater appearance.

Each jack strip provides mounting spaces for single (26 double) jacks. Horizontal and vertical spacings are arranged so that either single or double plugs can be used. Two types of mounting brackets are available: flush mounting or standoff. Jack strips are also available without brackets.

In addition to the basic jack strip, four styles of telephone-type jacks are offered for assembling complete jack panels. Lenkurt Sales Co., Dept. ED, County Rd., San Carlos, Calif.

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

Meter Multipliers

Hermetically Sealed



Generally used with 1ma instruments, as well as other measuring equipment, Type MFA Resistors will withstand indefi-

nite exposure to high humidity, salt spray conditions, or immersion in salt water. They are hermetically sealed, precision wire-wound, high-voltage resistors.

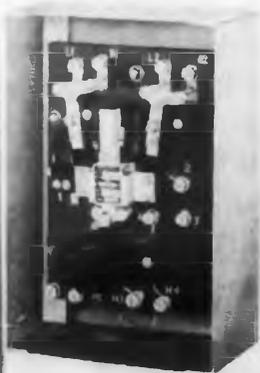
Each unit consists of a number of multiple-pie non-inductively-wound resistors, electrically connected in series. Total voltage is divided into a large number of individual resistor sections with a very low gradient between adjacent sections. The resistor assembly is hermetically solder-sealed within a glazed steatite tube with metal and ferrules.

Units fully comply with JAN-R-29. Standard tolerance is $\pm 0.5\%$. Special tolerances of 1%, 0.25% and 0.1% are also available. Resistance Products Co., Dept. ED, Harrisburg, Pa.

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

Time Delay Relay

Can Handle Motor Loads Directly



With this Time Delay Relay any delay from 1/2-sec to 6sec may be obtained for all standard a-c voltages (120, 240, 460, 600v, 60cy). The relay is also available for other frequencies, and for d-c. An important feature is its capacity for handling motor loads directly: it contains both a time delay relay and a contactor.

The unit has proved especially adaptable for use in conjunction with motors with brake windings. With this brake motor-relay combination, dynamic braking for a-c motors without a separate d-c source being necessary is economically practical.

The relay may also be used as a "single pulse" time delay. Each momentary closing of the pushbutton causes the relay to close, connecting the line to the controlled equipment. The relay automatically disconnects the circuit 1/2sec to 6sec later, depending upon the setting. For repeated cycling, with external contact closed, the relay repeatedly closes and drops out at intervals of 1/2sec to 6sec as required. Automatic Switch Co., Dept. ED, 391 Lakeside Ave., Orange, N. J.

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

KEPCO KR SERIES

7 NEW

VOLTAGE REGULATED POWER SUPPLIES for powering electronic equipment

SAVE TIME AND MONEY

Build these compact Power Supplies into your equipment!

Kepeco Voltage Regulated Power Supplies are conservatively rated and are designed for continuous duty at 50°C ambient. The regulation specified for each unit is available throughout its output voltage range for line voltage variations from 105-125 volts and load variations from 0 to full load.

FEATURES:

- Superior Regulation.
- Ultra-Stable 85A2/DG3 Reference Tube.
- Low Ripple.
- Low Output Impedance.
- Fast Recovery Time, Suitable for Square Wave Pulsed Loading.
- Voltage Range continuously variable without Switching.
- Either Positive or Negative may be Grounded.
- Oil Filled Condensers.
- Wire Harness and Resistor Board Construction.
- Power Requirements 105-125 volts, 50-60 cycles. Units operate up to 400 cycles.
- Terminations and locking type voltage control on rear of unit.
- AC, DC Switches, Fuses, and Pilot Lights on Front Panel.
- Color Grey Hammertone.
- Guarantee One Year.

To include 3" Current and Voltage Meters, Add M to Model number (e.g. KR 1-M) and Add \$30.00 to the Price.
To include Dust Cover and Handles for Table Mounting, Add C to Model number (e.g. KR1-C) and Add \$10.00 to the Price.
To include Meters, Dust Cover and Handles, Add MC to Model number (e.g. KR-1MC) and Add \$40.00 to the Price.
PRICES F.O.B. Flushing.



KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, N. Y.
INDEPENDENCE 1-7000

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



125 ma. KR SERIES

MODEL	OUTPUT	VOLTS	CURRENT	REGULATION		RIPPLE (RMS)	19" Rack Mount		
				line 105-125V	load 0-max		W	H	D
KR1 \$90.	1	100-200	0-125 ma.	0.3 volts	0.3 volts	3 mv.	19"	7"	7½"
	2	6.3 AC	3 amp.	*	*	*	*	*	*
KR2 \$90.	1	200-325	0-125 ma.	0.2 volts	0.2 volts	3 mv.	19"	7"	7½"
	2	6.3 AC	3 amp.	*	*	*	*	*	*

*AC Voltages unregulated.



300 ma. KR SERIES

MODEL	OUTPUT	VOLTS	CURRENT	REGULATION		RIPPLE (RMS)	19" Rack Mount		
				line 105-125V	load 0-max		W	H	D
KR3 \$180.	1	100-200	0-300 ma.	0.3 volts	0.3 volts	3 mv.	19"	7"	11"
	2	6.3 AC	5 amp.	*	*	*	*	*	*
	3	6.3 AC	5 amp.	*	*	*	*	*	*
KR4 \$180.	1	200-325	0-300 ma.	0.2 volts	0.2 volts	3 mv.	19"	7"	11"
	2	6.3 AC	5 amp.	*	*	*	*	*	*
	3	6.3 AC	5 amp.	*	*	*	*	*	*

*AC Voltages unregulated.



600 ma. KR SERIES

MODEL	OUTPUT	VOLTS	CURRENT	REGULATION		RIPPLE (RMS)	19" Rack Mount		
				line 105-125V	load 0-max		W	H	D
KR5 \$240.	1	100-200	0-600 ma.	0.3 volts	0.3 volts	5 mv.	19"	10½"	13"
	2	6.3 AC	10 amp.	*	*	*	*	*	*
	3	6.3 AC	10 amp.	*	*	*	*	*	*
KR6 \$240.	1	195-305	0-600 ma.	0.2 volts	0.2 volts	5 mv.	19"	10½"	13"
	2	6.3 AC	10 amp.	*	*	*	*	*	*
	3	6.3 AC	10 amp.	*	*	*	*	*	*
KR7 \$250.	1	295-405	0-600 ma.	0.2 volts	0.2 volts	5 mv.	19"	10½"	13"
	2	6.3 AC	10 amp.	*	*	*	*	*	*
	3	6.3 AC	10 amp.	*	*	*	*	*	*

*AC Voltages unregulated.



MILLIONS of crystals made to ANY specifications but only ONE standard quality

Midland frequency control units are on the job in two-way communications on land, sea and in the air throughout the world. Now they're playing a leading role in color television. The range of applications Midland serves is wide, but every Midland crystal has one thing in common: a single level of quality.

That one quality is simply the highest that modern methods and machines can produce. It's assured by Midland's system of critical quality control—exact inspection and test procedures through every step of processing.

Result: Your Midland crystal is going to give you the best possible service in frequency control—with stability, accuracy, and uniformity you can stake your life on... as our men in the armed forces and law enforcement do every day.

Whatever your Crystal need, conventional or highly specialized. When it has to be exactly right, contact



Midland

MANUFACTURING COMPANY, INC.
3155 Fiberglas Road, Kansas City, Kansas



WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

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

Temperature Sensitive Resistor

For -100° to $+500^{\circ}$ F Thermometers



The "RdF Stikon" line of resistance-thermometer elements has been broadened by the addition of the SN-1, a new type for higher temperature applications.

In common with other "RdF Stikons", a temperature-sensitive grid of very fine nickel wire is bonded between two paper-thin wafers of insulating material. Silicone-impregnated glass-fiber fabric permits continuous operation at 500° F and short term use at 600° F.

"RdF Stikons" can be attached by means of appropriate cements to almost any surface anywhere. Unaffected by shock or vibration, the element will indicate temperature and temperature changes with high sensitivity and speed. The change in resistance with temperature may be used to actuate direct-reading indicators, recorders, or controllers of various types. In laboratories, temperature may be determined by direct measurement of the element resistance by means of a Wheatstone bridge.

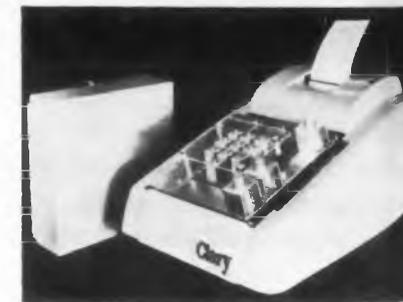
Only 0.0001" thick and $9/16"$ x $1-7/16"$ in width and length, the Type SN-1, excluding external leads weighs about 2 grains, a little less than $1/200$ th of an ounce. At 70° F, resistance is 100 ohms. Manufacturing tolerance is ± 2.0 ohms, and each element is marked to the nearest 0.5 ohm. Ruge-De Forest, Inc., Dept. ED, 50 Moulton St., Cambridge 38, Mass.

CIRCLE ED-100 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Read-Out Unit

Eight or Ten Column Printers

This 10-key Digital Read-Out Machine is designed as a practical, inexpensive and flexible device for printing data in electrical pulse form. Eight and 10-column printers are available.



Pulses may be entered into the amount solenoid at speeds up to 40 millisecc total pulse resolution with 20 millisecc on time. Solenoids are available for operation on 24v d-c, 40v d-c, 110v a-c/d-c. The unit will accept serial information without switching from column to column. Clary Multiplier Corp., Dept. ED, San Gabriel, Calif.

CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION

Delay Cable For Color TV



The Type HII-4000 Delay Cable is an ultra-high impedance, compact, delay element which offers new design possibilities in amplifier circuits because

of the higher possible gain and higher available voltage output from a given tube. Its use in advanced color TV receiver models made it possible to eliminate one stage in the conventional two-stage video amplifier.

The cable has a nominal characteristic impedance of 4000 ohms, and a time delay of $1.0\mu\text{sec}/\text{ft}$. The attenuation for a delay of $1\mu\text{sec}$ is 0.2db at 1Mc, 1.2db at 4Mc, and 3.0db at 6Mc, resulting in a bandwidth (3db down) of 6.2Mc. The pulse rise time is $0.06\mu\text{sec}$ for a delay of $1\mu\text{sec}$, and correspondingly faster for shorter time delays. The phase characteristic of the cable is designed in such a manner as to compensate for any delay errors.

A strong polyvinyl-chloride jacket protects the cable against moisture and abrasion. OD is 0.32", and the cable can be bent around a minimum radius of 3". It can be supplied in bulk (100' lengths) or in precalibrated sections terminated with molded vinyl endcaps. Columbia Technical Corp., Dept. ED, 5 E. 57th St., New York 22, N. Y.

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

Size 11 Resolvers

In High and Low Impedances



These Size 11 Resolvers are especially suitable for precision reduction systems, industrial process control, radar positioning, guided missile control, fire control systems, automatic plotters and computer systems.

They feature an ambient range of -55° to $+85^{\circ}\text{C}$. Weighing 4.7oz the resolvers have a 1.065" OD x 0.85" BuOrd type case and are available with various shafts, including spline, pinion, or plain termination, per customer requirements. They meet the environmental qualifications of MIL-E-5272A.

Units are available with input impedances of 3500 ohms/ $78^{\circ} \pm 10\%$ or 800 ohms/ $76^{\circ} \pm 10\%$, with input voltage at 400ey of 0-100v or 0-60v, respectively. Maximum functional error (% of sine function at max coupling) is 0.1%. American Electronic Mfg., Dept. ED, 9503 West Jefferson Blvd., Culver City, Calif.

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



CAPTIVATED MINI-SHIELDS





flanged
base
for top
mounting



roll-over base
for UHF use

(patent pending)



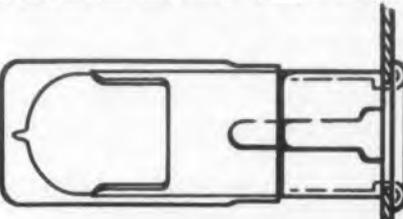
... For easy tube replacement, top half of shield telescopes, exposing tube. Shield is quickly locked back in place.

NO ROCK

NO OSCILLATION

NO RADIATION

SINGLE UNIT CONSTRUCTION



...Special "flexible fingers" inside the shield act as shock-absorbing supports to hold mounted tube firmly in place, providing high shock resistance.

Staver's NEW CapTiVated Mini-Shields end short circuit problems in "hot" chassis due to loose tube shielding, because these new shields are permanently mounted, with a unique telescoping feature permitting quick access to tubes.

Staver's single-unit shield construction permits simplified assembly... cuts production line costs... provides safe tube shielding in "hot" chassis metal cabinet receivers.

Staver's CapTiVated roll-over base model, specifically designed for UHF applications, is a single-unit, shield-socket combination, providing complete shielding of both tube and socket... no part of the socket is exposed above the chassis.

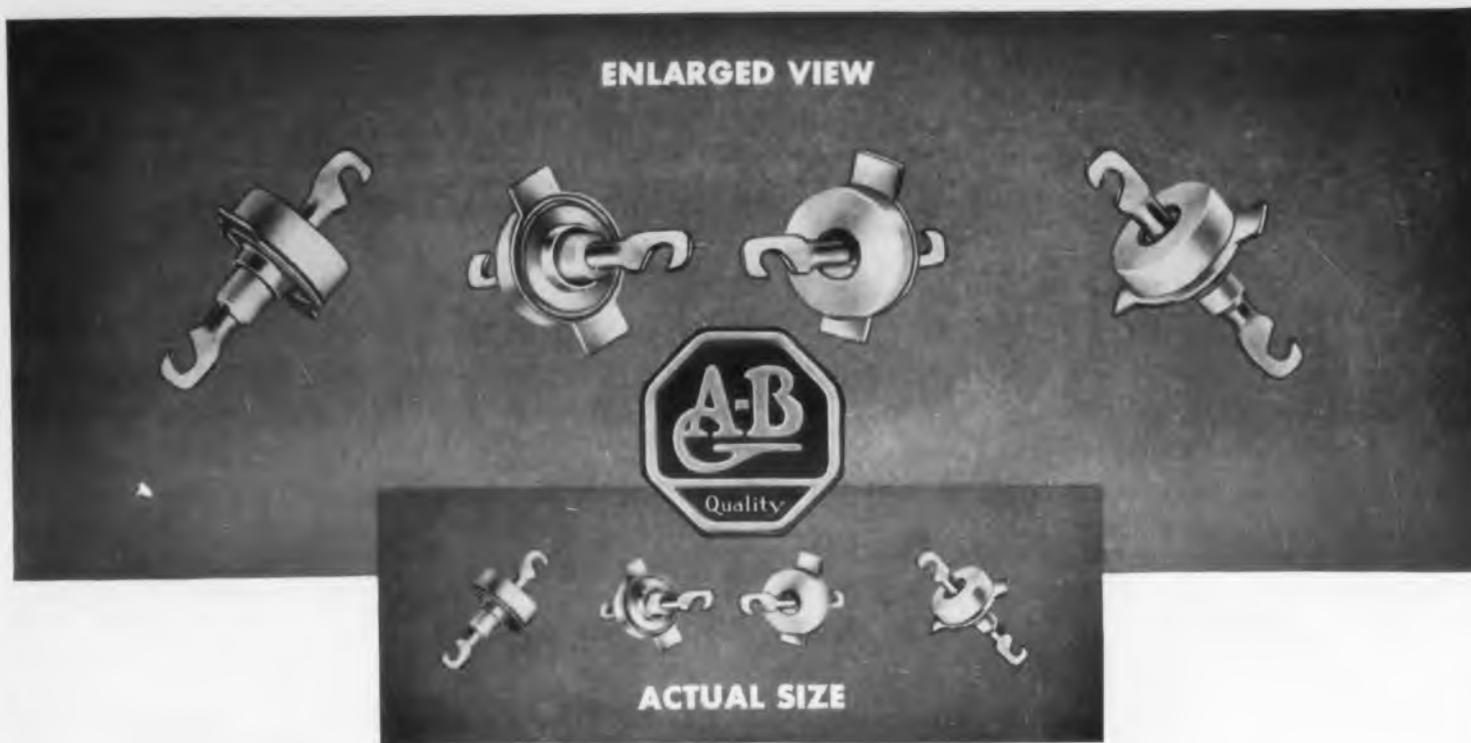
Both flanged base and roll-over base designs of CapTiVated Mini-Shields are available for 7 and 9-pin miniature electronic tubes—as separate shields or as complete shield-and-socket units ready for chassis installation. Complete technical data, prices and delivery information sent on request.



INCORPORATED

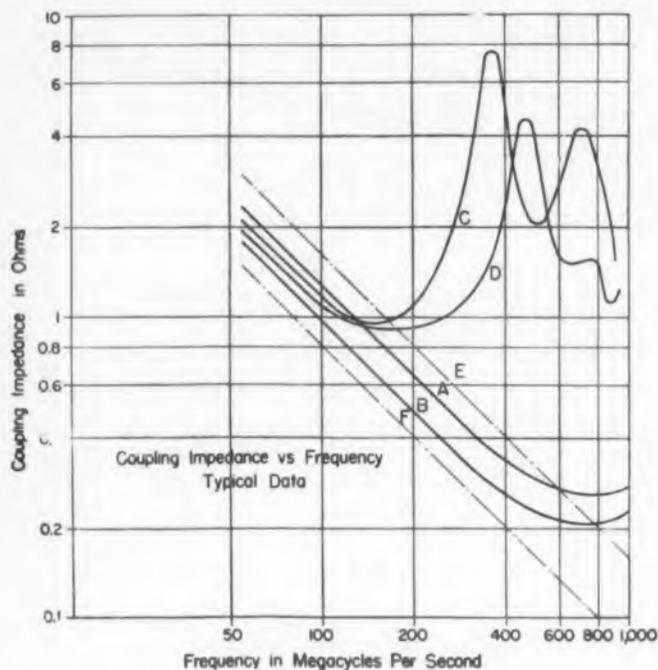
**47 N. SAXON AVE.,
BAY SHORE, L. I., N. Y.**

CIRCLE ED-104 ON READER-SERVICE CARD FOR MORE INFORMATION



ANNOUNCING—An Improved UHF

Discoidal Feed-thru Capacitor



Discoidal vs. Tubular Feed-thru Ceramic Capacitors

Allen-Bradley Discoidal Type	Curve A—1300 MMF at 1 KC Actual
	Curve B—1600 MMF at 1 KC Actual
Representative Tubular Type	Curve C—1400 MMF at 1 KC Actual
	Curve D—1500 MMF at 1 KC Actual
The "Ideal" Capacitor	Curve E—1000 MMF at 1 KC
	Curve F—2000 MMF at 1 KC

Allen-Bradley Co., 1344 S. Second St., Milwaukee 4, Wis. • In Canada—Allen-Bradley Canada Limited, Galt, Ont.

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

CIRCLE ED-105 ON READER-SERVICE CARD FOR MORE INFORMATION

Measuring Magnifier

Uses Real Glass Reticle

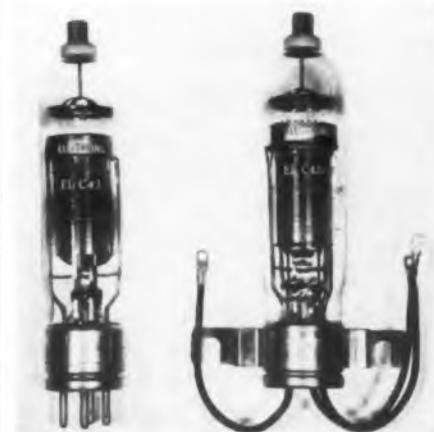


A "vest-pocket" size version of this firm's pocket comparator, this tiny device is about half the size of the larger unit. Its major feature is a real non-warpable etched-glass reticle, instead of the film reticle found on other low-price miniature comparators. The reticle pattern compares hole diameters as well as takes linear measurements. A special feature of the reticle is the thickness comparison scale, a series of parallel lines 0.002" to 0.007" apart. This makes it possible to measure directly the thicknesses of sheet material such as paper or plastic. The linear scale is given both in millimeters and decimal inches. The decimal inch scale is 0.5" long, subdivided into units of 0.005". Hole diameters are given in fractions from 1/64" to 1/16"; in decimals from 0.005" to 0.050". Both the reticle and the object to be measured are magnified six times. The complete unit measures only 2" long and 1" diam. Edmund Scientific Corp., Dept. ED-106, Barrington 3, N. J.

CIRCLE ED-106 ON READER-SERVICE CARD FOR MORE INFORMATION

Thyratrons

For Motor Control; Ignitor Firing



Two xenon-filled thyratrons, available from this firm in identical electrical characteristics, are designed for application in motor control and ignitor firing circuits. The EL C4J is designed for socket mounting and the EL C4J/1 for panel mounting wherever conventional sockets might not be desirable.

Ratings of both units are 4amp d-c continuous average anode current; 30amp oscillograph peak current with maximum peak forward and peak reverse of 900v. The average arc drop is 12v, and heating time is 60sec. Stable grid characteristics are maintained throughout life, and the critical grid current is less than 10amp. Electrons, Inc., Dept. ED-107, 127 Sussex Ave., Newark 3, N. J.

CIRCLE ED-107 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1954

Telemetry Oscillator

For Many Measuring Uses



Series 0200 Inductance Controlled Telemetry Oscillators can be supplied to work with most variable inductance (variable re-

actance) type end instruments, on any center frequency from 1kc to 100kc. The circuit used in this device employs a highly stable fm oscillator followed by an isolating voltage amplifier. Inductance variations of an end-instrument connected across the oscillator tank circuit produces proportional deviation in oscillator frequency; and a cathode-follower amplifier meets isolation and matching requirements to low impedance loads. A wide variety of measuring applications is possible with these units, including many airborne uses.

Output signal amplitude is 2v rms across 10,000 ohm load (min). Total harmonic distortion is less than 3%. Useful temperature range is -65° to $+250^{\circ}$ F. Plate voltage requirement is 150v d-c at 6ma or 108v d-c at 6ma. Filament voltage requirement is 6.3v at 600ma or 12.6v at 300ma. Size is 3" x 1-1/2", and weight is 3 oz. Datran Engineering Corp., Dept. ED, 6312 West 92nd St., Los Angeles 45, Calif.

CIRCLE ED-108 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire-Wound Resistor

In Tolerances to $\pm 0.02\%$

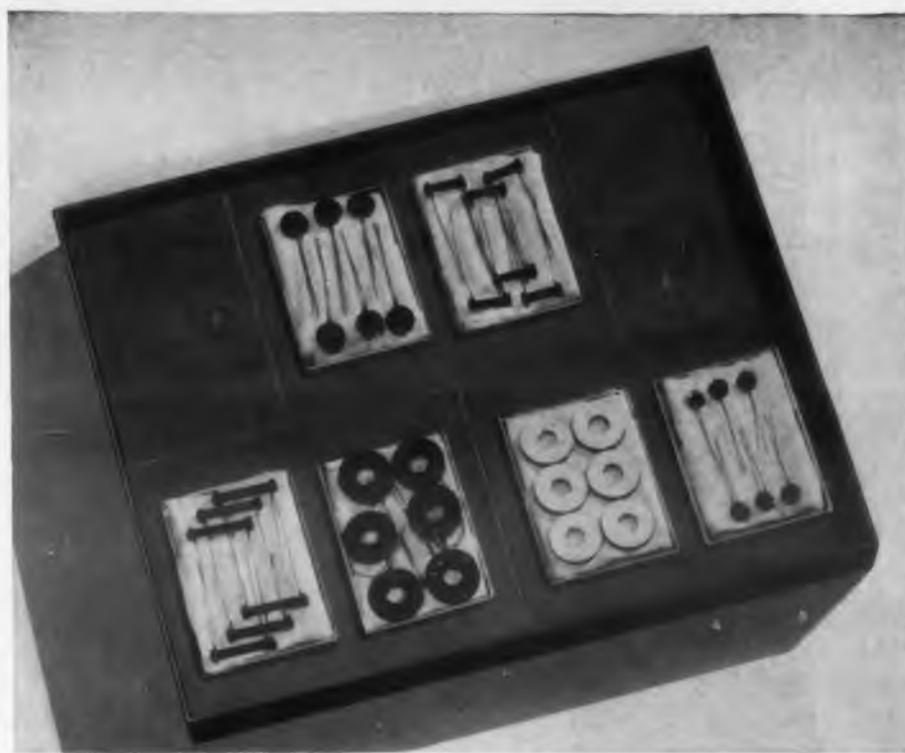


The "Davohm" Type 1274 precision wire-wound resistor, only 3/16" in diameter x 7/16" long, is completely encapsulated and meets all requirements of MIL-R-93A Characteristics A.

The resistor can be subjected to salt water immersion, humidity, and extremes of temperature without effect to characteristics. It is especially suitable for applications where space is at a premium, as in airborne communications and radar systems. Such applications require the mounting flexibility provided by the unit's narrow diameter and axial leads.

A maximum resistance of 180,000 ohms can be wound on the unit. It can dissipate 1/4w at 125°C without derating. Tolerances as close as $\pm 0.02\%$ can be obtained. The Davon Co., Dept. ED, 191 Central Ave., Newark 4, N. J.

CIRCLE ED-109 ON READER-SERVICE CARD FOR MORE INFORMATION



This NEW TEST KIT of GLOBAR®

Type H THERMISTORS

may help solve your circuit problems

Quantity	Cat. No.	R@25°C	B Constant	Load Watts
6	416	1200	3200	0.7
6	479	1000	3800	1.85
6	373	10	2700	3.0
6	343	20	2700	3.0
6	549	5000	3200	1.5
6	588	11000	3200	2.0

KIT No. 2 Type H THERMISTORS PRICE \$24.50

to evaluate use of GLOBAR® Type H Thermistors for

- Providing time delays in relay and solenoid circuits.
- Temperature compensation in meters.
- Controlling remote temperature-indicating devices.
- Temperature compensation in transistor circuitry.
- Stabilization of television oscillator circuitry during warm-up.
- Protective resistors in series filament circuits of radio and television receivers.

ORDER YOUR KITS NOW...

use this Handy Coupon

GLOBAR Division
THE CARBORUNDUM COMPANY
Dept. ED 87-55, Niagara Falls, New York

Please ship kits as follows:

____ No. 1 (Quantity) _____ No. 2 (Quantity)

____ No. 3 (Quantity) _____ No. 4 (Quantity)

Check enclosed (to which we have added applicable local tax)

Please invoice us.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Please send FREE engineering bulletin on Kit No. _____

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

OTHER TEST KITS

of GLOBAR® Ceramic Varistors and Thermistors now available for design and application use include:

KIT No. 1 PRICE \$29.25

Type F THERMISTORS

● To evaluate series filament circuit applications in radio and television receivers.

Quantity	Cat. No.	R @ 25°C	R @ Rated Current	B Constant	Load Watts
6	763	15		1500	0.5
6	441	880	100 ohms @ 150 ma	1900	2.7
6	341	375	40 ohms @ 300 ma	1950	3.6
6	525	250	20 ohms @ 600 ma	1900	7.2
6	327	460	35 ohms @ 600 ma	1900	12.6
6	421	125	43 ohms @ 600 ma	1100	16.5

KIT No. 3 PRICE \$20.00

Type BNR VARISTORS

● To evaluate reduction of surge voltage peaks and contact arcing time; stabilizing speed voltage and amplifier gain.

Quantity	Cat. No.	R @ Calibration Voltage	Load Watts
6	432	100000 @ 10 volts	0.25
6	479	100000 @ 100 volts	0.3
6	328	10000 @ 40 volts	0.5
6	463	24000 @ 40 volts	1.0
6	524	24000 @ 100 volts	1.5
6	430	17500 @ 175 volts	2.7

KIT No. 4 PRICE \$18.25

Type F, Type BNR VARISTORS and THERMISTORS

● To evaluate stabilizing rectifier circuits by limiting peak voltages.

Quantity	Type BNR Cat. No.	R @ Calibration Voltage	Load Watts	
6	432	25000 @ 10 volts	0.25	
6	432	100000 @ 10 volts	0.25	
6	432	200000 @ 10 volts	0.25	
Type F				
Quantity	Cat. No.	R @ 25°C	B Constant	Load Watts
6	763	15	1500	0.50
6	763	120	1750	0.50
6	763	330000	2150	0.50

EACH KIT CONTAINS 36 resistors

—6 of each specified type, packaged in attractive transparent plastic boxes. Pertinent engineering bulletins giving detailed engineering data are sent with each kit. Kits will be shipped postpaid to any point in the United States and Canada. All resistance values specified carry standard production tolerance.

Beam Triode

Sharp Cutoff for Color TV



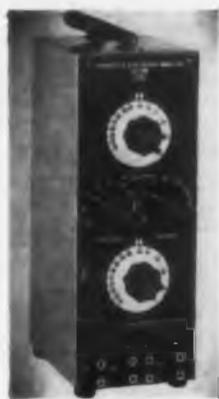
The 6BK4 is a low-current beam triode of the sharp-cutoff type designed specifically for voltage regulation of high-voltage, low-current, d-c power supplies in color TV receivers. It has a maximum d-c plate-voltage rating of 25,000v, a maximum d-c plate-current rating of 1.5ma, and a maximum plate dissipation rating of 25w.

High-voltage insulation is obtained by the use of a double-ended structure utilizing a suitably designed electron gun which consists of a thermionic cathode and one grid. The plate connection is made to a small cap at the end of the bulb. Tube Div., Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE ED-111 ON READER'S SERVICE CARD FOR MORE DATA

Audio Frequency Filter

With Cut-Off Down to 15cy



The Model 2-A Filter Set is engineered for extreme low frequency applications ranging from 15cy to 10,000cy. The new passive network unit, which eliminates vacuum tubes and power supply, is designed to fulfill a need for a continuously variable high-pass and low-pass audio frequency filter for laboratory and production

applications in many fields.

The equipment has only two controls for each group of filters. One control is a switch in octave steps, while the second control is a multiplier, making the filter continuously variable between the octave steps on the switch. High attenuation outside of the pass band of 30db per octave is adequate for most uses. The filter will handle 5w in a 600 ohm circuit, which makes its use possible where a vacuum tube type would not handle the power. Loss in the pass band is approximately 1db, making amplification to compensate for loss unnecessary. Calibrated vernier control allows the use of bands either wider or narrower than an octave.

Also available is the Model 2-B Filter, which covers a frequency range of 60cy to 20,000cy. Allison Laboratories, Dept. ED, 14185 Skyline Dr., Puente, Calif.

CIRCLE ED-112 ON READER'S SERVICE CARD FOR MORE DATA

BUILDING BLOCKS

serving industry through coordinated precision technology

	● Manufacturing	●● Manufacturing and product development	●●● Manufacturing, product development and research	□●● Pilot manufacturing, product development and research
PRECISION MECHANICS, OPTICAL DEVICES, CERAMICS	●●●	●●	●●	□●●
ELECTRICAL EQUIPMENT and COMPONENTS	●●●	●	●	
ELECTRONICS	●●●	●●	●●●	●●●
HYDRAULICS, LIQUIDS PROCESSING, HEAT EXCHANGE		●●		●●●
TELEVISION Studio, Theatre, Educational, Business, Industrial	●	●	●●●	●
INSTRUMENTS, SERVOS, CONTROLS Hydraulic, Pneumatic, Magnetic, Electronic	●●●	●	●●	□●●
AIRCRAFT and MISSILE GUIDANCE, CONTROL, SIMULATION	●●●	●	●●●	●
AUTOMATIC COMPUTERS and COMPONENTS	●●●	●	●	□●●
RADAR, MICROWAVE, ULTRASONICS	●●●	●	●●	●
MOTION PICTURE and AUDIO EQUIPMENT		●●●	□●●	●●●
NUCLEAR POWER COMPONENTS and CONTROLS	●●●		●●	
SYSTEMS ENGINEERING Aeronautical, Naval, Industrial	●●●		●●●	●●●
KEARFOTT COMPANY, INC.				
INTERNATIONAL PROJECTOR CORPORATION				
BUDWORTH MARINE DIVISION				
GENERAL PRECISION LABORATORY INCORPORATED				
THE GRISCOM-RUSSELL COMPANY				
LINK AVIATION, INC.				
THE HERTNER ELECTRIC COMPANY				
THE STRONG ELECTRIC CORPORATION				
J. E. McAULEY MFG. CO.				
ASKANIA REGULATOR COMPANY				
AMPRO CORPORATION				
LIBRASCOPE, INCORPORATED				

THE GPE PRODUCING COMPANIES

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION

One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

advanced techniques & resources

The producing companies of General Precision Equipment Corporation are engaged in the development, production and sale of advanced technological products. Each of these companies specializes in particular areas of advanced competence and possesses highly developed techniques and resources in its particular field or fields. These are the building blocks of GPE Coordinated Precision Technology, through which GPE serves more than a dozen important industries.

The chart at the left shows the areas in which each GPE Producing Company works. But it cannot show the high degree of specialization and the important position each GPE Company occupies in its field or fields.

Take **TELEVISION**, for instance, and the work of General Precision Laboratory Incorporated, the GPE leader in the field. GPL's research, development and manufacturing activities in TV are concerned with quality equipment for theatre, studio, business, industrial, institutional and military TV and do not relate to the home TV field. In all the areas in which GPL operates it has played an important part in the making of television history.

- GPL equipment was used for all video recording of the Coronation, both U. S. and Canadian. It is used by 90% of the studios equipped for video recording.
- The first appearance of a President on closed-circuit TV—President Eisenhower speaking from the White House to distinguished guests at the dedication of the Ford Research Center in Dearborn—was projected via GPL equipment.
- High quality portable projection equipment, newly developed by GPL, enabled guests assembled in several separate ballrooms of the Waldorf-Astoria to see and hear the Queen Mother at two New York dinners last Fall; made possible the historic 53-city TV hook-up which was a feature of GM's fifty-millionth car celebration. This equipment played a key role in the recent nationwide "heart-video-clinic"—the largest meeting of its kind ever held—attended by over 20,000 heart specialists in thirty-five cities. It is rapidly making closed-circuit TV a practical, everyday business and institutional meeting medium.
- Many broadcast studios, including CBS's famous TV 61—the largest in the East, are exclusively equipped with GPL cameras and control equipment.
- New uses are developing steadily for GPL's "Bullet," the new, portable, easily operated, industrial television camera: in banks to speed service, eliminate congestion and reduce personnel costs; in railroads to better control and speed train make-up and freight car loadings; in industry to monitor and improve manufacturing processes, for surveillance and security, and to view hazardous operations.

GPL is a leader in military TV with its special and exacting requirements for airborne, shipboard and under-water uses and is also at work on color TV. A color film camera chain of high quality, for studio use, is in production and additional color equipment will be announced in 1955.

A broad description of the work of GPL and the other GPE Companies is contained in the GPE brochure, "Serving Industry Through Coordinated Precision Technology." For a copy, or other information, address:

General Precision Equipment Corporation

92 GOLD STREET, NEW YORK 38, NEW YORK

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION



The "Bullet" TV Camera; for industrial, institutional and educational use. Produces useful pictures under conditions of poor light; feeds any TV receiver or monitor; unique packaging permits placement in ordinarily inaccessible areas; unitized construction with plug-in component chassis minimizes maintenance requirements.



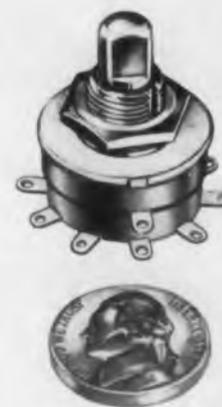
Projection TV System; projects bright, clear pictures on screens from 3' x 4' to 9' to 12'. Completely self-contained; easily transported; set up in matter of minutes; does not require skilled operator. Designed especially for closed-circuit meetings in hotels, clubs, auditoriums.



Remote Control TV Camera; for broadcast and industrial use. Pre-set control permits memory of 6 different shots. Mounted on servo-operated pedestal, provides complete remote control of lens selection, iris, pan and tilt. Highly useful for observing dangerous phenomena; permits broadcasting without use of camera man.

Single Deck Switch

Miniature Tap Type



The 24YY2100 Single Deck Switch, incorporating a positive detent section, has been added to the Series No. 24 family of miniature tap switches. Its construction reduces back-of-panel depth of a single deck unit to a minimum of only 0.562", with an overall diameter across the terminals of 1.032".

The unit is designed to provide positive detent action as the switch is indexed. Rated to break 1amp 115v a-c resistive load, it will carry 5amp if not required to make or break the circuit. A maximum of 10 positions are available within its compact area. Stops are built in for nine positions or less, while the 10-position switch permits continuous rotation in either direction. Grayhill, Dept. ED, 561 Hillgrove Ave., LaGrange, Ill.

CIRCLE ED-114 ON READER'S SERVICE CARD FOR MORE DATA

Clinch Nut

Low-Cost Unit

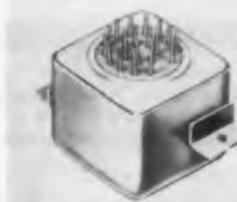


Automation of production makes this clinch nut available at low cost. At the same time, it is made to close tolerances to satisfy the requirements of the automotive industry and other industries that require precise clinch nut applications. It is available in all machine screw sizes from No. 6 to 3/8". Jacobson Nut Mfg. Corp., Dept. ED, Kenilworth, N. J.

CIRCLE ED-115 ON READER'S SERVICE CARD FOR MORE DATA

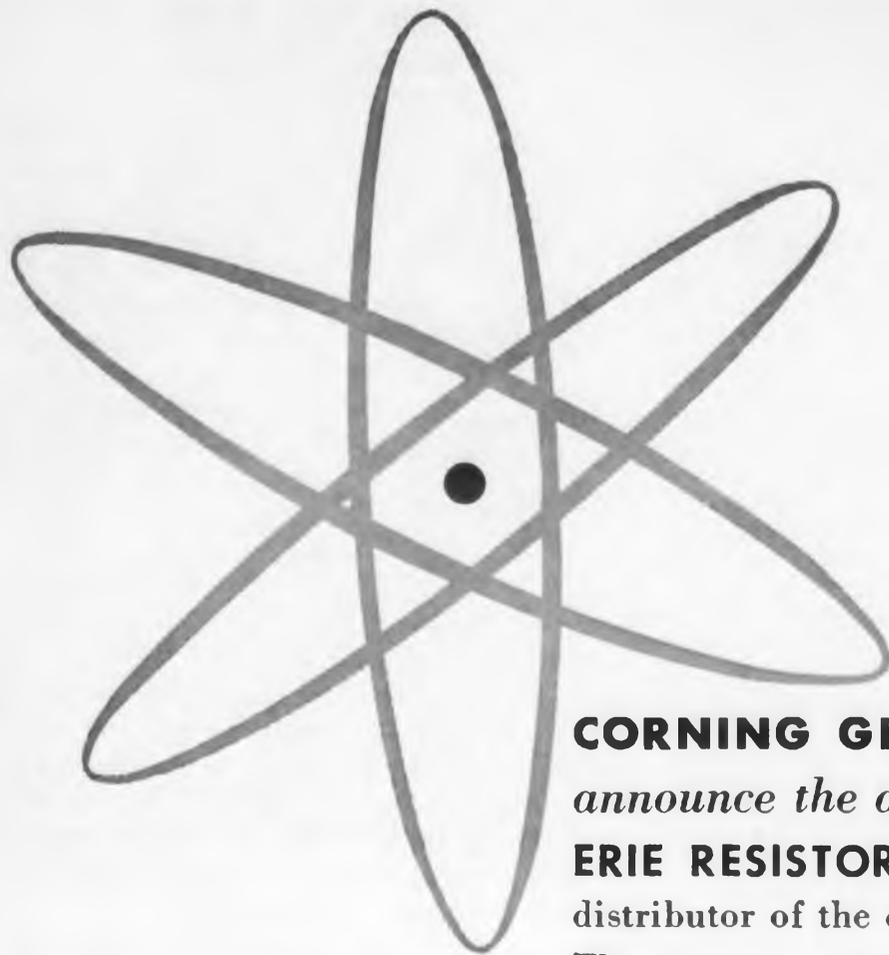
Power Transformer

1.65 cu in Unit for Airborne Uses



With a volume less than 1.65 cu in, this power transformer has a range from 400cy to 6000cy with efficiency up to 95%. Wattage is 6mw to 200w. Operating temperatures are -55° to +155°C. A plug-in type unit, it is in a hermetically sealed case. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

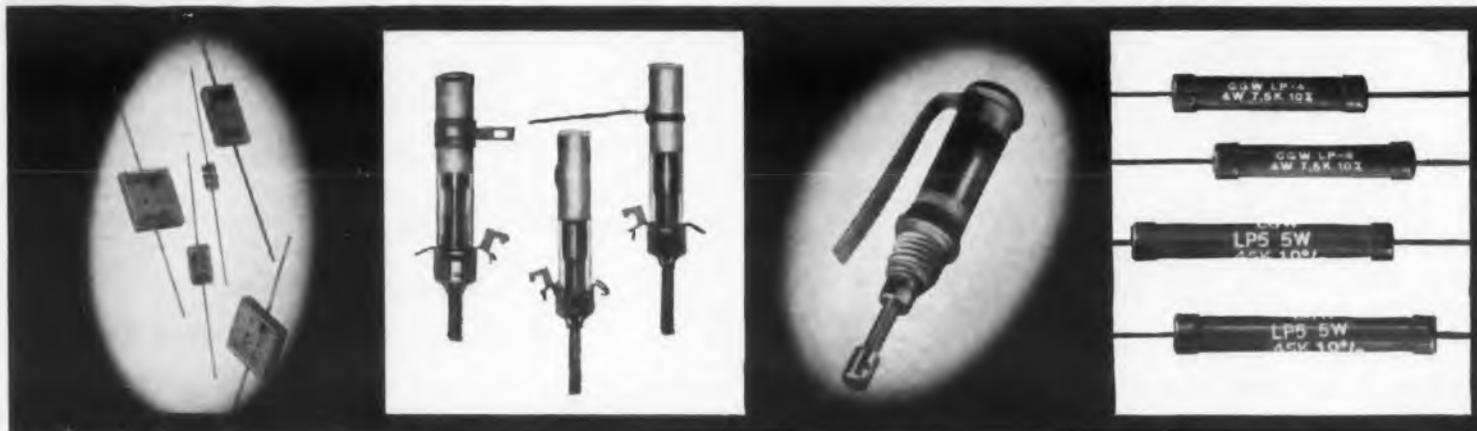
CIRCLE ED-116 ON READER'S SERVICE CARD FOR MORE DATA



CORNING GLASS WORKS is pleased to announce the appointment of the **ERIE RESISTOR CORPORATION** as a stocking distributor of the electronic components listed below. These components are available for immediate delivery through authorized **ERIE** distributors in the United States and Canada



For information and prices, write, wire, or phone Erie Resistor Corporation, 644 West 12th St., Erie, Pa., or your Erie Distributor.



Corning Fixed-Glass Capacitors CY10, CY15, CY20 and CY30 300 and 500 VDCW
Corning Fixed-Glass Capacitors for extreme miniaturization, strength, stability.

Corning Midget-Rotary Trimmer Capacitors. Wide mounting variety in range from 1-12.0, 1-8.0, 0.3-3.0 mmfds. Accurate. Economical.

Corning Direct-Traverse Trimmer Capacitors. For critical applications where you need an absolutely smooth capacitance curve even under extremely variable ambient temperatures.

Corning Low-Power Resistors LP4-4 Watt, 200-40,000 Ω
LP5-5 Watt, 200-45,000 Ω
Corning Low-Power Resistors give you the highest resistance range of any low-power resistors available.



CORNING GLASS WORKS, Corning, New York

New Products Division

Corning means research in Glass

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

Rotary Joint For K_u , X, and S Band Waveguides



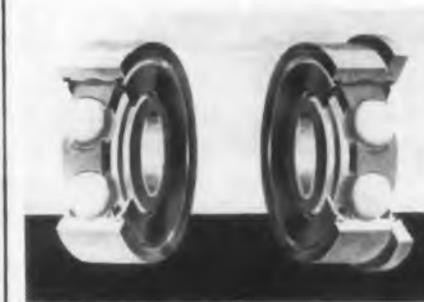
This compact rotary joint, for waveguides in the K_u , X, and S bands, is available for both 90° and 180° orientation of input and output waveguide sections, and provides 360° continuous rotations at high speeds with broadband operation and very high power handling capabilities. At the same time, vswr is extremely low (less than 1.10 over the entire frequency range of $f_0 \pm 0.06 f_0$).

Construction is such that operation may be under fully pressurized waveguide conditions if desired to raise the power handling capabilities and to ensure ideal environmental conditions. Peak power without pressurization is 80kw for the K_u band, 175kw for the X band, and 1500kw for S band. Pressurization will increase these values proportionally to the absolute pressure.

The coupling loop is supported rigidly in an oil bearing, and the main housing is supported on ball bearings. R-f chokes have been incorporated in the design to prevent leakage of r-f power from the joint. Finish and constructional details are in accordance with MIL specifications, and the complete unit is weatherproofed for outdoor use. Reeves Instrument Corp., Dept. ED, 215 E. 91st St., New York 28, N.Y.

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

Radial Bearings With Single or Double Shields



"Micro" Retainer Radial Bearings are now available with single or double side shields for added protection against contamination during installation and use.

Metallic type shields may be removed for cleaning the bearing. Oil or grease lubrication can be specified.

Types include straight and flanged outer rings. Most sizes are being scheduled in stainless steel (SAE 440) at no increase in price over chrome steel (SAE 52100). Tolerances are ABEC 5 or better. Sizes range from 3/64" bore, 1/2" overall diameter. New Hampshire Ball Bearings, Inc., Dept. ED, Peterborough, N. H.

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

ELECTRONIC DESIGN • May 1964

Logarithmic-Linear Amplifier

Valuable for Recording Uses



Logarithmic functions, such as gain and attenuation expressed in decibels, are rapidly plotted on linear paper using a standard recording

millimeter in conjunction with the Logarithmic-Linear Amplifier, Model 120A. Complete antenna radiation patterns have been obtained in less than 2 minutes using the unit in automatic antenna pattern recording systems.

Designed primarily for use with an r-f source modulated at 1000cy, the input provides a metered, variable 0 to 10ma d-c supply for bolometer operation. Alternatively, the instrument can be supplied with crystal input.

The output is presented on a 4" meter and is also available at a meter jack for driving either a 1ma d-c recording milliammeter or a high-impedance recorder. The logarithmic channel has a dynamic voltage range of 100db, equivalent to a 50db power range in a square-law detector. The corresponding meter scale reads attenuation from 0 to 50db in equally spaced 1db graduations. When the linear channel is used, the output is read on a typical db scale with 3db at approximately midscale so that antenna half-power points can be accurately determined. Color Television Inc., Dept. ED, 932 E. San Carlos Ave., San Carlos, Calif.

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

Rotary Shear

Precision Trims 16ga Steel



The "Toolmaster" is a hand-operated low-cost rotary shear which provides sufficient mechanical advantage to cut steel (other than stainless) as heavy as 16 gage without undue effort. It will handle even heavier gages of aluminum or brass.

The unit provides a clean, straight cut, plus positive adjustment for width of cut, from 2" max down to a trim as fine as 0.005". It can be bolted to bench or truck to prevent loss. Cutting wheels can be replaced for about one-fifth the cost of a new pair of snips. Fidelity Tool Supply, Inc., Dept. ED, 309 1/2 St. Camden 2, N. J.

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

the efficient socket
for your printed-circuit

Sylvania Printed-Circuit Sockets

7-pin and 9-pin sockets now available

... for more efficient *printed-circuit* design

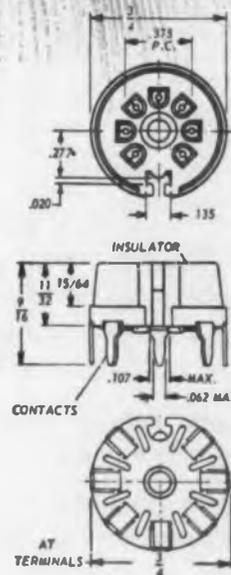
Contacts fit through smaller holes in the circuit board, providing more space and greater freedom in design of circuitry. Circuits can be arranged for shorter conductor paths and greater compactness, including cross circuits between contacts.

... for more efficient *printed-circuit* production

Sockets lend themselves to automatic socket-to-board assembly techniques. Tube shield ground strap location keys the socket for positive orientation. Strap retains and grounds the tube shield. Sockets are supplied with ground strap loose, eliminating the need to stock two production assemblies.

... for more efficient *printed-circuit* performance

Sylvania's printed circuit socket, provided with an all-molded insulator, eliminates moisture traps, offers higher insulation qualities and superior contact characteristics. Top surface installation allows greater heat dissipation.



INSULATOR:
General Purpose or
Low Loss Phenolic

CONTACTS:
Brass, Cadmium
plated

**TUBE SHIELD
GROUND STRAP:**
Brass, Cadmium
plated

Sylvania manufactures a complete line of high quality sockets, terminal strips, and other electronic components. Write for the complete catalog. Address literature or quotation requests to Department E22S.



SYLVANIA

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg.,
St. Catherine Street, Montreal, P. Q.

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



A complete range of MIL-T-27 units is available for quick delivery from your Chicago Standard distributor.

CHICAGO
HERMETICALLY
SEALED
TRANSFORMERS

that meet the full requirements of

MIL-T-27

- POWER
- FILAMENT
- BIAS
- CHOKES
- AUDIO INPUT
3 frequency ranges
- AUDIO OUTPUT
3 frequency ranges
- PULSE
- 400 CYCLE
Power
Filament
Chokes
- MS (Military Standard)
Power,
Filament



Ask for the free CHICAGO catalog, listing detailed electrical and physical specifications on all these transformers. Available from your electronic parts distributor or from Chicago Standard Transformer Corporation.

CHICAGO STANDARD TRANSFORMER CORPORATION

ADDISON AND ELSTON • CHICAGO 18, ILLINOIS

Export Sales: Roburn Agencies, Inc., 431 Greenwich Street, New York 13, N.Y.

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

Audiosweep Generator

For Displaying Response Curves



The Audiosweep Generator is an instrument designed to eliminate time-consuming point-by-point plotting of frequency response curves. It presents a frequency response

curve at a glance by automatic visual plotting of the curve as a display on a cathode-ray tube.

The instrument can accurately analyze the audio and supersonic spectrum. The frequency sweep is achieved by a continuous variation of the sinusoidal output frequency between any two frequency limits in the range from 20cy to 200,000cy. The frequency swing is achieved entirely by electronic means. A variable marker makes possible accurate frequency readings at any point along the curve. A selection of sweep types and sweep rates is available.

The instrument may also be used as a f-m signal generator with modulating frequencies from d-c to 10,000cy. As a beat frequency oscillator it covers the entire spectrum from 20cy to 200,000cy in one continuous range, and as a sweeping harmonic wave analyzer over all or any part of the spectrum from 100cy to 200,000cy. The unit is made in three models: for 20-200,000cy, 2-20,000cy, and 0.2-2000cy. Technomatic Instrument Co., Dept. ED, 11368 W. Olympic Blvd., West Los Angeles 64, Calif.

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

Contact Relays

For High-Speed Switching



Two mercury-wetter contact relays, the Type HG and HGP, are capable of over a billion operations without maintenance, and are designed for use in high-speed switching machines and devices. These relays will operate at up to 60 operations/sec; have high current-carrying capacity (up to 5amp) and high voltage-handling capacity (up to 500v); are bounce-and-chatter-free; and keep a uniformity of operation to within 1.5milli-sec under constant drive conditions.

These characteristics are achieved by the use of platinum contact surfaces, continuously wetted with mercury by capillary action, and the hermetic sealing of the magnetic switch in a protected glass capsule, pressurized with hydrogen. C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

These characteristics are achieved by the use of platinum contact surfaces, continuously wetted with mercury by capillary action, and the hermetic sealing of the magnetic switch in a protected glass capsule, pressurized with hydrogen. C. P. Clare & Co., Dept. ED, 3101 Pratt Blvd., Chicago 45, Ill.

CIRCLE ED-125 ON READER-SERVICE CARD FOR MORE INFORMATION

use dag dry films for trouble free lubrication



'dag' Colloidal Graphite improves CRT performance



Coat inside walls of CRTs with a dispersion of 'dag' Colloidal Graphite in de-ionized water to retard secondary emission and adsorb gases. The resulting film also acts as an electric conductor and a ray-focusing material.

A 'dag' dispersion in lacquer sprayed onto exterior tube surfaces dries in one to two minutes and produces a smooth, black, adherent, conductive coating on any type of glass. Once thoroughly dried, the film is resistant to removal by water.

You'll find a surprising number of ways to use 'dag' dispersions described in our free booklet on 'dag' Colloidal Graphite for electronics and electrical applications. Write for Bulletin D-433-V12.

Dispersions of molybdenum disulfide are available in various carriers. We are also equipped to do custom dispersing of solids in a wide variety of carriers.

ACHESON COLLOIDS COMPANY

PORT HURON, MICHIGAN

3150 ACHESON COLLOIDS LTD.
LONDON, ENGLAND

CIRCLE ED-126 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1964

Automatic Printer Identifies Recording Charts



The "Identi-chart" is a compact device that automatically prints a number, date, or time on "Brown" strip chart or similar recorder charts at any instant when a voltage is ap-

plied to the device during process, test, or control work. The unit makes it easy to identify individual sections of charts in relation to particular conditions taking place at a remote point. It mounts on the outside of the door of the recorder, regardless of type of instrument, and does not interfere with or obscure the recording procedure.

The device is made for 28v d-c operation, but can be adapted to other electrical requirements. It is supplied in kit form for easy installation. The kit consists of a strip of rubber for the chart platen, mounting screws, plexiglass window to replace the original window in the door, plastic transparent cover for the device itself, and instructions for installing. Wires from the unit go to the power supply and switch which is connected to the process. Royson Engineering, Dept. ED, Hatboro, Pa.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

Dual Triode

Serves as Cascode Amplifier

The 6BC8, a miniature 9-pin, medium- μ dual triode with semi-remote cutoff characteristics, lends itself readily to applications as a cascode amplifier in v-h-f TV tuners. It also gives more satisfactory performance in AGC systems under both strong and weak signal conditions.

In addition, the tube provides relief from objectionable cross modulation effects when reception of a weak signal is degraded because of strong adjacent channel station interferences. This effect is minimized because the transfer curve of the tube ap-

proaches the desirable square law characteristic, which is the optimum shape for minimizing cross modulation. Sylvania Electric Products, Inc., Dept. 1740 Broadway, New York 19, N. Y.

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

ANOTHER UNUSUAL PROBLEM SOLVED BY LORD

**LORD
MOUNTINGS
TAKE THE SHOCK LOSS
OUT OF SHIPPING!**

Why accept costly shipping damage as a "necessary evil" when your equipment can be shipped safely with LORD re-usable Shock and Vibration Control Shipping Mountings?

Available in standard models or specifically designed for extraordinary problems, these bonded-rubber mountings have practically eliminated costly shipping damage to such fragile units as electronic tubes and instruments, business machines, and other easily-damaged equipment.

LORD mountings effectively reduce shock damage with the proved com-

bination of specially designed, shock-absorbing rubber bonded to metal for structural strength and mounting accuracy.

Whether your "shipping-shock" problems can be solved with standard LORD mountings or will require a special design, LORD engineers will gladly show you how LORD mountings can insure delivery of your equipment without damage to its accuracy or sensitivity.

Remember—LORD Products are engineered to provide the best in shock and vibration control! Contact the LORD Field Engineer nearest you, or

LORD MANUFACTURING COMPANY, ERIE, PA.

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SINCE 1924

CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION



EIMAC Vacuum Switches

for high voltage, airborne service

Compact, fast action Eimac vacuum switches are custom designed for high voltage application. Single pole, double throw action contacts are precision spaced in high vacuum, permitting reliable performance regardless of ambient atmospheric conditions. In antenna switching service, RF peak potentials as high as 20kv may be applied between the switch terminals. Eimac vacuum switches are not limited to this service, however, as they will handle 1.5 amps at 5kv in DC switching. Efficient operation in severe airborne conditions, small size and instant response give these switches a distinct advantage over conventional relays. Now available are four Eimac switch types, including one for pulse service.

*For further information contact our
Application Engineering department*



EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

CIRCLE ED-130 ON READER-SERVICE CARD FOR MORE INFORMATION

Ovens

Compact Units for Crystals



The Type VCO-2 temperature - controlled oven is for use with JAN type HC-6/U and HC-13/U crystals. The unit comprises a heavy anodized-aluminum housing arranged to accept two, two-prong mounted crystal units. The base of

the housing fits a standard octal socket. The housing cover is threaded onto the base for simplified removal when changing crystals.

The connections to both crystals are brought out independently to allow the greatest flexibility of oscillator circuit adaptation, and are kept isolated from heater and thermostat leads. A connection is brought out for operation of an external pilot lamp to indicate heater operation.

Heater power is 4w available for use with 6.3v, 12.5v, or 28v operation, either a-c or d-c. Temperature of the crystals is maintained at $75^{\circ}\text{C} \pm 1^{\circ}$. Oven cases are optionally available with height of 1-9/16" or 2-1/16", to fit specific crystal sizes. Case diameter is 1-9/16"; weight, 57.5gr, exclusive of crystals. Valpey Crystal Corp., Dept. ED, 1244 Highland St., Holliston, Mass.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope

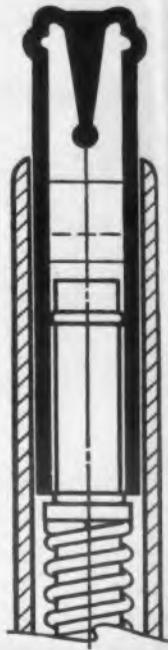
Versatile Midget Unit



This D-C "Mid-getscope", Model No. 534, combines linear sweep with a d-c amplifier for color TV restorer circuits and for complex waveforms. Other features include provisions for a-c coupling; full

vertical and horizontal expansion of trace; automatic astigmatism control circuit; linear time base and sweep; returned trace automatically blanked, and vertical or horizontal operation. Frequency range is d-c to 500kc. Sensitivity is better than 50mv. The unit has push-pull deflection throughout. Radio City Products, Inc., Dept. ED, Easton, Pa.

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION



something
new on

MARS

Staedtler has been coming up with something new in pencils ever since the first Staedtler pencils were made three centuries ago.

Now it's the new, sturdy, solid brass lead sharpener built into the Technico Mars-Lumograph push-button lead holder. Saves you work, time, money.

Get the imported Mars Technico lead holder and leads today—they are the best, yet cost no more.

The 1001 Mars Technico clutch mechanism holds leads securely; lightweight, perfectly balanced; \$1.20 each, less in quantity.

1904 Mars-Lumograph leads are opaque, inking-in is unnecessary, won't flake or smudge, give better reproduction. Perfectly graded 18 degrees—EXB to 9H; \$1.20 each, less in quantity.



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CIRCLE ED-133 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1964

designed for
AUTOMATION!

first for printed
circuits



**UPRIGHT
CAPACITORS**



- Space-saving
- Compact
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CIRCLE ED-134 ON READER-SERVICE CARD

Digital Decade Counters

For Rates to 100,000/sec



Two Digital Decade Counters, each available in three variations, are for use wherever high-speed electronic counting is required. Both types employ the printed circuit principle, thereby permitting maximum ventilation, low operating temperature and longer life.

The Type "A" group has decades with a staircase output of voltage proportional to the count. This enables the output of the decades to be recorded on a direct-writing oscillograph. The type "B" group has decades with a four-line coded output which can be used to operate mechanical printers.

Both types are applied to Models 100, N-100, and N-101 high-speed electronic counters, each of which will accept input pulses at rates varying from 0 to 100,000cps. For each ten impulses received at the input, one pulse is generated at the output.

Model N-100 is a low-power (150v plate supply) neon version similar in design to Model 100, which is the standard decade using a drum or meter type display. Model N-101 is designed as a direct replacement for neon-type counting decades operating at plate potentials of 350v. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION

Generator Noise Filter

For Mobile Applications



For amateur, marine, aviation, police, utility, civil defense, military, and similar uses, the Model 1080 is a completely shielded generator filter designed to materially reduce commutation "hash" and "whine" throughout the high-frequency amateur bands. These filters are supplied complete with a 4-way mounting bracket for quick, easy installation on one end of the vehicle generator.

The units may be quickly adjusted after installation for highest efficiency and maximum noise reduction. Model 1080 is for 10-11-15-20-40 meters; Model 10 0A is for 2-6-10-11 meters.

Also available is the Model 1081 Regulator Noise filter, a companion unit to the Model 1080 designed for the popular amateur bands. Rex Bassett, Inc., Dept. ED, Bassett Bldg., Fort Lauderdale, Fla.

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-134 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1955

Engineer using BURROUGHS PULSE UNITS loses no time designing test equipment



- 1. FAST SET-UP.** Engineer draws pulse sequence, then determines by block diagram how to connect his Burroughs Pulse Units. Usually this can be done in a matter of minutes.



- 2. JOB COMPLETED.** No time lost. Because engineer spends no time designing test equipment, he can spend his full time on the real problem. This means he can do more, accomplish more.



- 3. NEXT ASSIGNMENT.** Without losing time, engineer simply determines the block diagram needed to produce the next pulse sequence and sets up his Burroughs Pulse Units. He shifts quickly from one assignment to the next—saving considerable time otherwise needed to design and build special test equipment.

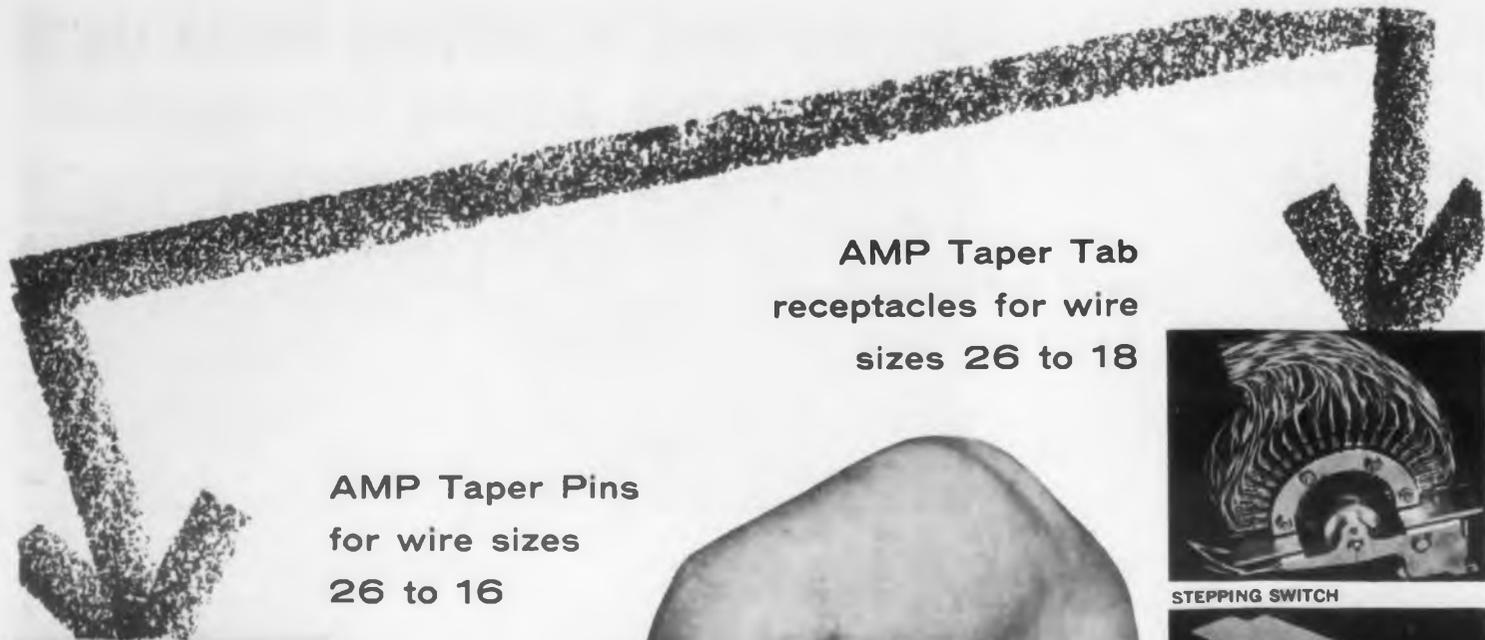
GET THE FACTS

Learn how you can make your time worth more. Burroughs Pulse Units save weeks of engineering, uncertainty, and considerable equipment cost. Can be used over and over again on different future projects. Immediate delivery from stock. Write for detailed brochure. *Burroughs Corporation, Electronic Instruments Division, Dept. 4-E, 1209 Vine St., Phila. 7, Pa.*

ELECTRONIC INSTRUMENTS DIVISION
Burroughs

FIRST IN PULSE HANDLING EQUIPMENT

CIRCLE ED-137 ON READER-SERVICE CARD FOR MORE INFORMATION



AMP Taper Tab
receptacles for wire
sizes 26 to 18

AMP Taper Pins
for wire sizes
26 to 16



AN CONNECTOR



CONNECTOR BLOCK—2000 CONNECTIONS



AMP TAPER BLOK



STEPPING SWITCH



PRINTED CIRCUIT CONNECTOR



TAPER TAB RELAYS

less cube and cost WITH ADDED RELIABILITY

Cubic restrictions have brought about a whole new concept of wire termination. The AMP Taper Technique with AMP taper pins, tab receptacles, blocks and modified miniature components will help you take full advantage of small wire, small insulation and small space for your wire terminations.

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CIRCLE ED-138 ON READER-SERVICE CARD FOR MORE INFORMATION

Meter Calibrator With 0.05% Accuracy



Meter Calibrator Model M100A-2 is a standard de reference that provides both voltage and current calibration range from 0 to 1000v and 200ma max, and from 0 to 100ma at 1000v max. The unit maintains long time stability

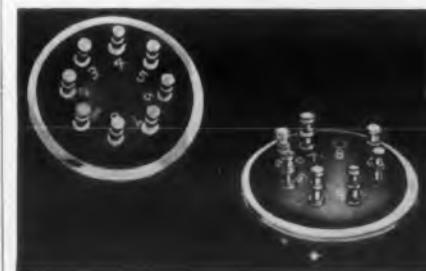
of 0.01%, accuracy of 0.05%, and regulation of $\pm 10\%$ line voltage change of 0.01%.

The voltage output is variable in 0.1v steps, and the current output is adjusted in four ranges. On the lowest range of 0 to 0.1ma, the output varies in 0.01 μ amp steps. Other full-scale current ranges are 1ma, 10ma, and 100ma.

The instrument employs absolute d-c power supply circuitry which constantly compares the output voltage against a standard cell and maintains the long time stability and accuracy of a standard cell. The unit is for use in analog computer facilities, telemetry, instrumentation groups, automatic frequency control calibration, and as a secondary standard voltage source, Kalbfell Laboratories, Inc., Dept. ED, P. O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Headers In Variety of Styles, Materials



These Single and Multiple Terminating Headers are available in a wide variety of styles and insulating materials, and plated to suit specifications. They are used extensively in the manufacture of hermetically sealed components, including transformers, condensers, coils, relays, and other components.

Body materials are designed to meet requirements of MIL-P-14 and MIL-T-27. In addition, various other insulating compounds are available to meet operating temperatures of 550°F. Terminals are made in turret head, hollow tube, straight wire, or to custom specifications, and are plated in tin zinc, silver, gold plate, gold flash, palladium, rhodium, and other materials. Garde Manufacturing Co., Dept. ED, 588 Eddy St., Providence 3, R. I.

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

American Electric PNEUMATIC Power Supply



for jet engine starting and check-out of air driven accessories

- Provides contaminant-free air at rates up to 160 lbs/min. under pressures of 55 psia, at temperatures to 550° F.

- Uses rotary positive, Roots type blowers.

- Completely portable operation with gasoline driven engines.

- All components are readily available in commercially manufactured equipment; reliable, easily serviced and proven over long use.

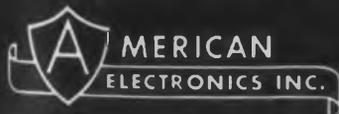
- Available in several models and capacities for fuselage or nacelle connections.

Write our engineering department for more detailed information.

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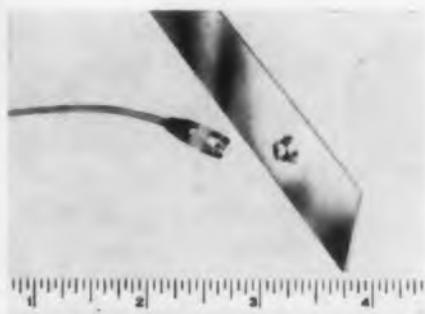
Electric Machinery
& Equipment Division of



112 Chico Avenue, El Monte, California

CIRCLE ED-141 ON READER-SERVICE CARD

Quick-Connect Plugs For Miniature Coaxial Uses



Offered in "microminiature" size for coaxial circuitry, the QC Series of connectors is available in a complete series of 50 ohm, 70 ohm, and 93 ohm types, offering over two

million coaxial circuitry design possibilities. The line is particularly well suited for blind and hard-to-reach applications.

Mating is accomplished by simply pushing the units together with a "snap-on action" over a spring-loaded locking design. A constant pressure is maintained, holding the mating connectors tightly together. The company's 1/2 oz hand tools permit these parts to be readily assembled to all types of "Microdot" cable. The series includes jacks, feed-thrus, bulkhead receptacles, adapters for BNC, Ell, Tee, Cross Adapters, and many specials.

All connectors are 100% "Teflonx" dielectric. The finish is silverplate with pins, gold-plated. Life is guaranteed for over 100,000 engagements. The standard type QC-50 (50 ohms) has a length of 0.73", with nut OD of 0.225". Weight is 0.8 oz. Insulation resistance is over 100,000 megohms, capacitance is 2mmfd, and voltage rating is 600v rms. Microdot, Dept. ED, 1826 Fremont Ave., South Pasadena, Calif.

CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

Shields

For T-12 Tube Sizes



Originally developed for special missile requirements, these T-12 shields are now mass-produced for use under similar environmental conditions. The shields are for use with

tubes of the T-12 envelope size similar to the 6080, 6146, and 6293. The base fits the following JAN approved submounted sockets: TS 101P 01, TS 101P 02, TS 101C 01, and TS 101C 02.

A handle has been made an integral part of the shield to aid in its removal from tight places. For greater stability under vibration and shock, two additional counter-sunk holes have been added to the base, the use of which is optional. International Electronic Research Corp., Dept. ED, 177 W. Magnolia Blvd., Burbank, Calif.

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW DEVELOPMENTS

NEW Bandpass Filters

FROM 200-2000 Mcs.

To meet the rapidly growing need for accurately defined bandpass networks, A R I introduces its new line of BANDPASS FILTERS, covering the frequency range of 200 Mcs. to 2000 Mcs., with bandwidths of from 1% and up of center frequency.

These NEW Bandpass Filters incorporate multiple tuned resonant circuits with an insertion loss of less than 1 db., and will display the typical Tschebycheff response.

These space-saving filters have been kept to the absolute minimum size, consistent with the number of resonant circuits. These filters may be readily incorporated as external adjuncts to any existing equipment.

Although the A R I Bandpass Filters are available at standard frequencies and bandwidths, they may be obtained at any frequency and bandwidth desired.

TYPE HFF

For bandwidths of 5% and greater of center frequency.

TYPE HFF-T

For bandwidths from 1% and up of center frequency.

TYPE HFF

QUADRUPLE TUNED



CHARACTERISTICS

TYPE HFF & HFF-T BANDPASS FILTERS

Center Frequency:	200-2000 Mcs.
Bandwidth:	From 1% and up of center frequency; Maximum 100 Mcs.
Impedance:	52 ohms (Input and Output)
Connectors:	BNC to 1000 Mcs. Type N 1000-2000 Mcs.
Insertion Loss:	Less than 1 db.
Peak to valley ratio:	Less than 1 db.
Selectivity:	Defined by resonant elements. Doublets to Sextuplets available.
Standard Frequencies:	400 Mcs.; 1000 Mcs.; 1680 Mcs.

ALSO AVAILABLE

- Filters up to 3000 Mcs., to meet your specifications.
- Filter applications with R.F. amplifiers, up to 3000 Mcs.
- Band Rejection filters.
- Bandwidths greater than 100 Mcs.

TYPE HFF-T



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WRITE TODAY for full information, and latest prices

MANUFACTURERS OF: BNC Attenuators and Coaxial Terminations, Bandpass and Bandreject Filters, Broadband Sweep Generators, Community TV Components, Crystal Mode Indicators

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

Why has G-V in
3 Years Become the
Preferred Supplier of



Thermal Time Delay Relays?

Because G-V OCTAL & MINIATURE RELAYS have been... adopted as production components by hundreds of principal producers of electronic, electrical and aviation equipment.

Delivered for use on over 250 Government contracts.

G-V ENGINEERING OFFERS A NEW APPROACH TO THERMAL RELAY DESIGN

- Stainless steel mechanism welded into a single integral structure and supported at both ends for unequalled resistance to vibration and shock
- Heater built inside expanding member for maximum efficiency and protection
- Rolling contact action for positive operation
- Easy adjustability where desired
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- Unequalled for ruggedness and precision

U. S. and Foreign Patents Pending



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Write for bulletin and help with your particular problems.

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Greatly expanded production facilities assure prompt deliveries.

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

Accelerometer

Highly Sensitive and Stable



Model 602A Accelerometers are engineered to meet the requirements of jet aircraft and missile applications. They are extremely sensitive to linear movement applied along the sensitive axis, and feature

an air-damped spring-mass system which travels on precision bearings, thereby eliminating, for all practical purposes, side acceleration effects.

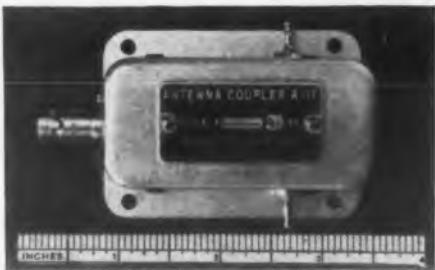
Stable damping characteristics from -65° to $+200^{\circ}$ F are maintained by the use of a unique damping orifice. To meet individual customer ranges and specifications, the damping ratio can be adjusted to any value between 0.1 and 1.0 critical, within a tolerance of ± 0.05 critical. The operating mechanism is pressure-sealed within an anodized aluminum case and meets Government specs covering protection against salt spray, humidity, and fungus.

Performance characteristics include resolution of 0.25% to 0.45% for resistances from 5000 ohms to 1000 ohms. Linearity is ± 0.5 to $\pm 1.0\%$. Life expectancy is 1,000,000 cycles. The accelerometer is recommended for use where total ranges are less than 20G. Weight is 8 oz, and size is 1-1/4" diam x 4-1/8" long. Power rating is 1/2w at 160°F. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

Airborne Antenna Coupler

Weights Less Than 0.1 lb



The A-17 Antenna Coupler is designed to couple an airborne dipole antenna into a 52-ohm coaxial cable over a band of 108Mc to 125Mc. The

weight of the coupling unit is under 0.1 lb.

The dipole antenna usually consists of two rods in the shape of a "V" fastened on the inside of the canopy of jet aircraft. Due to the height of the plastic canopy above the surrounding metal of the fuselage, the resulting 'submerged' antenna is entirely satisfactory. Placing the omnicalizer antenna inside the canopy helps to further streamline the plane. Aircraft Radio Corp., Dept. ED, Boonton, N. J.

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

TRANSISTOR & DIGITAL COMPUTER TECHNIQUES

*applied to the design, development
and application of*

AUTOMATIC RADAR
DATA PROCESSING,
TRANSMISSION AND
CORRELATION IN LARGE
GROUND NETWORKS

ENGINEERS & PHYSICISTS

*Digital computers
similar to the successful
Hughes airborne fire control
computers are being applied by the
Ground Systems Department to
the information processing
and computing functions of
large ground radar weapons
control systems.*

The application of digital and transistor techniques to the problems of large ground radar networks has created new positions at all levels in the Ground Systems Department. Engineers and physicists with experience in the fields listed, or with exceptional ability, are invited to consider joining us.

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CIRCLE ED-149 ON READER-SERVICE CARD

Vertical Attenuator Permits 10 Mixers on 19" Panel



This low-cost vertical attenuator covers the audio range. It has straight-line, fingertip operation, accomplished without any guide rods, through the use of a new linkage system that completely eliminates any backlash or stickiness, minimizing wear and

extending the life of the unit. It is possible to tie a number of units together for simultaneous operation, with narrow construction permitting use of as many as 10 mixers on one 19" panel.

Both plug-in and fixed-panel designs are available. Standard units are furnished in two sizes of 30 and 20 steps. The 30-step units are at 1.5db, and 20-step units at 2db. Ladder "T" or potentiometer circuits are standard, with impedance values for ladders ranging from 30 ohms to 600 ohms, and 250,000 ohms for potentiometers. Additional features include a completely shielded and dust-proof construction and new floating switch blades with better adjustment of spring tension. Tech Laboratories, Inc., Dept. ED, 50 E. Edsall, Palisades Park, N. J.

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

Metal Panel Enclosures In 15 NEMA "12" Sizes



Fifteen standard sizes of NEMA "12" sheet metal panel enclosures (16" x 12" x 6" to 60" x 36" x 8") are available from this firm to supplement its line of oil-tight "JC" electrical pull boxes and troughs. These enclosures are constructed to be completely liquid tight. All seams are welded, and there are no

holes. The cover is gasketed with neoprene sponge.

The enclosures have external mounting feet. The cover is hinged on one side with a continuous type hinge; it is fastened to the box by means of external clamps. A print holder is provided on the inside of the cover. There is a removable mounting panel for mounting electrical equipment. The interior is finished with a baked white enamel and the outside with a prime coat. Hoffman Engineering Corp., Dept. ED, Anoka, Minn.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

Pacific rate gyros



... advanced wheel design
gives **higher natural frequency**
over any rate range!

Now in production, an entirely new concept in wheel design provides Pacific Rate Gyros with unusually accurate and dependable performance. Combined with a special precision potentiometer, this advanced design Rate Gyro gives greater resolution and shock resistance...lower power consumption...light weight...and a higher natural frequency with any rate range!

A wide variety of Pacific Rate Gyros are built for any application. Production models from sub-miniature designs for use in stabilization or damper systems, to gyros for precision computer applications. Special models can be custom designed to your own specifications by Pacific's large staff of experienced gyro engineers.

For any Rate Gyro, Pacific's creative designs, complete manufacturing facilities and experience are backed by fully approved quality control. You're assured precision performance and rugged dependability in every unit.

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CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

EXPANDED SCALE, THREE BANDWIDTHS ENABLE FASTER, MORE ACCURATE VSWR MEASUREMENTS



Speed up production of microwave components through faster, more accurate reading of low VSWR. An expanded meter scale is provided on the PRD Type 277 Standing Wave Indicator for readings up to 1.3. Choice of not one, nor two, but *three* bandwidths allows greater flexibility in the choice of modulation. The narrow and broad band positions are useful when the modulator is less stable or accurate and for convenience in making preliminary adjustments in the test setup. The very narrow bandwidth, on the other hand, permits operation with minimum noise and interference. These features, coupled with high gain and wide range of input levels, make this instrument extremely versatile. Only \$235.00 f.o.b. New York. Write for complete new catalog of precision microwave and VHF-UHF test instruments and components.

S P E C I F I C A T I O N S

	Very Narrow Band	Narrow Band	Broadband
Center Frequency (cps)	1000 \pm 2%	1000 \pm 2%	350-2500
Bandwidth (cps)	15	50	
Sensitivity for Full Scale Deflection (μ v)	0.3	1	4
Noise Level (μ v)	0.03	0.06	0.4
Range of Input Level (db)	70	70	70
	Db	0 to 10	
Meter Scales	Expanded	VSWR 1.0 to 1.3	
	Normal No. 1	VSWR 1.0 to 4.0, 10 to 40, etc.	
	Normal No. 2	VSWR 3.2 to 10.0, 32 to 100, etc.	
Input Selection	(1) Crystal; (2) Bolometer, 4.5 ma bias; (3) Bolometer, 8.75 ma bias; (4) 75,000 ohm impedance.		

Polytechnic

RESEARCH & DEVELOPMENT CO. INC

202 TILLARY ST.
BROOKLYN 1, N.Y.
Telephone
ULster 2-6800



Midwest Sales Office:
1 SO. NORTHWEST HWY., PARK RIDGE, ILL. — TAicot 3-3174
Western Sales Office:
741½ NO. SEWARD ST., HOLLYWOOD 38, CAL. — HO 5-5287

CIRCLE ED-155 ON READER-SERVICE CARD

Instrument Receptacles

Seal Against Temperature, Humidity

These sealed instrument receptacles are designed for use on delicate precision instruments where the greatest reliability is required. They will perform all functions of Army-Navy 3102A, 3102C, E, F, L, and M receptacles and will mate with standard Army-Navy 3106 and 3108 plugs. They meet all requirements of Specification MIL-C-5015B.

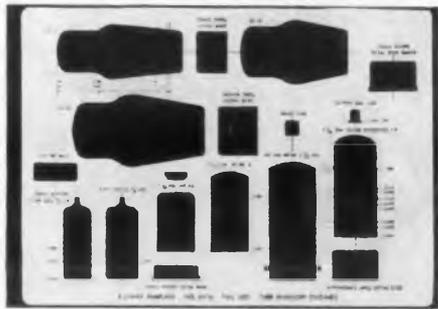
Simple in design and easy to assemble, the receptacles have only two pieces, an aluminum shell and a neoprene or silicone rubber insert with permanently bonded pin or socket contacts. All materials are non-magnetic. A silicone rubber insert is available for temperatures up to 450°F. Rubber O-rings molded as a part of the flange both front and rear form automatic seals when the insert is mounted in the shell, making additional gasketing unnecessary. The sealing remains permanent over a wide temperature range and under high humidity conditions.

Pin or socket contacts are available. They are permanently bonded into the insert dielectric material. Contacts are turned from solid-bar copper-alloy stock, silver plated and gold flashed. Electronics Div., Whitney Blake Co., Dept. ED, New Haven 14, Conn.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

Drafting Templates

Tube Envelopes, Sockets



For electronic engineers, draftsmen, and designers, the No. 6116 Template contains cutouts of standard vacuum tube envelopes, and is useful in three-dimensional

layout problems. It is made of 0.030" rigid vinyl plastic.

Authentic standard dimensions are used throughout, with pencil tolerance allowed. Horizontal, vertical, and centerline indexes, plus nomenclature and sizes, are clearly shown.

Also available are two other templates. No. 6110 contains cutouts for top and bottom views of tube sockets, and No. 6120 contains cutouts of electrolytic capacitor twistlock bases and a rotary selector switch. E-Z-Way Templates, 2242 S. Colby Ave., Los Angeles 64, Calif.

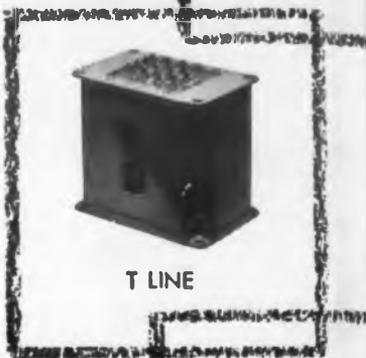
CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION



MINIATURE



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TRANSFORMERS**
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CIRCLE ED-156 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May

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-Corrosio
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SINGLE SPIDER GEAR DIFFERENTIALS

by FORD INSTRUMENT are

**7 ways
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AVAILABLE IN

four sizes: 1/8", 3/16", 1/4", and 5/16"
shaft diameters

FOR EARLY DELIVERY

Ford Instrument's single spider gear differentials are engineered to highest military and commercial standards... to provide *extreme accuracy* in addition and subtraction, and in servo loop applications.

- High sensitivity.
- Minimal lost motion.
- Precision Zerol gears.
- Corrosion- and wear-resistant materials throughout.
- Minimum working diameters for compactness.
- Minimum weights.
- Rugged, long-life design.

FREE a fully illustrated data bulletin gives performance curves and characteristics. Please address Dept. ED.



FORD INSTRUMENT COMPANY

Division of The Sperry Corporation
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Long Island City 1, N. Y.

Ford Instrument's standard lines



Rate Generators



Differentials



Servo Motors



Telesyn Resolvers

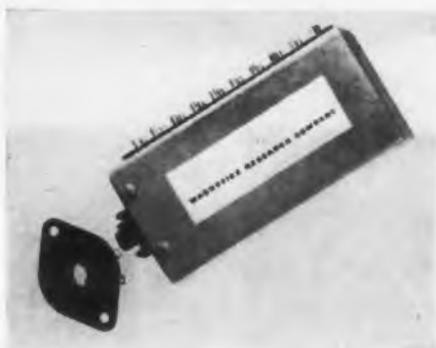


Integrators



Telesyn Synchros

Shift Registers With 19 Bit Capacities



Four Magnetic Shift Registers are being offered by this firm for radar, computer, and business machine system applications. Each package contains storage capacity for 10 bits and is

so designed that the output of one package provides the input for a second. The package is extremely compact, measuring 4" x 1-3/4" x 1-1/4". For ease of interchangeability, the units plug into standard octal sockets.

The four different models are offered to provide various combinations of serial or parallel read-in and read-out. At 100kc, four 10-bit units may be driven from a pair of 5881 receiver tubes. At 10kc, 10 units may be driven from a pair of miniature tubes. For customer convenience, a compatible timing and driving unit is also available.

Ruggedly constructed for military applications, the units have a life expectancy greatly in excess of 15,000 hours. Magnetics Research Co., Dept. ED, 142 King St., Chappaqua, N. Y.

CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Generator Features Accurate Control



The Model B-2A Pulse Generator is a general-purpose instrument giving repetition rates from 10cy to 100-ke, widths from 0.1μsec and delays from 0 to 10,000-μsec, with an output pulse of 40v

into 93 ohms. It is an improved version of this company's previous unit.

An input trigger circuit has been added to permit the selection of external triggering levels and operation from slowly rising trigger wave forms. The cooling fan has been relocated on the rear of the cabinet, increasing the area of the dust filter by a factor of five times, giving vastly improved cooling. The output circuit has been changed to eliminate starting and switching transients. Rutherford Electronics Co., Dept. ED, 3707 S. Robertson Blvd., Culver City, Calif.

CIRCLE ED-159 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-157 ON READER-SERVICE CARD

precision instruments by DeJUR

SERIES BC-200-E
(Extended Terminal Board)



BC-200
(Typical Cross-Section)

Linear and non-linear function Ball Bearing Potentiometers

- External phasing
- Starting torque: 0.5 oz. in. max.
- Backlash: 0.05° max.
- Logarithmic, sine-cosine and other functions
- Multiple, adjustable taps
- Unitized design for universal coupling
- Precision machined aluminum housing
- Servo or single hole mounting

Our engineering department can supply prototypes quickly to meet unusual design specifications for tests and approval. Write for complete technical literature. No obligation.

DeJUR

Electronic Sales Division

DeJUR-Amsco Corporation
45-01 Northern Blvd., Long Island City 1, N. Y.

- Fully enclosed precision ganging types
- Standard and power types
- High resolution precision types

"You're always sure with DeJUR potentiometers"

CIRCLE ED-160 ON READER-SERVICE CARD FOR MORE INFORMATION

RMC
5000RMC
3900RMC
1500

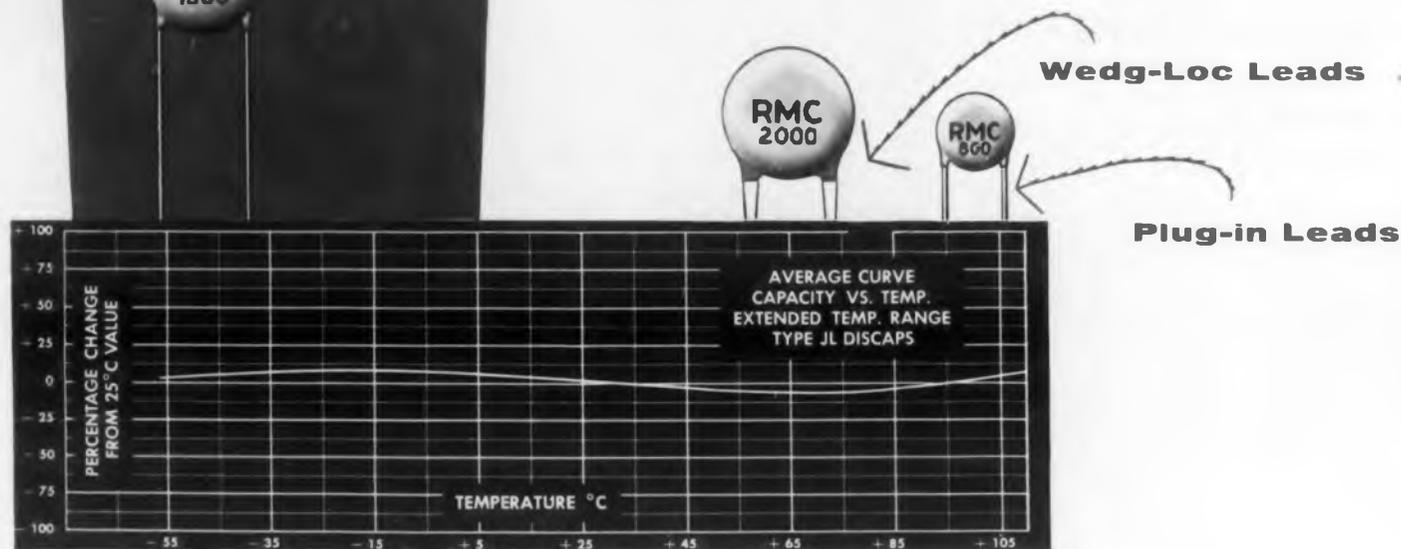
MAXIMUM EFFECTIVENESS AT LOWEST COST...

RMC Type JL DISCAPS

RMC Type JL DISCAPS provide ideal performance over an extended temperature range. The maximum capacity change between -60° and $+110^{\circ}$ C is only $\pm 7.5\%$ of capacity at 25° C. Lower initial cost, smaller size, and greater mechanical strength combine to effect worthwhile economies in production line operations.

In addition to standard leads, Type JL DISCAPS, as well as temperature compensating and by-pass types, are available with RMC's exclusive "Wedg-Loc" leads or plug in leads for printed circuit applications.

If you have a capacitor problem RMC engineers are prepared to work with you. Your inquiry is invited.



POWER FACTOR: 1% max. ($\text{at } 1 \text{ K C (initial)}$)
POWER FACTOR: 2.5% max. ($\text{at } 1 \text{ K C, after humidity}$)
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)

INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
CAPACITY TOLERANCE: $\pm 10\%$ $\pm 20\%$ at 25° C

DISCAP
CERAMIC
CAPACITORS

RMC

RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

CIRCLE ED-161 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Pressure Gage With Size, Weight Reduced 75%



The Model D-400 "Dynagage" measures static and dynamic pressure and displacement under the most adverse temperature and vibrations. The new model with integral power supply, retains all the

features of the original "Dynagage", with size and weight reduced over 75%.

Housed in a rigid aluminum casting, the unit may be used with a complete new series of pressure pickups for measuring pressures up to 75,000psi. Features include: a stable output of $\pm 15\text{v}$ into a high impedance load; frequency response from 0 to over 20,000 cycles per second; cable lengths up to 1000' for remote applications and simplified tuning controls. The unit is suitable for pressure studies in rocket and jet motors, aircraft and aircraft reciprocating engines, hydraulic systems, compressors, pumps, and explosive systems. Photo Research Products, Dept. ED, 421 N. Foothill Blvd., Pasadena 8, Calif.

CIRCLE ED-162 ON READER-SERVICE CARD FOR MORE INFORMATION

5" Oscilloscope Has Wide Range, High Sensitivity



The Model 7500 a 5" wide-range high-sensitivity oscilloscope, has been engineered for maximum dependability. The unit provides a frequency range from d-c to 2.5Mc, with band width switch in narrow position; and d-c to 5Mc, with band width switch in wide position.

horizontal amplifier is d-c to 500ke, 3db down. The sweep circuit oscillator is 2cy to 30ke. Fixed sweep frequencies are 30cy and 7875cy.

Vertical amplifier input impedance is 2.2 megohms, 50 μmf and the horizontal amplifier is 2.2 megohms, 50 μmf . Vertical amplifier deflection sensitivity is 0.010v/in rms (narrow position) and 0.035v/in rms (wide position). The horizontal amplifier is 0.075v/in rms. Hickok Electrical Instrument Co., Dept. ED, 10525 Dupont Ave., Cleveland 8, Ohio.

CIRCLE ED-163 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

For 28v Aircraft Equipment



Model KM88 Aircraft Battery Eliminator is for testing and operating aircraft electrical and communication equipment. It operates on 115v a-c 60cy single phase and

provides a continuously variable output from 0 to 28v d-c. The maximum continuous load current rating is 20amp. Overload capacity is 400% for 1/2 minute and 200% for 2 minutes. Ripple does not exceed 1% at maximum ratings.

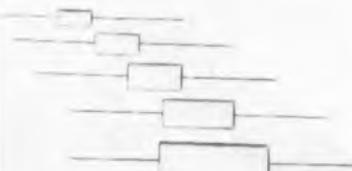
Large 4" panel meters indicate output voltage and current, and an ammeter protection circuit automatically disconnects the instrument during periods of high inrush current. This feature permits starting of motors, converters, and other types of rotating machinery without injury to the ammeter.

All controls are on the front panel. The unit mounts in a standard 19" rack cabinet and occupies 15-1/4" of panel height. Opad Electric Co., Dept. ED, 69 Murray St., New York 7, N. Y.

CIRCLE ED-164 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

For High-Humidity Applications



Series 337 and 338 miniature flat "Mylar" polyester film dielectric capacitors are sealed in non-metallic cases and are de-

signed to meet MIL-G-91A moisture resistance requirements. They are recommended for high-humidity applications requiring reliable operation from -55° to +85°C, and up to +125°C when proper derating is applied.

The capacitors withstand a d-c voltage equal to 50% of the rated voltage for 1 minute at 25°C. They withstand a 250hr accelerated life test with 100% or rated voltage at 85°C and with 140% of the specified derated voltage at 125°C. Power factor is less than 1% at a frequency of 1000cy at 25°C.

Minimum insulation resistance is 50,000 megohms at 25°C, but need not exceed 150,000 megohms; at 85°C it is 1000 megohm-mfd minimum, but need not exceed 6000 megohms; at 125°C it is 50 megohm-mfd minimum, but need not exceed 300 megohms. Gudeman Co., Dept. ED, 340 W. Huron St., Chicago 10, Ill.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

marion
advancement
in instrument
design

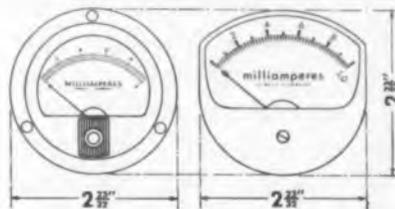
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MEDALIST*
meters



Model MM2 MEDALIST
Actual Size

Greater readability and modern styling in minimum space. Interchangeable with ASA/JAN 2 1/2 and 3 1/2 inch sizes. Up to 50% longer scale in same space as ordinary type. Available in various colors.

Comparison of Medalist and Standard Style



marion electrical instrument company

417 CANAL STREET, MANCHESTER, N. H., U. S. A.

Manufacturers of Ruggedized and "Regular" Panel Instruments & Related Products

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marion meters

CIRCLE ED-166 ON READER-SERVICE CARD FOR MORE INFORMATION



PRESSURIZE ELECTRONIC EQUIPMENT

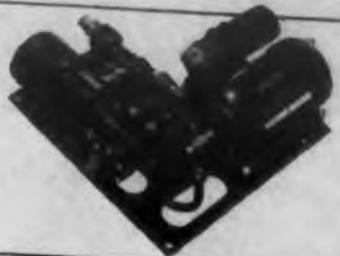
with **Eastern** UNITS

The extensive line of Eastern Pressurization Units for airborne electronic equipment accommodates a broad range of requirements, and meets appropriate government standards.

Units can be modified to meet your specific requirements. These modifications usually consist of: 1) Different compressors; 2) Motor change to meet your requirement; 3) Change in pressure switch settings; 4) Different mounting provisions. Eastern welcomes the opportunity to discuss and quote on your particular application problem.

MODEL E AP-100 TYPE 202

- Maintains a system pressure of 25 P.S.I.A. minimum.
- Motor is .03 H.P.—10,000 R.P.M., 208 V., 3 ph., 400 cy.
- Current draw is .7 amperes/phase maximum under normal operating conditions
- Unit operates continuously
- Weight is 4¾ lbs. maximum



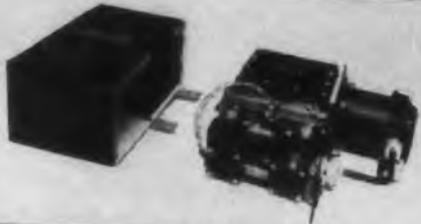
MODEL E AP-150 TYPE 205

- Operating pressure switch maintains a system pressure of 17 P.S.I.A.
- Motor is 1/25 H.P. 7,500 R.P.M., 27 volts D.C. — T.E.B.B.
- Current draw is 2.0 amperes maximum under normal operating conditions
- Life is 500 operating hours
- Weight is 8 lbs. maximum



MODEL E AP-1500 TYPE 203

- Operating pressure switch maintains a system pressure of 30 P.S.I.A.
- Motor is 1/15 H.P. nominal 24-28 volts D.C., 5,000 R.P.M., continuous duty, shunt wound
- Current draw is 3.4 amperes maximum under normal operating conditions
- Life is 500 operating hours
- Weight is 12 lbs. maximum



MODEL E AP-2400 TYPE 201B

- Maintains system pressure of 31 P.S.I.A.
- Motor is 1/10 H.P., 24-28 volts D.C., 5,000 R.P.M. continuous duty
- Current draw is 5.5 amperes maximum
- Life is 500 operating hours
- Weight is 10-3/4 lbs. maximum



MODEL E AP-3600 TYPE 200

- Maintains system pressure of 31 P.S.I.A.
- Motor is 1/7 H.P., 10,000 R.P.M. { 208 V., 400 cy., 3 ph. } continuous operation { 24-28 V.D.C. }
- Current draw is { 1.3 amp./phase } amperes { 7.1 on D.C. } maximum under normal operating conditions
- Life is 1,000 operating hours
- Weight is 8-1/2 lb. maximum



Eastern

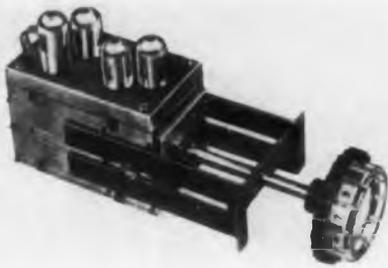


INDUSTRIES, INC.
100 SKIFF STREET
HAMDEN 14, CONN.

COMPLETE
AVIATION
CATALOG #330-P
ON REQUEST.

12-Channel Tuner

Takes Any Channels from 2 to 83



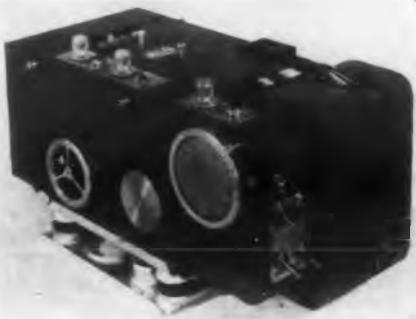
This tuner is a single unit no larger than the average v-h-f tuner and is operated without complicated drives or knobs. Channel segments (not converter strips) to suit local TV station requirements are snapped into the easily accessible turret and they may be arranged in any desired order. The segments consist of simple circuits which are factory tuned and need no further adjustment in the field. All channels, 2 to 83, are available at the same low price, and as many as 12 channels may be inserted.

One single conversion circuit is used throughout. Channel segments from 2 to 83 are all alike, except for values of inductance and capacity. Also new is the use of a 6AN4 r-f amplifier operating in both v-h-f and u-h-f. Better sensitivity, improved bandwidth control for black-and-white or color, and suppression of oscillator radiation are claimed for this circuit. Four tubes are used. Anchor Radio Corp., Dept. ED, 2215 S. St. Louis Ave., Chicago 23, Ill.

CIRCLE ED-168 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscillograph

A Rugged Flight-Test Instrument



The Model 581 Oscillograph has been designed to fill the need for an extremely small flight-test instrument where automatic features are needed. Dimensions have

been held to a minimum without affecting ability to obtain highly accurate recordings. It measures stresses, strains, vibrations, and other physical phenomena under extreme acceleration, shock, and temperature conditions.

Some of the features are: automatic record-numbering, automatic length-control (resettable by remote control), no-record warning, lamp burn-out indicators, full-width timing lines at 0.01sec and 0.1sec, trace identification, footage indicator, and a wide selection of paper speeds from 1/2ips to 44-3/4ips. The instrument's capacity of 14 separate channels of information on 3-5/8" paper also makes it usable as a small laboratory oscillograph. Midwestern Instruments, Dept. ED, 3401 S. Harvard, Tulsa, Okla.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

buy your COUNTER TUBES

from the world's
leading source
of supply



The type 1885 counter tube aluminum wall construction.



The type 1846 gamma counter, miniature glass tube.



The type 6530 counter tube aluminum wall 3-pin base.

Victoreen's research into cosmic ray phenomena, extends many years into the past — with the pioneer developments in X-ray instrumentation. Only naturally then should Victoreen become the leading source for geiger tubes. These tubes have been developed for every type of application from the extremely accurate laboratory units to the heavy duty, portable field type.

In every application where counter tubes are used, Victoreen has set the standard of performance. Send for Bulletin 3026.



Victoreen

Instrument Company

3811 Perkins Ave. • Cleveland 14, O.

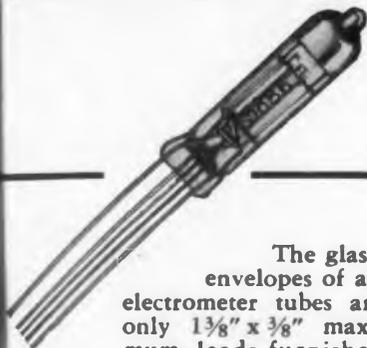
CIRCLE ED-170 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1954

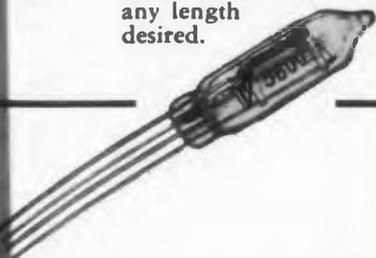
HOW SMALL ARE SUBMINIATURE ELECTROMETER TUBES

?

Victoreen engineers have pioneered subminiaturization by the process of reducing the physical size without affecting the performance. As a result the operating characteristics of Victoreen electrometer tubes exactly meet the requirements of the application with added assurance of long life.



The glass envelopes of all electrometer tubes are only $1\frac{3}{8}$ " x $\frac{3}{8}$ " maximum, leads furnished any length desired.



Victoreen has every facility for making diode, triode, tetrode, and pentode tubes to standards of operating performances that will inherently improve the performance of their application. In addition to exceptional quality, Victoreen offers engineering skill to assist in solving your problems and production facilities to meet your requirements. Send specifications of your needs.



For further information, write for catalog.

Victoreen
Instrument Company

3811 Perkins Ave. • Cleveland 14, O.

Relay

Gives Full Wiping of Contacts



Engineered for d-c applications, the 100-C Relay is available either hermetically sealed or with dust cover in contact combinations from spst to dpdt. It incorporates the unique feature of thorough wiping action yet with a sensitivity of 10mw. This wiping effect has the advantage of eliminating the bounce and chatter at normal operating voltage.

Coil resistance is up to 30,000 ohms and contact capacity up to 1 amp inductive and 3 amp resistive. Non-ferrous metals and hydrogen annealing of magnetic components eliminate the iron-aging and residual magnetism. Silver contacts are used; headers are available in any specification. The armature is securely locked without hinge pins.

Hermetic sealing is done exclusively by welding. Accessible spring-screw adjustment is provided for dust-cover type. Size standardized with other Diameter of the relay is $1\frac{1}{4}$ " x $3\frac{5}{8}$ " above mounting line. Hedin-Tele-Technical Corp., Dept. ED, 640 W. Mt. Pleasant Ave., Livingston, N. J.

Hermetic sealing is done exclusively by welding. Accessible spring-screw adjustment is provided for dust-cover type. Size standardized with other Diameter of the relay is $1\frac{1}{4}$ " x $3\frac{5}{8}$ " above mounting line. Hedin-Tele-Technical Corp., Dept. ED, 640 W. Mt. Pleasant Ave., Livingston, N. J.

CIRCLE ED-172 ON READER-SERVICE CARD FOR MORE INFORMATION

Bridge

Measures Resistance, Capacitance



This "R.C." low-cost, completely self-contained, portable resistance-capacitance bridge is designed to increase the speed and accuracy of making measurements on capacitors from 10mmfd to 50mmfd, and resistors from 10 ohms to 50 megohms. It can also be used for making

continuity measurements on circuits, coils, and transformers.

The bridge is constructed with 1% precision resistors and 2% precision capacitors and highest components throughout. It detects paper, mica, electrolytic, and air capacitor faults, including open and short circuits, high and low capacity, and high power factor. It has a simplified direct-reading scale, and the power factor of electrolytic capacitors is indicated by means of a visual eye detector tube. Deltron, Inc., Dept. ED, 2905 N. Leithgow St., Philadelphia, Pa.

CIRCLE ED-173 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-171 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1955

To Wind Coils of "INVISIBLE WIRE"

(or other minute
precision operations)



At the Hathaway Instrument Company, tiny galvanometer coils are wound with wire so fine that it is almost invisible to the unaided eye. Ingenious tooling and use of an AO Stereoscopic Microscope assure fast, precise workmanship.

These unique AO Microscopes provide two complete optical systems (one for each eye) to enhance the perception of depth and to provide three-dimensional reality plus an exceptionally wide field of view. Unlike ordinary microscopes, objects and movements are *not* inverted. Instead they appear in their natural directions. Because AO Stereoscopic Microscopes are unequalled for fabrication, assembly, inspection of minute precision parts, they are widely used in electronics, metal working, food and many other industries.

Let AO Stereoscopic Microscopes help you achieve high precision at low cost. Mail coupon below.

You NEED



Stereoscopic Microscopes

American Optical

 INSTRUMENT DIVISION
BUFFALO 15, NEW YORK

American Optical Company
Dept. Q 219
Instrument Division
Buffalo 15, New York

Gentlemen:

Please send me further information on AO Stereoscopic Microscopes.

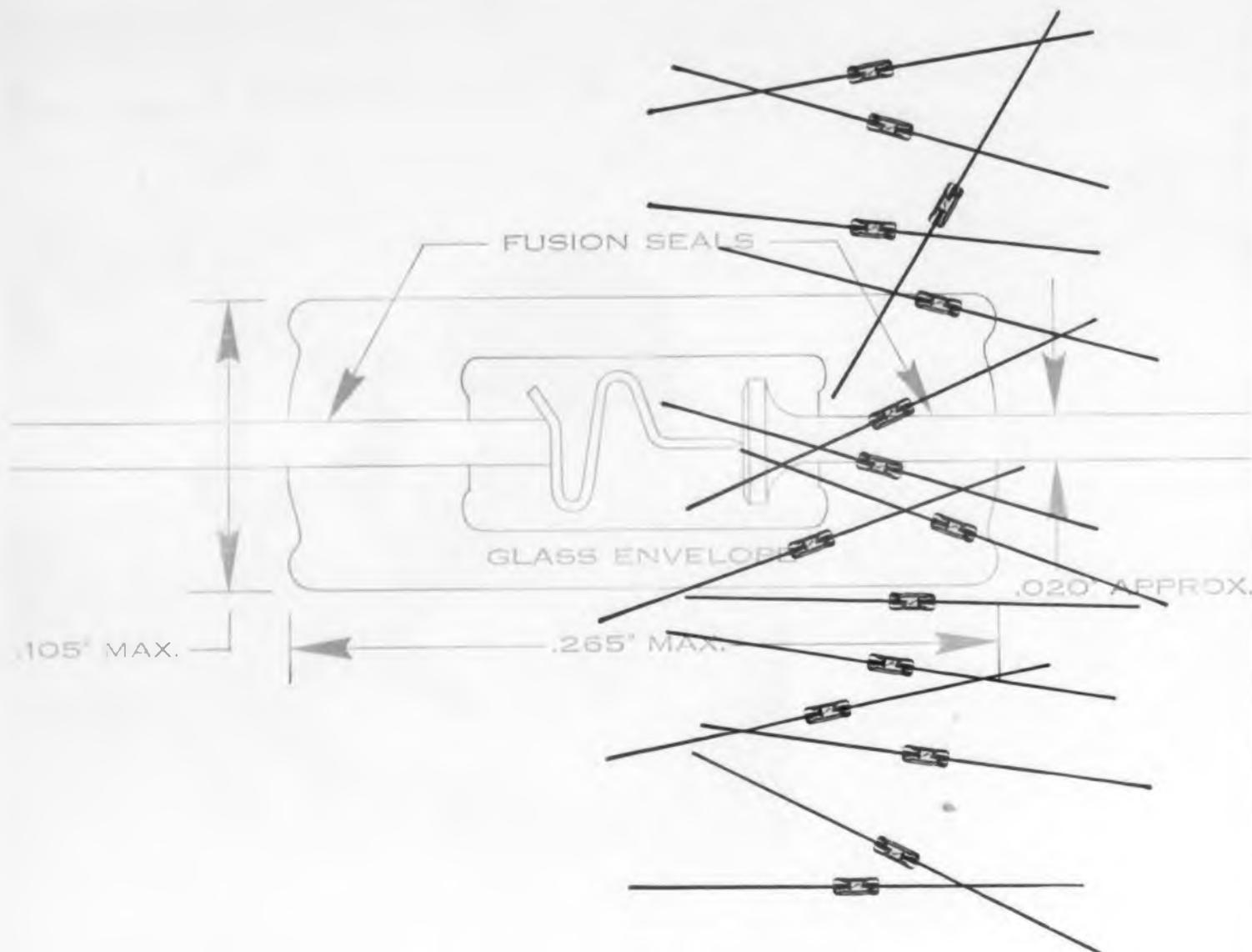
Signed

Organization

Address

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

CIRCLE ED-174 ON READER-SERVICE CARD FOR MORE INFORMATION



FIRST OF ALL FOR **RELIABILITY**

HUGHES SEMICONDUCTOR PRODUCTS

Why should you use Hughes semiconductors? First of all—for reliability. You can depend on these devices to stay within published ratings and specifications under varied and severe operating conditions.

All diodes made by Hughes are:

MOISTURE-PROOF—Fusion-sealed in a one-piece glass envelope. This construction eliminates a major cause of diode failure.

RUGGED—Small volume and mass enable them to withstand physical shock and vibration.

STABLE—Internal elements are isolated from damage or contamination. Mechanical and electrical characteristics remain stable throughout a long operating life.

THOROUGHLY TESTED—All diodes are tested for electrical and mechanical characteristics. They operate faithfully over wide ambient temperature ranges.

SUBMINIATURE—In miniaturized circuitry, the high component density possible with these diodes promotes greater volumetric efficiency.

For instance, Hughes subminiature diodes have now been used by many major manufacturers of electronic equipment. Without exception, available performance reports indicate that, in military and commercial installations alike, the Hughes components have maintained an extraordinary record of failure-free service. Today, these same diodes are continuing to add to the reputation for superior reliability synonymous with Hughes Semiconductor Products.

The Hughes line of semiconductor devices is being steadily expanded. It now comprises a wide selection of Germanium Point-Contact and Silicon Junction Diodes, and Photocells. New products, now under development, are being readied for commercial production. Watch for their release. They, too, will embody the same Hughes quality in design and manufacture that spell out unsurpassed stability and reliability. Specify Hughes—with confidence.

HUGHES

Aircraft Company, Culver City, California

SEMICONDUCTOR SALES DEPARTMENT



New York Syracuse
Philadelphia Chicago

*Maximum dimensions, standard germanium diode glass envelope: 0.265 inch by 0.105 inch.

CIRCLE ED-175 ON READER-SERVICE CARD FOR MORE INFORMATION

Sealed Panel Meters

1" Units for Electronics, Aircraft



A gasket and locknut are provided for sturdy, shock-proof mounting. Watertight qualities meet MIL-STD-883C specifications.

This sealed meter (the round unit in the illustration) can be ordered with white, black, or luminous markings on white or black scale background, and a choice of colors for the pointer. The round mounting flange measures 1-1/4". The square unit shown (Model 102) is available on special order. DeLamco Corp., Dept. ED, 45-01 Northern Blvd., Long Island City 1, N. Y.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

Ultrasonic Equipment

For Wide Ranges of Applications



Utilizing highly efficient low-frequency ultrasonic vibrations, Model DR-40C Ultrasonic Generating Equipment is primarily intended for cleaning and degreasing precision metal, glass, plastic products such as bearings, potentiometer lenses, printed circuit microwave components

and intricately machined pieces. The equipment descales heat-treated parts, accelerates the dyeing of fabrics, and has numerous other uses.

In operation, the glass detergent or solvent tank containing the parts to be cleaned is seated atop of a rugged magnetostriction-type transducer developing intense vibrations at an optimum cleaning frequency just beyond hearing range. Groups of these transducers energizing larger tanks can be driven by economical motor-generator sets for cleaning applications involving huge assemblies. Acoustic Associates, Inc., Dept. ED, 421 Seventh Ave., New York 1, N. Y.

CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

Solenoid

Small, Lightweight and Rugged

This solenoid is available in quantity for small equipment and components. Incorporating a new type positioning of a double winding coil for high seat-pull, it is a lightweight, powerful unit especially adapted to rugged duty.



The solenoid will operate in any position and is regularly furnished for both constant and intermittent duty. 115v 60cy a-c. Blade terminals are standard, with flexible leads optional. Dormeyer Industries, Dept. EDN, 3418 N. Milwaukee Ave., Chicago 41, Ill.

CIRCLE ED-178 ON READER-SERVICE CARD FOR MORE INFORMATION

Right-Angle Drive

Valuable for Ganging Applications

This right-angle drive, Model RAD, features unusually sturdy construction with a die cast zinc housing and gears. It is especially valuable for

ganging condensers, potentiometers, or other parts located in hard-to-reach locations on a chassis. Total length, including shaft, is 4-1/2". The shaft is standard 1/4" diam. Action is smooth and free from backlash. The National Co., Dept. ED, 61 Sherman St., Malden 48, Mass.

CIRCLE ED-179 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrical Tachometers

In Single and Multi-Range Units

A redesigned circuit is now put in all of this firm's single-range and triple-range tachometers. Under normal conditions, this new circuit lengthens the life of the

tachometers about five times. It is linear, making it a reliable easy-to-read single and multiple range indicator. The indicators can be calibrated in any units of time. Metron Instrument Co., Dept. ED, 432 Lincoln St., Denver 3, Colo.



Selenium Rectifiers

The WIDEST RANGE in the INDUSTRY



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industrial power rectifiers



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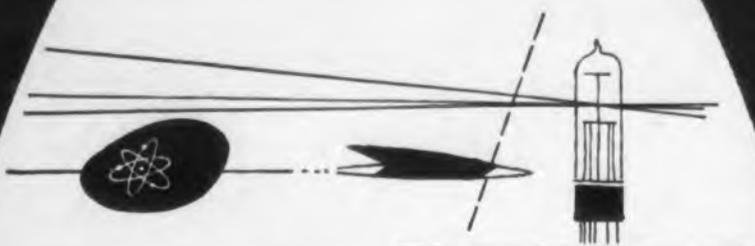
NEW YORK: 501 MADISON AVENUE • PLaza 3-4942

CHICAGO: 205 W. WACKER DR. • FRANKLIN 2-3889

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CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

INFORMATION ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION



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Westinghouse is a CAREER!

Long-range expansion programs in two Westinghouse divisions have created excellent ground-floor openings in *career* positions.

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World-leader in the field of aviation - electronics. Work involves computer, autopilot, radar and other advanced projects.

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BALTIMORE DIVISIONS

Ceramic Capacitors

For Color TV



The "Cart-wheel" heavy-duty ribbed-case Ceramic Capacitor has been made available to meet the higher operating voltages of color TV receivers. Of particular interest in

high-voltage applications is a special ribbed construction which provides extra-long "creepage path" in a relatively small size.

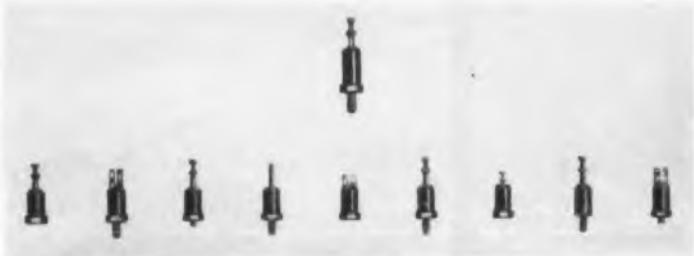
Rated at a working voltage of 30v d-c, or a test voltage of 50kv d-c for 1 minute, the unit is encased in a cast insulating material, completely permanently sealed in one operation. The potting compound provides an insulation resistance greater than 50,000 megohms. Power factor is 1.5" max at 1000cy.

Units withstand 37.5kv after exposure to 200 hours of 90-95% relative humidity at 40°C. Standard capacitance is 500mmfd, with tolerance of +50% minus zero. Hi-Q Division, Aerovox Corp., Dept. ED, Olean, N. Y.

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Terminals

Stand-Offs for H-F Use



These miniature and subminiature insulated stand-off terminals for high-frequency applications and miniaturized equipment are supplied with taper pin connectors to accommodate "Amp" taper pins for solderless connections. These taper pins are also available on "Garde" feed-thru terminals, headers, connectors, terminal boards, and other components.

The terminals are manufactured in a wide variety of styles and insulating materials, plated to suit the application. Body materials are designed to meet requirements of MIL-P-14D. Terminals are plated in tin zinc, silver plate, gold plate, gold flash, palladium, and other materials. The studs in all insulated stand-off terminals are cadmium plated to QQ-P-416 specifications. Garde Manufacturing Co., Dept. ED, 588 Eddy St., Providence 3, R. I.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION



American Electric Model 430 AIRCRAFT DRIVE MOTOR COMPLETELY QUALIFIED TO MIL M 7969 SPECS.

1/2 H.P. 11,000 R.P.M. Teflon construction; Operates from -65° F. to +160° F. Totally enclosed; explosion-proof, oil-proof. Resists shock, vibration, salt spray, fungus and humidity. Flange and shaft details, per AND 10457 type II permit easy adaptation to a multitude of uses. Rotates clockwise, counter-clockwise or both. Basic dimensions: Length 3". Bell Cap O.D. 3.214", Housing O.D. 2.500" — Operates on 115/220 V. 3 phase 400 cycle.

Many Other Models Fully Developed

American Electric Miniatures are available for operation on 60, 400, 1600, 2000 c.p.s. or on variable frequency from 320 to 1200 c.p.s.

TWO TYPES:

INDUCTION — Output torque range from in. oz. to 120 in. oz.

SYNCHRONOUS (Hysteresis or Reluctance Models) Output torque range from .01 in. oz. to 16 in. oz.

Ask for quotations on special requirements



MODEL 182DA AXIAL FAN MOTOR — Totally enclosed, panel mount, screened intake, high temp. operation, 20 CFM N.A.F.M. at free air. O.D. 1.45", 115 V., single phase, 400 cycle, or variable frequency models.



MODEL 323 HIGH TORQUE DRIVE MOTOR — 1/2 h.p. 11,200 r.p.m. 400 cycle phase 200 V. Teflon plated, -65° F. to +160° operation.



MODEL 313 COMBINATION DRIVE & BLOWER — 1/2 h.p. at 7200 r.p.m. 400 Cycle, 3 phase, 200 V. Continuous duty. Meets all general MIL specs.



MODEL 2010 HYSTERESIS SYNCHRONOUS MOTOR — Reference Timing 12,000 r.p.m., 50 gm. cm. torque. Fully geared shaft extension.

FIELD ENGINEERING OFFICES:

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American Electric Motors, Inc.
Miniature Components Division



4811 Telegraph Road, Los Angeles 22, California

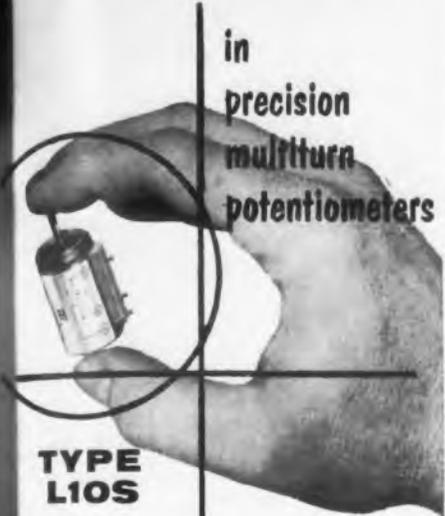
CIRCLE ED-187 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1964

NOW

MINIATURIZATION plus PERFORMANCE

in
precision
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TYPE
L10S

NEW

ULTRA-LINEAR
RUGGED
HIGH TEMPERATURE

TIC, a leader in precision potentiometers, again sets the standard. New L10S provides miniaturization for compact assemblies . . . without sacrificing performance.

Designed to meet stringent military specifications — tested to MIL-E-272A. Manufactured to extremely close mechanical tolerances — precision pilot . . . centerless ground shaft . . . precision ball bearings. Made for high electrical accuracy. Type L10S provides rugged construction . . . light weight . . . low torque . . . inherent stability . . . and high resolution.

Wide temperature and resistance ranges of miniature L10S provide greater versatility. Extend its application in servo systems . . . computers . . . control . . . telemetering . . . and measurement systems. Check the L10S features. Then write for free brochure.

CHECK THESE FEATURES

LINEARITY:
±0.05% standard;
±0.025% special.

TEMPERATURE
RANGE:
-55 C to +130°C.

RESISTANCE RANGE:
1000 ohms to
100,000 ohms.

WEIGHT:
1 ounce.

TORQUE:
Starting .75 in. oz.
Running .60 in. oz.

TECHNOLOGY INSTRUMENT CORP.

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P.O. Box 3941, North Hollywood, Calif.

CIRCLE ED-188 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1955

Logic Building Blocks

For Digital Systems



A basic building block for doing complicated switching operations at speeds up to 200kc, the "Logiblock" contains four cores, three diodes, and a buffer amplifier tube.

A maximum of eight input signals can be accepted and combined to give output signals in accordance with the built-in logic.

The "Logiblock" is split into two output sections. One output occurs when there is coincidence between two pairs of input signals (Or-And). The other output occurs in accordance with the presence of either of two input signals (Or-Inhibit). Provision is made for mixing the two outputs at the option of the user.

Each output is capable of providing inputs to four other "Logiblocks". In this way very complicated switching operations can be performed. The units are ruggedly packaged, have low power drain, and the inherent reliability and life associated with magnetic core switching devices. Magnetics Research Co., Dept. ED, 142 King St., Chappaqua, N. Y.

CIRCLE ED-189 ON READER-SERVICE CARD FOR MORE INFORMATION

Plugs and Jacks

One-Half Former Size



To meet the demand of small-size radios, tape recorders, and musical instruments, this firm has made available miniature

plugs and jacks, approximately one-half the size of the former standard. The illustration indicates comparative size. The new items are called "Tini-Plugs" and "Tini-Jax".

The plugs feature high-grade insulation throughout; a one-piece tip rod staked into the tip terminal to insure tightness; terminals and body which interlock, eliminating any shifting; black and red Tenite, shielded handles. The jacks feature notched insulating washers which mechanically interlock the springs and solder lugs, eliminating the probability of shifting resulting in "electrical shorts" or change in adjustment; a contact area (of the tip spring) which firmly holds the mating plug; and springs of special alloy of nickel silver produced in special dies, for maximum spring life. Switchcraft, Inc., Dept. ED, 1328 N. Halstead St., Chicago 22, Ill.

CIRCLE ED-190 ON READER-SERVICE CARD FOR MORE INFORMATION



“powder to part”

Quality Controlled Fluorocarbon Plastics

U.S.G. quality control extends through every operation in the fabrication and custom molding of parts from duPont TEFLON, Kellogg KEL-F and BAKELITE fluoroethene.

This quality control insures uniform electrical, chemical and physical characteristics of the highest quality. It also assures uniform density and dimensional stability permitting superior accuracy and dependability in the finished part.

Get the advantages of these fluorocarbon plastics at their best. Whether your requirements are for sheets, rods, tubing, tape, bars, cylinders, beading, electrical spaghetti, or parts extruded, molded or machined to your specifications . . . see U.S.G.

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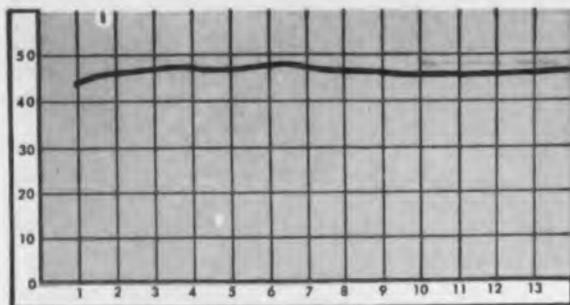
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Camden 1, New Jersey

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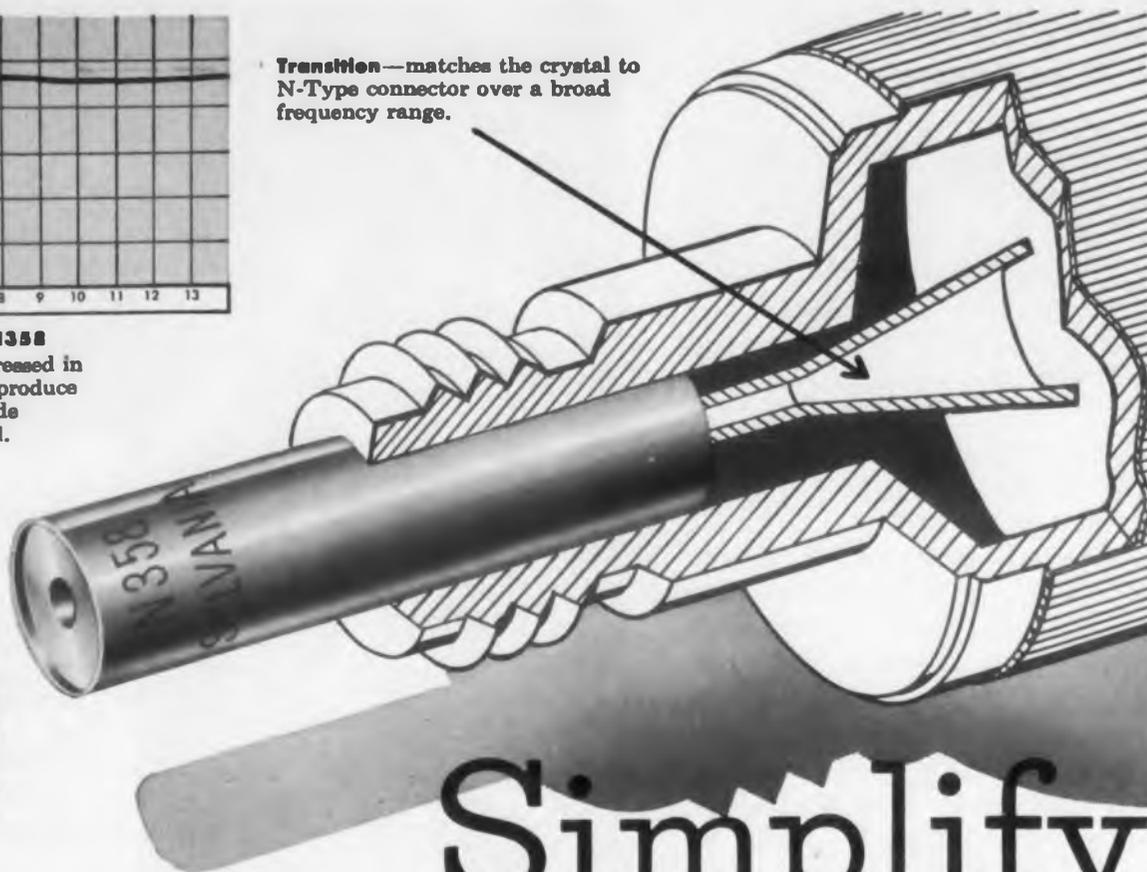
Representatives in principal
cities throughout the world





Tangential Sensitivity of IN358
The input signal level, expressed in db below 1mw required to produce an output pulse of amplitude tangential to the noise level.

Transition—matches the crystal to N-Type connector over a broad frequency range.



Simplify front-end design over a BROADBAND microwave frequency range

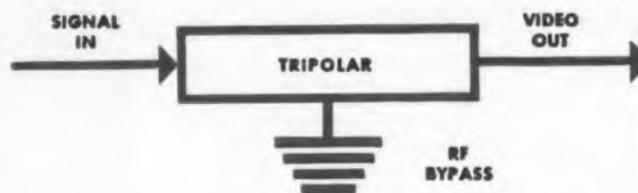
NEW TRIPOLAR CRYSTAL DIODE offers these five advantages

- Simpler, broadband crystal mount
- No extra plumbing is required
- Signal goes in one end— is taken off the other
- Built-in rf bypass capacitor
- Available with or without built-in dc return

By matching the inherent broadband characteristics of coaxial cable, the Tripolar crystal diode introduces an entirely new concept in broadband microwave circuitry and opens a fresh, simplified approach to front-end design.

The IN358 video detector is the first of these new broadband crystal diodes. In a simple holder, it covers the frequency range from 1 to over 12 kmc. The IN358 is connected in series with standard coaxial cable between the signal source and amplifier.

Other broadband video types are available now and broadband mixer types will be ready soon.



SPECIFICATIONS

Frequency Range:..... 1,000—12,400 Mc
Figure of Merit: (1)..... 10 min. at 6750 ± 10 Mc
Tangential Sensitivity:—40 DBM over frequency range @ 25°C
Video Resistance:..... 450 ohms—18000 ohms @ 25°C
Ambient Temperature:..... —40—70°C
Note 1. Measured in untuned broadband holder

ANOTHER REASON WHY IT PAYS TO SPECIFY SYLVANIA

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
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CIRCLE ED-192 ON READER-SERVICE CARD FOR MORE INFORMATION

Subcarrier Discriminator For Telemetry and Recording



The Model 67 Precision Subcarrier Discriminator is for use in f-m telemetry and data recording systems. The discriminator contains its bandpass input filter, frequency determining network, and interchangeable output filter in a single front-panel plug-in unit. Three outputs are provided, one of which will drive most pen motors to full deflection. Each discriminator contains its own electronically regulated power supply.

The unit provides ±0.1% linearity, slope constant to ±0.25%, and zero drift of ±0.5% of full bandwidth in a 15 hour period. Wide-range base-line limiting of the subcarrier eliminates amplitude modulation effects and reduces to a minimum the effect of step function changes normally encountered in magnetic-tape drop outs.

This discriminator provides constant time delay of intelligence through a subcarrier channel, permitting reduction of recorded or transmitted multiple data, occurring at maximum intelligence frequencies with errors of less than 1% of bandwidth. As intelligence approaches d-c, error is reduced to 0.1% of bandwidth. Complete compensation for speed change error in tape-recorded data can be provided. Electro-Mechanical Research, Inc., Dept. ED, Ridgefield, Conn.

CIRCLE ED-193 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Cam Assembly For Adjustable Timing



The Type P1 precision cam assembly is designed to be used where a physical displacement or any microswitch or similar actuating device is required. The

stainless-steel cams can be rotated with respect to each other and locked at any desired timing position. The assembly's stainless-steel shaft adapters are designed for three basic shaft sizes: 1/8", 3/16", and 1/4"; they have setscrews for holding and sub-holes for fixed pinning as desired. PIC Design Co., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE ED-194 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1957

Trouble Free VACUUM CAPACITORS

A
COMPLETE
LINE



32 KV
RATING
2 7/8" O.D.
6 1/2" L.

ALSO

Special Engineering TO HELP SOLVE YOUR PROBLEMS

COMPACT AND RUGGED — for heavy duty application in transmitters, communications services, aviation radio, induction and dielectric heating, industrial oscillators, diathermy and amateur radio.

FOR HARD OPERATION UNDER LOAD Large copper-to-glass seals, specially processed copper cylinders, maximum spacing, high temperature braze of low vapor pressure for "hard" operation under load.

HIGHER PERMISSIBLE TEMPERATURES WITH PYREX GLASS—better vacuum "bake," bell-shaped bulb for maximum external voltage breakdown.

**NO R.F. PICK-UP
ALL OFHC COPPER**
—non-magnetic, low coefficient of expansion, high thermal and electrical conductivity, high "Q"

20 KV RATING
2 3/4" O.D.
4 1/2" L.

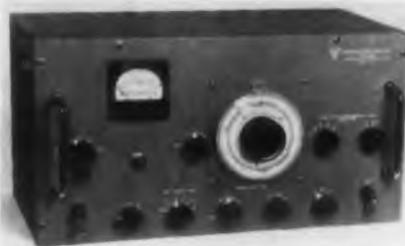
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AND PRICES



Dolinko & Wilkens, Inc.
1901-7 Summit Ave. Union City, N. J.

Phase Detector

Accuracy of 0.1° from 10kc to 15Mc



This instrument will measure time delay, phase delay, or envelope delay with error less than 1% or 0.1° between two alternating voltages from 10kc up to

15Mc. Known as Type 205a Precision Phase Detector, it consists of two input amplifiers, a continuously variable delay line, a step variable delay line, a differential tuned amplifier, a balanced phase detector, and a sensitive output indicator.

Applications include measuring phase characteristics of video amplifiers and envelope delay of television networks. Because constant time delay for all frequency components is important for faithful reproduction of TV pictures or pulse waveforms, the unit is valuable for measuring performance characteristics of TV and pulse equipments.

The smallest time delay that can be read on the dial is 5×10^{-10} sec; the smallest phase angle in degrees that can be read is equal to $5 \times 10^{-10} \times 360 \times$ frequency in cycles. The time delay of the step variable delay line is $5 \mu\text{sec}$ in steps of $0.05 \mu\text{sec}$. Three plug-in units of continuously variable delay lines are supplied with the instrument, 0 to $0.4 \mu\text{sec}$, 0 to $0.25 \mu\text{sec}$, and 0 to $0.05 \mu\text{sec}$. Indicator sensitivity is approximately 0.01v full scale maximum without probe, and 0.1v with probe. Two low-capacity probes are supplied. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-196 ON READER-SERVICE CARD FOR MORE INFORMATION

Data Recorder

For Ground and Airborne Applications



The R-1021-D Recorder is a 210-channel fixed-stylus recorder, writing on a 5" width electrosensitive chart. It is a light, compact unit, designed for use on airborne as well as ground applications. It operates

from either 115v, 400cy or 60cy power. A direct-writing unit adaptable to analog, digital, or sequential data recording, it is a ruggedized package whose accuracy is unaffected by temperature, humidity, or vibration. Radiation, Inc., Dept. ED, Melbourne, Fla.

CIRCLE ED-197 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-195 ON READER-SERVICE CARD

ELECTRONIC DESIGN • May 1955

extruded TEMPREX teflon* HOOK-UP WIRE

*for
reliability*



Temprex Extruded Striped Teflon Wire



Temprex Extruded Teflon Wire-Shielded (Metal)



Temprex Extruded Teflon Wire-Fiberglass Braid, Teflon Saturated



50-70-90 Ohm Coaxial Cable also available

● Insulated with a smooth sheath of extruded Teflon, Hitemp's new TEMPREX hook-up wire is unaffected by commercial solvents, temperatures from -90° to $+260^{\circ}\text{C}$ (Class H or better), fungus growth, moisture, or weathering. Retains its excellent electrical properties over a wide range of frequencies, conforms to MIL-W-16878A (Navy) E and EE constructions, and to MIL Standard 104.

Furnished in 14 solid colors extruded over silver-plated, stranded copper wire, or a solid conductor. Sizes 26—10 AWG in production lengths. Delivery within 10—14 days . . .

Write for complete engineering information and price list.



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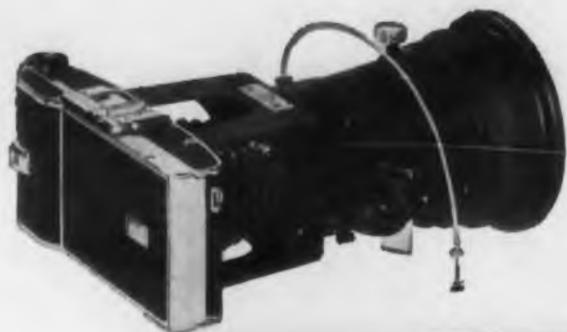
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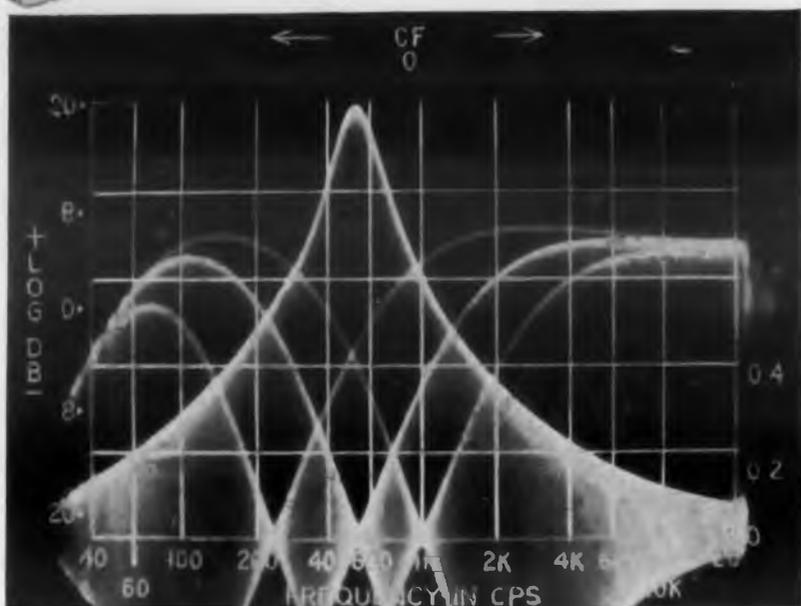
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TEMPCLAD TEFLON FIBERGLAS LEAD WIRE
RETEP TEFLON SATURATED GLASS BRAID
LEAD WIRE
NEBROC TEFLON-FIBERGLAS LACING CORD
TEMPTUBE TEFLON FIBERGLAS TUBING

*Du Pont's Trade Name for Polytetrafluoroethylene

CIRCLE ED-198 ON READER-SERVICE CARD FOR MORE INFORMATION



*in
sixty
seconds...*



Performance evaluation of a Fischer electronic (low frequency—high frequency) filter; wave forms signify the following: Variable null marker to check points on response curve at 1 Kc, 2.2 Kc and 5.5 Kc. This is a log amplitude presentation where the frequency is multiplied by a factor of 10. Instrument used is SGI Sweep Generator; courtesy Panoramic Radio Products Corporation.

a full-size photo of any scope pattern for evaluation of transient phenomena!

This special Fairchild adaptation of the Polaroid-Land principle delivers a permanent, photographically accurate, full-size record of single transients or identical repetitive phenomena in 60 seconds after they appear on the C-R Tube. It is the only practical method to obtain a quick, permanent record of scope patterns like the one above. Because this photographic method is so fast, laboratory work can proceed continuously without interruptions or delays so usual where conventional film is used. The life size $3\frac{3}{4} \times 4\frac{1}{4}$ in. image makes evaluation easy and accurate. Camera is automatically in focus when attached to the oscilloscope. Also provides for critical focusing adjustment where thick grids or filters are interposed between the tube face and camera hood.

For accurate records of continuously varying phenomena or single transients and stationary patterns on 35 mm. film, the Fairchild Oscillo-Record Camera is available. For more information, write Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Expressway, Jamaica, New York, Department 120-23N.

FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

CIRCLE ED-199 ON READER-SERVICE CARD FOR MORE INFORMATION

Internal Timers For Automation Uses



"I.T." Electronic Interval Timers have been added to the "Decitron" counter line. Normal 60cy current is converted to

120cy and each impulse is registered by the "I.T." Timed operations, in seconds, are automatically controlled.

There are two rows of selector switches on Model "I.T.2," shown, and a dual timing circuit is possible. In a filling operation of liquid and gas, for example, the top row can be set to a desired time-fill interval, such as 4sec or 480 on the dials: 4 on the left control, 8 in center, 0 on the right control ($120\text{cy} \times 4 = 480$). The lower row can be set for any desired time up to $8\frac{1}{3}\text{sec}$ by the same method. By connecting the "I.T." to each operation with rear solenoid connections, the liquid will flow 4sec, shut off, and then gas will be drawn for 6sec. At this point, the timer automatically shuts off and repositions itself to liquid station again. A coincidental solenoid at the instant of stop on the second operation can signal a conveyor line to start again (bringing the next unit to filling station).

Single, dual, triple or quadruple "I.T." models are available, and various combinations to permit lengthy timed sequences are possible. Electronic Products Div., Post Machinery Co., Dept. ED, Beverly 11, Mass.

CIRCLE ED-200 ON READER-SERVICE CARD FOR MORE INFORMATION

Bandpass Filters Displaces 0.55 cu in



The dimensions of this standard series of subminiature bandpass filters are $23/32'' \times 23/32'' \times 1\text{-}1/16''$ high. The units have a 0.55 cu in displacement and exhibit excellent

characteristics for telemetering and airborne applications. They are designed to meet MIL specifications with 6% bandwidth at 3db, 40db/octave.

The units are hermetically sealed with a compression glass header and drawn metal can. The 2/56 studs afford a positive mounting arrangement. Custom designs can be produced. Communication Accessories Co., Dept. ED, Hickman Mills, Mo.

CIRCLE ED-201 ON READER-SERVICE CARD FOR MORE INFORMATION



FOR
ELECTROMECHANICAL
DESIGNERS...
IN THE DEVELOPMENT
OF RADAR AND
COMPUTING EQUIPMENT.

The most advanced developments in electronics are being made in the sphere of airborne radar and related ground control systems because of military emphasis. Further applications of electromechanical techniques in these fields are creating new openings in the Systems Division of Hughes Research and Development Laboratories.

Engineers who have demonstrated ingenuity and inventive ability will find interest in work that call for devising reliable, maintainable, manufacturable designs for precision equipment developed at Hughes Research and Development Laboratories.

The design of this equipment, manufactured at Hughes, involves mechanical, electromechanical, electronic, microwave computing problems. Design also requires the use of such advanced techniques as miniaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and military applications is useful.

ENGINEERS
experienced in the field of electromechanical design at the research and development level, or those interested in entering this area, will find outlets for their abilities and imagination.

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3350D W.

CIRCLE ED 20

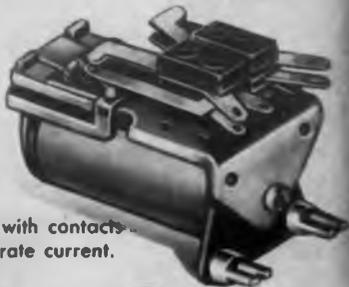
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RELAYS

for EXACTING REQUIREMENTS



Class 22 with contacts for heavy current.



Class 22 with contacts for moderate current.



Class 22 with bifurcated contacts for low voltage and current.

A.C. or D.C., open, plug-in, dustproof, hermetically sealed and many special models.

Available with resistance to shock, vibration, and temperature change to meet military specifications.

Special variations engineered to exacting application requirements.

Whatever your service, just tell us what you need or send for catalog.

Tell us what you need or send for catalog



MAGNECRAFT ELECTRIC CO
3350D W. Grand Ave. Chicago 51, Ill

CIRCLE ED-202 ON READER-SERVICE CARD

Coaxial Triodes

For 10-15kw Equipment



The ML-6422 and ML-6423 Coaxial-Terminal Triodes, employing thoriated-tungsten filaments, are for industrial and

broadcast equipment having 10-15kw power outputs. As replacements for types 892 and 892R as well as 5668 and 5669, the new triodes provide improved performance ratings, safety margins, and strength.

The thoriated-tungsten filaments greatly reduce power requirements while offering life increases to 100%. Plate current ratings are increased by 25%, grid current ratings by 20%, terminal inductances are very low; and high transconductance characteristics, up 70%, assure stable operation, low grid drive, and high plate efficiency. ML-6422 uses the company's standard water jacket and is rated for 30kw input, 20kw anode dissipation. ML-6423 employs an aluminum radiator to reduce weight to 16 lb as compared with 52 lb for a conventional type; this unit is rated for 30kw input, 12.5kw anode dissipation. Full ratings on both tubes are to 30Mc; reduced ratings to 90Mc. Machlett Laboratories Inc., Dept. ED, Springdale, Conn.

CIRCLE ED-203 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Locking Nut

Provides 80% Weight Saving



This all-metal self-locking miniature nut is designed to use only one-half the space of comparable standard anchor nuts and to be only one-fifth the weight, thus effecting weight savings of 80%. It retains the full tensile strength of the original "Kaylock" self-locking standard anchor nut.

The nut utilizes a simple positive locking principle wherein the upper threads are made elliptical and highly resilient, allowing all threads to carry the actual load, thus eliminating the necessity for an auxiliary locking device. It can be used in temperature ranges up to 550°F, and is fungus-proof. The company's "Kaylock" miniature nuts are now produced in a complete range of sizes from 4-40 to and including 1/4"-28 in three basic configurations: two lug, one lug, and corner types. The Kaynar Co., Kaylock Div., Dept. ED, 820 E. 16th St., Los Angeles, Calif.

CIRCLE ED-204 ON READER-SERVICE CARD FOR MORE INFORMATION

A detailed black and white illustration of a hand holding a cylindrical coil. The hand is shown from the side, with fingers gently gripping the coil. The coil has a textured, ribbed surface and a dark circular opening at one end. The entire illustration is framed by a white border.

Your Coil...

**Designed
and Produced
by COTO-COIL**

Save valuable laboratory time, avoid production delays and unnecessary overhead. Put your coil problem in the hands of experts with the experience and facilities to design and produce your coil quickly and in volume.

Send details to COTO-COIL COMPANY, INC.
66 Pavilion Avenue, Providence 5, Rhode Island
New York: 10 East 43rd Street, New York 17, N. Y.

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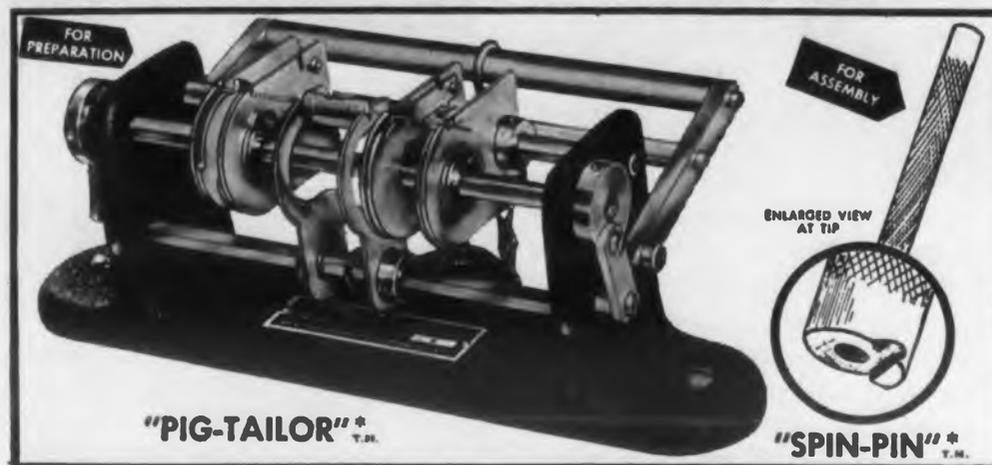


Coils

CIRCLE ED-205 ON READER-SERVICE CARD FOR MORE INFORMATION

"PIG-TAILORING"

... a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.



The "PIG-TAILOR" plus "SPIN-PIN" — Accurately Measures, Cuts, Bends, Ejects and Assembles both leads simultaneously to individual lengths and shapes — 3 minute set-up — No accessories — Foot operated — 1 hour training time.

PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters.
2. Long-nose pliers.
3. Operator judgment.
4. 90% operator training time.
5. Broken components.
6. Broken leads.
7. Short circuits from clippings.
8. 65% chassis handling.
9. Excessive lead tautness.
10. Haphazard assembly methods.

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. ED 5-P

BRUNO-NEW YORK INDUSTRIES CORPORATION

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET

NEW YORK 1, N. Y.



Broadband RF Power Meters

THE CHOICE OF ALL ARMED SERVICES FOR MICROWAVE POWER MEASUREMENTS

POWER: PULSE and CW — 5 μ W to 5W average

FREQUENCY: 20MC — 10,000MC

ACCURACY: 5% Absolute at all ranges, frequencies, temperatures

- **INDICATIONS:** Direct Reading
- **CALIBRATION:** Compensates for All Variables
- **R-F COMPONENTS:** 3, 6, 10 and 20db Attenuators, Bolometer Mount and Elements, R-F Cable
- **BOLOMETER:** Broadband, High Overload Capacity
- **PLUMBING:** 3/8" and 7/8" 50-ohm Coaxial
- **POWER SOURCE:** 115VAC \pm 15%, 50-1000 cps
- **CONSTRUCTION:** Rugged, meets all JAN, MIL requirements

TYPICAL APPLICATIONS

Microwave Links . . . Television . . . Communications . . .
 Radar . . . Telemetry . . . Signal Generators . . .
 Laboratory Standards.

Write for descriptive literature to Department ED J-M

Bruno - New York Industries Corporation

DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

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NEW YORK 1, N. Y.



CIRCLE ED-207 ON READER-SERVICE CARD FOR MORE INFORMATION

Electrometers

With Terminals for Recording Uses



Models 200 and 200A Electrometers, battery-operated d-c vacuum tube voltmeters with input impedances exceeding 10^{14} ohms, and available in an improved version. These are now fitted with output terminals, providing

a convenient means for recording a very broad range of voltage, current, and resistance measurements. In addition, amplifier-recorder systems can be given an inexpensive ultra-high input. The electrometer tube is used as a cathode follower, providing an output voltage gain of 0.65, a zero drift within 0.1% of full-scale per hour on each range, and response of d-c to about 100cy.

When used with accessories, the instruments measure full-scale voltages of 2v to 20,000v, currents down to 2×10^{-12} amp full scale, and resistances to 16^{14} ohm full scale. Applications include indicating and recording potentials of charged capacitors and vacuum tube grids; measuring currents in photocells, in chambers, and semi-conductors; making insulating leakage resistance and volume resistivity tests; and detecting static charges. Keithley Instruments, Dept. ED, 3868 Carnegie Ave., Cleveland 15, Ohio.

CIRCLE ED-208 ON READER-SERVICE CARD FOR MORE INFORMATION

Toroid Transformers

In Four Ranges to 50-200 kc



The Series ST4 Transformers are for use in applications requiring a compact,

efficient multiwinding transformer, operating at impedance circuits over a wide frequency range.

Transformers are toroidally wound on molybdenum-permalloy cores. Four different types of cores are utilized, each the most efficient in the range to be covered. Ranges available are: up to 15kc; 10-50kc; 30-75kc and 50-200kc. Each core type is available in either two, three, or four identical windings.

Transformers occupy less than 0.85 cu in, including terminals. Convenient single-hole mounting with anti-rotation pin is provided. Voltage rating between windings is 100v. Mico Instrument Co., Dept. ED, Trowbridge St., Cambridge 38, Mass.

CIRCLE ED-209 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1954

NEW! Vibrator Power Supply

for 6 or 12-Volt Battery Operation of G-R Unit Instruments

- ★ Supplies both D.C. and A.C. from a 6- or 12-volt battery or from 115-volts 60 cycles, a-c line.
- ★ Takes Unit Instruments out of the laboratory and into the field.
- ★ Output from storage battery (40 watts max.): 300 volts at 55 ma, d-c; 6.3 volts at 2.7 amps, a-c; 115-volts 115 cycles.
- ★ Can be used in the field with megohmmeters, v-t voltmeters, oscillators, etc.

Type 1202-A
Unit Vibrator Power
Supply: \$125



GENERAL RADIO Company 275 Massachusetts Ave.
Cambridge 39, Mass.
90 West St. NEW YORK 6 8055 13th St. Silver Spring, Md. WASHINGTON, D. C.
920 South Michigan Ave. CHICAGO 5 1000 North Seward St. LOS ANGELES 38

CIRCLE ED-210 ON READER-SERVICE CARD FOR MORE INFORMATION

ElectroVoice

SPEAKS UP ON...

PHALO COM CABLES

- ✓ CONDUCTIVITY
- ✓ FLEXIBILITY
- ✓ DURABILITY

PHALO COM Scores High In ALL THREE!

Electro-Voice, Inc. of Buchanan, Michigan, pioneer producers of electro-acoustic products, have this to say about the Phalo Com cables used in famous Electro-Voice equipment — "The main advantages of the Phalo cables we use on our microphones are their excellent conductivity, flexibility and durability".

Throughout the wide field of communications, Phalo cables are very much "in the current picture to stay". Have you compared Phalo cable qualities with those of your present cables? Why not make the test NOW!

Write PHALO for cable samples — or for the name of the Phalo cable man nearest you. Complete Phalo catalog on request.

PHALO PLASTICS CORPORATION
25-1 FOSTER STREET, WORCESTER, MASS.

Southern Plant: Monticello, Miss.

Insulated Wire and Cables — Cord Set Assemblies

CIRCLE ED-211 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1955

Coaxial Tuner For Broad-Band Use



The Model G50-A Broad-Band Coaxial Tuner, for use in the microwave region, makes possible impedance matching over a wide frequency range with a single instrument. Utilizing the line-stretcher and single-stub principal for matching to 50-ohm lines, the unit reduces vswr's in excess of 30:1 to less than 1.2 over the frequency range 750Mc to 10,000Mc.

Ruggedly built, the tuner is constructed largely of coin silver, rhodium plated for tarnish resistance. Settings are retained by simple, finger-tightened locking nuts. The tuner is intended for use with systems employing Type N fittings and is furnished with male or female Type N connectors in combinations specified by the customer. Dunn Engineering Associates, Inc., Dept. ED, 11 Windsor St., Cambridge, Mass.

CIRCLE ED-212 ON READER-SERVICE CARD FOR MORE INFORMATION

Vector Analyzer

Can Measure Fractional Degrees



The Type 202 "Vectorlyzer" can be used to measure very small phase angles, such as 1° or a fraction of a degree with maximum error less than 2.5%. The instrument is based on a circuit which permits unusual speed and accuracy to measure vectorrelations of alternating voltages.

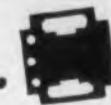
Applications include measuring vector sum or difference of two voltages; imaginary and real components of an unknown voltage in terms of a reference voltage; phase angle between two alternating voltages; voltage across two points which are both above a-c ground potential; and magnitude and phase angle of an unknown impedance.

The frequency of this instrument is 8cy to 2Mc with amplifier. The upper limit decreases to 200kc without amplifier. The probe has a frequency range from 100kc to 500Mc. The voltage range is 0.04v, 0.4v, 4v, and 40v rms full scale with amplifier. All ranges increase fifty times without amplifier. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

CIRCLE ED-213 ON READER-SERVICE CARD FOR MORE INFORMATION

INSULATE + SEAL + HOLD
WITH 1 PRODUCT — IN 1 OPERATION

BRADY POSITIVE PLACEMENT PRODUCTS



SEALING

Self-Sticking pre-cut vinyl gasket seals out moisture, corrosive fumes in Jet Starter Relay. Fast-to-apply — low cost — meets govt. specs.

INSULATING



U/L approved precision-cut self-adhesive shields eliminate arcing in switch. No fasteners required.



HOLDING

Microphone diaphragm held in place with double-coated self-sticking ring .006" thin. Economical to apply. Long aging qualities

Brady Positive Placement Products may be the solution to YOUR sealing, holding, spacing and insulating problems. Over 300 different materials to choose from. For information, samples and Engineered Case Histories write:

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768 W. Glendale Ave. Milwaukee 12, Wis.

CIRCLE ED-214 ON READER-SERVICE CARD FOR MORE INFORMATION

**FIRST TRANSISTOR RADIO
MADE POSSIBLE . . BY
INSUROK® COPPER-CLAD
PRINTED CIRCUITS!**



This 12-ounce radio was made possible mainly through the use of printed circuits and transistors!

Regency laid out the circuit. Croname, Inc. printed it on Richardson T-725 copper-clad INSUROK, then etched it. Result: Light, compact circuit . . no tedious wiring . . faster assembly.

Ask for bulletin, "INSUROK T-725 Copper-Clad Laminates"

**RICHARDSON Laminated
and Molded Plastics**

The RICHARDSON COMPANY

Founded 1858

2682 Lake Street, Melrose Park, Illinois (Chicago District)
SALES OFFICES IN PRINCIPAL CITIES

CIRCLE ED-215 ON READER-SERVICE CARD FOR MORE INFORMATION

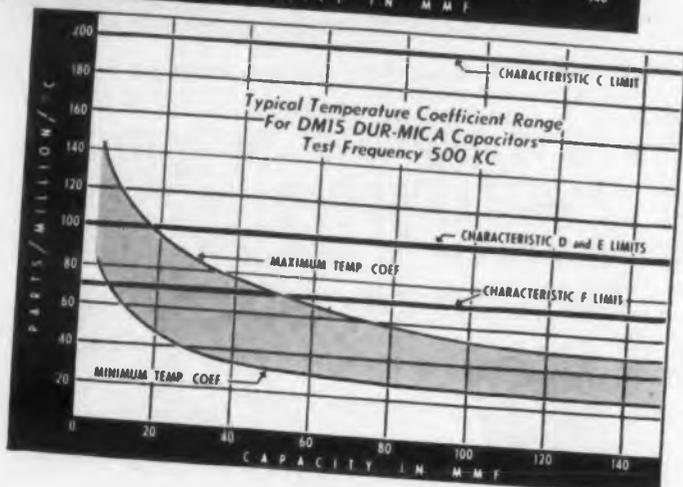
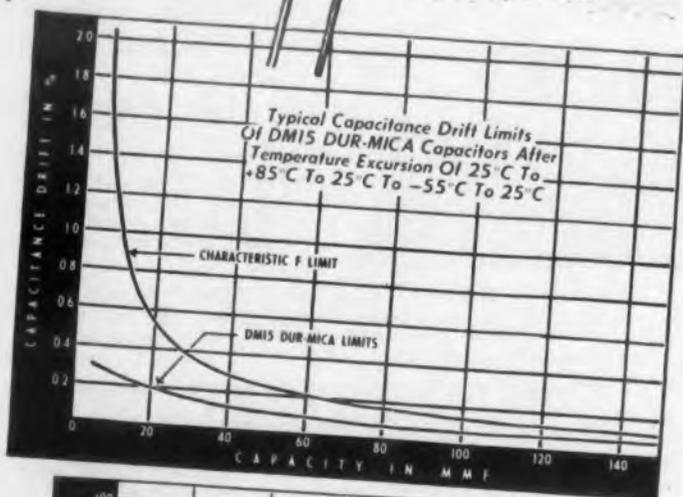
El-Menco

provides
positive proof
of performance

of the powerful new
**Dur-Mica
DM 15**
world's smallest
mica capacitor

ideal for
printed circuits

meets all humidity,
temperature and
electrical requirements
of MIL-C-5 specs!



... First Miniature Dipped Mica Capacitors with Parallel Leads.

El Menco's Dur-Mica DM15 provides assurance of peak performance in a variety of transistor circuits and other miniature electronic equipment in military and civilian applications.

A new, tougher phenolic casing provides assurance of long-life and stability through wide ranges in temperature. Parallel Leads provide greater versatility — allow efficient, safe use of the El Menco Dur-Mica DM15 in applications heretofore impractical.

Saves Money — El Menco's Dur-Mica DM15 costs even less than the famous El Menco CM15. Provides economy of size.

CAPACITIES AVAILABLE :

- DM15—Up to 510 mmf at 300vDCw
- Up to 400 mmf at 500vDCw
- DM20—Up to 5100 mmf at 300vDCw
- Up to 3900 mmf at 500vDCw

Available in 125°C operating temperature. Minimum capacity tolerance available— $\pm 1/2\%$ or 0.5 mmf (whichever is greater).

Test El Menco "Dur-Micas" For Yourself!

Jobbers and distributors write to Arco Electronics, Inc.,
103 Lafayette St., New York, N. Y.

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

CIRCLE ED-216 ON READER-SERVICE CARD FOR MORE INFORMATION

Frequency Divider Extends Meter Ranges



The FM-5 Frequency Divider is designed specifically to extend the frequency measuring range of either the Gertsch FM-3 or AM-1 down to 500kc and the frequency generating range down to 200kc with no loss of accuracy. It both measures and generates up to 20Mc with continuous coverage. The FM-3, shown at left, is direct-reading v-h-f frequency meter (20-640Mc) rated at 0.001%.

The FM-5 consists basically of two tuned frequency dividers in cascade, each dividing by ten. These dividers are used to divide the fundamental output frequency (20-40Mc) of either the FM-3 or the AM-1 by exactly ten or one hundred, depending on whether one or both dividers are being used. This gives a source of 2-4Mc and harmonics, or 200-400kc and harmonics, as accurate and stable as the 20-40Mc input. Included is a detector-audio system for heterodyne type measurements.

The FM-5 is available in both rack panel and portable models. The portable model is available for either battery or a-c operation. Gertsch Products, Inc., Dept. ED, 11846 Mississippi Ave., Los Angeles, Calif.

CIRCLE ED-217 ON READER-SERVICE CARD FOR MORE INFORMATION

Hermetic Seal Terminal

Takes -60° to $+500^{\circ}$ F Temperatures



This terminal is composed of Steatite insulators which compress a silicone rubber grommet against an extruded hole in the header, forming a leak-proof oil seal capable of withstanding extremely high internal pressure. D-c metallic migration is prevented, and operating temperatures range from -60° to $+500^{\circ}$ F. Standard voltage rating is 2000v to 7000v.

The terminal is approved under MIL-T-27 for transformers and MIL-C-25 for capacitors, and is used extensively in relay lines and as feed-throughs on metal panels. The minimum size is 0.187" diam, and the terminal can be mounted on 1/4" centers.

This company also announces a service to fabricate complete headers. Robco Manufacturing Div., Pilot International Corp., Dept. ED, 27-01 Bridge Plaza North, Long Island City 1, N. Y.

CIRCLE ED-218 ON READER-SERVICE CARD FOR MORE INFORMATION

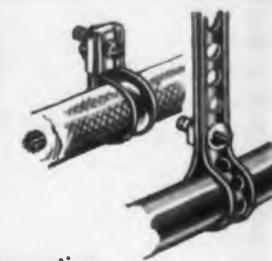


Yes, our complete line of plastic cable clips and perforated Nylon strapping will "Hold Everything"... wiring, tubing, fragile objects, safely and economically.

MANY STYLES AND TYPES—
ETHYL CELLULOSE AND NYLON

Special

Non-corrosive Nylon screws and nuts now available.



WRITE TODAY For samples and complete information.

WECKESSER CO.

5253 N. Avondale Avenue • Chicago 30, Illinois

CIRCLE ED-219 ON READER-SERVICE CARD FOR MORE INFORMATION

New Bulletin

ON FENWAL
THERMOSWITCH®
CONTROLS
MIDGET AND
MINIATURE...

YOURS FREE NOW



To solve temperature control and detection problems "tight spots" these controls are truly miniaturized... space saving, sturdy, versatile and adaptable for compact, modern design... with the same positive action and instant sensitivity to temperature change as Fenwal's larger size standards.

MIDGET: Single wire and two wire types; wide range from -50° F to 500° F; $1/4$ " outside shell diameter, sensitive to temperature changes over entire shell; high sensitivity; shock and vibration resistant. Units which either make or break on temperature rise for temperature control in gases, solids, liquids. Applications include: Antennas, Electronic Equipment, Reciprocating Engines, Molding Presses or Platens.

MINIATURE: Control within 2° to 6° F is typical, even under acceleration. Fully adjustable ranges of from -20° to 200° or -20° to 275° F. Hermetically sealed units -20° to 200° F. For control or detection in Crystal Ovens, Precision Instruments, Radar, Antennas, Computers, Aircraft, Guided Missiles, Motors, Wave Guides.

For "tight spot" temperature control information, get the bulletin now. Your free copy will be sent upon request. Write for bulletin MC-124, Aviation Products Division, Fenwal Incorporated, 95 Pleasant Street, Ashland, Mass.

Fenwal THERMOSWITCH®
Controls Temperature... Precisely

CIRCLE ED-220 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1958



DURABLE, ACCURATE Decade Resistance Boxes

36 types 1 to 6 dials

ACCURACY:
10Ω & above ± 0.1% 0.1 Ω ± 1%
1.0 Ω ± 0.25% 0.01 Ω ± 5%

Closer tolerance on request.

TEMPERATURE COEFFICIENT: 0.002%/°C.

MAXIMUM LOAD: 1/2 watt per step

FREQUENCY LIMIT: Non-inductive to 20 Kc.

TYPE	DIALS	OHM STEPS	TOTAL RESISTANCE OHMS	PRICE
550	1	1,000,000	10,000,000	\$ 66.00
823	3	1,000	1,110,000	77.00
824	3	10,000	11,100,000	120.00
817-A	4	0.01	111.1	75.00
819	4	0.1	1,111	71.00
825	4	1	11,110	77.00
826	4	10	111,100	79.00
827	4	100	1,111,000	92.00
828	4	1,000	11,110,000	139.00
817-B	5	0.01	1,111.1	94.00
8285	5	0.1	11,111	94.00
829	5	1	111,110	101.00
830	5	10	1,111,100	113.00
832	6	1	1,111,110	121.00
833	6	10	11,111,100	169.00

Write for Bulletin L-17A for a complete listing of Shallcross Decade Resistance Boxes.

Shallcross MANUFACTURING COMPANY

526 PUSEY AVE., COLLINGDALE, PA.

Power Supply With Two High-Voltage Outputs



The Model D3-300D Power Supply provides two high-voltage output ranges, each independent of the other, on one compact chassis. It delivers 0-300v d-c at 300ma max load; 0-300v d-c at 150ma max; d-c variable bias 0-150v at 5ma max load (regulated by VR tube); and 0-10v a-c unregulated, at 10amp max load which is variable with powerstat control.

For line voltage of 115v a-c ±10%, the output voltage change is 0.15%. For d-c regulated high voltage, the change from no-load to full-load is less than 30mv. Ripple for both high-voltage outputs is less than 500μv rms. Both positive or negative of either high-voltage outputs may be grounded.

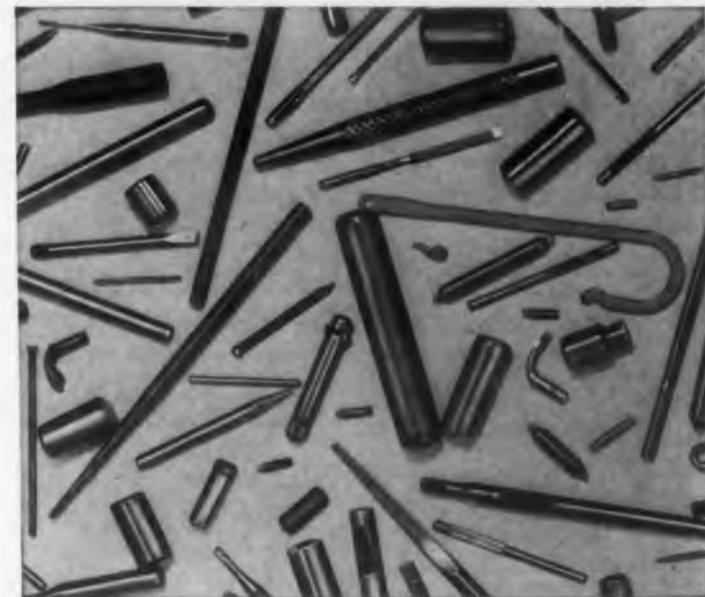
All components in the unit are derated for long service life. Tapped screw holes, readily removable tops and bottoms, and easy-to-trace wiring are features included to simplify maintenance. Dressen-Barnes Corp., Dept. ED, 250 N. Vinedo Ave., Pasadena 8, Calif.

CIRCLE ED-221 ON READER-SERVICE CARD FOR MORE INFORMATION



Avoid long delays...

TORRINGTON *delivers small precision parts promptly*



"On time" shipments of Torrington small precision metal parts will keep your production lines moving.

Special automatic machinery of our own design, plus almost 90 years of precision metalworking experience, enables us to produce your small precision parts *faster, better and for less* than you can make them yourself. And we follow your specifications *exactly* on tolerances, temper, hardness and finish.

Send a sample part or blueprint for our quotation. Our Condensed Catalog illustrates many of the parts we can produce for less. Ask for it.

THE TORRINGTON COMPANY

Specialties Division

37 Field Street, Torrington, Conn.

TORRINGTON SPECIAL METAL PARTS

Makers of Torrington Needle Bearings

CIRCLE ED-225 ON READER-SERVICE CARD FOR MORE INFORMATION

VALPEY Quartz Crystals

symbol of craftsmanship for over 23 years



TYPE
CBC-0

Temperature-
controlled
oven

essential and critical part of Valpey's quality-control process is X-raying blanks accurately determine the angle of cut. This inspection occurs after slices have been sawed from large natural quartz crystals prior to lapping to fine surface finish.

Quartz blanks not cut to the exact angle are rejected. The X-ray pictured here, accurate to within two minutes, is used in this vital inspection.

Valpey precision produces the finest crystals available for every application in ranges from 40 Kc. to 100 Mc. Bulletin FE-1 describes all conventional units. Available on request.

VALPEY Crystal CORPORATION

242 Highland Street
Holliston, Mass.

Craftsmanship in Crystals since 1931

CIRCLE ED-222 ON READER-SERVICE CARD FOR MORE INFORMATION

Breadboard Kit

Contains 630 Different Parts



Breadboard Kit "P" consists of 630 different parts, such as gears, shafts, differentials, breadboard plates, hangers, bearings, etc. It is designed to include all parts necessary

to solve any mechanical or electronic problem. Material is designed for reuse.

The kit can be used for military engineering or development contracts, laboratories, and for all electronic applications. It is contained in an attractive leather carrying case 5" x 12" x 18", felt lined to protect the precision instrument parts. It is complete with tools to assemble and disassemble parts as desired. Two other smaller kits are also available as standard. Pie Design Corp., Dept. ED, 160 Atlantic Ave., Lynbrook, L. I., N. Y.

CIRCLE ED-224 ON READER-SERVICE CARD FOR MORE INFORMATION

OHMITE AMRECON[®] RELAYS

High quality, general purpose relays featuring compactness, dependability and long life!



MODEL DO

Ideal for mobile equipment and aircraft. Contact Rating: 10 amp at 115 VAC or 32 VDC noninductive load.



MODEL DOS

Meets rigorous aircraft standards. Contact Rating: 15 amp at 115 VAC or 32 VDC noninductive load.



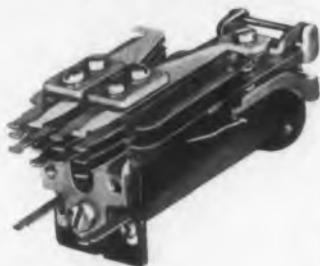
MODEL TKL

Miniature of long telephone type relay. Contact Rating: 1 amp at 115 VAC or 32 VDC noninductive.



MODEL DOSY

Twin coils provide extra sensitivity. Contact Rating: 15 amp at 115 VAC or 32 VDC noninductive load.



MODEL TG

Use where fine adjustment is needed. Contact Rating: 1 amp at 115 VAC or 32 VDC noninductive.

**30 TYPES
AVAILABLE
FROM STOCK**

Write for
Catalog
R-10



**American Relay
& Controls, Inc.**
3643 Howard St.
Skokie, Ill.
(Suburb of Chicago)

a subsidiary of

OHMITE[®]

MANUFACTURING COMPANY

CIRCLE ED-226 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Transformers 200w Pulse and Broadband Types



A full line of miniature broadband and pulse transformers for universal applications is offered by this firm for applications requiring up to 200w peak power. The line consists of two basic styles. One type is encapsulated in epoxy resin, and the other hermetically sealed in a metal can. A choice of silicon ribbon or ferrite as core material is available.

Type 19 is an epoxy-encapsulated unit employing a toroidal core of oriented-grain silicon steel. Type 50 is a similar transformer hermetically sealed in a metal container. Both are useful to 200w peak power in coupling and blocking oscillators requiring pulse widths from 0.5 μ sec to 10 μ sec and rise times to 0.02 μ sec.

Type 60 is a ferrite-core transformer of high efficiency in coupling circuits. It is also useful for fast pulses of 0.05 μ sec to 0.5 μ sec widths, and rise times to 0.01 μ sec. The three types are made to pass MIL-T-27 requirements. Carad Corporation, Dept. ED, 2850 Bay Rd., Redwood City, Calif.

CIRCLE ED-227 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Power Supply

125v 25amp Germanium Unit

This 125v 25-amp Germanium Rectifier D-C Power Supply contains no moving parts, is compact, lightweight, and has an inherent regulation of 4% from no-load to full-load. It is identified as Model No. G 125-25.

Specifications include: d-c output, 125v at 25amp (continuous); a-c input, 230v, 60cy, 3 phases; regulation, 4% no-load to full-load, 1-1/2% from 1/2 load to full-load; ripple, 5% rms; efficiency, 94%; power factor, 98%; weight, 125 lb (approx); and dimensions, 22" x 15" x 19". A tap switch will give output voltage adjustment over the range of 115-125v for normal line and load variations. Metering is on a 4-1/2" ammeter and a 4-1/2" voltmeter, with 2% accuracy. Perkin Engineering Corp., Dept. ED, 345 Kansas St., El Segundo, Calif.



CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION



improve design
simplify purchasing
speed production
with

C-D-F SPIRAL TUBING

Looking for low-cost tubing to reduce unit costs and improve product performance? Consider the use of C-D-F Spiral Tubing, a high strength plastic made from paper or fibre that is spirally wound and cured at high temperatures. In many cases it can replace rolled or molded laminated plastics... at a good cost saving. Small sizes, thin walls are not a problem. For many applications, dimensional stability and moisture resistance

is excellent. Coil forms, insulating tubes, paint roller tubing, shipping containers, bushings are just a few applications. Write today for 8-page Technical Folder ST-53, giving properties, sizes, tolerances on pregated and unimpregnated round, square and rectangular C-D-F Spiral Tubing. Well illustrated. Call your C-D-F sales engineer (offices in principal cities) — he's a good man to know!



Continental-Diamond Fibre

CONTINENTAL-DIAMOND FIBRE COMPANY, NEWARK 107, DELAWARE

CIRCLE ED-229 ON READER-SERVICE CARD FOR MORE INFORMATION

STABILITY $\pm 1^\circ\text{C}$

**NEW TCO-22
SERIES
CRYSTAL OVEN**

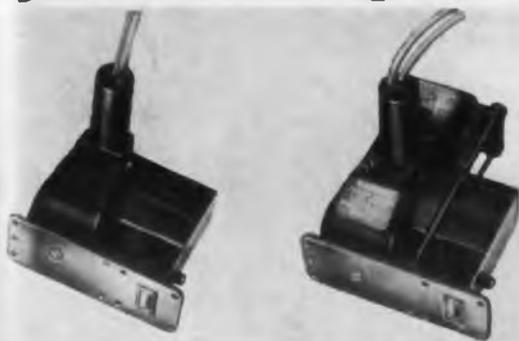
A new concept of frequency stability, with compact design, is introduced by the TCO-22 series oven. Features include provision for mounting two BH6A crystal holders (MIL type HC-6/U), quick heating, easy access for frequency change, in addition to a *stability* of $\pm 1^\circ\text{C}$. Standard units are rated 7.75 Watts supplied for either 6.3 V or 26.5 V operation. Nominal temperature $+75^\circ\text{C}$ or $+85^\circ\text{C}$.



BLILEY ELECTRIC COMPANY
UNION STATION BUILDING
ERIE, PENNSYLVANIA

CIRCLE ED-230 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetrons for High Altitude Operation



MICROWAVE ASSOCIATES, INC. has developed two new magnetrons for high altitude unpressurized operation. The 2J42H is a modification of the popular 2J42 and the MA-201 of the higher power 6027 (2J42A). The 2J42H and MA-201 are capable of delivering 14 and 20 watts (min) average power at altitudes used by modern intercept planes. Both tubes are provided with glass pressure windows to prevent RF breakdown and heavily insulated pigtailed embedded in plastic at the filament end to prevent corona. Although normally produced at a center frequency of 9375, tubes are available on special order from 9000-9600 mcs.

For further information, contact D. W. Atchley, Jr., Sales Department, Microwave Associates, Inc., 22 Cumington St., Boston, Mass. Phone, COpley 7-7577.



CIRCLE ED-231 ON READER-SERVICE CARD FOR MORE INFORMATION



WRITE TODAY for your copy of the new Thomas & Skinner Bulletin No. L-355 on electrical laminations. Complete data with sketches, dimensions, and characteristics charts. Also, complete details on new T&S Test Procedure for Standard EI Laminations.

Call on your Thomas & Skinner engineering staff for expert assistance on your lamination problems.

Specialists in Magnetic Materials

THOMAS & SKINNER
Steel Products Company, Inc.

1157 EAST 23RD STREET, INDIANAPOLIS 7, INDIANA

CIRCLE ED-232 ON READER-SERVICE CARD FOR MORE INFORMATION

Scaler

For Binary and Decimal Counting



The Model 200 Scaler utilizes decimal or binary units which are directly interchangeable; it may be changed from one to the other in a matter of seconds.

A direct-coupled non-overload linear amplifier is followed by a discriminator that drives the decimal or binary scaling stages. The output of the counting units drives a register driver circuit which in turn operates a mechanical register. A pulse generator is incorporated to furnish an accurate check of calibration and operation.

The discriminator utilizes a flutter-free reference tube permitting use of the scaler as an integral type pulse-height analyzer or to discriminate between pulses in the 0 to 87-1/2v range. The high-voltage supply of this unit utilizes a voltage doubler which keeps the high-voltage transfer noise down to an absolute minimum. Provisions are made for this firm's Automatic Sample Changer, utilizing glow transfer tubes as a six digit register, permitting any number from 10 to one billion to be selected as a preset count. Radiation Instrument Development Laboratory, Dept. ED, 2337 W. 67th St., Chicago 36, Ill.

CIRCLE ED-233 ON READER-SERVICE CARD FOR MORE INFORMATION

Glass Trimmer Capacitor

Has Low Minimum Capacitance

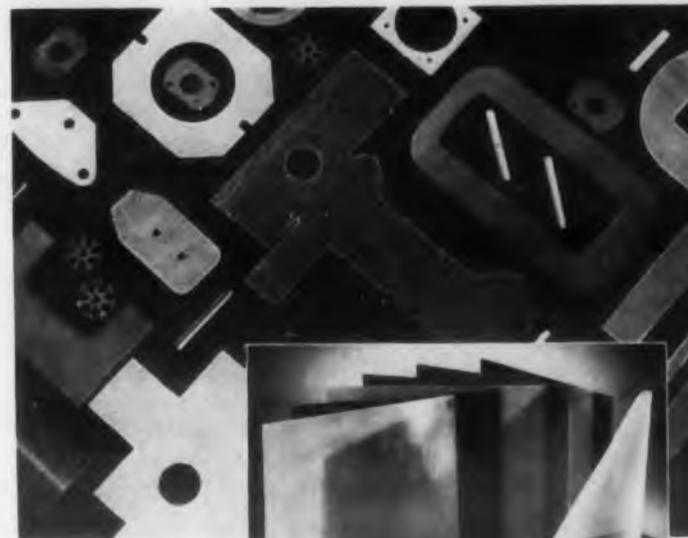


Only 3/4" in overall length, this midget glass rotary trimmer capacitor features a very low minimum capacitance and smooth trimmer adjustment. It is suitable for application in any commercial

circuit requiring an economical trimmer.

The unit is available in two sizes: 0.5-3.0mmfd and 1.0-4.5mmf. Q is 500 at 50Mc. The temperature coefficient of the body of the trimmer is 200ppm. Constructed of glass tubing with a coating of metal bonded to it, the capacitor has a self-lubricating nylon bushing threaded to take a 6-32, Class 2 type screw. Corning Glass Works, Dept. ED, Corning, N. Y.

CIRCLE ED-234 ON READER-SERVICE CARD FOR MORE INFORMATION



This is

WHY

CONOLITE POLYESTER LAMINATES

may surpass your specifications

Specifications for laminates that give your electrically operated equipment a competitive edge may be more than met by Conolite polyester laminates. This is possible because Conolite is made of thermosetting polyester resins reinforced with filler materials in combinations or individually, and built up in layers.

Here is why. Three basic laminates: 1) extremely flexible, cold-forming glass cloth, and glass cloth-asbestos paper, 2) flexible glass base, postformable under heat, 3) rigid paper base, postformable under heat. Excellent room or low-temperature punching quality. Low specific gravity—more area per unit weight. Dielectric strength 20-100% better than phenolic laminates. Excellent arc resistance—106 seconds for a .062" thickness in a paper grade. Extreme uniformity of thickness within close tolerances. Chemically inert, noncorrosive polyester resins. Outstanding impact strength—10 times better than phenolic laminates. Excellent power loss factor. Unlimited color range. Complete line in thicknesses from .005" to .062" for class A and B requirements.

Conolite polyester laminates are available in continuous coils for sustained automatic fabricating operations, and also in sheets. Conolite laminates in coils are packaged in fibre drums that reduce storage 2 to 3 times compared to other laminates. The fibre drums also cut handling and shipping costs.

Investigate Conolite polyester laminates and you'll learn why they may more than meet your specifications. Call in an IMC sales engineer today or write the nearest IMC office for more information. Also ask about IMC's Chicago Fabricating Division that can supply you with fabricated Conolite parts to meet your requirements.

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ELECTRONIC COMPONENTS . . .



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Wire and Strip

Electron tubes, lamp leads, interference shielding, magnetostrictive components, thermostat parts, fine wire springs, and hundreds of other electronic applications rely on Nickel and Nickel Alloy Wire and Strip for dependable performance and long service life. Good electrical properties, high mechanical strength, excellent resistance to high temperatures and corrosion are the properties that make the Nickel group of metals a must in electronic design. We can supply you with wire and strip in Nickel, Monel, Inconel, Nickel Irons, Incoloy and special processed Gas-Free Nickel and Gas-Free Nickel-Iron Wire for your electronic applications.

Nickel-clad and Inconel-clad copper wire are also available for applications requiring high electrical conductivity plus outstanding resistance to high temperatures. Send today for free 40-page Nickel Handbook.



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**High-Emissivity
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ALLOY METAL WIRE DIVISION

HKP
H. K. PORTER COMPANY, INC.

H. K. PORTER COMPANY, INC.
Prospect Park, Pennsylvania

CIRCLE ED-236 ON READER-SERVICE CARD FOR MORE INFORMATION

112

Induction Motor Sub-Fractional Low-Slip Unit



Combining good speed regulation with low slip, the AC-93 Miniature Sub-Fractional Induction Motor offers favorable application characteristics for magnetic tape recorder

operation; servo or actuator motors; and geophysical equipment uses. Although the standard unit is an induction motor, its design is such that it can be supplied, with minor changes, as a synchronous unit with reduced power output.

Operating at 115v, 400cy single-phase, the unit has a speed of 11,800rpm with a 15w output. Locked rotor torque is 1.8 oz-in minimum. Maximum power input is 45w, and rotation is reversible. Driving shaft design and arrangement of input terminals or leads can be adapted to user requirements. Weight is 14 oz. Dalmotor Co., Dept. ED, 1326 Clay St., Santa Clara, Calif.

CIRCLE ED-237 ON READER-SERVICE CARD FOR MORE INFORMATION

Oscilloscope

Measures Extremely High-Speed Pulses



Precise measurements and analyses of phenomena which take place at extremely high rates of speed may be made with the Type 336 Cathode-ray Oscilloscope. The instrument is expected to have applications in nuclear studies, development and maintenance of high-speed electronic computers, design

of radar systems, and similar applications requiring high-frequency measurements.

The Y-amplifier of this unit has a rise time of 0.02 μ sec with less than 2% overshoot, and a useful response from d-c to beyond 30Mc. There is no degradation of high-frequency bandwidth or sensitivity with either conductive or capacitive coupling. The d-c amplifier is extremely stable, exhibiting very low drift for long time measurements. There is no d-c shift or slump. Operating voltages are electronically regulated to increase stability. Full scale ranges extend from 1v to 500v. Instrument Div., Allen B. Du Mont Laboratories, Inc., Dept. ED, 760 Bloomfield Ave., Clifton, N. J.

CIRCLE ED-238 ON READER-SERVICE CARD FOR MORE INFORMATION

Stycast[®] 2850GT



**Epoxide
Casting Resin
for Electronic Embedments**

Wide Temperature Range -100° F to +400° F
(for short periods to +500° F)

Coefficient of Thermal Expansion

Approximately the same as Aluminum and Brass

Good Adhesion Low Shrinkage Cures at Room Temperature



Write for detailed information on Stycast 2850GT
and other Stycast Plastics for Electronics

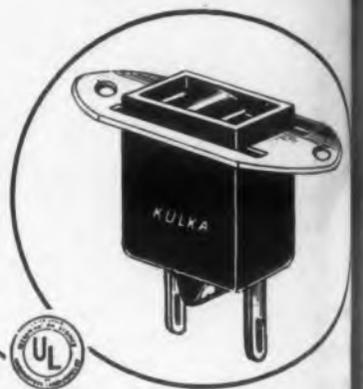
Emerson & Cuming, Inc.
PLASTICS for ELECTRONICS
869 Washington Street, Canton, Mass.

CIRCLE ED-239 ON READER-SERVICE CARD FOR MORE INFORMATION

New Miniature POWER OUTLETS

For Small Electrical and Electronic Units
SHOWN FULL SIZE

- SMALLEST MADE
- TAKE STANDARD PLUG
- MOUNT FROM TOP OR BOTTOM OF FLAT BRACKET
- CHOICE PRE-WIRED STYLE, OR WITH SOLDERING TERMINALS
- PHENOLIC BLOCK HAS BARRIER TO PREVENT SHORTS
- AC and DC



No. 221 (above) with solder terminals and steel bracket with #6 clearance mounting holes. Also No. 222 with 6-32 tapped mounting holes. No. 223 with 8" #14 or #16 plastic leads and steel bracket with #6 clearance mounting holes. No. 224 with 6-32 tapped mounting holes.

KULKA ELECTRIC MFG. CO., Inc.

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

CIRCLE ED-240 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1964

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507

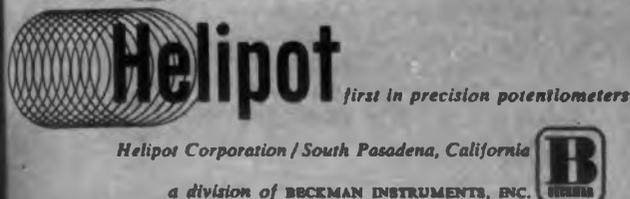
Electrical Noise in Wire-Wound Potentiometers

BY IRVING J. HOGAN

Research and Development Division
Helipot Corporation

Presented at the 1952 WEST COAST I.R.E. CONVENTION

387



CIRCLE ED-241 ON READER-SERVICE CARD FOR MORE INFORMATION

SIMPLYTROL AUTOMATIC PYROMETER



10 temperature ranges cover from -75° to 3000°F.

Several special ranges to -400°F.

Cat. No. 4531 0 2500° F.
Price \$132.00

Thermocouple type Automatic Pyrometer for controlling temperature in furnaces, ovens, and processes. The Simplytrol is economical and reliable with few moving parts. There are no vacuum tubes. The regular load relay is S.P.D.T. 5 Amps. Optional heavy duty relays to 40 Amps.

10 temperature ranges cover from -75° to 3000° F. Several special ranges to -400° F. "On & Off" control for holding the desired temperature works on gas, oil or electric heat. Indicating meter-relay is medium high resistance and has metal cold junction compensation. For use with all standard thermocouples. Accuracy 2%.

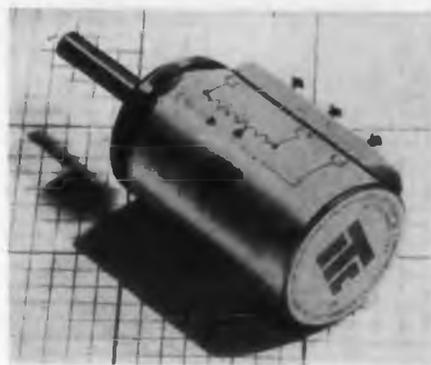
"Auto-Limit" switch changes Simplytrol from automatic controller to limit pyrometer for safety shut down or warning. Cabinet: 6½x6½x9½ inches. Also flush panel mount models. Send for new Bulletin G-7 for more data. Assembly Products, Inc., Chesterland 17, Ohio.

CIRCLE ED-242 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May 1955

Potentiometer

Miniature with 0.05% Linearity



The L10S miniature 10-turn potentiometer features linearity of 0.05% standard and 0.025% as a special tolerance where required. Overall length is 1-3/8" from front mounting surface.

Diameter of the pilot is 3/4". The red anodized aluminum housing is fully shielded. High resolution, low torque, long life, and stability under environmental conditions meeting military specifications are features of the unit. The synchro-type mounting provides precision positioning.

Resistance range is 1000 ohms to 100,000 ohms, with a tolerance of ±5% standard, ±0.05% special. Ambient temperature range is -55° to +125°C. Power rating is 5w at 40°C, derated to zero at 130°C. Maximum starting torque is 0.75 in-oz at 20°C, and running torque 0.60 in-oz. Taps may be provided to within ±1° std. Multiple taps are available on special order. Technology Instrument Corp., Dept. ED, 531 Main St., Acton, Mass.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

Toggle Switch

Miniature Long-Life Type



In addition to precision electrical control and extreme life span, the miniature toggle switch Model A3-8 features a new patented spring mechanism which provides smooth operation and a positive snap-action in either direction. The switch is designed for testing equipment, electronic apparatus, business machines, aircraft, and other types of panel-mounting applications.

The actuator shell is made of stainless steel, and the spring mechanism is of durable beryllium copper.

Two miniature basic switches, encased in the actuator, provide a dpdt circuit arrangement. The switch is also available in a momentary contact model.

Electrical life is 100,000 cycles minimum. Size is 7/8" long x 1/2" thick (approx). Electrical rating is 125/250v a-e, 5amp; 30v d-e, 4amp resistive; 30v d-e, 2.5amp inductive. Electro-Snap Switch & Mfg. Co., Dept. ED, 4218 W. Lake St., Chicago 24, Ill.

CIRCLE ED-244 ON READER-SERVICE CARD FOR MORE INFORMATION



Superior makes quantity molded mechanical parts... of iron, brass, nickel, silver and tungsten alloys... with individual precision

● Why machine or cast small, intricate parts? Superior can produce quantities of accurate parts at a very low cost per piece by powder metallurgy. Every piece of a run will be uniform in size, strength and density. Superior can make alloyed metal parts to fit your application, recommending the right material for the job you have in mind. Consult Superior first.

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SUPERIOR CARBON PRODUCTS, INC.

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CIRCLE ED-245 ON READER-SERVICE CARD FOR MORE INFORMATION

In a
HURRY?
order **GTC**
Custom-Specified
TRANSFORMERS



NOW ... through a unique method ... "GTC" manufacturers' representatives are prepared to give you on-the-spot answers on delivery time, price and other pertinent details ... to accurately order to your particular electrical and mechanical requirements ... yet, to provide delivery practically from stock.



"GTC" calls it "Custom-specified." Prototype transformers are illustrated in detail to:

✓ eliminate time-consuming liaison between your engineers and ours



✓ reduce time for processing orders because sample submission is usually unnecessary

✓ realize cost economies through application of mass production techniques to limited quantities

✓ simplify and assure more accurate specifying of your requirements

Write today for the "GTC" representative in your area ... he'll be glad to call upon you at your convenience and show you how to save time and money on your transformers.

Our new and complete catalog is just off the press ... write for your copy.

**GENERAL
TRANSFORMER COMPANY**

serving industry since 1928
18240 Harwood Avenue,
Homewood, Illinois
(Suburb of Chicago)



CIRCLE ED-246 ON READER-SERVICE CARD FOR MORE INFORMATION

VSWR Measuring System

For 8500-9600Mc Range



The Model 110B X-Band VSWR Measuring System has an added attenuation scale and new vswr scales reading from 1.02 to 1.20 and 1.1 to 2.50.

The system includes a tunable oscillator, permitting complete and continuous coverage from 8500Mc to 9600Mc, an accurate wavemeter to supplement the direct-reading dial of the oscillator, a bi-directional coupler with bolometer detectors for incident and reflected power, and a direct-reading vswr indicator.

Overall accuracy is better than 2%. Simple operation makes the system easy to use. Other specifications are: r-f power source, V-260 klystron; wavemeter accuracy $\pm 0.08\%$; directivity of couplers, greater than 45db; output waveguide fitting, UG-39/U; indicator cabinet, 8-3/4" front panel for bench use or standard 19" rack; overall length of waveguide assembly, 31-3/4"; primary power, 115v 60cy. Color Television, Inc., Dept. ED, 932 E. San Carlos Ave., San Carlos, Calif.

CIRCLE ED-247 ON READER-SERVICE CARD FOR MORE INFORMATION

Klystron

For Airborne Radar Applications



flex klystron, the VA-203 is for airborne X-band radar receiver and beacon local oscillator service. It has a brazed-on external tuning cavity to assure exceptional frequency stability. This klystron can withstand shocks of 50G to 100G without malfunction or damage.

Among the unit's characteristics are negligible microphonics, slow tuning rate, long tuning life, and a single-shaft tuner which adapts easily to motor tuning. Weighing only 8 oz, it mates directly to standard waveguide flanges.

A companion klystron, the VA-201 is equipped with silastic leads, and resists shocks as high as 250G while performing with the same dependability as the VA-203. Varian Associates, Dept. ED, 711 Hansen Way, Palo Alto 2, Calif.

CIRCLE ED-248 ON READER-SERVICE CARD FOR MORE INFORMATION

DONNER analog computer

\$995

model 30 with 30-3 problem board as illustrated. f.o.b. Berkeley, Calif.



This versatile and compact Donner Model 30 is the first electronic computer specifically designed as a personal tool of the engineer, mathematician and scientist. It offers the speed and accuracy of electronic computation with slide rule operating simplicity wherever differential equations are used.

Write for Booklet No. 302 on the Model 30 and its applications.

DONNER SCIENTIFIC COMPANY

2829 SEVENTH STREET • BERKELEY 10, CALIFORNIA

CIRCLE ED-249 ON READER-SERVICE CARD FOR MORE INFORMATION

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.

**BAKER
& COMPANY INC. PRECIOUS METALS**

113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • CHICAGO • LOS ANGELES

CIRCLE ED-250 ON READER-SERVICE CARD FOR MORE INFORMATION

NEWLY-
DEVELOPED
Sub Miniature
Type 10
H-SERIES

hermetically sealed resistors

The "H" Series Precision Resistors are encapsulated in a tough plastic compound. The result is a solid, homogeneous unit with unparalleled ruggedness, impervious to the effects of moisture, thermal shock and mechanical shock. The plastic is filled with heat conducting mineral which dissipates the heat and equalizes the "hot spots" in the resistor winding. The sealed-in terminal connections are welded.



SPECIFICATIONS:

MILITARY SPECIFICATIONS:
Performance characteristics satisfy all requirements of MIL-R-93A & JAN-R-93.

TEMPERATURE COEFFICIENT: $\pm 0.0022\%$ per degree C.

OPERATING TEMPERATURE:
-65°C. to +125°C.

RESISTANCE ACCURACY:
Standard resistance tolerances are 1%, 0.5%, 0.25% and 0.1%.

TYPE 10 (Illustrated):
1/4" dia. x 1/2" long.
Resistance range: 1.0 ohm
-0.35 meg.

Send for Bulletin H for complete description on other physical sizes and wattage ranges.
11423 VANOWEN ST., N. HOLLYWOOD 4, CALIF.
Subsidiary of International Resistance Company

HYCOR
Company, Inc.

Trimmer Potentiometer In Wide Ranges of Values



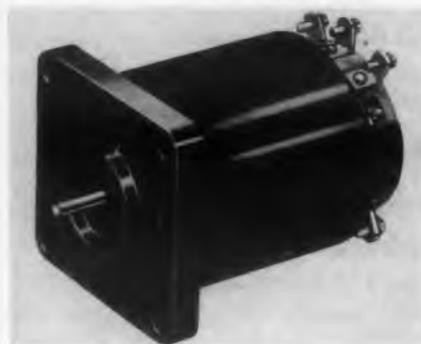
This 3/4" diam wire-wound potentiometer is available in standard values of 25, 500, 1000, 5000, 10,000, 50,000, and 100,000 ohms. A 5% resistance tolerance is standard with a temperature

coefficient of 0.00002 and a resolution of 0.1% available in the higher resistance values. The trimmer was especially designed for use in military aircraft instruments. The case is made of an unusually high-tensile-strength aluminum, terminals are gold plated, contacts are of precious metals, and the shaft and locating pins are of 303 stainless steel.

A standard locking device firmly holds the resistance setting under rugged vibration and shock conditions. The unit is moisture resistant with a Teflon gasket sealing the shaft. The pot is designed to operate at a temperature range of -55° to +125°C with a dielectric breakdown exceeding 1000v rms at 25°C. Maurey Instrument Co., Dept. ED, M-16, 2450 E. 72nd St., Chicago 49, Ill.

CIRCLE ED-253 ON READER-SERVICE CARD FOR MORE INFORMATION

Motor-Gear Train In a Single Case



The Type 3094 Power Motor-Gear Train combines motor and gear train in a single homogeneous unit. This homogeneous compactness reduces space and weight substantially. A typical example is 10-1/2 oz weight, 1-1/2" diam, and 3-1/2" length for the entire unit at a ratio of 523:1.

The motor-gear train has an extremely versatile range covering any ratio from 3:1 to 10,500:1. It is capable of withstanding an exceptionally high torque in relation to its size and weight. Typical examples are 100 lb-in of torque at a ratio of 523:1, and 1600 lb-in at 10,500:1. This versatile unit is designed for a wide variety of applications requiring a precision speed reducer with low backlash and low composite error at a moderate price. John Oster Manufacturing Co., Avionic Div., Dept. ED, 1 Main St., Racine, Wis.

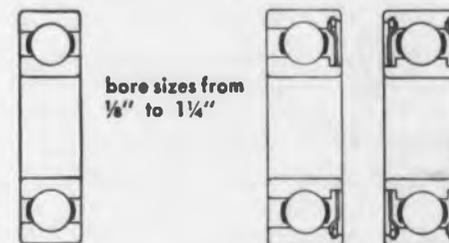
CIRCLE ED-254 ON READER-SERVICE CARD FOR MORE INFORMATION

Here's a way to pare instrument costs without pinching pennies

The wider selection of Fafnir instrument type ball bearings in ABEC classes 1, 3, 5, and 7 has resulted in important cost savings for many instrument manufacturers. With standard bearings available to meet your precise specifications, perhaps you can pare manufacturing costs without pinching pennies. Write for revised catalog. The Fafnir Bearing Company, New Britain, Conn.

A Few Standard Types

Inch Dimension Series



bore sizes from
1/8" to 1 1/4"

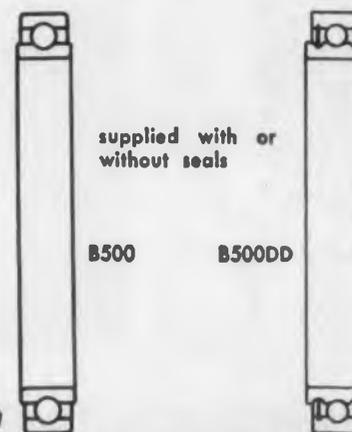
Flanged Bearings



(straight outside diameters) bore sizes: .1250, .1875, .2500, .3750
Flanged bearings (tapered outside diameters) bore sizes: .1250, .1875, .2500, .3125.

Both types available with removable steel shields.

Extra Light Torque Tube Type (500 SERIES)



supplied with or without seals

B500

B500DD

FAFNIR
BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

CIRCLE ED-255 ON READER-SERVICE CARD FOR MORE INFORMATION

SEE THE LATEST IN Electronics EQUIPMENT



FREE

Send for Newark's 1955 Catalog

Here are the latest releases in tubes, transformers, capacitors, test instruments and everything in electronics parts and equipment. See also the newest developments in Radio, TV and High Fidelity.

NEWARK
ELECTRIC COMPANY

Dept. ED-5, 223 W. Madison, Chicago 6, Ill.

CIRCLE ED-252 ON READER-SERVICE CARD FOR MORE INFORMATION

LECTRONIC DESIGN • May 1955

For knots that tie easier—faster—tighter
and will not slip!

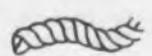


Fungus-Proof

NYLON Flat Braided TAPES and NYLON Lacing CORDS



TAPES Specially developed in wax finish,
wax-free and resin-coated finish.



CORDS Comply with ALL Construction and
Finish requirements of Gov. Spec.
Jan-T-713 and Jan-T-152.

The greater strength of these Tapes and Cords mean minimum breakage—minimum rejects—easier tying. Their special construction prevents knot slippage. Lacing actually tightens itself after knot is made.

Write for **FREE SAMPLES** and prices

The Heminway & Bartlett Mfg. Co., ELECTRONICS DIVISION, 500 5th Ave., N. Y. 36.
Sales Offices: Chicago, Philadelphia, Boston, St. Louis, Cincinnati, Dallas,
San Francisco, Los Angeles, Detroit, Charlotte, N. C., Gloversville, N. Y.,
Lynchburg, Va. Foreign Agent: Turner, Halsey Co., Inc., 40 Worth St., N. Y.

CIRCLE ED-256 ON READER-SERVICE CARD FOR MORE INFORMATION

3 Soldering Operations in 1 Easy as ABC

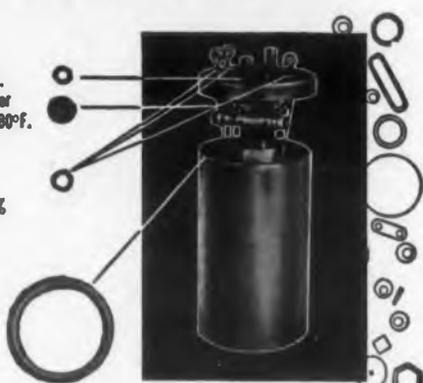
with

KESTER "SOLDERFORMS"

A Solder screws and stud to can cover.
"Solderform" Disc & Rings 5% Silver
—85% 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 • Brentford, Canada

CIRCLE ED-257 ON READER-SERVICE CARD FOR MORE INFORMATION

116

Color Picture Tube Uses Phosphor-Dot Screen



RCA-21AXP22
is a directly
viewed picture
tube of the metal-
shell type for use
in color TV recei-
vers. It is capa-
ble of produ-
cing either a
full-color or a
black-and-white
picture measur-
ing 19-5/16" x
15-1/4" with

rounded sides and having a projected area of 260 sq in.

The tube utilizes three electrostatic-focus guns spaced 120° apart with axes tilted toward the tube axis to facilitate convergence of the three beams at the shadow mask; individual convergence control of each beam radially by internal magnetic poles and supplemental control of the blue beam tangentially by internal magnetic poles; and an assembly consisting of a spherical metal shadow mask with uniform holes and a metallized, tricolor, phosphor-dot screen on the inner surface of the spherical Filterglass faceplate. The screen is composed of an orderly array of small, closely spaced, phosphor dots arranged in triangular groups. Each group consists of a green-emitting dot, a red-emitting dot, and blue-emitting dot, and is aligned with a corresponding hole in the shadow mask. Tube Div., Radio Corp. of America, Dept. ED, Harrison, N. J.

CIRCLE ED-258 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Generator Covers Wide Frequency Range



The Model 1420-B Variable Frequency Electronic Generator is a versatile power source for use in the development or testing of equipment operating over a range of power supply frequencies. The frequency range of its internal oscillator is 50-6000cy with an external oscillator of 25cy-20kc.

Power output is 300va. Distortion is under 2%. Regulation is less than 2%, no-load to

full-load. Nominal output voltages of 80, 120, 135, 215, 255, and 270v are available. The unit's 12db inverse feedback insures low dynamic output impedance. Communication Measurements Laboratory, Inc., Dept. ED, 350 Leland Ave., Plainfield, N. J.

CIRCLE ED-259 ON READER-SERVICE CARD FOR MORE INFORMATION

The Sign of precision engineered TRANSFORMERS for greater DEPENDABILITY QUALITY CONSTRUCTION



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PULSE**

TRANSFORMERS & INDUCTORS
High Temperature-Miniaturized
Encapsulated Units.

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latest brochure

**INDUSTRIAL TRANSFORMER
Corporation**
GOULDSBORO PENNSYLVANIA

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



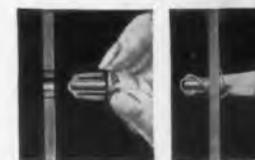
It's a Shelf Support... For ranges or refrigerators—in plastic and metal. Leading appliance makers have achieved substantial installation savings through it.



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. Head can be designed without affecting fastening principle.



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

What's Your Application?

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

Send for more data and samples today.

**Simmons
Fasteners**

**QUICK-LOCK • SPRING-LOCK
ROTO-LOCK**

CIRCLE ED-261 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May



GUIDE TO VOLTAGE SPEED CURRENT SERVO CONTROL

ON REQUEST

This new 12-page illustrated bulletin describes the wide variety of control situations to which the REGOHM electro-mechanical controller is adaptable.

Learn how REGOHM will provide sensitivity, speed of response and system stabilization under severe operating conditions in your control system.

Circuit diagrams illustrating the many applications of this versatile, automatic controller, are given.

Text and illustrations describe the functions, design advantages, operation and control characteristics of this small size, lightweight, plug-in device.

Write for Bulletin 505.00. Address Dept. G, Electric Regulator Corporation, Norwalk, Conn.

REGOHM



CIRCLE ED-262 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.

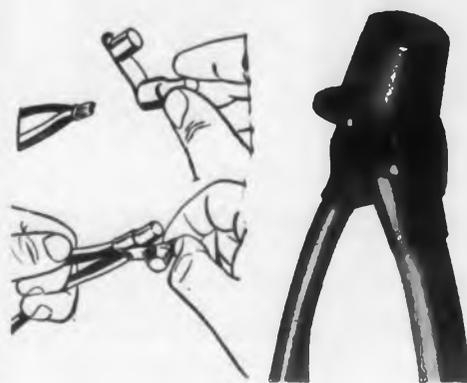
Bourns also manufactures precision potentiometers to measure Linear Motion; Gage, Absolute, and Differential Pressure and Acceleration.

Bourns Laboratories

6135 MAGNOLIA AVENUE, RIVERSIDE, CALIFORNIA
3 U.S. PATENTS PENDING Technical Bulletin on Request, Dept. 232

CIRCLE ED-263 ON READER-SERVICE CARD FOR MORE INFORMATION

Crimp Connector For Diaper-Wrap Insulators



This crimp-type wire connector with a diaper-wrap insulator provides a connection of extremely high mechanical strength and insulating qualities. The connector has only two

parts, the sleeve and the patented insulating "Wrap-Cap". Both parts are listed by Underwriters' Laboratories, Inc., for general use for branch circuits and fixture wiring.

The insulator is applied by pushing it down over the crimped sleeve and wires and then drawing the tabbed cap and connecting strip through the wires and over the end of the joint in a diaper-wrap. The insulator provides a prefabricated insulating job; without the use of tape, it insulates all around the joint and between wires, and provides double thick, puncture-proof insulation over the sleeve and wire ends.

The insulator is made of the same type of flexible vinyl material used for TW wire and is practically impervious to aging, corrosive atmospheres, sunlight, gasoline, etc. It is listed for maximum temperature of 165°F and works easily at -10°F. The crimp sleeve is made of cadmium-plated steel to insure greater holding power. It is open at both ends to allow visual observation of the joint. Ideal Industries, Inc., Dept. ED, Sycamore, Ill.

CIRCLE ED-264 ON READER-SERVICE CARD FOR MORE INFORMATION

Elapsed Time Meters Available in Sealed Cases



This Elapsed Time Meter is available in 2-1/2" and 3-1/2" sealed and Bakelite cases conforming dimensionally to MIL specifications. Standard ratings include commercial voltages and frequencies, with five-digit registers reading total hours or tenths of

hours. Standard ratings are stocked. Special ratings to customer requirements are available. All sizes are styled to match other panel meters in this firm's line. Instrument Div., Roller-Smith Corp., Dept. ED, Bethlehem, Pa.

CIRCLE ED-265 ON READER-SERVICE CARD FOR MORE INFORMATION



Corning Type N Precision Resistors. Rugged. Stable. And Economical.

For critical accuracy, extreme stability...

Rugged Corning Type N Film-Type Resistors

When you need a precision resistor for really hard work, our Type N accurate grade is a likely job candidate.

We make it to a standard tolerance of 1%, but we can tighten up if you wish. You can operate Type N's at ambient temperatures up to 140°C. with derating. Their noise level is so low, you'll have difficulty measuring it.

They have a negligible voltage coefficient averaging less than .001% per volt. You needn't worry about moisture because both core and film are absolutely impervious.

Stability means that the average change of resistance after 500 hours at maximum dissipation is less than 0.5%. A standard 5-second overload of 6.25 times rated power causes a permanent resistance change of less than .75%. Type N resistors are non-inductive.

These accurate grade resistors overcome the inadequacies of conventional resistors in many advanced circuits. We recommend them to you for use in circuits where other resistors aren't up to the task or cost too much.

Specifically, you'll find these resistors most useful for radio and TV equipment, HF circuits, test equipment, and low-signal, hi-gain amplifier stages. Their stability and ruggedness make special handling unnecessary. Made to MIL-R-10509A Specifications.

Fine as they are, Corning Type N Resistors cost remarkably little. For complete technical information and price lists, use the coupon.



Corning Type R High-Power Resistors—Range from 25 to 1,000,000 ohms, ratings from 7 to 115W, are non-inductive. Exceptionally good noise and frequency characteristics. Excellent moisture resistance and overload capacity recommend them for stable long-life service under adverse conditions. Meet MIL-R-11804A Specifications.



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New Products Division

Please send me descriptive catalog sheet on Corning Type N Film-Type Resistors.

Name.....

Title.....

Company.....

Address.....

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

CIRCLE ED-266 ON READER-SERVICE CARD FOR MORE INFORMATION



What's
Your Use for...

vernistat... The Revolutionary New Precision Variable-Ratio Transformer

Analog Computers? Servos? Control Systems? The Vernistat is a completely new type of voltage divider that combines low output impedance with an inherently high resolution and linearity not ordinarily attainable by precision potentiometers.

The Vernistat consists of a tapped auto-transformer which provides the basic division of voltage into several discrete levels. These levels are selected and further sub-divided by a continuous interpolating potentiometer that moves between 31 transformer taps.

Because of its unique operating principles, electrical rotation is held to close tolerances eliminating the need for trim resistors. In many applications there is no need for impedance matching amplifiers.

Specifications of the standard model Vernistat are shown below. Other versions are under development to meet specific end uses.

What are your requirements for this unique precision voltage divider?

SPECIFICATIONS

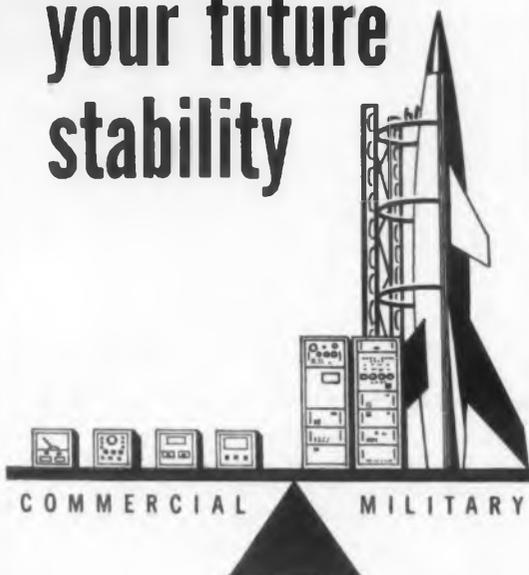
Linearity Tolerance better than $\pm 0.05\%$	Frequency	50-3000 cps
Output Impedance 130 ohms (max.)	Max. Output Current	50 ma
Minimum Voltage Increment	better than .01%	

Other models including a miniaturized 400 cps version will soon be available.

vernistat division Perkin-Elmer Corporation, Norwalk, Conn.

CIRCLE ED-267 ON READER-SERVICE CARD FOR MORE INFORMATION

In Hycon's balance.... your future stability



Hycon activities are part military, part commercial... a balanced blend of electronics, ordnance, photography. Qualified men with the following specialized electronic training or experience can find in this atmosphere long-term careers both satisfying and stimulating:

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MICROWAVE CIRCUIT AND COMPONENT DESIGN... in radar, microwave, traveling wave tubes, etc.

PULSE CIRCUITRY DESIGN... radar and allied applications, microwave circuitry.

SERVOMECHANISM AND ANALOG COMPUTER DESIGN... control systems, magnetic amplifiers, and similar fields.

ELECTRONICS SYSTEMS ENGINEERING... instrumentation, microwave, and control system design, particularly in guided missiles.

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Hycon Mfg. Company

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CIRCLE ED-269 ON READER-SERVICE CARD FOR MORE INFORMATION



High speed, direct reading. Indicates increment of measurement in radar navigation instruments.



"Y" Rotary Counter used in navigating instruments.

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For RADAR • ELECTRONIC • INSTRUMENT Applications



Special counter for Tape Recorder to indicate position of tape passing through recorder.



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PRODUCTIMETERS

SINCE 1879 *Count Everything*

CIRCLE ED-268 ON READER-SERVICE CARD FOR MORE INFORMATION

Vertical Gyro

Stabilizes Free Drift Rate



This new-type vertical gyro, Series 2153, is designed to reduce and stabilize free drift error. It is a vertical reference for such gyro-stabilized equipment as remote attitude indicators, autopilot

lots, and bombing systems. It eliminates variations in free drift with changes in operating temperatures heretofore a major deficiency in operational gyro. The success in meeting this problem is attributable largely to techniques which permit the use of steel parts throughout, removing the factor of differential expansion. Steel construction should also reduce cost.

Friction-reducing features, combined with the increased momentum of a large wheel, results in three-to-one improvement in the vital friction-to-momentum ratio.

Power requirements are 115v, three-phase, 400cy and 27.5v d-c. Spin axis erection is accomplished by 400cy, single-phase 55v for initial erection, and later to 20v during normal erection. The gyro has a minimum angular momentum of 8.0×10^8 gm-cm²/sec. Rotor speed is approximately 23,500rpm. It has 360° of freedom in roll and $\pm 82^\circ$ in pitch. The erection system is capable of maintaining the spin axis within $1/10^\circ$ of vertical when free of external acceleration. Free drift error is less than 0.25° per minute. Let's contact Wirt Co., Dept. ED, 80, 110 Ionia, N.W., Grand Rapids 2, Mich.

CIRCLE ED-270 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors

In Ratings from 5-18,000 ohms



The units shown are the test additions to this fine line of resistors. Employing a unique method for attaching the leads to the body of the resistor, the construction is designed to provide desirable in mechanical and electrical connections. Wound on ceramic cores and covered with an extremely hard ceramic based coating, they are available in 4w to 25w, 5 ohms to 18,000 ohms resistance.

Wirt Co., Dept. ED, 5221-27 Greene St., Philadelphia 44, Pa.

CIRCLE ED-271 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicating Controller For Automation Applications



The basic purpose of the "Versatrol" is to detect minute changes of current or voltage while indicating their magnitude. It trips relays for control as a result of these changes.

Some of the present applications include: milling water monitors (a dull tool pulls more load), automatic pH alarm, photocell light detectors, battery chargers, control of vacuum in TV tubes, moisture content, and gas alarm devices.

Contact is made directly in the sensitive meter-ay. There is a signal input section and a section that controls the power. Signal input may be microamps or millivolts, a-c or d-c. Control sensitivity may range from 0.2 μ amp to 1000amp or more, voltage sensitivities from 0.1mv to over 500v.

Contact setting is adjustable, from front, to any point on the scale. Or, contacts may be preset and non-adjustable. The power relay is rated 5amp, 115v, and is non-inductive, spdt. Built-in heavy-duty relays 40amp are available and can be supplied in the cabinet. There are "Panelmount" and U-Mount styles for custom installations. Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE ED-272 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Mounts

Serve as Mixers, Detectors



The Model 497C and 497K Microwave Mixer Crystal Mounts operate without tuning over the 5.4-5.9-kMc and 15.75-17.25kMc ranges, respectively. These

mounts are useful in the laboratory as mixers also as video detectors. They have single-ended output for operation into 400 ohms, nominally. Output capacitance is about 13mmfd.

High detection efficiency is afforded because the crystal effectively terminates the waveguide to present a low vswr over the operating range. Thus, neither an attenuator nor an absorption termination is necessary to maintain the low vswr. Commercial products, Div. of Aircraft Armanents, Inc., Dept. 4003 Seven Mile Lane., Baltimore 8, Md.

CIRCLE ED-273 ON READER-SERVICE CARD FOR MORE INFORMATION

Inconel spring maintains vital contact pressure in Edison 501 Thermal Relay

Special-purpose relay uses 7 different Nickel Alloys



A preloaded Inconel spring fulfills one of the most important requirements in this Edison Time Delay Relay. It maintains steady contact pressure.

Inconel was chosen because it remains strong and resilient. Retains its spring properties at the operating temperature of the bimetal elements. Retains them during evacuation and out-gassing in manufacture.

Other Nickel Alloys used

In this thermal relay, Thomas A. Edison Incorporated also uses: *Monel rivets* that combine corrosion resistance and high strength. *Nickel-chromium heater resistance wires* that give long stable life at high temperatures. And "*A*" *Nickel wire leads* that retain stable electrical characteristics after repeated heating. They also use *Invar and Wilson Alloy #20 and Nickel-iron alloy glass-to-metal wire leads*.

Heating element and bimetal can be selected to introduce a circuit delay of from 2 seconds to 5 minutes.

Perhaps one of the Inco Nickel Alloys can help solve your problem on a specialized electronic design.

Get this helpful FREE booklet

Inco Nickel Alloys for Electronic Uses is the title of a booklet that you will find convenient for reference when you have a metal selection problem. It gives you the general characteristics, typical uses and available forms for 16 nickel alloys most useful in electronic design. It also gives you a list of more detailed literature. For your free copy of this helpful booklet, circle the number below on the reply card in this magazine.

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"S"® MONEL • INCONEL® • INCONEL "X"®
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NICKEL • LOW CARBON NICKEL • DURANICKEL®

CIRCLE ED-274 ON READER-SERVICE CARD FOR MORE INFORMATION

Here is a pair of "Problem-Solvers" For Designers of Electrical Control Systems

FRAHM® REED RELAYS

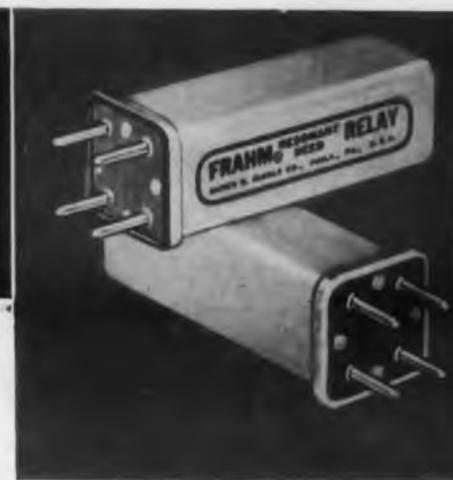
◀ FRAHM OSCILLATORS



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.

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
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PHILADELPHIA 7, PA.

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.
Gentlemen:

Please send me Bulletin 33-ED—
Frahm Relays
 Bulletins 34-10-ED—Frahm
Oscillators

NAME

JOB FUNCTION

COMPANY

ADDRESS

CIRCLE ED-206 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW TRANSFORMER CORE!

Valparaiso, Indiana, April, 1955
—The Indiana Steel Products Company has developed a new product...a wound core, consisting of just ONE PIECE, not two pieces as in conventional C-type cores.

ADVANTAGES: One air gap, instead of two gives better performance...exciting current normally lower, often by significant amount. Vacuum impregnating unnecessary...resulting electrical losses eliminated. No "halves" to mix up. Slight "tilt," sometimes present on ground pole faces of C-cores, completely eliminated.

Manufacturing economies reflected in low price. For descriptive literature, write Indiana Steel Products Co., Dept. M-5, Valparaiso, Indiana.

CIRCLE ED-275 ON READER-SERVICE CARD FOR MORE INFORMATION

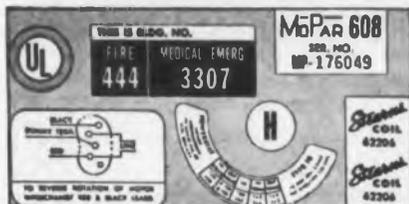
SELF-STICKING MARKERS

FOR WIRES

For marking wires, harnesses, circuits, coils, assemblies, etc. Stick and stay stuck up to 300°F. Fast, foolproof, low cost identification for any size wire. 2000 NEMA - ASA markers in stock.



FOR SPECIAL APPLICATIONS



Instructions, trade marks, wiring diagrams, serial numbers, part numbers, etc. Any wording, size, color and die-cut shape you need. Cut to exact tolerances.

SELF-STICKING • FAST • LOW COST

Informative literature and free samples. Write:

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CIRCLE ED-276 ON READER-SERVICE CARD FOR MORE INFORMATION

Capacitors

Withstands Severe Environments



In these "Stea-caps", steatite encased tubular paper capacitors, the capacitor section is assembled in a dense steatite tube that is a practically perfect moisture barrier. The ends

are sealed with a thermo-setting plastic compound that forms a moisture-proof bond to the wire terminals and the steatite tube. This construction makes a capacitor capable of withstanding the most severe tests and operating conditions, including the temperature of soldering and body contact with a soldering iron.

The capacitors are conservatively rated for continuous operation in the temperature range of -40° to $+85^{\circ}$ C. They are made in all the preferred standard capacitance values for $\pm 20\%$ and $\pm 10\%$ tolerances in the ranges of from 0.01-1mfd at 200v d-c, 0.005-0.04mfd at 400v d-c w, 0.001-0.27mfd at 600v d-c, and 0.001-0.1mfd at 1000v d-c. Micamold Radio Corp., Dept. ED, 1087 Flushing Ave., Brooklyn 37, N. Y.

CIRCLE ED-277 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic Counter

Uses Multiple Decades



Making use of quickly interchangeable plug-in miniature decade counters, the direct-reading Model C-101 multiple decade counter employs one 30ke and four 10ke decade counters. The 30ke counter is provided with an input shaper circuit and is operable with inputs ranging from 6v to 50v.

The entire decade counter is only 10" long x 3-1/4" high x 3-1/2" deep. It is provided with a self-contained power supply for direct operation from a 117v single-phase source. It can be used for counting operations, objects, and other electrical and physical phenomena. It can be used directly as a measuring instrument in laboratories and in industrial applications, or can be integrated into other apparatus used in automation or computation. Ransom Research, Dept. ED, P. O. Box 382, San Pedro, Calif.

CIRCLE ED-278 ON READER-SERVICE CARD FOR MORE INFORMATION

new!

MicrodotTM Brochure

...How to use the world's smallest, lightest coax

Write for our helpful free Brochure illustrating the world's only complete line of microminiature Coax Connectors, Cables, Tools and Assemblies, including MininoiseTM Cable to reduce self-generated noise 99%.



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Erie-ChemelecTM TEFLON

Insulated ELECTRONIC COMPONENTS

Now Available
From Electronic Distributors



TEFLON Tube Sockets **KEL-F** Tube Sockets

Illustrated above are ERIE TEFLON and KEL-F seven and nine pin Miniature Tube Sockets, which meet all RETMA and JAN Specifications and below the spaghetti which comes in five sizes and three colors. The Erie-Chemelec Teflon line also includes Stand-Off and Feed-Thru Insulators; Crystal Sockets; and nine, fifteen and eighteen pin Connectors.

Write for catalog, price list and the name of your nearest stocking Erie-Chemelec Electronic Parts Distributor.

TEFLON SPAGHETTI



ELECTRONICS DISTRIBUTOR DIVISION
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CIRCLE ED-280 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • May

specify standard



UNBRAKO SHOULDERSCREWS

Use them in tool and die work. Use them in assembly. These heat-treated alloy steel screws have knurled heads for sure finger grip and fast assembly; accurate hex sockets for positive nonslip internal wrenching. Shoulders are held to extremely fine tolerances, and finished threads run close up for maximum holding power. Standard sizes— $\frac{1}{4}$ " to $\frac{3}{4}$ " in a full range of body lengths—are stocked by authorized industrial distributors. Write for Bulletin 877. STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

UNBRAKO SOCKET SCREW DIVISION

SPS

JENKINTOWN PENNSYLVANIA

CIRCLE ED-281 ON READER-SERVICE CARD FOR MORE INFORMATION



NEW FULL-TRACK REDHEADS FOR PROFESSIONAL RECORDING

New full-track magnetic recording heads join the famous Brush Redhead series. Designed for the best in professional recording, these heads provide improved signal to noise ratio and greater dynamic range. Uniform track width and $\frac{1}{4}$ mil gap assure faithful reproduction over an extended frequency range. Separate full-track heads for recording, reproducing and erasing are available. For information on the complete line of Brush magnetic heads—single and multi-channel—write Brush Electronics Company, Dept. ED-282, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

INDUSTRIAL AND RESEARCH INSTRUMENTS
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MAGNETIC RECORDING EQUIPMENT AND COMPONENTS



Division of
Clevite Corporation

CIRCLE ED-282 ON READER-SERVICE CARD FOR MORE INFORMATION

Digital Cycling Counter Gives Speeds to 100,000cps



This five-bank Digital Cycling Counter, Model N-655, is suitable for counting events, measuring frequencies, determining rpm, and other similar basic

measurement applications. It consists of an amplifier at the input, together with a shaping circuit for converting the input information into trigger pulses suitable for driving high-speed electronic counters. A gating circuit is inserted between the trigger and the counter for controlling the flow of information; this permits counting over a precise time interval which is supplied from an internal time base generator controlled by a temperature compensated crystal. Dividers reduce the intervals to 0.01, 0.10, and 1.00-sec, or, on special order, to 10.0sec.

By proper choice of time intervals, the number of events per second, frequency in cycles per second, or speed in rpm can be obtained. Speeds as high as 100,000 counts per second are possible. When using this instrument, it is possible to utilize an accessory device which permits the presetting of one or more counts. It is thus possible to use the cycling counter as a control device in which frequency or speed may be controlled to very close limits by presetting an upper and lower limit. The output of the decade counter may also be recorded on a Brush Direct-Writing Oscillograph. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

CIRCLE ED-283 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformers 0.07 μ sec Rise Time



The GFZ 10-1, a 7-pin impedance-matching ferrite-core pulse transformer, has an impedance ratio of 10:1 for matching 1000 ohms to 100 ohms. The unit is epoxy-resin impregnated and cast. It is designed to surpass MIL-T-27, Grade 1, Class A test specifications, and is useful for coupling a 2μ sec pulse with less than 5% tilt and overshoot. Rise time is less than 0.07μ sec. Size is $23/32$ " diam x $1-1/16$ ". The Gudeman Company of California, Inc., Dept. ED, 9200 Exposition Blvd., Los Angeles 34, Calif.

CIRCLE ED-284 ON READER-SERVICE CARD FOR MORE INFORMATION

KAY Mega-Sweep



Wide Range, Wide Sweep

SWEEPING OSCILLATOR

Widest range of the Kay line of sweeping oscillators, the Kay Mega-Sweep provides continuous frequency coverage up through UHF-TV bands—50 kc to 1000 mc. Widely used in radar system development and in alignment and testing TV and FM systems and components, as well as wide band IF and RF amplifiers and filters.

SPECIFICATIONS

Freq. Range: 50 kc to 1000 mc.

Freq. Sweep: Sawtooth, adjustable to 40 mc. Repetition rate, 50 to 100 c/s.

RF Output: High, approx. 100 mv max into open circuit. Low, 5 mv into open circuit.

RF Output Control: Microwave attenuator continuously variable to 26 db.

Output Waveform: Less than 5% harmonic distortion at max. output.

Meter: Provides crystal detector current for peak output.

Regulated Power Supply: 105-125 v., 50 to 60 cps. Power Input, 100 watts.

Write for Catalog 100-A

Price: \$465.00 f.o.b. factory.

KAY ELECTRIC COMPANY

Dept. ED-5 14 MAPLE AVE., PINE BROOK, N. J.

CIRCLE ED-285 ON READER-SERVICE CARD FOR MORE INFORMATION

Now you can
DIP-SOLDER
resistor connections
with

THE SPEER SOLDER-BATH RESISTOR

- Specifically made for automatic dip-soldering to printed circuit terminals.
- Assures secure dip-soldered joints without flux and without re-tinning.
- High solderability of specially tinned leads gives firmer joints—closer to the resistor body.

Send coupon for complete information on Speer's new solder-bath resistor.

SPEER RESISTOR DIVISION
Speer Carbon Company
Bradford, Pennsylvania

Please send the full story on your solder-bath resistor.

NAME _____ TITLE _____

COMPANY _____

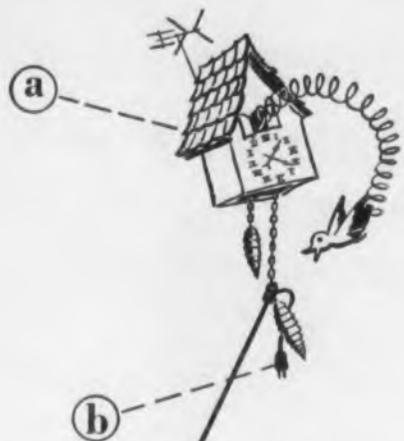
ADDRESS _____



SPEER RESISTOR DIVISION
SPEER CARBON COMPANY
Bradford, Pennsylvania

Other Divisions: Jeffers Electronics International Graphite & Electrode

CIRCLE ED-286 ON READER-SERVICE CARD FOR MORE INFORMATION



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For lack of **a** time his cord set requirements **b** were ordered late and with haste. Result **c** big trouble (and losses) for himself, his company and its products.

Standardized CL cord sets ordered now will lick this gruesome possibility. Take a minute and call your Cords Ltd. salesman today. No obligation.



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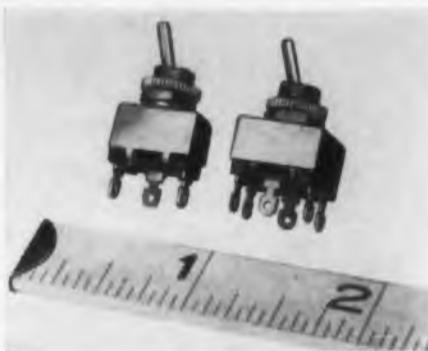
RAPIDESIGN INC.

P. O. BOX 592 GLENDALE, CALIF.

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Toggle Switches

Offered in 50% Smaller Designs



These subminiature "TorBal" toggle switches reduce by a half standard size and weight. Available in spdt and dpdt, they are contact rated for 10amp at 50v d-c and weigh 0.15 oz and 0.22 oz, respectively. They are available for commercial as well as aircraft and other military electrical-electronic circuit applications where savings in space and weight are important.

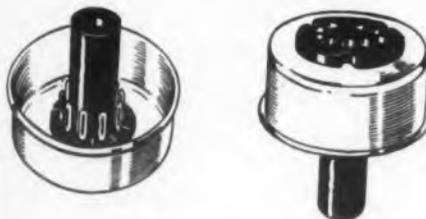
Dimensions, including terminals and handle, are 0.25" x 0.5" x 1.047" for the spdt and 0.5" x 0.5" x 1.047" for the dpdt. Both switches conform to electrical and environmental requirements of JAN S-23 Amendment 3. They are corrosion proof, will operate in the temperature range of -55° to +85° C, and have a contact resistance of less than 0.003 ohms and insulation resistance of over 100,000 megohms at 100v d-c and 70°F.

The switches are single-hole mounted, and the one-piece housings are of aluminum bronze alloy. A silicone boot is available to cover the handle for panel-sealing. The mounting bushing length and threads can be varied for special applications. The Torsion Balance Co., Dept. ED, Clifton, N. J.

CIRCLE ED-289 ON READER-SERVICE CARD FOR MORE INFORMATION

High Voltage Sockets

Eliminate Corona Problems



These "Hi-Voltage and Anti-Corona" sockets for 1 x 2 type tubes meet UL requirements and are guaranteed against tracking or carbonizing from corona. The sockets are designed to eliminate arcing when subjected to voltage between socket pins and the screw extending 3/8" in the hole at bottom of post. Extremely compact in design, they are easily mounted to the chassis with a self tapping screw.

Available in general-purpose phenolic or mica-filled phenolic, the units have a cup diameter of 1-1/2" or 1-5/16". Depth of cup is 1/2" or 11/16". Height of post under socket is 1-1/8" or 1-3/8", or any combination required. National Fabricated Products Inc., Dept. ED, 2650 W. Belden Ave., Chicago 47, Ill.

CIRCLE ED-290 ON READER-SERVICE CARD FOR MORE INFORMATION

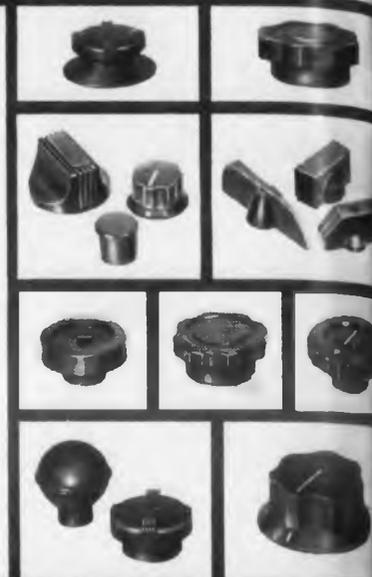
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★ Clarostat-exclusive Series 42-900 is a stock item. Immediately available from distributor or factory. Ideal for prototype assemblies or pilot runs; for lab and instrument usages; for rigid military requirements. Functional outputs obtainable by resistance-loading each side of center tap. Extension rear shaft. Can be coupled to other potentiometers; to switches, servos and other devices. ★ Descriptive literature on request.

Single-turn. Contact resistance to 100,000.

★ Quality plus. Gold terminals, bushings. Anodized end-plates.

★ Continuous rotation. Changing stop screw.

★ Inserted oil-impregnated bearings for great operational life.

★ Exceeds JAN-R-19 where applicable.



CIRCLE ED-292 ON READER-SERVICE CARD FOR MORE INFORMATION

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POWER
PICK-UP
OR
STOPS!**

Miniature, precision **CLUTCH or Clutch Brake**

These components provide instantaneous response for use in electro-mechanical control systems, servo-mechanisms, computers, missile instrumentation, and other devices.

Energizing the coil magnetically engages input and output shafts. De-energizing disengages shafts, and provides brake action if desired. Energizing or de-energizing will induce no angular displacement error. Through output shafts allow concentric input and output on the same end for use in gear train mounting. Standard coil voltage is 28v dc, but can be modified to requirements. Dia. 1 1/4". Lgth. 1 1/4". Wgt. 6.6 ozs.

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Generators • Governors
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**1797 STANLEY AVE.
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High-Slope Pentode For Wide Band Amplifiers



The Mullard *E180F* is a new miniature pentode with a high mutual conductance of 16.5ma. This, together with its low interelectrode capacitances, makes the tube ideal for all wide-band amplifier applications, such as radar i-f amplifiers, high definition television cameras and transmission equipment, and carrier telephone equipment, especially that used with coaxial telephone cables.

Control grid wires are spaced only 60 microns. The construction employs unusually fine grid wire and enables variations from valve to valve to be kept small, resulting in close tolerances on certain electrical characteristics, notably interelectrode capacitances.

The cold input and output capacitances are 7.9 μ f and 2.9 μ f respectively, giving a slope to capacitance ratio of about 1.7:1. The anode current under normal operating conditions is 13ma, at an anode voltage of 180v. Under these conditions the working input capacitance is 11.2pF. The heater rating is 6.3v, 0.3amp, and the base is B9G (noval). The equivalent noise resistance is only 460 ohms. Where even lower noise is called for, the valve may be triode connected; the equivalent noise resistance is then 150 ohms. Mullard, Ltd., Dept. ED, Century House, Shaftesbury Ave., London, W. C. 2, England.

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CIRCLE ED-295 ON READER-SERVICE CARD FOR MORE INFORMATION

Decade Delay Line

Only 1 μ sec Overall



The Model GD-D2-1000-1 Decade Delay Line has an overall delay of 1 μ sec. Dial-selected taps are at 0.1 μ sec intervals. Impedance is 1000 ohms, and overall rise time is 0.1 μ sec.

The delay element is hermetically sealed in epoxy resin, and the selectors for delay and termination are equipped with ceramic wafer switches which have solid silver contacts. Size of the unit is 7-5/8" x 4-3/8" x 4-3/8". The Gudeman Co. of California, Inc., 9200 Exposition Blvd, Los Angeles 34, Calif.

CIRCLE ED-296 ON READER-SERVICE CARD FOR MORE INFORMATION



8 pin Octal
to Octal

7 pin Min.
to 8 pin Octal

8 pin Octal
to 7 pin Min.

Available to adapt from
any standard tube socket
to almost any other socket.

Write for free catalog.



Change Tube Types Without Rewiring use *Vector* TUBE SOCKET ADAPTORS

Enable you to quickly adapt from one socket to another easily, neatly and economically without change in chassis wiring. Can be wired by factory in production quantities. Also supplied with like sockets and plugs for test or modification uses.

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0.001% Regulation at 1/2 Amp.



MODEL UHR-240

- 0-500 volts 0-500 ma
- 0.001% Regulation
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- 0.1 Millivolts Ripple
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The internal impedance is less than 0.005 ohms for low frequencies and d-c and less than 0.1 ohms for frequencies as high as 100 kc.

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The ultra-high regulation applies over the entire operating range. Full maximum current can be drawn continuously at any output voltage, from 105 to 125 volt line.

For further details write

Price \$550.00

KROHN-HITE INSTRUMENT COMPANY

Dept. ED, 580 Massachusetts Avenue, Cambridge 39, Mass.

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161 control steps!

That's what you get in Ward Leonard's 13" Multi-step plate rheostat — what's more, you get 161 steps whether it's a 2 ohm or a 1000 ohm plate.

You get smoother operation and longer life in any W/L rheostat and you take your pick from the most complete line of power rheostats ever offered for industrial and commercial applications.

Write for free data-packed Bulletin 60A. Ward Leonard Electric Co. 77 South St., Mount Vernon, N.Y. 4.12

WARD LEONARD ELECTRIC CO.

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RESISTORS • RELAYS • MOTOR CONTROLS • CHROMASTER



CIRCLE ED-300 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Toggle Switch

Sealed and Tested to 75psi



The miniaturized, panel-sealed, "K-W" toggle switch, tested to more than 300,000 cycles, reduces behind-panel space by 50%, and can

withstand acceleration, impact, and vibration to 200G. Because of special, patented features, the switch eliminates contact bouncing. Advantages include corrosion-proof and explosion-proof construction. Construction eliminates the need for a bulky boot to keep out moisture and dust.

The miniaturized device has a switch case 1.15" x 0.625" x 0.415". Silicone rubber bonded to its stainless-steel bushing gives the switch its panel-sealed feature. Screw-type terminals emerging from the rear are also offered.

The switch now makes possible the control of hermetically sealed assemblies by toggle action. Each sealed bushing is tested to 75psi. Official underwater tests have been successful beyond 150 feet. Contact rating is 10amp at 125v a-c; 10amp at 30v d-c; and 1.5amp at 125v d-c. Opening force is 95gr; closing force is 85gr. Insulation resistance is better than 1000 megohms at 70°F. Dielectric strength is checked at 1000v rms.

The switch has military authorization for replacement of JAN S-23: ST 42, and ST 52 types. Hermetronic Controls Div., General Hermetic Sealing Corp., Dept. ED, 99 E. Hawthorne Ave., Valley Stream, N. Y.

CIRCLE ED-301 ON READER-SERVICE CARD FOR MORE INFORMATION

Mechanical Differential

In Four Hollow-Shaft Sizes



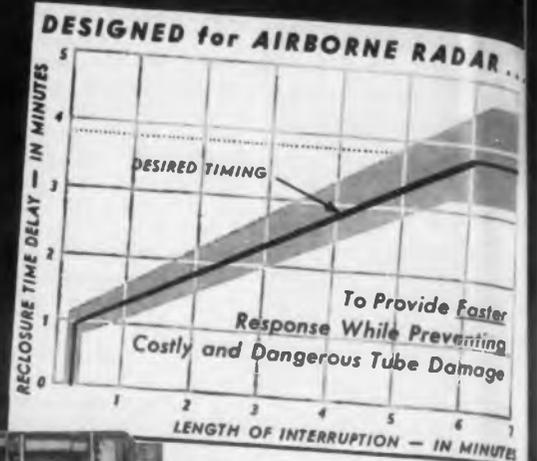
This precision, hollow-shaft differential provides high speed rotation, minimum backlash, and low breakaway torque. A simple shaft lock provides for easy removal of the differential from

a gear train without disassembly of the end plates.

Differentials are available for shaft sizes of 0.062", 0.125", 0.187", and 0.250". All differentials have precision ball bearings throughout and are constructed of stainless steel. Sterling Precision Instrument Corp., Instrument Division, Dept. ED, 34-17 Lawrence St., Flushing 54, N. Y.

CIRCLE ED-302 ON READER-SERVICE CARD FOR MORE INFORMATION

There'd be no "blip" without power control by the **A.W. HAYDON CO.**



**double
delayed reset
time delay relay**

WHEN TIMING POSES A PROBLEM COME

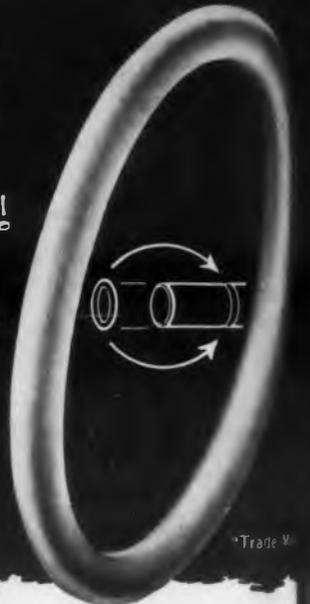


Design and Manufacture of Electro-Mechanical Timing Devices

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Plasti-Rings*
CUT SHAFT
RETAINING COSTS

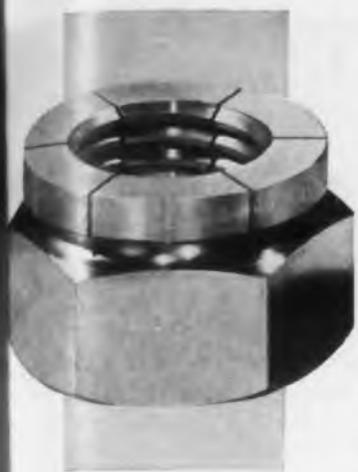


Slash costs of shaft retention and provide a more powerful, efficient retaining device. Made of elastic vinyl that's oil, chemical and corrosion resistant, SHAKEPROOF Plasti-Rings roll into prepared grooves on shaft . . . provide a shoulder that withstands up to 250 lbs. direct shear. 16 sizes: 1/8" - 1" shaft size. Send for free Sample Kit and Booklet today!

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specify
standard

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SELF-LOCKING NUTS

FLEXLOC
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FEATURES

one-piece, all-metal
construction
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segments

lock and stop nut in
one
every thread carries
its full share of load
controlled locking torques

DO YOU KNOW? Because they have resilient locking segments, FLEXLOCs can be used effectively on bolts of varying diameter tolerances. The resilient segments accommodate themselves to the diameter of the bolt. And FLEXLOCs are stocked in a full range of sizes from 1/4 to 2" by authorized industrial distributors. Write for Bulletin 866. STANDARD PRESSED STEEL CO., Jenkintown 12, Pa.

FLEXLOC LOCKNUT DIVISION

SPS
JENKINTOWN PENNSYLVANIA

CIRCLE ED-305 ON READER-SERVICE CARD FOR MORE INFORMATION

Polarized Relay

Has Anti-Chatter Contacts



The P255A Polarized Relay utilizes a reed-type, Permaloy armature with anti-chatter contacts. The armature is equipped with extra-heavy (3/32" diam) palladium-copper contacts. The contact screws have 1/16" diam tungsten contacts rated at 2amp 110v d-c.

The relay is especially valuable for use in teletypewriter applications. It consists of a coil with two parallel windings of 136 ohms each. It is mounted through a Western Electric No. 18B connecting block and is insulated from the mounting. Kurman Electric Co., Inc., Dept. ED, 35-18 37th St., Long Island City, N. Y.

CIRCLE ED-307 ON READER-SERVICE CARD FOR MORE INFORMATION

Commutator-Generator

Provides High-Speed Switching



The Precision Commutator and Impulse Generator has been added as a standard component to this firm's line of miniature precision potentiometers. The

unit is intended for use as a high-speed switching device, for counting, digital indication of shaft rotation, pulse shaping, pulse gating, sequence circuit control, and similar applications.

The commutator-generator consists of a series of conducting segments, bonded to a high-temperature plastic base, insulated from one another, and interconnected to form a wide variety of coded commutation or pulse sequences. The use of multiple isolated wipers permits commutation in several circuits simultaneously, and increases total pulse count per revolution. The commutator element can be nested with the firm's standard potentiometer elements for various analog-to-digital conversions, potentiometer excitation control, pulse shaping, etc.

The element is approximately 1" in diameter and weighs 2/10 oz. Precious-metal contacts are employed throughout. Operational speeds up to 1000rpm are permissible, with a life in excess of 1,000,000 revolutions. The commutator element is available either unmounted or in a precision end-bell assembly with ball-bearing supported shaft for extremely low-torque operation. Computer Instruments Corp., Dept. ED, 1964 Utica Ave., Brooklyn 34, N. Y.

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CEN-TRI-CORE
"ENERGIZED or PLASTIC"
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SPECIALISTS
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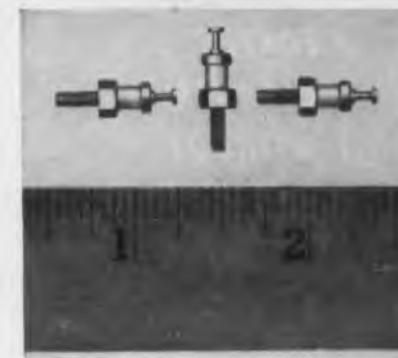
ALPHA METALS, INC.

69 Water Street, Jersey City, N. J.

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**New, Tougher Miniature Insulated
Terminal . . . for tight spots**

C. T. C.'s X2128 is the first of a family of quality-controlled miniature standoff terminals for wide production line application. X2128 supplements C. T. C.'s standard line providing engineers and technicians with rugged units of exceptional mechanical features.



Of solid ceramic rod, grade L-5, X2128 is silicone impregnated to resist moisture. Nickel-plated mounting stud is securely bonded to the ceramic insulator. Solder terminal of copper plated brass with 24K gold flash is rolled over shoulder at top of insulator and provides excellent solder-ability during extended shelf life. Long soldering operations will not loosen this insulator.

X2128 has 1/4" long screw stud, 3/48 THD, base diameter 3/16", lugs are available in a variety of mounting studs. O.A. height when mounted .447".

Write for full data and prices NOW to Sales Engineering Dept., Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge, Mass.

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Metron



MINIATURE
SPEED CHANGERS

COMPLETE
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ADAPTABLE

Over 400 different Standard ratios!
10:9 to 531,441:1

SMALL! 1.050" Diameter. Overall
lengths: Class A, 3-1/8" Class B, 3-
15/16" Class C, 4-3/4"

Transmit power either way to 100:1
ratios!

Concentric ball-bearing input and out-
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Hardened steel spur gears.

Permanent lubrication.

Prompt deliveries on production or ex-
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for baking
conditioning • drying
pre-heating • sterili-
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- Quality made, yet moderately priced
- Wide area heater for more uniform heating and longer heater life
- All-welded steel construction—no screws to loosen
- Dependable hydraulic thermostat for automatic control
- Braided asbestos door gaskets—will not burn or deteriorate
- Hazard-safe latch prevents dangerous internal pressures
- Insulated with glass wool—won't pack, deteriorate or char
- Life-time pilot light—adjustable air exhaust

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No. 331 describes complete
Theco oven line

Automatically Maintains a
Constant Temperature from
5° Above Room Tempera-
ture to 180° C.



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STRIP WIRE

- ✓ FASTER
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- ✓ WITHOUT CRUSHING!

WITH THE

Speedex

AUTOMATIC WIRE STRIPPER

Now . . . save at least 50% of your wire stripping time. New Speedex Automatic Wire Stripper strips both solid and stranded wire. Heavy duty for shop or production use. "Delayed return action" prevents crushing. Range of models for every requirement. See your distributor or write direct for information.

Model 766-B

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(\$8.25 list)

Wood Specialty MANUFACTURING CO.

DIVISION OF GENERAL CEMENT MFG. CO.

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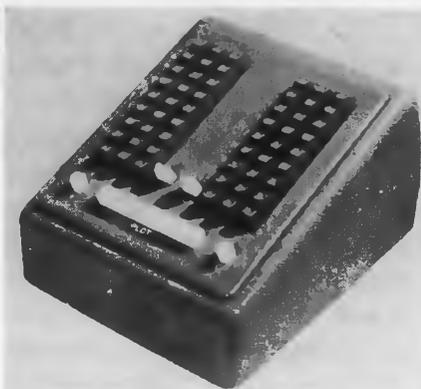
Rockford, Illinois

CIRCLE ED-312 ON READER-SERVICE CARD FOR MORE INFORMATION

126

Decimal Keyboard

Activates X-Y Plotter



This manually operated decimal keyboard activates a plotter by supplying excitation for the X and Y input transducers. It simulates resistance potentiometers by means of two voltage dividers (one each for

the X and Y axes), each consisting of three banks of series-connected precision resistors which are switches into the input circuit by pressing the front panel keys.

The quadrant in which an input signal is plotted is controlled by the position of two selector switches on the front panel. Pressing the plot bar drives the pen to the correct position on the chart, where it will not mark until its drive motors have positioned it in exact correspondence to the numerical value of the depressed switch keys.

All keys are released automatically. A switching arrangement halts the release of depressed keys until the point has been plotted. A hold switch button and a clear switch button override these automatic arrangements and enable the operator to clear all keys manually or to prevent automatic clearing of depressed keys.

The keyboard is energized by voltage from the recorder. No external power sources are required. It is enclosed in a casting 6" x 11" x 8-1/2" and weighs only 12 lb. Models are available for use with the Librascope Type "A" X-Y Plotter, Type "B" X-Y Plotter, and Punched Card Converter System. A variety of contact configurations are available which make possible the manual feeding of decimal or binary coded decimal inputs to computer and other system. Librascope, Inc., 808 Western Ave., Glendale, Calif.

CIRCLE ED-313 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors

Made to MIL-R-10509A Specs



Type RN20. These precision units are manufactured in resistance values from 10 ohms to 2 megohms with tolerances of 1%. Higher or lower values are available on request. Dale Products, Inc., Dept. ED, Columbus, Nebr.

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PRINTED CIRCUITS

can simplify your design . . .
speed output . . . cut costs

Eliminate wires! With Du Pont Conductive Coatings, you can print circuits for capacitors and couplings; for static shielding to replace foils and cans; for resistors and solder seals. Streamline your designs in television sets and radios, electronic equipment, meters and switch boards.

Coatings are easily applied by spray, brush, dip or stencil on metals or non-conductors. Right into high-speed assembly-line operation. Save you money. For up-to-date, descriptive bulletin write to: E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

DU PONT CONDUCTIVE COATINGS

—Best for printed circuits!



BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

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Miniature, Hermetically Sealed, Aircraft Type Relay

Have a New, Wider Range of Performance Characteristics

If you need a small, light 4 PTD or DPDT relay to operate consistently under extremely critical or downright adverse conditions, chances are your requirements can be readily met by one of a multitude of variations possible with the basic "Diamond H" Series R relay. Originally designed to meet all requirements of USAF Spec. MIL-R-5757B, they far surpass many. For example: Various brackets of vibration resistance from 10 to 2,000 cps; temperature ranges from -55° to +200° C.; coil resistances from 1 to 50,000 ohms, contact capacities from 350 V., D.C., 400 MA. at 10 A. at 30 V., D.C. (20 A. for reduced life). Also reliable in circuits. Operating time (24 V. models) 10 ms. or less; dropout less than 3 ms. Dielectric strength 450 to 1,250 V., RMS. Insulation resistance 1,000 megohms at room temperature (100 at 200° C.). Operational shock resistance 30, 40 or over 50 "G". Mechanical shock resistance to 1,000 "G". Single or two independent contacts, either or both of which will operate unit. All standard mounting arrangements.

Call on "Diamond H" engineers to work with you in developing a variation to meet your specific needs.

THE HART MANUFACTURING COMPANY
210 Bartholomew Ave., Hartford, Conn.

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ELECTRONIC DESIGN • May 1964



portable

**FREQUENCY COUNTER
STRAIGHT (Batch) COUNTER
TACHOMETER**

direct reading MODEL

DS-6100 FREQUENCY COUNTER

INPUT
1 Volts RMS
FREQUENCY RANGE
20 to 100,000 CPS
GATE TIME
1 second (.1 and 10 sec. available)
STABILITY
Short Term — 1 part in 10⁵ (10⁴ with crystal oven)
ACCURACY
Inherent ± 1 Event
TIME BASE
100 KC Crystal Oscillator (Oven Available)

MULTI-SAMPLING
3 to 60 second manual
MANUAL RESET
Display until reset
AUTOMATIC RESET
Display .5 to 6 sec. variable
READ-OUT
direct in events per sec. to 100,000
SIZE and WEIGHT
14 1/4" W x 7 1/2" H x 13 1/2" D — approx. 28 pounds

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Make Better
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Economically—
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A type for every
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with wire clamp feature



**No lugs, looping or
hooking of wire**

Without a doubt, the simplest space, labor and cost saving Terminal Block made. Stripped wire is inserted between clamping members without looping or other preparation and the screw tightened — it's there to stay unless the wire itself breaks. Screws nest in blind holes in the solid molded base, eliminating danger of shorting. The type "E" is factory produced in any number of terminals from 1 to 22.

Write for Bulletin DS-123. Also, ask about wide selection of other Curtis Blocks available.

CURTIS DEVELOPMENT & MFG. CO.

3236 North 33rd Street, Milwaukee 16, Wisconsin

ED-318 ON READER-SERVICE CARD FOR MORE INFORMATION

Plug-In Circuits

Supplies, Relays, Interrupters



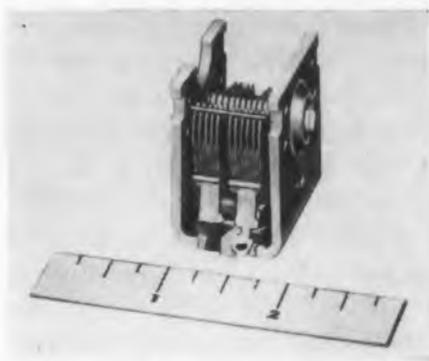
These plug-in power supplies, load relays, and automatic interrupters simplify the assembly of meter-relay controls. A typical unit, the 1817-2 Load Relay (illustrated), contains a 5ma relay, 200-mfd timing condenser, and limiting resistor. Connections are brought out to a 9-pin octal-type plug. There are four hold-down screws for mounting. The relay has a 12,000 ohm coil. It pulls in at 5ma and releases at 1.5ma. Snap-action contacts are conservatively rated at 5amp, 115v a-c resistive, spdt. The condenser, when connected across the coil, gives 5sec delay on release. Dimensions are 1-3/4" x 4" x 5".

There are several load relays in the series with coils for 6, 12, 24, and 75v. Other plug-in units include power supplies, both single and double. These have a transformer, for isolation, with tapped primary for 115v or 230v line; rectifier; and filter condenser. Output is 130v d-c at no load, 80v at 50ma (the maximum). Another plug-in unit is a complete automatic interrupter with a period of about 5sec. This can be speeded up by changing the timing condenser which is brought out to separate terminals for that purpose. There is also a motor-driven interrupter, with notched cam, that gives periods as long as 1 minute. Assembly Products, Inc., Dept. ED, Chesterland, Ohio.

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

Variable Capacitor

For Pocket Radios



This miniature two-gang variable capacitor, Model 2851, is designed especially for miniaturized portable and "pocket" radios using transistors and printed circuits. Only 15/16" high, and

weighing approximately 1 oz, it uses a cradle made of aluminum instead of steel, as in other models. It is so designed as to fit into printed circuit panels, if desired. General Instrument Corp., Dept. ED, Elizabeth, N. J.

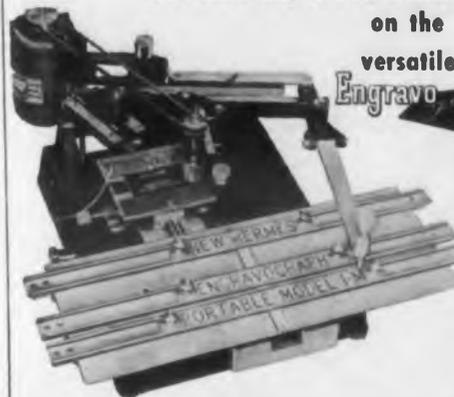
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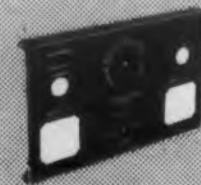
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UP TO 25%

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4- and 5-watt sizes

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CORNING GLASS WORKS, CORNING, N.Y.

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motordyne
will meet your specs
on fractional hp motors
in minimum time!



Designed to meet all applicable Mil. Specs., Motordyne motors withstand high altitudes and ambient temperatures. Sizes as small as 1 1/2" diam. H.P. 1/1000 to 1/2.



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— they come in a wide range of power and speed ratings, torques, weights and sizes. They're designed to drive actuators, valve controls, small blowers, radar antennas . . . many types of instruments and electronic equipment. If the standard Motordyne types don't quite fill your needs, we can vary the windings, the output shaft configurations or mounting arrangements in minimum time.

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Motordyne's fast, capable engineering staff is set up to submit prototypes usually within weeks. And with a large-capacity plant, fully integrated and operating under rigid quality control, we can meet promised delivery schedules with ease.

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Manufacturers of Fractional H.P. Motors, Dynamotors, Inverters

CIRCLE ED-323 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Relays
For Switching High Currents



These 200amp d-c relays are designed to meet the problems of switching high currents encountered in aircraft 28v d-c systems. They meet all requirements of Specification MIL-R-

6061, are spdt, and are identical except for mounting. The JH28007-1 relay illustrated, conforms to an AN-3370-1 mounting while relay JH28007-2 meets an AN3370-2 mounting.

Rated at 200amp, the relays operate on a nominal coil voltage of 24-28v, with 29v maximum. They pick up at 18v and drop out at 7v (+0, -5.5v). Designed for continuous duty (50,000 cycles minimum), they will function efficiently at altitudes to 50,000' within an ambient range of -55° to +71°C, and under acceleration forces to 10G. They have been specially designed to withstand extreme conditions of vibration, shock, sand and dust, humidity, and salt spray.

The relays weigh only 1.25 lb and measure (approx) 4.5" x 3.75" x 2.0" overall. Jack & Heintz, Inc., Dept. ED, 17600 Broadway, Cleveland 1, Ohio.

CIRCLE ED-324 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Vacuum-Tube Voltmeter

Measures 0.001-300v



The Model 202A voltmeter is designed for the accurate measurement of a-c voltages from 0.001v to 300v full scale in the frequency ranges from 20cy to 2Mc. The input impedance of 10 megohms and 25-mmfd minimizes errors due to loading of the circuit under test. Separate terminals are brought out from the

input and output of the amplifier section of the instrument, permitting its use as a separate amplifier with maximum gain of 50db for input voltages of 0.001v or less, and lesser gains with higher input voltages.

This instrument incorporates features to simplify operation and prevent misreading. This is accomplished by utilizing a large easy-to-read 6" meter with color matched voltage and db scales, and a simplified front-panel layout. Shasta Div., Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Station A, Richmond, Calif.

CIRCLE ED-325 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW SWITCH CATALOG

ALL NEW



ALL NEW
24 PAGES

Saves time in selecting the right switch

GIVES COMPLETE ENGINEERING DATA

- Photo of each switch type
- Detail drawing of each type
- Base and terminal data
- Operating characteristics
- Electrical ratings

Catalog gives detailed data on all these snap-acting switches: high-sensitivity, sub-miniature, low-cost, general-purpose, metal-cased, open-type, immersion-proof, and AN/JAN types.

Write today for your free copy.

UNIMAX

Division of the W. L. Maxson Corporation
460 WEST 34th STREET, NEW YORK 1, NEW YORK

CIRCLE ED-326 ON READER-SERVICE CARD FOR MORE INFORMATION

**A-C INDUCTION TYPE
New Series 15 and 18
SERVO MOTORS**

Two new G-M Miniature Servo Motors are now available for use in electronic control circuits. The motors are standard frame sizes 15 and 18 which are 1.437" and 1.750" in diameter respectively, and are designed for use in a wide variety of equipment such as computers, gun sights, navigation equipment, guided missiles, radar and similar applications. The light weight, high torque, low inertia, two-phase induction motors are available in 2, 4 and 8-pole models for 400 or 60 cycle supply, and can be supplied to meet performance specifications for military servo motors, Mark 7 and Mark 8. The control phase can be wound for connection by the user for either series or parallel operation. The stators of the motors, as in all G-M Servo Motors, are embedded in an insulating compound of high dielectric strength and high temperature stability. This material has a low mechanical coefficient of expansion and great stability at high temperatures. The dielectric strength is maintained between windings and housing when at high altitudes. Write for information on G-M Size 15 and/or Size 18 Servo Motors to



G-M LABORATORIES, INC.
4284 N. Knox Ave., Chicago 41, Ill.

CIRCLE ED-327 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW BARRY ALL-ANGL VIBRATION MOUNT

Works in Any Position — Has High Damping

Satisfying the need for a vibration isolator that protects the mounted equipment regardless of the position in which it is supported, the new Barry ALL-ANGL mount permits equipment to be mounted upside down, vertically on firewall or bulkhead, or at any odd angle. Damping is exceptionally high in all directions; transmissibility at resonance is less than 3.



The ALL-ANGL mount above has a standard one-inch cup to mount on 1-13/32" centers, and is interchangeable with other miniature BARRYMOUNT® isolators. Weighing less than one ounce, it handles loads up to 3 pounds.

This isolator answers the tough vibration-protection problems — permits design for easiest installation and best utilization. Let us show you what it will do for you at the New York I. R. E. Show.

The Barry Corporation, 775 Pleasant Street,
Watertown 72, Massachusetts

CIRCLE ED-328 ON READER-SERVICE CARD FOR MORE INFORMATION

Mercury Battery Weighs Only 4.5gr



This miniature mercury battery, with an unusually high rating for constant current, power, and service life, is for use in electronic equipment. Called the "General 625", it

measures 0.225" high x 0.605" diam, and weighs 4.5gr.

Applications include electronic testing devices, such as meters, transistor oscillators, and sound-measuring instruments; circuits, including audio, bias voltage, voltage reference, relay, and switching; communications, including transistor radios and hearing aids; and other equipment like digital computers and radiation detection instruments.

When the battery is operating at a drain of 2.0ma with an initial terminal voltage of 1.30v and cutoff voltage of 0.90v, it delivers 200 hrs of service with a 12 hr day test cycle. Tests show that the battery has a low internal impedance throughout its useful service life. It has a very low noise level, and keeps static and background noise to a minimum. General Dry Batteries, Inc., Dept. ED, 13000 Athens Ave., Cleveland 7, Ohio.

CIRCLE ED-330 ON READER-SERVICE CARD FOR MORE INFORMATION

Crystal Multiplier

For Ultramicrowave Research



The DB-350 Crystal Multiplier enables experimentation in the "Ultramicrowave" region up to 90,000-Mc. It is designed to operate with this company's new ul-

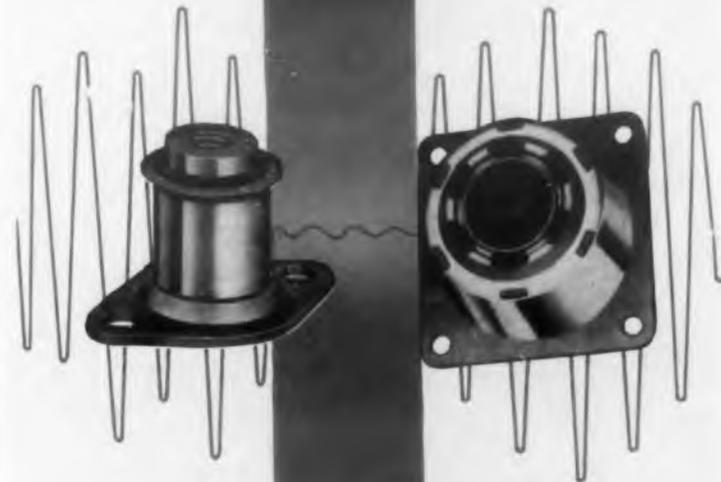
tramicrowave waveguide equipment.

The multiplier is especially for harmonic power generation at the second, third, fourth, or fifth harmonic. It consists of an input waveguide of a size appropriate to the input frequency, an output waveguide, and a tunable crystal holder. A BNC connector permits the introduction of low frequency modulation, or the biasing of the crystal to obtain optimum multiplication at the desired frequency.

Micrometer-driven plungers permit accurate tuning-in of the desired harmonic, and minimization of the other, unwanted, higher harmonics simultaneously present in the output. DeMornay-Bonardi, Dept. ED, 780 S. Arroyo Pkwy., Pasadena, Calif.

CIRCLE ED-331 ON READER-SERVICE CARD FOR MORE INFORMATION

SILENTBLOC simply smothers VIBRATION



Silentbloc rubber-in-metal mounts soak up sound and vibration through a unique deflection principal. It works equally well in shielding delicate equipment or protecting larger apparatus from the damaging effects of vibration.

There is practically no limit to the working life of Silentbloc. Units will stand unbelievable stresses for many years with no measurable fatigue.

For complete information on Silentbloc motion control products write to The General Tire & Rubber Company, Industrial Products Division, Dept. I-2, Wabash, Indiana.

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INSURE Proven Quality

with **JONES
PLUGS
AND
SOCKETS**

Plug, Cable Clamp P-306-CC1 in Cap. Jones Series 300 illustrated. Small Plugs & Sockets for 1001 Uses. Cap or panel mounting. S-306-AB Socket with Angle Brackets.

- Knife-switch socket contacts phosphor bronze, cadmium plated.
- Bar type Plug contacts brass, cadmium plated, with cross section of 5/32" by 3/64".
- Insulation molded bakelite.
- All Plugs and Sockets polarized.
- Metal Caps, with formed fibre linings.
- Made in two to 33 contacts.
- For 45 volts, 5 amperes. Efficient at much higher ratings where circuit characteristics permit.

Get for Jones Catalog No. 20 showing complete line of Electrical Connecting Devices, Plugs, Sockets, Terminal Strips. Write or wire today.

Jones HOWARD B. JONES DIVISION
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CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

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ELECTRONIC DESIGN • May 1955

Koiled Kords*

SOLVE PROBLEM FOR "UNI-TUNER"



Photographs courtesy of Allen Electric and Equipment Company, Kalamazoo, Michigan.

The test leads used on this automotive testing unit are KOILED KORDS retractile cords which retract into a special compartment in the bottom of the case for safety and ease of carrying. When the tester is in use, the cords extend to the battery, spark plugs or wherever required without getting caught or dangling down under the hood. KOILED KORDS stretch just as far as is needed and no further, they don't kink, tangle, or hang in dangling, trailing loops. KOILED KORDS always return to their neat, out-of-the-way coil when released.

KOILED KORDS are available in 48" mandrel lengths both as power and communications cords. They are also furnished in combinations of straight and coiled sections and as complete cord sets.

KOILED KORDS are as adaptable for supplying power to movable parts of electrical machinery as they are for portable electrical equipment.

If you have a design problem that KOILED KORDS might solve, write us about it, we'll be glad to help.

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Koiled Kords

INCORPORATED

Box K, New Haven 14, Conn.
*KOILED KORDS is the trademark of Koiled Kords, Inc.

CIRCLE ED-333 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature ...

R-F Interference Filters

334

A new 22-page catalog reviews this company's complete standard line of type FSR r-f interference suppression filters. Detailed information on each filter is given by means of cut-away views, dimension drawings, and descriptive text. Graphs of attenuation characteristics and complete engineering data on every unit permit the user to select and specify the right filter for a particular application. Filtron Co., Inc., 131-05 Fowler Ave., Flushing, L. I., N. Y.

Polyethylene

335

"Polyethylene's Potential in Large Plastic Structures", reprinted from *Product Engineering*, discusses the new application of the plastic in welded units where lightness in weight and corrosion resistance are decisive factors. Tables give physical and chemical properties of polyethylene and applications are illustrated. American Agile Corp., P. O. Box 168, Bedford, Ohio.

Peelable Plastic Packaging

336

A 15-minute, sound, 16mm motion picture has been produced describing the use and application of butyrate peelable plastic for packaging. The film is available to technical groups, societies, and members of industry who are concerned with protection of unit parts and assemblies either in storage or during shipment. Eastman Chemical Products, Inc., 260 Madison Ave., New York 16, N. Y.

Alloy Steels

337

A new 200-page handbook entitled "Alloy Steels Pay Off" discusses the economic advantages of fabricating with alloy steels for improved weight-to-strength ratios, longer life, and less maintenance, and lower operating costs. Advantages of high impact strength and shock-load resistance are explained. The economics resulting from alloy steel are documented by more than 60 case histories. Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.

Industrial Fasteners

338

A new bulletin describes and illustrates this firm's line of die cast zinc alloy in industrial fasteners. The bulletin contains illustrations of each type of fastener, diagrams with complete specifications, and lists of stock sizes to facilitate selection of the right size and type of fastener. Gries Reproducer Corp., 400 Beardwood Ave., New Rochelle, N. Y.

Electrical Instruments

339

This 8-page catalog gives descriptions and specifications for this firm's line of precision electrical instruments. Among those featured are impedance bridges, accessory null bridge amplifiers, and laboratory instruments. Circuit diagrams and sketches are provided. Electro-Measurements, Inc., 4312 S. Stark St., Portland 15, Oreg.

Glass-Reinforced Plastics

340

Technical data on custom-molded parts of glass reinforced plastics are given in Bulletin No. GRP. New high-pressure molding techniques, which permit economical production of complicated shapes with metal inserts if required, are described. Data also are provided on matched-die metal molding for mass production of relatively simple shapes with uniform cross-sections. American Hard Rubber Co., 93 West St., New York 13, N. Y.

Dielectric Capacitors

341

A 6-page, 2-color bulletin (No. 337-8) illustrates and gives complete technical information on miniature flat "Mylar" dielectric capacitors. Included are tables of capacitance values and voltage ratings, dimension drawings, and data on voltage derating for high temperature operation, dielectric material, end seal capacitance change, lead specifications, test voltage life test, power factor, and typical curves. Gudebrand Co., 340 W. Huron St., Chicago 10, Ill.

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.

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.

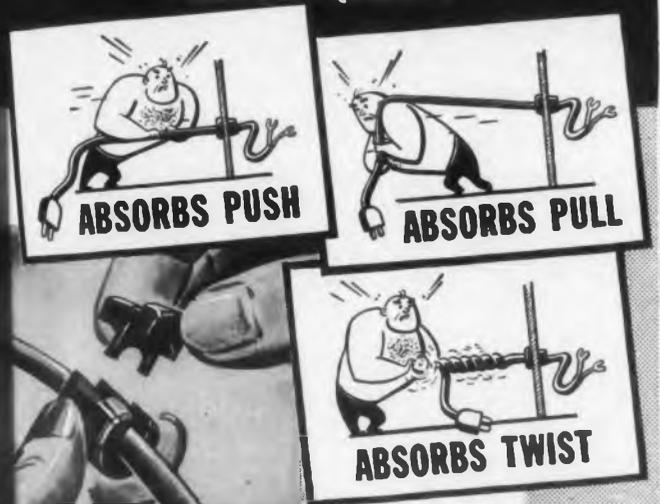
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Electrical Products Corp.
1100 North Main Street, Los Angeles 12, California

CIRCLE ED-342 ON READER-SERVICE CARD FOR MORE INFORMATION

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HEYMAN MANUFACTURING COMPANY
Kenilworth 16 New Jersey



Send wire sizes for free samples and specifications.



CIRCLE ED-343 ON READER-SERVICE CARD FOR MORE INFORMATION

Aircraft Battery Eliminator 344

This 2-page catalog sheet illustrates and describes this firm's model KM88 aircraft battery eliminator. The unit supplies from 0 to 28v d-c at 20amp with only 1% ripple. The bulletin includes detailed electrical and physical specifications and an outline drawing of the rack mounting type enclosure. Opad Electric Co., 69 Murray St., New York 7, N. Y.

Germanium Diodes 345

Bulletin No. GD-2 lists ratings and specifications for this company's complete germanium point contact diode line. It offers specifications on high temperature diodes computer diodes, uhf mixer diodes, meter protection diodes, and general purpose diodes. A complete interchangeability and replacement chart is included. Semi-Conductor Div., International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

Automatic Counters 346

A 4-page bulletin describes and illustrates this firm's line of electrically and mechanically actuated counters for indicating, recording, and automatic regulation of industrial machinery. Besides a photograph of each counter, the reference shows two typical installations. It also gives information on the enclosures, housings, and wirings of the impulsing switch and motor drive unit. Richardson Scale Co., Van Houten Ave., Clifton, N. J.

Weight Selection System 347

A proportioning system that permits remote dialing of individual ingredient weights is pictured and described in a 28-page, 2-color bulletin. Forty-seven photographs and engineering drawings illustrate actual installations of the system in varied operations. Design and operating characteristics are explained. Richardson Scale Co., Van Houten Ave., Clifton, N. J.

Electrical Steels 348

"Armco Hot Rolled Electrical Steels" is a new design data book on nine grades of silicon steel. A large part of the 88-page book is devoted to curves showing various magnetic properties for a wide range of flux densities. The curves present data on the core loss, exciting rms voltamperes, reactive volt-amperes, exciting ampere turns, d-c magnetization data, hysteresis loops, a-c and d-c normal permeability, and incremental permeability. Armco Steel Corp., Middletown, Ohio.

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AS you want them - WHEN you want them

SPURS & PINIONS
HELICALS & SPIRALS
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Specialists in manufacture of Fine Pitch Gears to close tolerances . . . from ordinary commercial grades to the most exacting aircraft specifications. Nylon gears with teeth molded or cut. Also gears made from stampings, with teeth stamped or cut. Send blueprints for proposals and/or engineering collaboration. No obligation to you.

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New!!

"STANDCO" PANEL MOUNTING VIBRATING REED FREQUENCY METERS

THREE STYLES OF CASES:
BAKELITE • METAL
HERMETICALLY SEALED

3-1/2" FLUSH PANEL MOUNTING

STANDARD FREQUENCIES:
25, 50, 60 AND 400 CYCLES

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Write for Bulletin 805

HERMAN H. STICHT CO., INC. 27 PARK PLACE, NEW YORK 7, N. Y.

CIRCLE ED-351 ON READER-SERVICE CARD FOR MORE INFORMATION

Directory of Testing Laboratories

The Directory of Commercial and College Testing Laboratories gives information regarding the location of testing laboratories together with the types of commodities and the nature of the investigations the laboratories are prepared to undertake. It is designed to be of assistance to purchasers who are not equipped to make their own acceptance tests and to manufacturers seeking testing laboratory services in the evaluation of raw materials and finished products. \$1.00. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Receiver 352

A 2-color, 4-page folder describes the new amateur and professional communications receiver, the Pro-310. The bulletin gives specifications, design and performance characteristics. Hammarlund Manufacturing Co., Inc., 460 W. 34th St., New York 1, N. Y.

Variable Auto-transformers 353

Banked-winding for variable auto-transformers is discussed in a technical data sheet. A description of the method and cut-away drawings are given. Rex Rheostat Co., 3 Foxhurst Road, Baldwin, L. I., N. Y.

NYLON CABLE HANGER . . . high-strength clip resists temperature extremes, chemicals



Seventeen 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 D, BURNDY, Norwalk, Connecticut.

CIRCLE ED-354 ON READER-SERVICE CARD FOR MORE INFORMATION

PHAZOR PHASE METER

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MODEL 200 A

PRICE \$349.50 F.O.B. NEW YORK

- HIGH ACCURACY
- MEASURES FROM 0 TO 360 DEGREES
- READINGS NOT AFFECTED BY NOISE AND HARMONICS
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Resinite flyback transformer coil forms are fabricated from select materials and resin impregnated by a special process to provide optimum dielectric characteristics.

In volume resistivity . . . low power factor . . . resistance to voltage break down . . . excellent thermal properties . . . and low moisture absorption . . . Resinite outperforms all other resinated products.

Resinite flyback transformer coils are available in any size or shape and are notched to your specification. Delivery is prompt in any quantity.

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Division of **PRECISION PAPER TUBE COMPANY**

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Miniature ELASTIC STOP[®] nuts *



Here is the world's smallest self-locking nut, developed especially for your miniaturization program. Sizes as small as .109 across flats. The famous red nylon locking collar damps out severe shock and vibration—grips the bolt thread—holds adjustment indefinitely. One-piece fasteners—no extra parts can drop into delicate equipment and short out circuits. Weight, installation space and assembly time are cut to a bare minimum. Nylon collar makes miniature ELASTIC STOP nuts reusable many times. And the installed cost is considerably less than set screws or other double-operation fastening methods.



For information on all electronic fastener problems write ESNA—address Dept. N56-557.

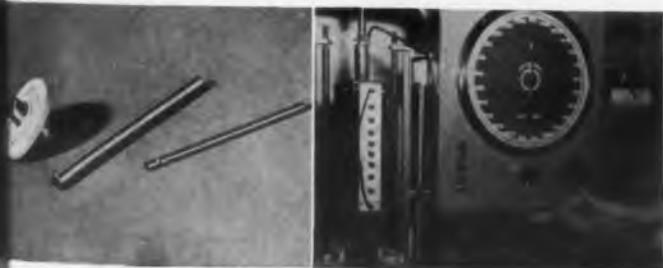
ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, N. J.

DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS
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Superior Tube's versatile CATHALOYS

Two new cathode alloys
simplify selection, prolong tube life



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*T.M. Superior Tube Co., Reg. U.S. Pat. Off. †Pat. applied for

CIRCLE ED-358 ON READER-SERVICE CARD FOR MORE INFORMATION

Long Life Tips 359

"Hexelad" plug tips and screw tips for soldering irons have a coating of iron alloy over copper base on all exposed surfaces for long wearing qualities. Dimensions and scale drawings of the tips are given in this data sheet as well as uses and a price list. Hexacon Electric Co., 161 W. Clay Ave., Roselle Park, N. J.

Rotating Equipment 360

A technical data sheet describes this company's line of rotating equipment. Facts and illustrations are given on synchros, servo torque units, a-c drive motors, d-c motors, a-c servo motors, tachometer generators, actuators, and motor driven blowers and fan assemblies. John Oster Manufacturing Co., Avionic Div., 1 Main St., Racine St., Racine, Wis.

Engineering Bulletins 361

A series of four engineering bulletins describe this company's line of miniature panel-mounting vacuum tube voltmeters, auxiliary power supplies, and the technique of obtaining automatic scale selection in test equipment design. Specifications and dimensional drawings are included. Trio Laboratories, Inc., 3293 Seaford Ave., Wantagh, N. Y.

DATA SHEET

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Type 753
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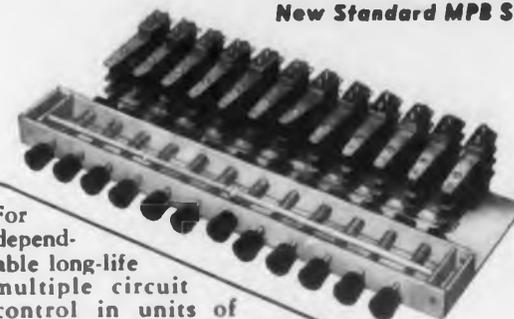
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Input Requirements:	0.1 v. peak to peak
Time Bases:	Frequency: 0.000002 to 20 seconds, decade steps. Time Interval and Period Meas: 1 mc to 1 cps, decade steps
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CIRCLE ED-365 ON READER-SERVICE CARD FOR MORE INFORMATION

Preheating Chart

366

The Tempil^o Preheating Chart lists the recommended preheat temperatures for 79 commonly used metals and alloys. Plain carbon steels, high tensile steels, medium chrome moly steels, and plain chrome steels are some of the metal groups for which approximate compositions and recommended preheat temperatures are shown. Factors influencing temperatures and the desirable effects of correct preheating on metal properties are enumerated. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.

Photocells

367

This company's complete line of photoelectric cells and apparatus is described and illustrated in this brochure. Specifications and dimensional drawings are provided. Scientific Specialties Corp., Snow and Union Sts., Brighton, Mass.

Industrial Facilities

368

This 16-page booklet describes the Upper Kanawha Valley of West Virginia pointing out its industrial advantages and facilities available to industry. The booklet contains statistics as to employment, transportation, and resources. The Upper Kanawha Valley Development Assoc., Montgomery, W. Va.

Instrument Catalog

369

A "Quick Reference Instrument Catalogue" lists the salient points of this firm's cathode-ray oscillographs and accessory instruments. The 8-page catalog is divided into three sections devoted to low frequency instruments, high frequency instruments, and accessory instruments. A picture of each instrument is provided together with a brief description of its features and some of the fields of application. Additional technical information is provided in tabular form. Technical Sales Dept., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.

Magnetic Test Limits

370

Technical Bulletin No. DMF-1 covers "Magnetic Test Limits for Standard El Laminations". This bulletin describes the test methods used, methods of determination of maximum limits, and shows schematic drawings of test equipment and complete tables covering maximum core loss at 10,000 gauss and maximum volt-amperes per pound values at 10,000 and 1000 gauss. Thomas & Skinner Steel Products Co., Inc., 1157 E. 23rd St., Indianapolis, Ind.

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CIRCLE ED-372 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistance Strips 374

Comprehensive data on resistance strips and concentric disc resistors is given in this 4-page bulletin. Included is information on construction, dimensions, machining technique, tolerances, resistance values, power and voltage ratings, temperature coefficient, voltage coefficient, etc. Charts and graphs illustrate characteristics. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

TV Picture Tubes 375

The "Quick Selection Guide for Television Picture Tubes" can help designers select a particular tube from the large number of tubes now available. It lists 205 tube types and for each of these the following information is listed: whether it is aluminized or not, external conductive coating capacitance, type of iron-trap magnet, face, dimensions, and style of anode terminal. Tube Dept., General Electric Co., 1 River Road, Schenectady 5, N. Y.

Tubing and Sleeving Chart 376

"Engineer's Cross-Reference Tubing and Sleeving Chart" enables the engineer to find the specific tubing and sleeving needed for any particular application. Full technical specifications such as dielectric strength, temperature rating, etc., are included. Alpha Wire Corp., 430 Broadway, New York 13, N. Y.

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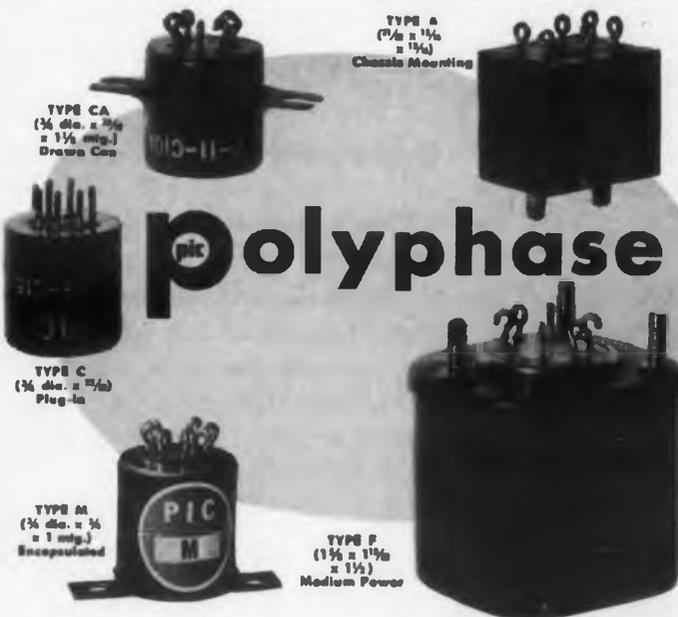
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CIRCLE ED-380 ON READER-SERVICE CARD FOR MORE INFORMATION

Self-Synchronous Motors

381

Folder No. EI-5A describes the various commercial types of self-synchronous motors made by this firm. The folder covers theory of operation and lists the design characteristics of over 30 different models. Characteristic curves, dimensional drawings, and electrical data are included for standard transmitters and receivers, differential units, phase shifters and resolvers, as well as for control and rotary transformer units. Electric Indicator Co., Inc., Springdale, Conn.

Engineering Service

382

The experience, facilities, and ability of a complete single-source engineering service are described in this brochure. Such services as product design and development, manufacturing cost studies, and production engineering are discussed in their application to engineering requirements. Pioneer Engineering & Mfg. Co., Inc., 19669 John R St., Detroit 3, Mich.

Aviation Products

383

This aviation products catalog covers aircraft pumps, electronic tube cooling units, refrigeration-type cooling units, pressurization units, and dehydrators. Complete engineering data gives performance and operation temperature range, weights and sizes of all models, and performance curves. Eastern Industries, Inc., 100 Skiff St., Hamden 14, Conn.

Opportunities for Industry

384

This report describes the opportunities offered to industries engaged in the manufacturing and assembly of electronic and scientific equipment by Michigan's upper peninsula. Among the location advantages cited are research facilities, quantities of raw materials, and good marketing area. Michigan Economic Development Dept., 110 Stevens T. Mason Bldg., Lansing, Mich.

Varistors

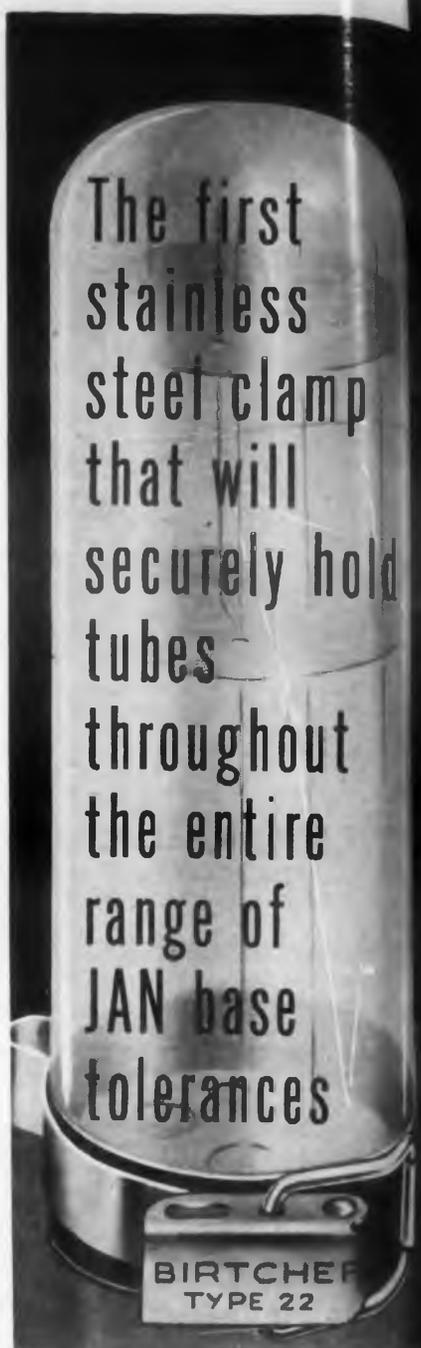
385

Comprehensive data in varistor applications, characteristics, current ratings, enclosures, terminations, is given in this 6-page bulletin. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Connectors

386

A 4-page brochure gives actual size illustrations, outline drawings, and specifications on AN-type connectors. DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.



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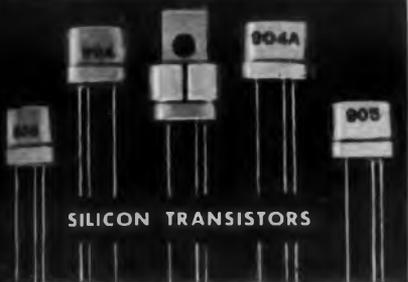
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CIRCLE ED-460 ON READER-SERVICE CARD

Resistors

388

Bulletin No. B-9 describes and illustrates 1/2w molded deposited carbon resistors. Data is given on characteristics, applications, tolerance, wattage rating, terminations, dimensions, insulation, etc. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Panel Meters

389

An engineering data sheet describes and gives complete performance information on a new series of large size indicator panel meters. Information includes standard ranges and approximate resistances available, special variations, specifications, physical dimensions, and mountings. International Instruments, Inc., P. O. Box 2954, New Haven, Conn.

Copper-Clad Phenolite

390

Methods of producing printed circuits from copper-clad phenolite are described in this booklet. Materials and properties as well as design details for printed circuits are given. Grades of copper-clad phenolite are described and applications described. National Vulcanized Fibre Co., Wilmington 99, Del.

Magnetic Cores

391

Specifications and data on standard grades of Ferramic S-1 magnetic cores are given in a 4-page booklet. Performance curves are included. General Ceramics Corp., Keasbey, N. J.

Electrical Tapes

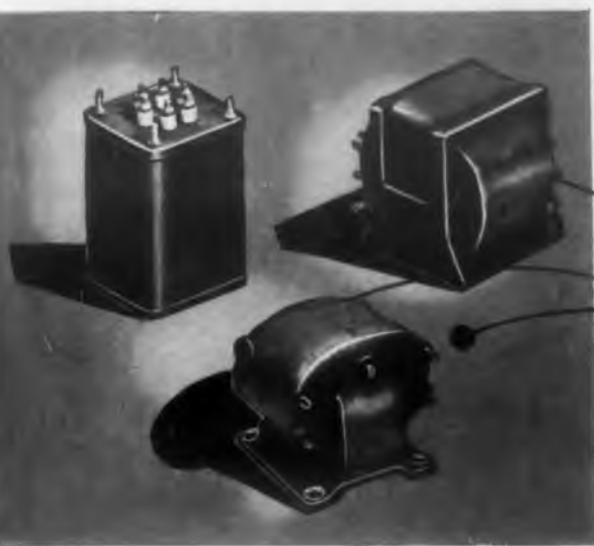
392

A 4-page brochure "Permacel 2 in 1 Electrical Tapes," discusses the application of one tape doing the work of two. The brochure supplies a complete table of technical data, illustrating the curing cycle, tensile strength, and seven other pertinent factors relating to the backing of these tapes. Permacel Tape Corp., New Brunswick, N. J.

Lathe Operation

Revised edition 53 of "How to Run a Lathe" covers new material on the use of toolmaker's buttons for locating work on the lathe face plate, the use of the steady rest, follower rest, internal grinding attachment, and precision gage blocks. This edition has 128 pages and over 365 illustrations. Paper binding, \$0.50, imitation leather fabrikoid binding, \$1.50. South Bend Lathe Works, South Bend 22, Ind.

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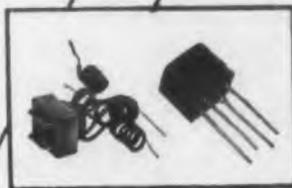


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CIRCLE ED-393 ON READER-SERVICE CARD FOR MORE INFORMATION

Regulator

395

Complete details and instructions for the use of Size 4 Regohm are given in this 8-page bulletin. This unit is a direct-action, finger-type electric circuit control regulator. Electric Regulator Corp., 604 Pearl St., Norwalk, Conn.

Height Gages

396

A fully illustrated 6-page folder describes a new and differently designed height gage. The gage is particularly suitable for layout and checking of large jigs, fixtures, and machine parts. George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y.

Potentiometers

397

Two types of broadband dielectric potentiometers are described in this 4-page 2-color brochure. Type PD-1 is used in closed-loop self-regulating systems or remote control of servo systems. The PD-2 is useful in control and measurement applications. Technology Instrument Corp., 531 Main St., Acton, Mass.

Lens Data Book

A photographic lens data book lists pertinent dimensions of 43 lenses. Listed in the data book are lenses covering 8mm, 16mm, and 35mm film, and lenses for film sizes to 9" x 9". Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N. Y.

Subminiature Toroids

A 4-page, 2-color folder describes the core type subminiature toroids in six different package styles. The brochure supplies Q curves, dimensional drawings, and application suggestions for the various types. Also described are components in special networks for use in airborne and telemetering equipment. Communication Accessories Co., Hickman Hills, Mo.

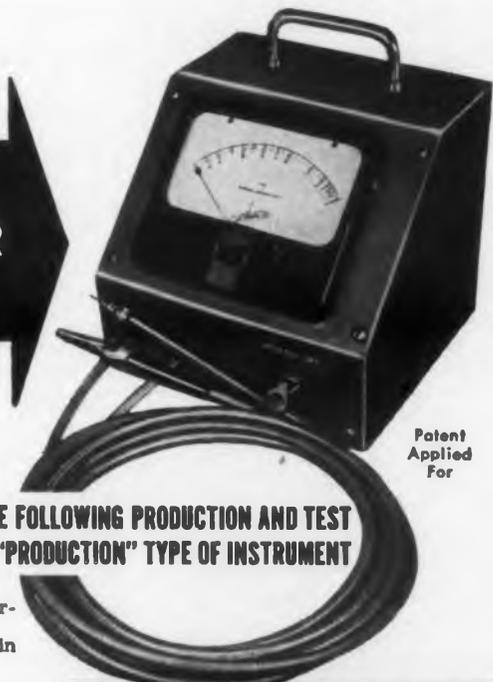
Tube Catalog

Various types of tubes made by this firm are illustrated and described in a 4-page bulletin. Electrical and mechanical data are provided. Chatham Electronics, Livingston, N. J.

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CIRCLE ED-401 ON READER-SERVICE CARD FOR MORE INFORMATION

39 Composite Catalog 402

Catalog No. 5002 is a new issue of the composite catalog which briefly describes this company's industrial instruments and equipment. Industrial Div., Minneapolis-Wayne Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

39 Hermetic Seals 403

Hermetic seals which can withstand high temperatures and severe thermal shock are described in a 4-page catalog. Dimensional drawings and ratings are given. Advanced Vacuum Products, Inc., 18 Liberty St., Stamford, Conn.

40 Fiberglass Sheets 404

A 4-page folder lists comparative properties of Fiberglass-polyester general purpose electrical flat sheets with Phenolic grade G.E. Recent developments in combining fiberglass reinforcements with polyester resins are discussed. Electrical Div., Dept. Owens-Corning Fiberglass Corp., 598 Madison Ave., New York 22, N. Y.

Platinum Clad Tungsten 405

A 4-page catalog describes platinum clad tungsten wire for high power vacuum tube grids. Applications and requirements are given. Baker & Co., 113 Astor St., Newark 5, N. J.

Accident Prevention Signs 406

A 16-page full color bulletin describes and illustrates self-sticking accident prevention signs. The signs come in three standard sizes. W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 12, Wis.

Capacitors 407

A 2-color, 32-page catalog describes this company's line of paper and Mylar dielectric capacitors for civilian, military, and specialty applications. This catalog, No. 551, includes line drawings and photographs of all case style mountings. Graphs and charts describe electrical and mechanical characteristics of each capacitor series. Good-All Electric Manufacturing Co., Ogallala, Nebr.

CIRCLE ED-408 ON READER-SERVICE CARD >

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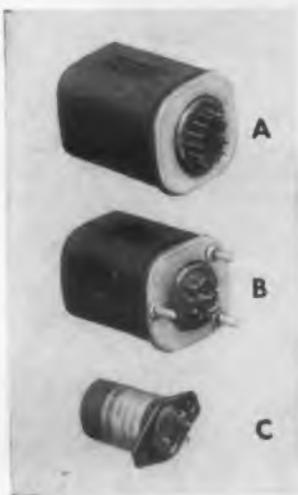
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Over 300,000,000 operations without a miss is the record of several G-E Miniature Relays in an actual application. One relay was checked after its 200 millionth operation—revealing only a 2 to 3 mil wear between armature tail piece and contact lifter. The G-E Miniature Relay met all factory tests at that point and could have been shipped as a new unit.

Successful results from this and other applications, plus results of extensive load-life tests assure you that G-E will aid in the selection of the relay best suited for your own application.

FOR MORE INFORMATION, SEND IN THIS COUPON FOR:



- A: High Speed Relay—Bulletin GEA-6212
- B: Miniature Relay—Bulletin GEA-6213
- C: Subminiature Relay—Bulletin GEA-6211

Section D-792-1, General Electric Company,
Schenectady 5, New York.

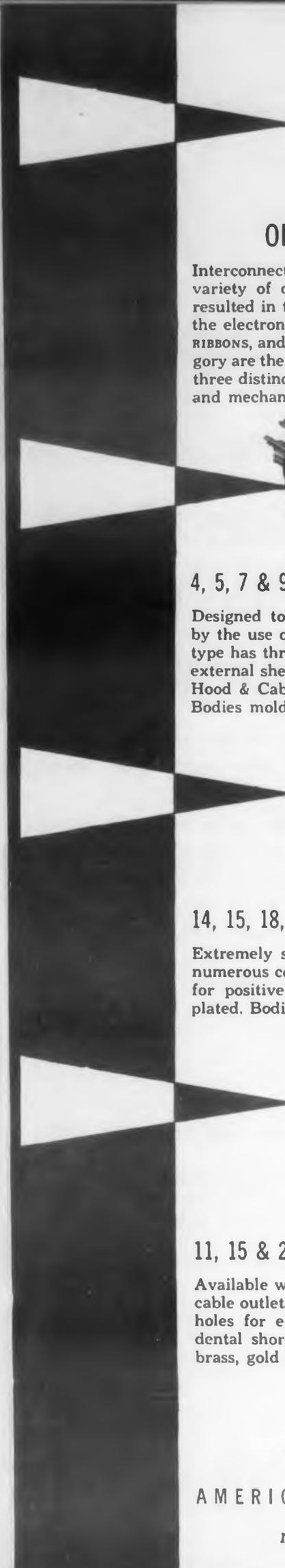
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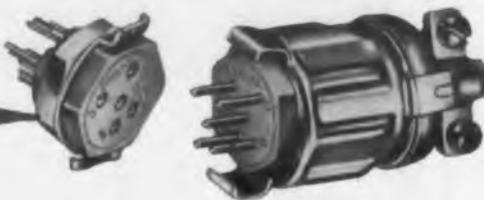
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GENERAL  **ELECTRIC**



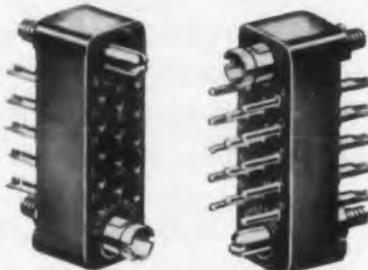
26 SERIES OF RACK & PANEL CONNECTORS

Interconnection of vital electronic equipment demands a wide variety of connector designs. At AMPHENOL this demand has resulted in the most comprehensive connector line available to the electronics industry—AN connectors, RF connectors, *Blue RIBBONS*, and hundreds of special components. In the latter category are the 26 series of Rack & Panel connectors, which includes three distinctly different designs, each offering excellent design and mechanical characteristics.



4, 5, 7 & 9 Contact Miniature Connectors

Designed to cover a wide range of miniaturized applications by the use of interchangeable hardware and contacts. Hex nut type has threaded body for panel mounting without the use of external shells. Locking Clip type permits positive mating with Hood & Cable Clamp type. All with male or female contacts. Bodies molded of AMPHENOL 1-501 blue: gold plated contacts.



14, 15, 18, 21 & 34 Contact Miniature Connectors

Extremely small pin and socket type connectors available in numerous contact arrangements. Have guide pins and bushings for positive alignment. Contacts are brass, gold over silver plated. Bodies are melamine.



11, 15 & 20 Contact Connectors

Available with protective aluminum housings with top or side cable outlets. Connectors have eyelets inserted in the mounting holes for extra strength. Interlocking barriers prevent accidental shorting. Bodies are mica-filled phenolic; contacts are brass, gold over silver plated, and are molded into the insert.



AMERICAN PHENOLIC CORPORATION

chicago 50, illinois

In Canada: AMPHENOL CANADA LIMITED Toronto

Color Concentrates 411

Three technical data sheets give properties, description, applications, and prices on color paste concentrates for coloring epoxy, thiokol, polyurethane, and isocyanate resins. Claremont Pigment Dispersion Corp., 110 Wallabout St., Brooklyn, N. Y.

Plastic Cabinets 412

This new catalog features transparent plastic drawer cabinets for storing small parts. Also included in the catalog are material handling equipment, lockers, storage cabinets, safety ladders, and other items for industrial use. General Industrial Co., 5737 N. Elston, Chicago 30, Ill.

Voltmeter Multipliers 413

Sealed precision voltmeter multipliers are the subject on this data sheet. Charts and graphs show data on construction, wiring, voltage rating, and dielectric strength. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Tubes and Coil Forms 414

A 4-page brochure contains technical data on square and round tubes, coil forms, bobbins, and mandrel services for electrical/electronic applications. Precision Paper Tube Co., Dept. EDN, 2035 W. Charleston St., Chicago 47, Ill.

Fuel Gage Test Unit 415

A direct-reading test for use in the installation and maintenance of capacitor-type fuel quantity gaging systems is described in this bulletin. Liquidometer Corp., Skillman Ave., 36th & 37th St., Long Island City 1, N. Y.

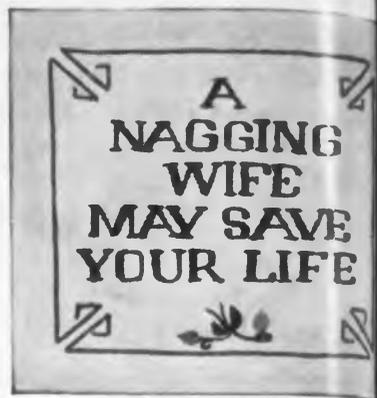
Vulcanized Fibre 416

The properties and applications of vulcanized fibre are described and illustrated in a 20-page, 2-color brochure. National Vulcanized Fibre Co., Wilmington 99, Del.

Auxiliary Relays 417

This technical data sheet describes auxiliary relays for all demands. A chart gives technical and performance data. Allgemeine Elektrizitats Gesellschaft; U. S. sales representative, Donald C. Seibert, Box 281, Wilmington, Del.

◀ CIRCLE ED-410 ON READER-SERVICE CARD FOR MORE DATA



IF YOU ARE OVER 40 and your wife keeps insisting that you should have two chest x-rays every year... don't blame her. Thank her. Semi-annual chest x-rays are the best "insurance" you can have against death from lung cancer.

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To see our new life-saving film "The Warning Shadow" call the American Cancer Society office nearest you or simply write to "Cancer" in care of your local Post Office.

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The Model TC-2 Temperature Test Chamber is a portable, self-contained, easy-to-operate unit ideal for laboratory and production line use.

MODEL

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The Model TC-2 Temperature Test Chamber is a portable, self-contained, easy-to-operate unit ideal for laboratory and production line use. Write for literature.

Temperature Range: -65°F to $+350^{\circ}\text{F}$.
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Heater: Electric Strip Heater.
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Test Load Capacity: 600 cubic inches.
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12411 W. Olympic Blvd., Los Angeles 64, Calif.

MODEL
TC-2

FOR RAPID AMBIENT
TEMPERATURE TESTS

PORTABLE
TEMPERATURE
TEST CHAMBER

PRICE \$550.00

F.O.B. LOS ANGELES

Tubes

420

"What's New with the Electron", a discussion of developments during the past year, covers this company's electron-power tubes. The booklet discusses new and improved tubes in the triode, tetrode, klystron, and rectifier fields. Technical Services Dept., Eitel-McCullough, Inc., San Bruno, Calif.

Carrier Equipment

421

The complete line of this company's power-line carrier equipment for voice communications is described in this 24-page booklet. Some features of the equipment are improved receiver selectivity, operation from station batteries, filament current regulation, and accessibility of assemblies. Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

Tool Design Facilities

422

This 24-page brochure describes tool design facilities for the electronics, aircraft, and appliance industries. Illustrations show how tool design, tool and die-making, stamping, and assembly are handled by this firm. August W. Holmberg & Co., Inc., 133-31 39th Ave., Flushing, N. Y.

Multi-Headers

423

A new catalog furnishes complete technical data on Vac-Tite compression multi-headers of all-glass and all-metal construction. Solid pin terminals, tubular terminals, and unit headers are available in the plain, flanged, and skirted multi-header body types. Hermetic Seal Products Co., 29-37 S. Sixth St., Newark 7, N. J.

Temperature Tester

424

This data sheet describes a portable temperature tester with readings from -50°F through 1000°F . A special internal temperature compensation circuit automatically corrects room temperature effects. Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.

Equalizers and Filters

425

This 16-page catalog, completely illustrated with response charts, covers, equalizers and wave filters. The catalog includes all applications of this type of equipment in sound and sound recording with case histories. Cinema Engineering Co., Div. of Aerovox Corp., 1100 Chestnut St., Burbank, Calif.

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RHEEM instrumentation units are:

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... Designed and built with components of the highest quality for lasting accuracy and dependability.

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SPECIFICATIONS

Size..... 7/8" x 2-5/16" x 4-3/8"
Weight..... 7 ounces
Frequency Response.... 5 to 20,000 cps with
less than $\pm 1\%$ deviation
Voltage Gain..... Adjustable 5 to 500
Linearity..... Within $\pm 1\%$
Output..... 5 v rms maximum
Input Impedance..... Over 100 megohms
Output Impedance..... Less than 100 ohms
Load..... 33,000 ohms minimum
Will maintain a constant output with B+ and
filament variations of $\pm 15\%$.

Different models available with variations of
frequency response and recovery time. Recov-
ery time as low as 30 milliseconds.



RHEEM R. F. POWER MINIATURE AMPLIFIER

Model REL-09

SPECIFICATIONS

Size..... 4.90 x 3.37 x 2"
Weight..... 16 ounces
Controls..... Plate tuning
Grid tuning
Filter..... 85-db attenuation filter
on all power leads
Tuning Range..... 215 to 235 megacycles
Power Output..... 12 watts nominal
Required Drive..... 1.4 watts minimum
Plate..... 250 V dc @ 90 ma
Filaments..... 12.6 V @ 0.41 amp
or 6.3 V @ 0.82 amp
Bias..... None Required



RHEEM SUBMINIATURE VOLTAGE REGULATOR

Model REL-11

SPECIFICATIONS

Size..... 1-3/4" x 2-5/16" x 4-3/8"
Weight..... 14 ounces
Output Voltage..... Any nominal voltage from
130 to 235 volts, adjustable
range $\pm 10\%$ of the nominal voltage
Current..... Up to 200 milliamperes
Ripple Reduction Factor..... 5×10^{-4}
Output Impedance.... Will not exceed 2 ohms
from 1 cps to 200,000 cps
Regulation... Within .05% for load variations
of $\pm 25\%$ and input
variations of $\pm 20\%$
Minimum DC Input Voltage.. Equal to 100 volts
greater than the regulated
output voltage

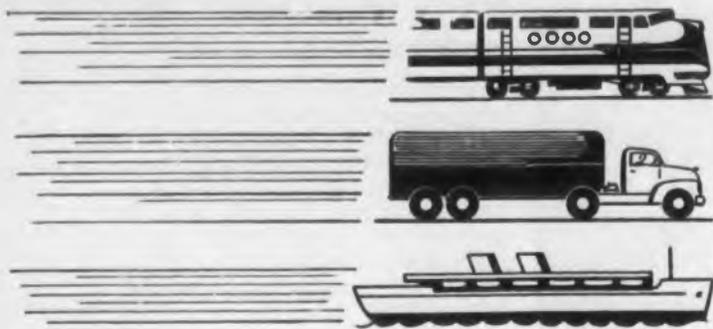
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9236 East Hall Road, Downey, California

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So HARTWELL did. *Flushness* for streamlining, efficiency and economy. *Safe*, rugged, compactness for dependable performance. *Simple*, positive-action to speed up maintenance operation.

Finger-tip pressure on the trigger of the latch releases the bolt and permits the door to open. Finger-tip pressure on the bolt, when the door is in place, locks it shut.

Dynamically flush and safe, they meet or surpass the most exacting requirements.

Write for engineering specifications and counsel.

HARTWELL COMPANY

Manufacturers of Flush Latches and Hinges, Fittings and Cable Terminals.
9035 Venice Blvd., Los Angeles 34, Calif.

CIRCLE ED-427 ON READER-SERVICE CARD FOR MORE INFORMATION

Winding Alloy Chart 428

To help the engineer in the determination and selection of platinum metals winding alloy wires for specific potentiometer applications, this firm has prepared a special cross-reference chart which plots bare diameter vs. resistance values of several platinum metals potentiometer winding alloy wire. Secon Metals Corp., 7 Intervale St., White Plains, N. Y.

Radar and Radio Controls 429

This 8-page catalog describes and illustrates control knobs, pointer-lever control knobs, and other electronic instrument knobs. A chart shows dimensions and types of set screws used in the knobs. Harry Davies Molding Co., 1428 N. Wells St., Chicago 10, Ill.

Transistor Packaged Circuits 430

A catalog sheet covers this firm's line of Transamp transistor packaged circuits. It covers transistor audio amplifiers, transistor controlled magnetic amplifiers, and other packaged circuits such as transistor oscillators and transistor photo-sensitive amplifiers. Electronic Research Associates, Inc., 67 E. Centre St., Nutley, N. J.

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Bristol, Connecticut

CONTENTS

Introduction	1
Features	1
Standard specifications	2
Other models	3
Construction	4, 7, 8
Models 100, 100A, 100B	9
Models 100, 100A, 100B	11
Models 100, 100A, 100B	12
Models 100, 100A, 100B	13
Models 100, 100A, 100B	14
Models 100, 100A, 100B	15
Models 100, 100A, 100B	16
Models 100, 100A, 100B	17
Models 100, 100A, 100B	18
Models 100, 100A, 100B	19
Models 100, 100A, 100B	20
Models 100, 100A, 100B	21
Models 100, 100A, 100B	22
Models 100, 100A, 100B	23
Models 100, 100A, 100B	24
Models 100, 100A, 100B	25
Models 100, 100A, 100B	26
Models 100, 100A, 100B	27
Models 100, 100A, 100B	28
Models 100, 100A, 100B	29
Models 100, 100A, 100B	30

The Superior Electric Co.
1705 Reynolds Avenue, Bristol, Conn.

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Position.....
Company Name.....
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CIRCLE ED-431 ON READER-SERVICE CARD FOR MORE INFORMATION

Popular SODECO COUNTER

- Toggle Reset
- Lower Power Requirement



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1. They have the famous Sodeco instantaneous toggle reset centered in the front plate. Just a touch of the toggle resets the counter to zero . . . instantly.
2. Power requirements are extremely low. Sodeco counters have been successfully operated in electronic circuits.

And that's not all. They are compact—the model illustrated measures only 1-5/16" x 1-3/16" x 4-3/8" deep. And they are fast—models are available with speeds up to 25 impulses per second.

SODECO Counters are extremely flexible. They can be supplied with auxiliary armature contacts either normally open or normally closed. They can be equipped with one or two periodical secondary contacts to be actuated at pre-selected impulses.

Get the facts on Sodeco Counters today. Write for our counter bulletins file.

LANDIS & GYR, Inc.

45 WEST 45TH STREET, NEW YORK 36, NEW YORK
CIRCLE ED-432 ON READER-SERVICE CARD FOR MORE INFORMATION

Does that new design call for a special transformer?

. . . One that's special in coil design or frequency response? Is insulation a problem? or weight? or size?

You may find the answer in our design department, staffed by engineers who are experienced not only in transformer design but also in the communications systems. They approach your problem with a knowledge of your over-all circuit requirements, and design a transformer that meets *all* your needs *exactly*.

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When you have a transformer problem, call on

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Dept. ED-5, Caledonia, N. Y.

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Power Gain.....12 db
Band Width.....200 KC to 250 MC
Power Output.....3 watts

Developed to fill the need for a broad band amplifier with moderate power output and reasonable gain possibilities, the new IFI Model 500 is particularly applicable in the field of narrow pulse amplification. For complete details, write for DATA SHEET #500.



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Automatic Electrolytic Grinding 436

How electronic control makes possible automatic electrolytic grinding of cemented carbide tools and other hard-to-work materials is the subject of a 12-page manual. The process and equipment is described in detail. Anocut Engineering Co., 631 W. Washington Blvd., Chicago 6, Ill.

Relay Catalog 437

A 72-page catalog covers this company's complete line of basic type relays. Each relay is fully described as to physical and electrical characteristics, complete operating data, and suggested applications. The book devotes two pages to definitions of engineering and electrical terms and laws. Guardian Electric Manufacturing Co., 1621 W. Walnut St., Chicago 12, Ill.

Temperature Indicators 438

A revised brochure covers this company's line of temperature indicating products. The brochure contains concise directions for use; indicates the choice of temperature indicating product for the intended application; and lists the various temperature ratings available in each of the product types. Tempil Corp., 132 W. 22nd St., New York 11, N. Y.



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CIRCLE ED-442 ON READER-SERVICE CARD FOR MORE INFORMATION

Tube Plate Characteristics

The second edition of Vacuum Tube Characteristics and Design Sheets in tablet form contains 48 different commonly used octal, miniature, and subminiature tube types. Each sheet features precision drawn plate characteristic curves 8-1/2" x 11" in size; circuit design information including filament voltage and current, tube schematic, absolute maximum ratings per MIL-E-1B, and the plate dissipation hyperbola. Single sheets of 52 different tube types are also available. \$0.85, plus mailing. Vacuum Tube Research, P. O. Box 4023, St. Louis 20, Mo., or P. O. Box 25892, Los Angeles 25, Calif.

Precision Tool Facilities 443

A working-hour tour of this company's plant, showing examples of fine die and gage making work is given in a 24-page brochure. Attention is called to the complete facilities and highly skilled personnel of the firm. Ehrhardt Tool and Machine Co., 914 Monroe St., St. Louis 6, Mo.

Tube Guide

This 24-page 2-color booklet contains sections on fundamentals of voltage reference and stabilizer tubes; the interpretation of published characteristics; and applications, including design formulas and associated components. The booklet is titled "A Guide to the Application of Voltage Reference and Stabiliser Tubes." Communications and Industrial Valve Dept. Mullard Ltd., Century House, Shaftesbury Avenue, London, W. C. 2, England.

Engineering Sound Catalog 444

This engineering catalog contains complete technical data on all this firm's engineering sound products. The 36-page catalog covers AM-FM tuners, transmission reproduction arms, twelve different broadcast, public address, and scientific microphones, more than twenty amplifiers and preamplifiers, power supplies, control consoles, speakers, horns, cabinets, and matching transformers. Altec Lansing Corp., 161 Sixth Ave., New York 13, N.Y.



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Multi-Wheel Numbering Machine Hand Shank

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Write for Bulletin ED-70



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NUMBERALL STAMP & TOOL CO.
HUGUENOT PARK STATEN ISLAND 12, N. Y.

CIRCLE ED-446 ON READER-SERVICE CARD FOR MORE INFORMATION

447 Compression Terminals

A new line of color-coded compression ferrules, called Hyrings, for grounding shielded wire and coaxial cable, terminating rod-type heating element leads, and splicing solid and stranded wire is described in Bulletin No. 55Y1. Burndy Engineering Co., Inc., Norwalk, Conn.

448 Cooling Devices

An 8-page brochure describes the complete line of cooling devices for the electronics industry made by this company and indicates applications for these devices. Rotron Manufacturing Co., Schoonmaker Lane, Woodstock, N. Y.

449 Pattern Recording Systems

Complete details on an antenna pattern recording system, including equipment, principles of operation, and descriptive specifications, are given in a new brochure. Airborne Instruments Laboratory, Inc., 10 Old Country Road, Mineola, N. Y.

450 Potentiometers

The single-turn, high precision Helipot series G potentiometer is the subject of data sheet 54-36. Specifications and linear coil characteristics are described in detail. Technical Information Service, Helipot Corp., Pasadena, Calif.

Map Computations

Experiments in the Computation of Conformal Maps contains descriptions and evaluations of three computation experiments in the general field of conformal mapping. The publication contains six papers on the three experiments. Conformal mapping is of principal importance in electromagnetic theory, aircraft wing design, and hydrodynamics. \$0.25. Government Printing Office, Washington 25, D. C.

451 Motors

An 8-page brochure describes and illustrates this company's line of motors. Among the types included are fractional hp, sub-fractional hp, miniature, and servo motors. National Pneumatic Co., Inc., and Voltzer-Cabot Divs., 125 Armory St., Boston 19, Mass.

452 Panel Meters

A 2-page brochure gives general specifications, table of standard ranges and approximate resistances, outline drawings, and ordering information for round and square watertight panel meters. Electronic Sales Div., DeJUR-Amseo Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

a "midget"* in size



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Type ET Electrolytic Capacitors...
Designed Specifically for Printed Circuitry

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CIRCLE ED-470 ON READER-SERVICE CARD FOR MORE INFORMATION



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 WITH BUILT-IN OSCILLOSCOPE**
 Model 7105

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Patents . . .

By John Montstream

Frequency Controllable Oscillating System . . . Patent No. 2,684,404. Robert Adler. (Assigned to Zenith Radio Corp., Chicago, Ill.)

Television receivers usually secure synchronization of the field frequency generator and of the line frequency generator by circuits of some complexity using a minimum of three tubes. With a special tube described in the patent, the synchronizing operation is accomplished with this one tube and a relatively simple circuit arrangement shown at the right.

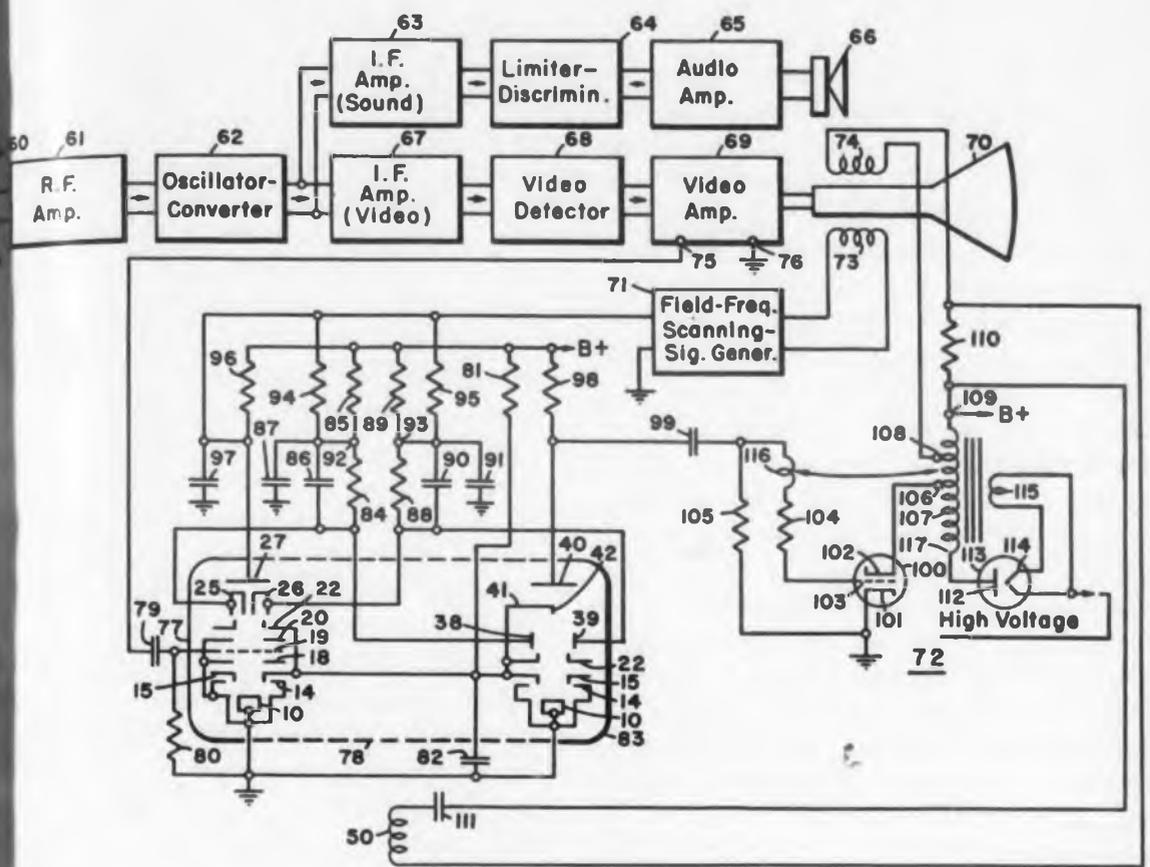
The sound and video circuit as well as the field synchronizing generator (71) is conventional. The synchronizing signals of the received program are applied to the control grid (19) of the specially designed tube (78) through an input circuit consisting of a condenser (79) and resistor (80). This input circuit has a time constant at least as long as the field frequency period. The tube in effect is a double or two section tube, but having a single cathode (10) that produces an elongated or rectangular form of electron beam. Electrodes 14, 18, and 20, are focusing elements, and electrodes 15 and 22 are accelerating elements connected through a resistor (81) with a source of potential. A pair of spaced anodes (25 and 26) normally divide the electron beam equally during line synchronizing signals so that the output voltages in each output circuit are the same. With equal output voltages, the field between electrodes 38 and 39 is uniform and the

electron beam in the second section of the tube is unaffected.

A coil (50) supplies a magnetic field that controls deflection of the electron beam in the second section of tube 78 from an interceptor anode (41) to the output anode (40). Current flow in the output circuit of anode 40 produces a pulse which controls line synchronization generator 72.

The magnetic field of coil 50 also determines whether or not the beam of the first section of the tube is deflected to anode 25 or 26. If the field of the coil passes through zero when the tube is conducting the beam is not deflected. If, however, the line synchronization generator 72 is not in step with the received synchronization signal, the field of coil 50 deflects the electron beam to one or the other of the anodes, 25 or 26, depending upon whether it leads or lags the received signal. This action in turn creates a field between deflection electrodes 38 and 39 of the second section of the tube which retards or advances the deflection of the beam from the left to the right. The triggering pulse is delayed or advanced thereby to bring line synchronization generator 72 into step with the line synchronization signal received from the transmitter.

The description given here is necessarily brief and many details of the operation of the circuit have not been given. In addition patent discloses other circuit arrangements that may be used. The tube construction is described in greater detail in this inventor's patent No. 2,606,300.



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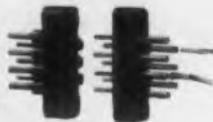
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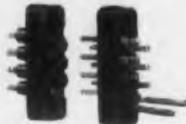
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CIRCLE ED-476 ON READER-SERVICE CARD FOR MORE INFORMATION

Commutator Tube . . . Patent No.2,684,449. S. R. Rich and E. E. Turner, Jr. (Assigned to Raytheon Manufacturing Co., Waltham, Mass.)

The tube shown opposite provides smooth commutation between two or more circuits without switching noises. It may be used in circuits for the determination of distance and direction of an object. The tube will operate with very low signal levels.

The tube has a cathode (1) and a cylindrical anode (2). The anode is provided with one or more circumferential slots through the anode, two slots (5 and 6) being illustrated. The slots are shown extending over about 180° of circumference so that two spaced slots extend over the entire circumference of the cylindrical anode. A series of vertical segments are spaced a short distance from the anode at the slot or slots. They may be provided on the surface of a carrier cylinder (3) of glass that surrounds the anode. Each segment constitutes a commutator element and is connected by a lead (11) to its respective circuit.

The cathode produces a beam of elec-

trons that is rotated by a magnetic field which may be produced in several ways such as by two coils 180° apart. As the beam rotates it passes through the slots from one segment to another and as the electron beam engages a segment a current is set up in its circuit which may connect to another circuit. The low switching noise is secured because the electron beam practically loses its velocity at the slot in the anode. It is for this reason, too, that the segments are placed close to the anode. This construction also assures little refraction of the beam from the segments. In addition smooth commutator effect is secured by placing the segments close together, that is, spaced from each other on the order of a few thousandths of an inch. Preferably the beam of electrons has a width approximately the width of a segment or even less.

When two or more slots are provided in the anode, a control grid (8 and 9) may be provided for each slot. The beam may be controlled by the control grid to prevent the beam from being projected through one slot and hence prevent commutation through any slot or slots. A common load resistor

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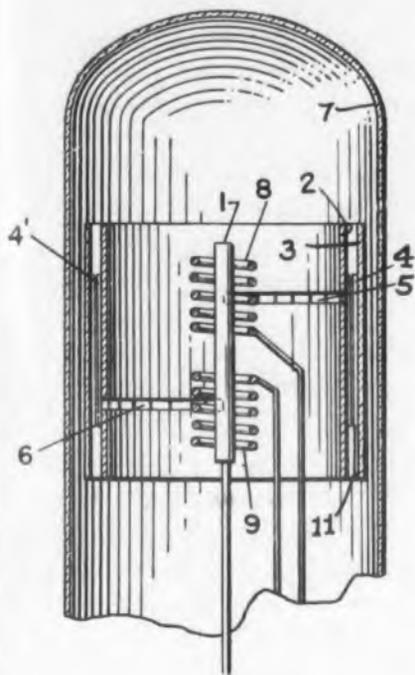
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Means for Delaying Electrical Signals . . .
Patent No. 2,685,067. H. N. Beveridge and J. J. Staller. (Assigned to Raytheon Manufacturing Co., Newton, Mass.)



One of the difficulties of the mercury pool type of delay line has been spurious signals caused by divergence of a portion of a signal beam. The path of this portion of the signal between the input transducer and the output transducer is reduced or increased from the desired path and in this manner produces a spurious signal. The delay means secures a delay from 25 to 10,000 microseconds.

The delay device shown on p. 151 includes a mercury tank of rectangular form having an input opening (15), marked *IN*, in the wall in which an input transducer is mounted. It is mounted at a slight angle such as by inclining the outer surface so that when the transducer is mounted on this inclined surface it is at the desired angle to provide a series of reflections of the signal from the walls of the tank. In the delay tank illustrated one corner may be provided with an inclined reflecting member (11a) so that with this particular type of tank, the signal is re-

may be employed in the cathode circuit. Smooth and rapid commutation from one segment and its circuit to another is assured by the tube. It is also a tube that can be manufactured economically.



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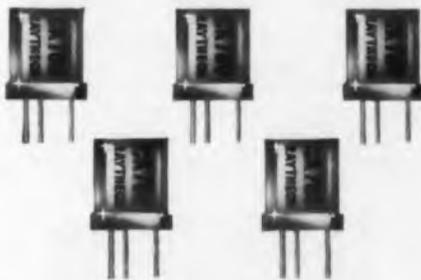
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	Volts	Cutoff μA							
CK760	-6	1	-1.0	75	40	5	85	0.62	14
CK761	-6	1	-1.0	75	45	10	85	0.62	14
CK762	-6	1	-1.0	75	65	20	85	0.62	14

Note: above characteristics are average except where noted.



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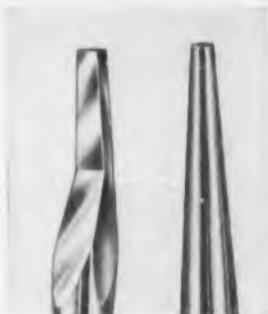
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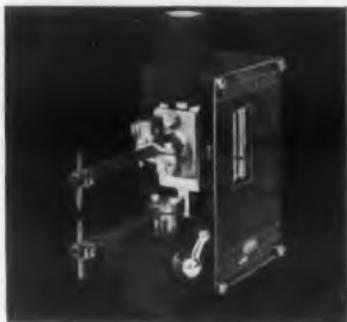
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flected from the first or right hand reflecting pad (17) on wall 13 to the pad (18) adjacent the input transducer. The signal is reflected from wall to wall until the last pad is reached in wall 13. At this point the signal impinges angular surface 19 and is multi-reflected in a similar manner between walls 14 and 12 until the reflected signal impinges on the output transducer in opening 16. With this type of delay tank, maximum utilization of reflection within the tank is secured. Reflections may use but two walls. In this type of construction the output transducer is mounted at the left hand end of wall 13.

It has been discovered that a smooth or polished wall surface absorbs about 9/10 of the signal. It has also been found that by roughening the surface such as by a sand blast, signal reflection of about 100% is secured. If, therefore, roughened reflector pads 17 and 18 in a smooth wall surface have a size the same as or approximating that of the transducer, then any divergence of the beam that would produce spurious paths or signals are practically clipped and are not reflected.

The inventors present a suggested theory

as to why a roughened surface would give better reflection of ultrasonic signals than a smooth surface. It is pointed out that the patentees do not bind themselves to the theory presented. This points up a principle of Patent Law that an inventor does not have to know the theory by which he secures improved results but only need to know the structure by which such improved results are secured.

To further augment clipping of a divergent portion of a signal, a ring-shaped trough or recess surrounds each reflecting pad. The bottom of the trough is smooth so that it will absorb 9/10 of the signal which impinges thereon. In addition the plane of the bottom of the trough is inclined so that any portion of the signal that diverges beyond that of the reflecting pad is deflected to the bottom or top of the delay tank so that very little of such signal reaches the output transducer.

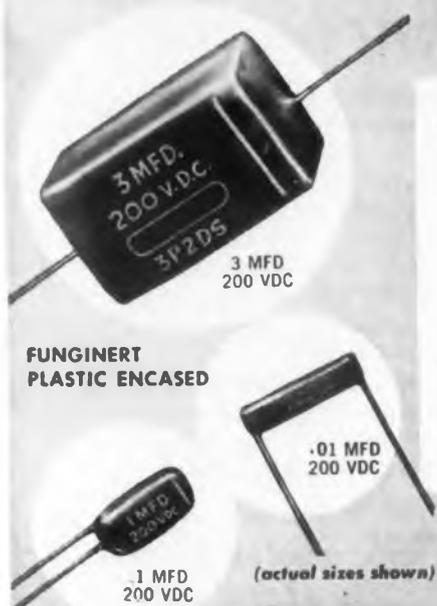
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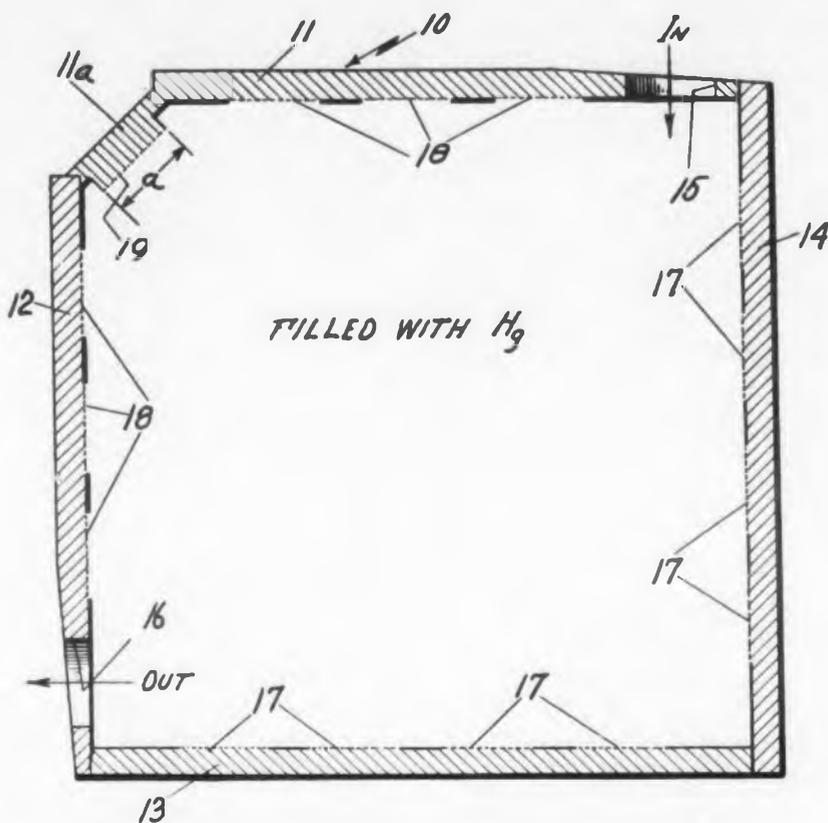
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means also may be used as a memory or
gnal storage channel of a computing
stem. Circuits for both of these types

of applications are illustrated. The delay
means described in the patent is an
inexpensive and easily made mechanism.

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ACTUAL SIZE

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Circuit	Number of CK776	Watts Output at Case Temperature† of		
		30°C	70°C	170°C
One Phase				
Half Wave	1	700	530	265
Full Wave	2	1600	1070	530
Bridge	4	3050	2040	1020
Three Phase				
Half Wave	3	3200	2150	1070
Bridge	6	6800	4550	2270



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At maximum power handling capability of CK776, an equivalent selenium rectifier could occupy as much as 100 times the volume.

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CASE TEMP. 30°C	40	60	50	15	40
CASE TEMP. 170°C*	40	60	15	5	10
NO HEAT RADIATOR					
AMBIENT TEMP. 25°C	40	60	6	2.0	3.0
AMBIENT TEMP. 170°C	40	60	2.0	0.5	2.0
TYPE CK776					
CASE TEMP. 30°C	125	200	50	15	40
CASE TEMP. 170°C*	125	200	15	5	10
NO HEAT RADIATOR					
AMBIENT TEMP. 25°C	125	200	6	2.0	3.0
AMBIENT TEMP. 170°C	125	200	2.0	0.5	2.0

*maintained by external heat radiator

At 25°C both CK775 and CK776 have Maximum reverse current is 25mA for CK775 maximum drop at 5 amperes of 1.5 volts. at -60 volts, CK776 at -200 volts.



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Model 320: 20 Amp. (Resistive) — 28 Volts DC

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115 Volt AC



400 SERIES - 4 PDT

Model 405: 5 Amp. (Resistive) — 28 Volts DC

Model 410: 10 Amp. (Resistive) — 28 Volts DC

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115 Volt AC

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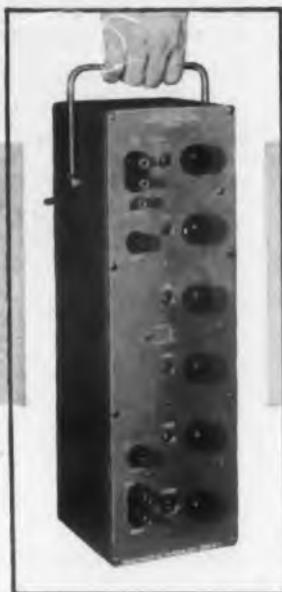
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CIRCLE ED-484 ON READER-SERVICE CARD FOR MORE INFORMATION

Electromagnetic Transducer Head . . .
Patent No. 2,683,774. Marvin Camras.
(Assigned to Armour Research Foundation
of Illinois Institute of Technology, Chi-
cago, Ill.)

A transducer head for magnetic recording and reproducing requires that the magnetic circuit must be small in dimension in order to secure fidelity and efficiency in the operation of the head. The small dimensions of the head also tend to make for high cost in manufacture of this piece of equipment. The head shown opposite is so designed that it can be manufactured to close tolerances and with maintenance of efficiency and high fidelity in operation.

The operational parts of the head are mounted in a two-part plastic housing (10) in which part 15 serves as a mounting base and part 16 forms a cover over the coils. The base carries two spaced screws (32) upon one of which is mounted a recording head (11) and on the other an erase head (12). Each head utilizes a cylindrical non-magnetic collar or spacer (22) which is received upon its screw (32). A pole tip member (18 and 19) of U-shaped form

encircles the upper part of the periphery of each collar 22 and provides downward extending legs. Each pole tip member is secured to its collar. The gap may be an air gap. The gap shown, however, is formed by an insert strip secured to the ends of each pole tip member. This insert strip may be recessed into collar 22 to aid in maintaining the part in position. An audio frequency coil (25) surrounds one leg of U-shaped member 18. A smaller high frequency coil (24) is also associated with the audio coil. Improved response is obtained if a second U-shaped yoke member (20 and 21) frictionally engage the ends of its tip member and hence has one leg extending through its respective coil.

The erasing head is essentially identical in construction with the recording head although the gap may be larger and the coil smaller. Coil 28, however, has high frequency applied to it for erasing the recording tape before it reaches the recording head as the tape passes through the erasing head.

Although the transducer head shown to the right has a single coil around the

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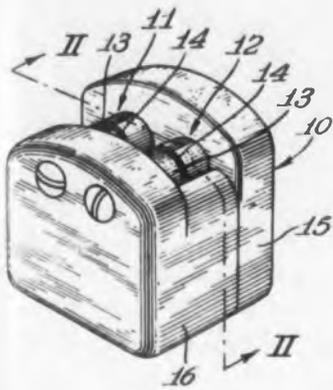
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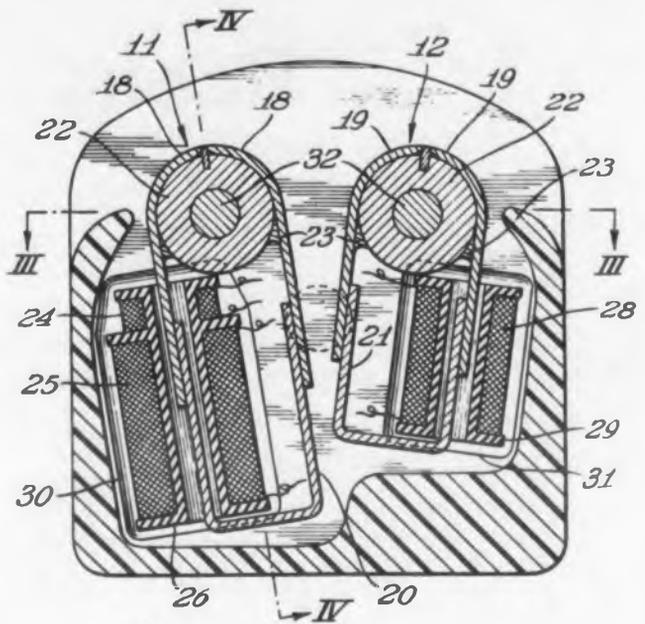
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The external (above) and internal construction of a new type of recording head.



U-shaped tip members 18 and 19, the patentee also contemplates a coil around each leg. A transducer head so constructed would be somewhat bulkier than the form illustrated above. Recording head 11 is also used as a play back head; however,

when so used, high frequency winding 24 is not energized and of course the erasing head coil 28 is similarly not energized. The head described is inexpensive to manufacture and assemble, yet the device is very efficient in actual operation.

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Books . . .

Noise . . . Aldert van der Ziel. 450 pages. Prentice-Hall, Inc., 70 Fifth Ave., New York, N. Y. \$10.35.

Designers of television, communications, radar, and measuring equipment will welcome this work. The problem of noise is becoming increasingly important in these types of equipment as their designers strive for greater sensitivity. The object of the first ten chapters is to reduce noise problems to network considerations that can be solved by standard methods. Noise in tubes at both high and low frequencies, in semiconductors, and in mixer and feedback circuits is discussed.

The noise problem from the theoretical aspect is treated in chapters 11 through 15.

Chapter titles in this section are: "Statistical Methods", "Fourier Analysis of Fluctuating Quantities", "Noise in Detector Circuits", "The Laws of Vacuum Tube Electronics", and "Space-Charge Wave in Electron Beams". Mathematics have been kept to a minimum in this section. The author follows the IRE recommendations on noise nomenclature and measurement.

Servomechanism Practice . . . William Ahrendt. 349 pages. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. \$7.00.

Written as a textbook, this work is valuable to the electronic engineer.

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shes to review his knowledge of servo- mechanisms after specializing in some other field of electronic design. The theory of servomechanisms is treated briefly, followed by detailed discussions of the actual components making up servo systems.

A method of designing a servomechanism is treated in one chapter, followed by chapters on the manufacture, maintenance, and testing of servomechanisms. A number of valuable appendices are given, including "minimum phase graph". The author is president of the Ahrendt Instrument Co.

Who's Who in Electronic Distribution, 1955 edition . . . Radio & Electronic Distributor News, Inc. 848 Leader Building, Cleveland 14, Ohio. \$7.50.

The problem of finding a source for a really needed component is simplified by reference to this comprehensive listing of thousands of electronic parts distributors and manufacturers' representatives. The book is divided into the following sections: address salesmen for each of more than 2000 manufacturers, listed alphabetically; an index of trade names; product listing;

rosters of manufacturers' representatives arranged alphabetically and by states and cities, respectively; and a wholesale distributors roster. The sturdily bound book is thumb-indexed.

Guides to Meeting Tomorrow's Production Needs . . . Manufacturing Series No. 209, 64 pages, paper cover, American Management Association, 330 W. 42nd St., New York 36, N. Y. \$1.25 (\$1.00 to AMA members).

Although written primarily for management, this volume includes a section on automation that should be of interest to designers of electronic automatic controls. Officials of several companies that are using automation in various manufacturing operations discuss their needs and problems. This section, "Automation to Date: Progress Toward the Push-Button Factory", covers the applicability of automation, automation in the chemical industry, and automatic materials handling.

The book also includes articles on cost reduction problems, production control, and methods engineering.

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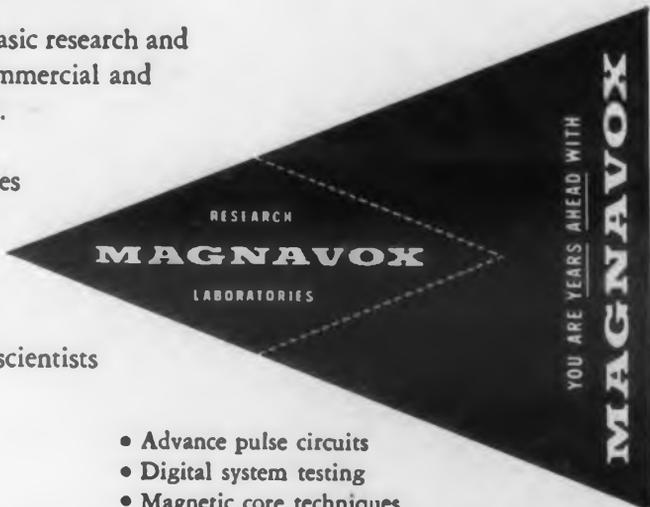
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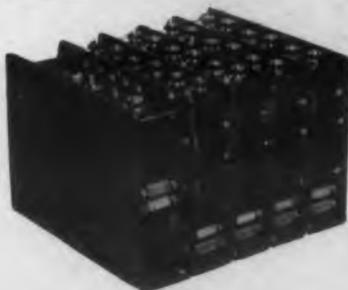


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Advances in Electronics and Electron Physics
volume VI . . . Edited by L. Marton, 538 pages
Academic Press Inc., 125 East 23rd St., New York
N. Y. \$11.80.

The latest volume in this series of critical reviews of essays of advances in electronics has a new and different title from previous volumes, but it serves the same worthwhile function. Contributors from the United States, England, and the Netherlands have written chapters on the following: "Metallic Conduction at High Frequencies and Low Temperature"; "Relaxation Processes in Ferromagnetism"; "Physical Properties of Ferrites"; "Space Charge Limited Currents"; "A Comparison of Analogous Semiconductor and Gaseous Electronics Devices"; "The Electron Microscope"; "Traveling-Wave Tubes"; and finally "Paramagnetism".

This compilation is recommended to electronic engineers who wish to keep track of developments in fields other than the one in which they are specializing. The editor is associated with the National Bureau of Standards.

Basic Electronics . . . Prepared by Van Valkenburg, Nooger & Neville, Inc., in five volumes. 560 pages, paper-bound, John F. Rider Publisher, Inc., Canal St., New York 13, N. Y. \$2.00 per volume, \$8.00 for set of five volumes.

Electronic Engineers faced with the problem of training technicians to assist them in their work should be able to recommend some basic textbooks. These five volumes fill the bill admirably. Originally prepared for the U. S. Navy for use in Naval schools they are full of illustrations and diagrams. Written in simple language and eschewing all mathematical derivations, they should help to build up the necessary force of electronic technicians.

Advanced Mathematics for Engineers, third edition . . . by H. W. Reddick and F. H. Müller. 440 pages. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. \$6.50.

More than other types of engineers, the design engineer must depend on mathematics as a part of his trade. All the familiar mathematical methods and theorems are treated extensively in this well-known textbook with problems based on actual physical situations. This revision has resulted in the addition of about 20% more problems. Many of the theorems are applied to more than one branch of engineering, reminding us that electrical analysis can often be set up for problems in heat and fluid flow. Answers to all the problems are given. This volume is recommended for the personal libraries of all electronic design engineers and for design department libraries.

Advertising Index

May 1955

Advertiser

Page

son Colloids Co.	84
Electric Corp.	146
craft Radio Corp.	155
craft-Marine Products, Inc.	88
Bradley Co.	78
Control Co., Inc.	11
Radio Corp.	123
Metal Wire, Div. of H. K. Porter Co.	112
Metals, Inc.	125
co, Inc.	138
American Electronics Inc., Electric Mach. & Equip. Div.	89
American Electronics Inc., Miniature Components Div.	100
American Lava Corp.	19
American Optical Co., Instrument Div.	97
American Phenolic Corp.	140
American Relay & Control	110
ied Research, Inc.	89
ld Engineering Co., The	39
mbly Products, Inc.	113
on Corp.	145
atic Electric Co.	70
atic Mfg. Co.	38
ite Co., Div. of Union Carbide & Carbon Corp.	73
r & Co.	114
Corp.	129
Chain Mfg. Co.	153
ix Aviation Corp., Eclipse Pioneer Div.	30
ley, Div. of Beckman Instruments	134
llium Corp., The	123
e, James G. Co.	119
er Corp.	136
y Electric Co.	110
ic Labs., Inc.	66
ns Labs.	117
ey Labs., Inc.	63
y, W. H. Co.	107, 120
o-New York Industries Co.	106
o Electronics Co.	121
y Engineering Co.	132
ll & Co., Inc.	16
ughs Corp.	87
onia Electronics & Transformer Corp.	142
ridge Thermionic Corp.	125
on Electric Co.	67
ga Corp.	146
orundum Co., The	79
relab, Div. of Globe Union	61
ham Electronics Corp.	151
ago Condenser Corp.	87
ago Standard Transformer Corp.	84
stat Mfg. Co., Inc.	122
y Corp.	153
ns Radio Corp.	21
inental Diamond Fibre	110
air, Div. of General Dynamics	56
ng Glass Works	82, 117, 127
l-Coil Co.	105
ns Development & Mfg. Co.	127
n Co., The	4
r Amsco Corp.	54, 93
lectron Corp.	127
e & Wilkens, Inc.	103
er Scientific Co.	114
Corning Corp.	57
en-Barnes Corp.	148
nt, Allen B. Labs.	47
nt, E. I. de Nemours & Co.	126
nt Mfg. Co.	118
C. Corp.	147
rn Industries, Inc.	96
Hugh H. Co.	52
McCullough, Inc.	86
ic Stop Nut Corp.	133
ical Industries	69
ical Products Corp.	131
ic Regulator Corp.	117
o-Mechanical Specialties Co., Inc.	152
o-Motive Mfg. Co.	108
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Hycor Mfg. Co.
Hycor Co., Inc.
Illco Corp.
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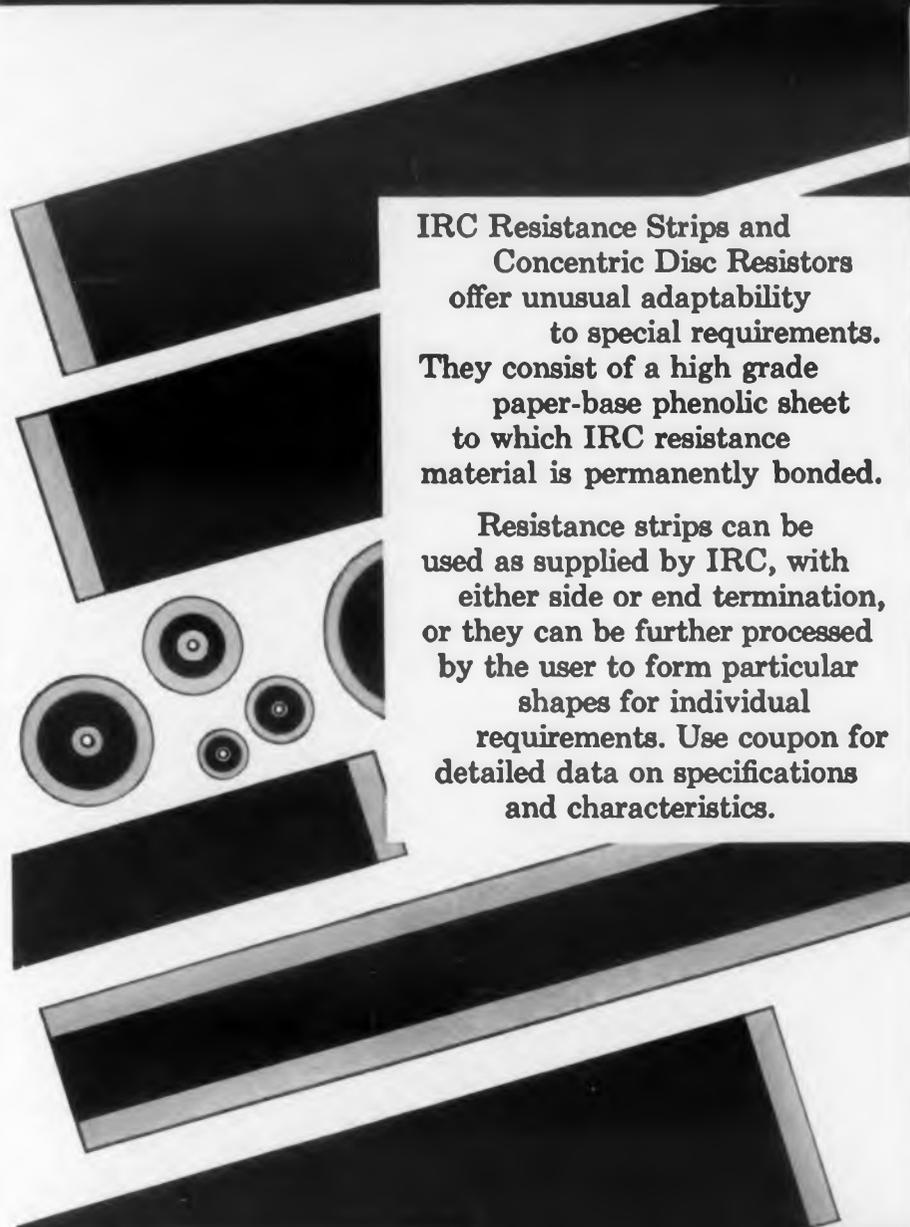
- (a) Iron, five-necked spur.
German, 17th Century.
- (b) St. George, King's
Coronation spur.
- (c) French ornamental spur,
16th Century.



Electronics, Inc.	49
Tool & Mfg. Co.	147
Electrical Instrument Co.	95
Coil & Transformer Corp.	91
Instrument Co.	125
Div. of Felts Corp.	120
Switch Div. of Minneapolis Honeywell	33
Associates, Inc.	111
Mfg. Co.	76
Engineering & Mfg. Co., Tru-Ohm Div.	20
Electric Co.	15
rdyale, Inc.	128
ional Fabricated Prods.	8, 9
ark Electric Co.	115
Hermes Engraving Machine Co.	127
Jersey Electronics Co.	157
berall Stamp & Tool Co.	144
er, John Mfg. Co.	53
ic Scientific Co.	91
ic Semiconductors, Inc.	72
in-Elmer Corp., Vernistat Div.	118
in Engineering Corp.	7
o Plastics Corp.	107
o Corp.	17, 18
hase Instrument Co.	135
technic Research & Dev. Co.	92
er Instrument Co.	3
ision Scientific	126
mid Electric Co.	10
ie Condenser Co.	55
io Corp. of America, Tube Dept.	160
io Materials Corp.	94
Design, Inc.	122
mond Rosen Engineering Products, Inc.	155
hewon Mfg. Co.	149, 150, 151
ington Rand, Inc.	148
inite Corp., Div. of Precision Paper Tube	132
lem Mfg. Co.	141
ardson Co., The	107
ron Mfg. Co.	138
seproof Div. of Illinois Tool Works	124
llcross Mfg Co.	109
ll Chemical Co.	22
na Instrument, Inc.	46
mons Fastener Corp.	116
hwestern Industrial Elec. Co.	40
ar Carbon Co.	121
ague Electric Co.	31
kipole Carbon Co.	27
dtler, J. S., Inc.	86
andard Pressed Steel Co.	121, 125
Stainless Screw Co.	135
ham Dev. Corp.	141
er Co., Inc.	77
ht, Herman H. Co., Inc.	132
rior Carbon Prods., Inc.	113
rior Electric Co.	142
rior Tube Co.	133
ania Electric Prods., Electronic Div.	83, 102
ania Electric Prods., Tungsten & Chemical Div.	35
ontrol Engineering Co.	154
onology Instrument Corp.	101
ranix, Inc.	41
s Instruments, Inc.	137
mador Elec. Mfg. Co., Div. of Norris Thermador Corp.	131
mas & Skinner Steel Products Co., Inc.	111
ington Co., The	109
itron Electronic Corp.	23
max Switch, Div. of W. L. Maxon Co.	128
ed States Gasket Co.	101
. Radium Corp.	153
ey Crystal Corp.	109
or Electronic Co., Inc.	123
reen Instrument Co.	96, 97
d Leonard Electric Co.	124
ness Co.	108
ing! use Electric Corp.	100
eler insulated Wire Co.	137
shes Electronics, Inc.	148

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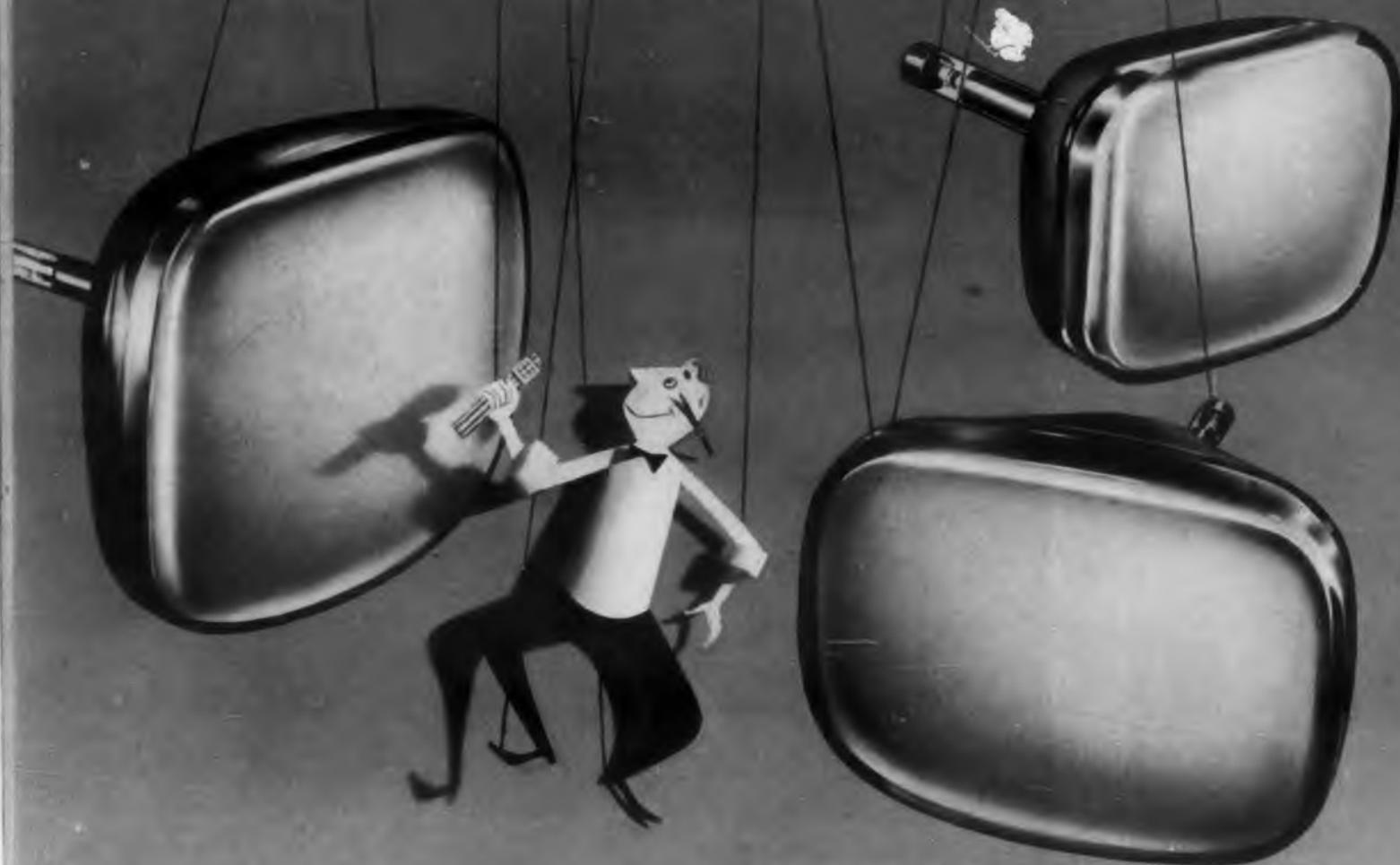
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