

ELECTRONIC

design

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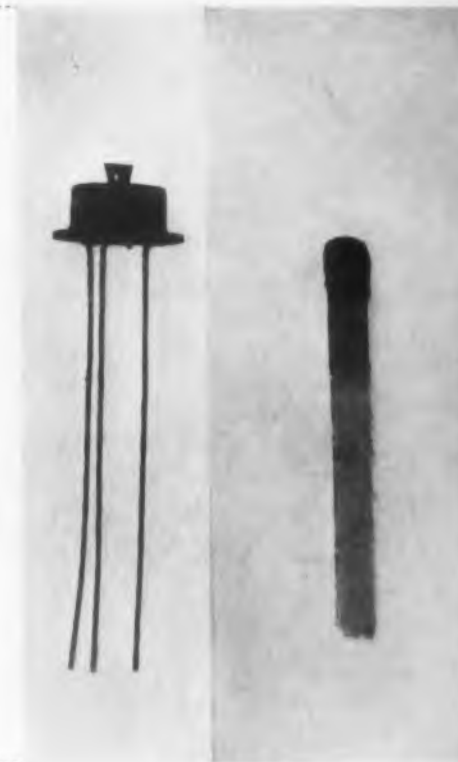
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All-Welded Junction Transistor

Ability to perform under wide temperature and humidity extremes is the outstanding feature of this all-welded, hermetically-sealed, fused junction transistor. Even when operated in boiling water (as shown at the left) or in a cake of ice, the unit performed satisfactorily as the heart of a miniature radio transmitter at the recent West Coast Electronics Show. Two units in a Class B push-pull circuit develop almost one watt.



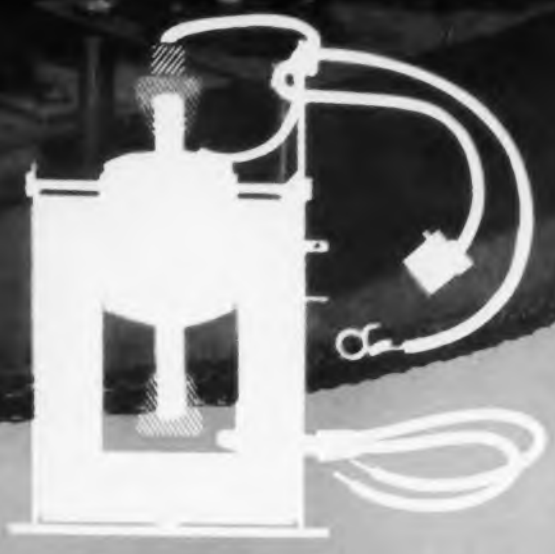
September 1953



they had a problem . . . Guthman solved it!



A prominent manufacturer of television sets had a problem . . . a new set was being designed, utilizing new components. They felt their TV set was sound, but they wanted a pre-production run of 100 sets to verify their engineering. And they wanted them in a hurry. They came to Guthman! Without final engineering approval—and working with special hand-made materials—Guthman custom built 100 high-voltage transformers to be used in this pre-production run . . . and built them in a hurry. The sets were produced on time and proved sound . . . Guthman engineering and manufacturing were subsequently credited by the set maker with a vital assist in the development of a new line. The diversity and magnitude of engineering knowledge found in the Guthman laboratory, and the flexible production setup, makes it practical for customers to bring such problems in . . . knowing that they'll be solved.
E. I. GUTHMAN CO., CHICAGO



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ELECTRONIC

design

Vol. 1
No. 9
September 1953

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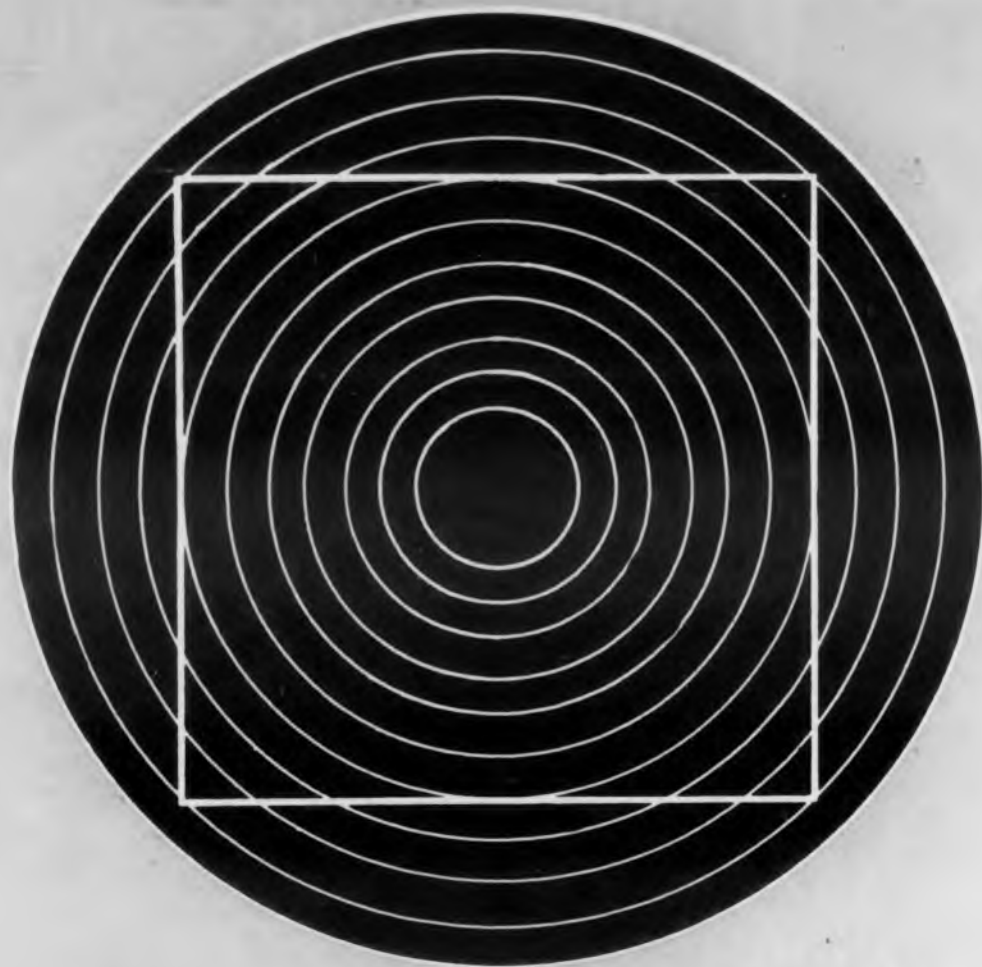


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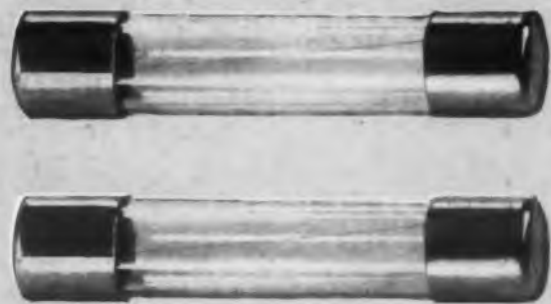
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things are NOT as they seem...

This is a perfect square within the circle
— it is an optical illusion that the sides bend.



Things are not as they seem...
These two fuses look alike...
But they are not.



This fuse may burn out anywhere along the length of the filament even in the cap—this blown fuse is impossible to detect visually.



This Littelfuse has a controlled blowing point—the filament is plated throughout its length except in the very center—the fuse will always blow here. A blown Littelfuse can be detected immediately—a Littelfuse feature.

Littelfuse holds more design patents on fuses than all other manufacturers combined.

LITTELFUSE

DES PLAINES, ILLINOIS

Editorial...

Engineers Should Write

Ask the editor of any technical publication what his greatest problem is, and his answer undoubtedly will be "trying to get engineers to write articles for publication".

We believe that there is no really good reason for this state of affairs.

In the first place, if engineers thought the problem through even casually and then acted upon the conclusions reached, they would literally flood magazines with good manuscripts. They have everything to gain by such action. Professional recognition by having their work published in the technical press; recognition in their own company (in many organizations published articles are an important factor in deciding upon promotions); financial return (most magazines pay for articles); disseminating information that helps to advance their industry and create more and better opportunities for growth: . . . these are just a few benefits that come to mind.

Naturally, the man's company benefits also. The publicity value of the company's name appearing in print is undeniable. The reputation of being associated with advanced technical thinking (as exemplified by the type of articles the company's engineers write), also is important. In fact, the entire industry benefits from the publication of good articles, for it is through the continuing interchange of technical information that the electronic industries (as only one example) have made their amazing progress.

Then too, many companies have derived great benefits by educating users of their products in the proper application of these products. In this way, customer complaints on product performance (often caused by improper application) have been reduced.

Thus there is every reason why engineers should write articles, and why companies should do everything possible to encourage this activity.

◀ CIRCLE ED-3 ON READER-SERVICE CARD

Engineering Review . . .

Computation Services . . . A high speed computation service, performed automatically on the Burroughs Laboratory Computer Model I has been made available to business, manufacturing, trade, and scientific organizations. Developed and improved over the last two years for laboratory study, this electronic digital computer has been proven on a regular schedule of computations. Test problems have included turbo-engine design and performance calculations; pipe stresses for chemical processing plants; optical ray tracing; antenna calculations; and statistical correlations.

Features of the computer include magnetic memory systems; punched paper tape input and output facilities, including photoelectric read-in; and extensive checking circuits to avoid error. It is made up largely of more than 750 standard electronic building blocks, known as Pulse Control Units, which are widely used as test equipment in electronic research on computers. Information on the new service can be obtained from the Electronic Instruments Division, Burroughs Research, 511 N. Broad Street, Philadelphia 23, Pa.

Electronically-Controlled Railroad . . . V-H-F radio will be used to control switches, signals, and interlockings on a 90 mile single track railroad constructed in Venezuela by the Orinoco Mining Co. (a subsidiary of U. S. Steel). The project will combine centralized traffic control and coded carrier (voice frequency) control systems manufactured by Union Switch & Signal division of Westinghouse Air Brake Co. (Pittsburgh 18, Pa.); and transmitters and receivers especially developed for this application by Radio Corp. of America.

The railroad will be used to transport iron ore from U. S. Steel's Cerro Bolivar mine to harbor facilities in Puerto Ordaz in Venezuela. An operator seated at a control panel in the Puerto Ordaz yards will be able to control train movements over the entire right of way merely by pushing buttons and flicking levers. Four sidings will be provided, two of which will be directly controlled by v-h-f waves transmitted from the Puerto Ordaz tower. The two sidings nearest the mine will be controlled by waves sent over a microwave trunk channel to a tower near

the mine. At the tower they will be demodulated and sent to tower locations at the sidings.

In addition to controlling two-way traffic on the single-track railroad, the system will be equipped to handle five telephone and two teletype channels over one full-duplex microwave circuit. Because of certain conditions associated with this application, the use of microwaves themselves is not required, and the system will be flexible enough to permit efficient functioning of the microwave channel by frequencies in the v-h-f range.

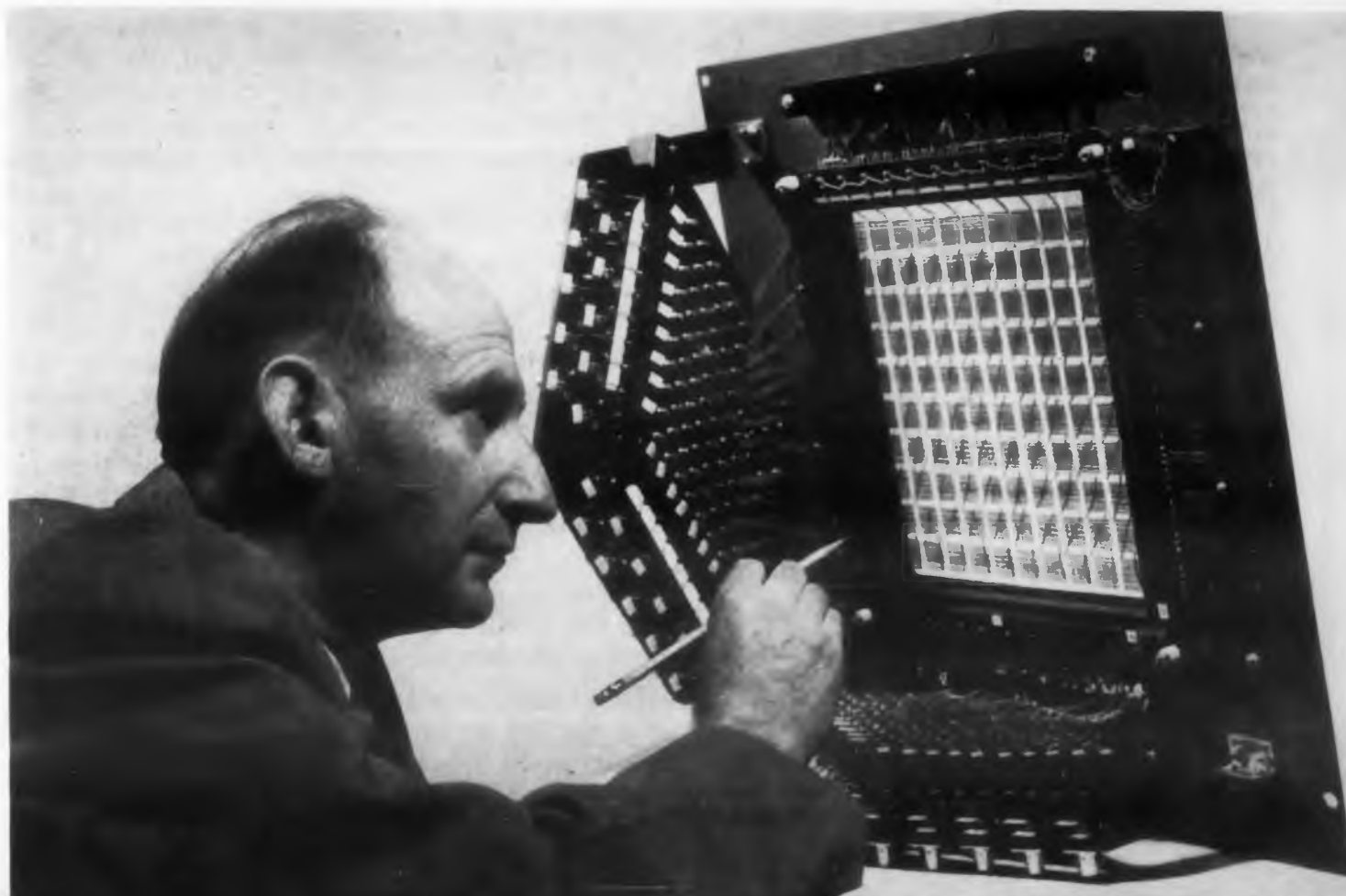
High Speed Memory

Some 10,000 tiny magnetic cores woven on a wire mesh comprise this high speed memory, developed at RCA (Princeton, N. J.) for use in electronic computers. Each square has 100 cores, and a signal sent along a horizontal and vertical wire changes the polarity of the core at their intersection.

Design Data Sheets . . . From time to time there have appeared in *ELECTRONIC DESIGN* a number of "design data sheets" . . . concentrated compilations of handy, practical design information in the form of charts, graphs, or nomographs. Many favorable comments on this type of material have been received and more have been requested. Therefore, an invitation is extended to the readers of *ELECTRONIC DESIGN*, to submit such articles. Specifications are simple. The chart, curves, or nomograph should be neatly drawn and lettered to fit a 7" x 10" space (or be roughly within these proportions if larger or smaller) on tracing cloth or white poster board in black ink. A brief explanation (about 350 to 400 words) of the purpose of the data sheet and how it is used, together with one or two illustrative examples should be included. Subject matter acceptable is limited by only one consideration: it must be of direct, practical interest to electronic designers.

In addition to being paid for their efforts, authors of such articles will have the satisfaction of knowing that they are helping fellow designers in their work. Contributions should be sent to *ELECTRONIC DESIGN*, 127 East 55th Street, New York 22, N.Y.

Information also has been requested on other types of articles that would be considered suitable for publication. In reply to these and for the benefit of authors who would like to submit manuscripts for consideration, a specification sheet is being prepared which briefly outlines the type of material considered desirable, length requirements, information on illustrations, etc. Readers may obtain this information by asking for the "Editorial Specification Sheet" on the Reader's Service Inquiry Card.



The LFE OSCILLOSCOPE

Model 401 FEATURES:



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- LINEARITY OF VERTICAL DEFLECTION
- HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER
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The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

Built-In Trigger Generator. Provides triggers from 500 — 5,000 cps. for internally triggering sweeps. These triggers are simultaneously available, delayed or undelayed, for external use.



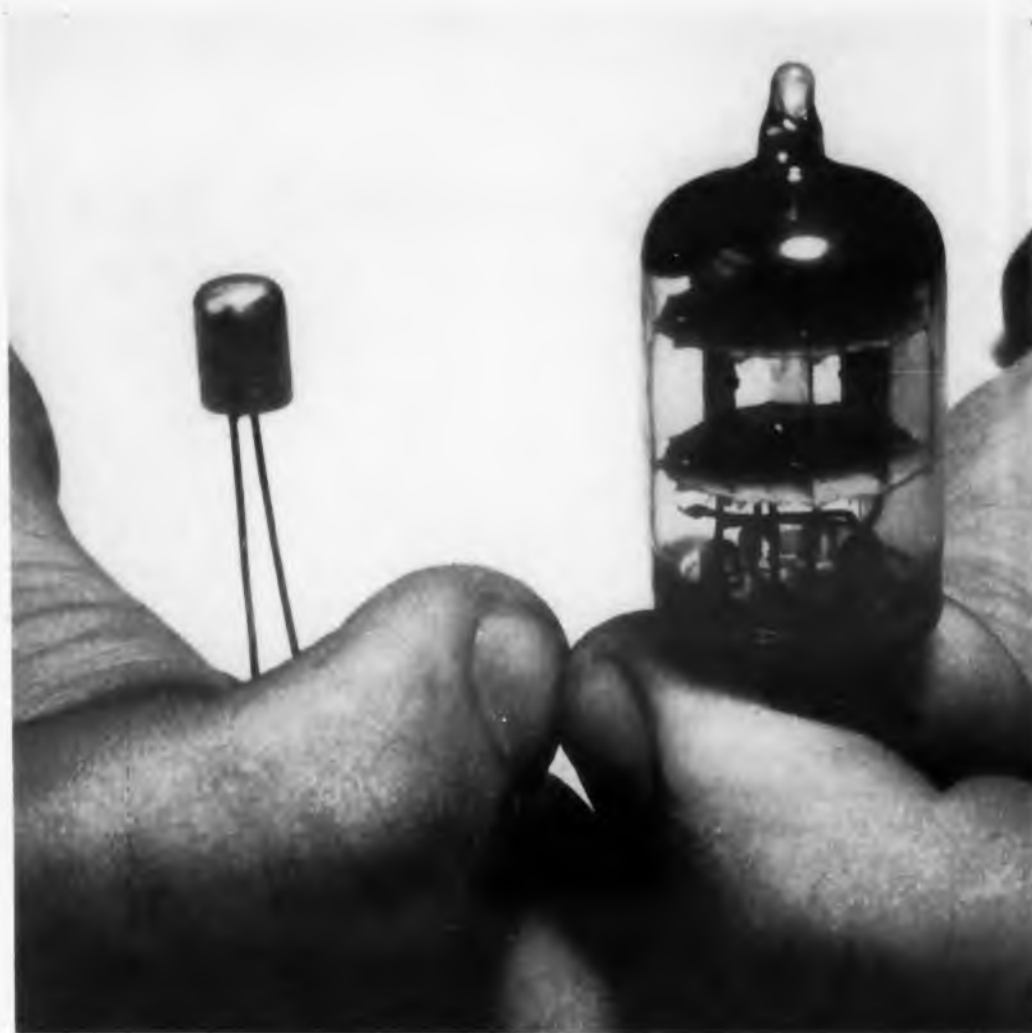
For complete information and specifications write:

LABORATORY for ELECTRONICS, INC.
75-5 Pitts Street • Boston 14, Mass.

CIRCLE ED-4 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicon Alloy Junction Diode

A new silicon alloy junction diode (developed by Bell Telephone Laboratories) compared with a miniature vacuum diode at the right. The unit has a reverse current rating of $5\mu\text{amp}$ at 10v. Its reverse resistance of 2,000,000 megohms compares with 10 megohms at 10v for some germanium diodes. Applications include switching and in memory circuits of a transistor-operated digital computer where its high back resistance is especially useful.



Portable X-Ray Unit . . . A portable industrial X-ray unit that fits into the trunk compartment of an automobile has been developed by North American Philips Co., Inc. (750 South Fulton Ave., Mount Vernon, N. Y.). Designed for rapid inspection of power plant, ship and aircraft equipment, it incorporates an X-ray tube head which also contains the 150,000v generator. This arrangement eliminates the need for high tension cables. The complete equipment weighs only 223 lb, the power supply can be either 115v or 230v a-c, and the current drain is only 20amp. The X-ray tube is fan-cooled.

Industrial TV Detective . . . Police recently received an eye-witness view of thieves at work by means of industrial TV equipment. Inventories at a stockroom of an RCA TV service branch in Hollywood, Calif., indicated that TV equipment was being stolen on a substantial scale (about \$38,000 worth on an initial check). An industrial TV camera unit was concealed among the rafters of the stockroom with the lens focused on the loading platform, and the TV receiver and viewing screen were placed in a second-floor room some distance away.

For two weeks the police watched the receiver, and they noted the suspicious actions of a clerk who casually placed a number of boxes of TV tubes on the

loading platform during the lunch hour when few other people were around. At apparently prearranged intervals, a pickup truck would back into the driveway, the boxes were put on the truck with the help of the suspect, and the truck would pull away. Once these facts were observed, a trap was set. The police waited until the truck drove off with another load of tubes. As they moved in to arrest the clerk, a police car trailed the truck to its destination and seized the driver and two alleged confederates.

Lifeboat Radio . . . A compact, self-contained, portable lifeboat radio transmitter-receiver that weighs only 56 lb, is designed to provide all the facilities needed for sending and receiving SOS calls in both intermediate (500kc) and high frequency bands (8364kc). Developed by the Marine Division of Mackay Radio and Telegraph Co. (67 Broad Street, New York 4, N. Y.), the unit is so constructed that it can be operated by a person without any knowledge of radio. A special device takes over the moment the set is placed in automatic operation and transmits alternate signals on both 500kc and 8364kc. Searching vessels use these signals to locate the lifeboat by means of direction finders. The equipment also can be operated by a radio operator for transmission and reception of messages on either frequency.

Opportunity . . . The rapid growth of ELECTRONIC DESIGN has created a position for an engineering editor on the staff of this magazine. Electronic engineers interested in a technical publishing career are invited to send a resume including age, education, and engineering and publication experience (if any) to the Editor, ELECTRONIC DESIGN, 127 East 55th Street, New York 22, N. Y.

Electronic Conduit Detector . . . An interesting device known as the Model 202 Wall Box and Conduit Detector locates conduit, outlet boxes, steel reinforcements, heating pipes, etc. in walls. Compact, and simple to operate, the device is powered by standard, low cost batteries, and it can locate outlet boxes which have been plastered over even though chicken wire is present in the wall. A product of Detectron Co. (Dept. M, 5420 Vineland Ave., North Hollywood, Calif.), the instrument is adjusted to a particular wall and the wall area is covered with the unit held about 1" from the wall. When a conduit is crossed or a box is approached, a loud squeal sounds in the speaker. Another application for the instrument is detecting lost tools or metal objects covered by sand.

Vibration Generator . . . An improved vibration generator for testing the effects of shock and vibration on electron tubes has been developed by J. D. Rosenberg, W. B. Hillstrom, and L. T. Fleming of the electron tube laboratory of the National Bureau of Standards (Washington 25, D. C.). The machine produces accelerations up to 20 times that of gravity, and has a frequency response that is flat within 20% over the unusually wide range of 100cps to 10,000cps. The tube being checked is fitted into a hole in the vibrator's moving element or armature which is a cylindrical block of nonmagnetic material with a "voice coil" at its lower end.

Two flexible metal strips hold the armature centered in an electromagnetic field structure which is powered by 120v, 40w, d-c. Although the model developed accommodates subminiature tubes only, it can be modified for miniature or octal tubes.

Commercial vibrators of the electrodynamic or "loudspeaker" type seldom are useful above 3000cps because their moving coil usually is fastened to a drive rod that has sharp resonances around 2000cps. In this new machine, the frequency limit has been raised by making the armature simple, rugged, and of a material having a high ratio of rigidity to weight. Linen bakelite (which is only moderately good in this respect) was employed because of its convenience and availability. The fundamental resonance occurs at about 18,000cps, and response begins to rise at about 10,000cps. A tiny barium titanate accelerometer, similar in shape and weight to a T-3 subminiature tube is mounted on the armature of the vibrator to sense the vibration amplitude.

New!

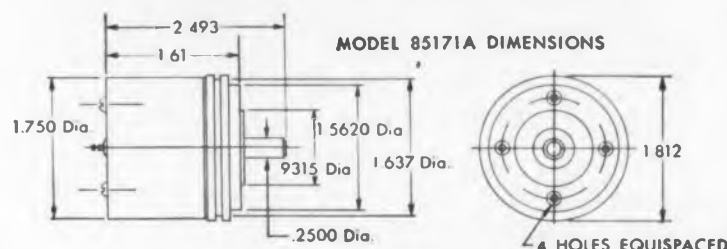
± .01% Linearity

Infinite Resolution



Long Life

Low Noise



Two New Models Added to Spiralpot Line

New precision grades of Spiralpot potentiometers meet exacting requirements of Servo and Computer design.

Model 85171A—one to 20 turns; 2 to 5,000 ohms; 1.750" Diameter. Now available with linearities to ±0.01%

Model 85172—25 to 40 turns; 50 to 10,000 ohms; 1.750" Diameter

Model 85173—1 to 40 turns; 6 to 25,000 ohms; 3.320" Diameter

DESIGN FEATURES

- POSITIVE 500 OZ. IN. END STOPS
- NORMAL OR ZERO BASE LINEARITIES
- RESISTANCES FROM 2 TO 25,000 OHMS
- NO BACKLASH
- LOW INDUCTANCE AND CAPACITIVE EFFECTS
- LOW TORQUE: BALL BEARINGS
- SYNCHRO-MOUNTING
- PRECISION GROUND SHAFT

SPECIFICATIONS

RESISTANCE: Model 85171A—2 to 5,000 ohms
Model 85172—40 to 10,000 ohms
Model 85173—5 to 25,000 ohms

POWER RATING: 5.0 watts at ambient = +25°C (85171A)
10.0 watts at ambient = +25°C (85173)

LINEARITIES AVAILABLE: (Based on percent of terminal voltage)

- ±0.1% Normal (Independent)
- ±0.05% Normal (Independent)
- ±0.025% Normal (Independent)
- ±0.01% Normal (Independent) (85171A only)
- ±0.1% Zero Base
- ±0.05% Zero Base
- ±0.025% Zero Base

RESOLUTION: Infinite. (True Slide Wire)

MECHANICAL SHAFT ROTATION: One to 40 turns Tolerances +3°, -0° on standard units. +1°, -0° on precision grade units.

TORQUE: Starting: Less than 0.6 oz.-in. Running: less than 0.3 oz.-in.

LIFE: Will operate within specifications after one million cycles (20 million revolutions for a 10-turn unit).

TEMPERATURE RATING: Operating range from -55°C. to +71°C.

VOLTAGE BREAKDOWN: Will withstand 1,000v 60-cycle (rms) for 5 minutes. (At sea level).

OTHER GIANNINI POTENTIOMETERS



Gangpot

2 1/2" dia; 1/4" shaft; 1 to 6 sections, Aluminum Case; 360° rotation; ±0.3% lin. 4 watts/sec; 2K to 300K ohms; Vernier Screwdriver Phasing. Ball bearings.



Minigang

1 1/8" dia; 1/4" shaft; 1 to 6 sections, Aluminum Case; 360° rotation; ±0.5% lin. 2 watts/sec; 500 to 70,000 ohms. Ball bearings.



Rectipot

Straight-line motion along axis. Linear or functional output. 200 to 60,000 ohms. 5 sizes, 1" dia. from 2.33" to 6.54" long. Stroke 1/2" to 5".



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1.74" dia; 1/4" shaft; 360° rotation; ±0.3% lin; 4 watts; 2K to 200K ohms, Aluminum Case. Ball Bearings. 40 and 50 db log functions 20K ohms.

Giannini

INSTRUMENT QUALITY POTENTIOMETERS

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

THE TRANSISTOR, a semi-conductor amplifying device, was discovered in 1948* by Bardeen and Brattain at the Bell Telephone Laboratories. One aspect of considerable interest which has been somewhat overlooked in the rush toward larger markets, is the optical sensitivity of semi-conductor devices, and in particular germanium diodes and transistors. Recently Transistor Products, Inc., Boston, Mass., has developed certain experimental *photodiodes* and *phototransistors*. The Type X-4 is an n-p germanium grown junction photodiode. The Type X-25 is an n-p-n germanium grown junction phototransistor, which provides a multiplication of the photo current by transistor action.

Mechanism of Operation

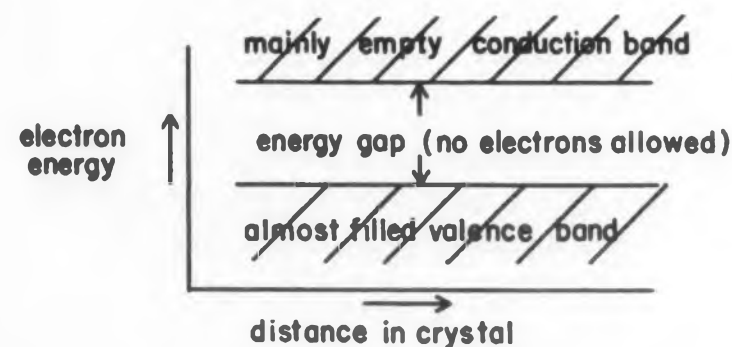
Germanium forms a regular cubic crystal identical in structure with the diamond. The properties of polycrystalline material are sometimes markedly different from single crystals. It is possible with care and effort, to grow single crystals of germanium in sizes of several cubic inches; and we shall therefore consider only such single crystals.

We shall take as axiomatic that a periodic array of fixed atomic charges produces a series of bands of energy levels in which the associated electrons move. (This can be proved by means of quantum mechanical calculations). In the case of germanium this is seen diagrammatically in Fig. 1.

After the germanium has been carefully refined it is possible to introduce controlled amounts of impurities into the single crystal. These impurities are of the donor (i.e., they are of chemical valence 5 and give up electrons readily) or of the acceptor type (of valence 3 and readily accept electrons). The energy level diagram may look like that shown in Fig. 2. In this diagram the donors and acceptors are assumed to be completely ionized. Notice that the donor atoms tend to lie near the conduction band and the good acceptor atoms tend to lie near the valence band.

If the number of donor atoms exceeds the number of acceptor ions then electrical conduction in the crystal is mainly by the excess donated electrons and is called *n* type (for negative). If the number of

* Phys. Rev., 74, 230, 1948.



acceptor ions exceeds the number of donor ions, conduction is mainly due to the positive holes created in the otherwise filled band of electrons. These holes result from the removal of electrons from the filled band by acceptor atoms. The charged impurity atoms (donor and acceptor) are fixed in position in the crystal and not free to move. If the conduction is predominantly by holes the conduction is called *p* type.

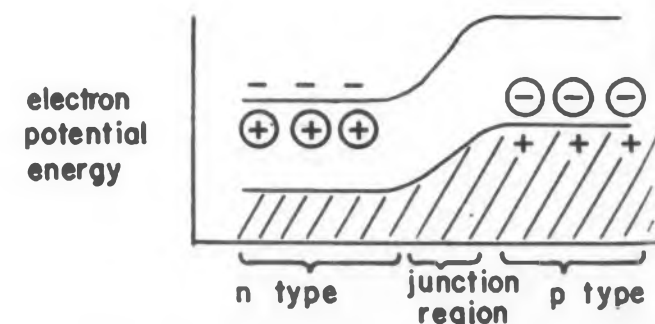
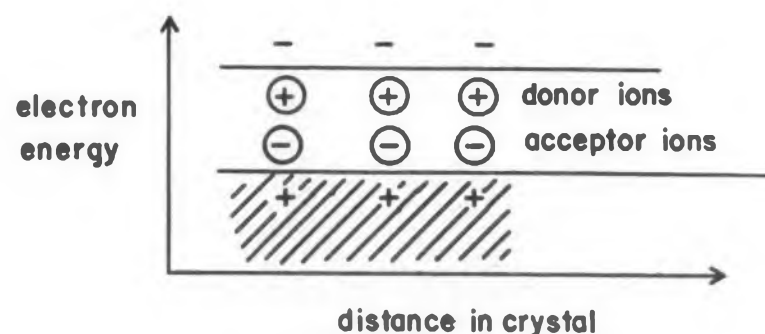
A single crystal of germanium which contains an abrupt internal junction between *n* and *p* type material has interesting rectifying properties. This can be seen by aid of the diagram shown in Fig. 3. In this diagram electrons like to flow "downhill" to regions of lower potential energy (more positive) and holes like to flow "up hill".

Now these bars of n-p material have the interesting property that any potential (voltage) applied across the unit will appear mainly across the junction region. If the left or n-region is made positive the electrons would like to flow from right to left, down the junction hill. But, there are few electrons on the right to flow downhill and few holes on the left to flow up hill. Thus little current results. This is the direction of difficult current flow or the "reverse

Fig. 1 (left). Energy levels in a germanium crystal.

Fig. 2 (center). Diagram when impurities are added.

Fig. 3 (right). Condition when an abrupt internal junction exists between *n* and *p* type material in the crystal.



Photodiodes and Phototransistors

Richard G. Seed, Roland B. Holt
Transistor Products, Inc., Boston, Mass.

direction". If light falls in the region of the junction hole, electron pairs will be generated on both the left and right. Holes will be swept right and electrons swept left resulting in a photo current. It should be emphasized that even in the absence of light some current flows, called the "dark current".

When the n-region is made negative with respect to the p-region the height of the potential barrier is reduced instead of increased. The electrons, tending to flow from left to right, find only a slight potential barrier obstructing their path and flow relatively easily in the "forward direction". Light incident near the junction will cause exactly the same effect only now it is, relatively speaking, "lost" in the large forward current.

The energy level diagram of the n-p-n type phototransistor is shown in Fig. 4. When biased, the applied potential *V* occurs mainly across the second or collector junction (See Fig. 5).

Light falling in the right or collector region excites electrons into the conduction band and leaves holes in the valence band. The electrons will largely drift to the right electrode and participate no further in the action. The action of the holes, on the other hand, is more important. Some of these will diffuse to the left and collide with the junction and be swept across in the favorable direction. Once in the base region, they are lightly held by the retarding potential across the emitter or left junction. The presence of these lightly trapped positive holes lowers the potential of this region for the excess electrons in the left n region, thus permitting greatly enhanced electron

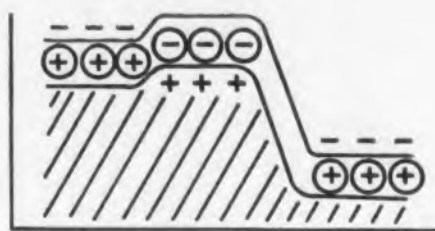
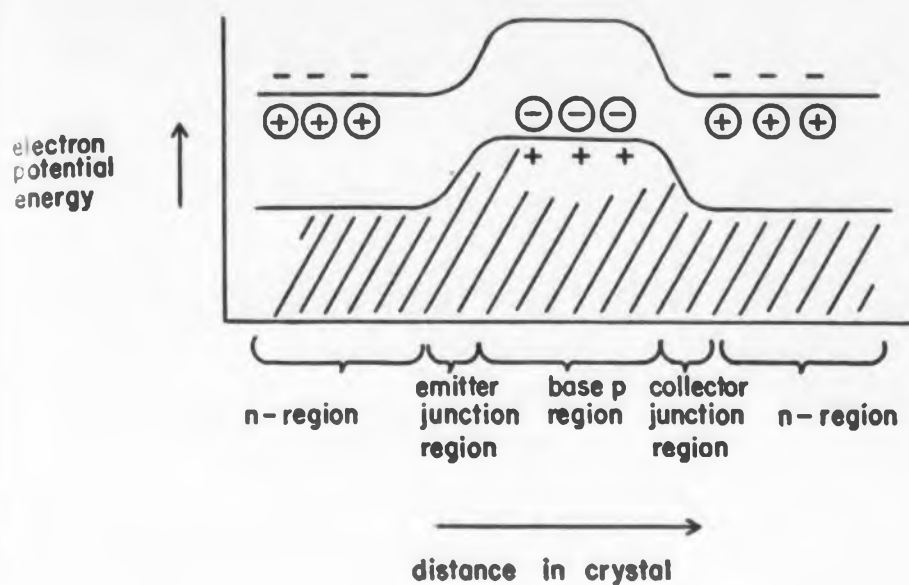


Fig. 4 (left). Energy level diagram of the n-p-n phototransistor.

Fig. 5 (above). A bias voltage appears at the collector junction.

flow. Light falling in the base region itself will also apparently be effective in generating holes which are lightly held.

Device Characteristics

Photodiodes and phototransistors have the following general desirable properties:

1. Small power consumption.
2. Very little power loss (high efficiency devices).
3. Operation at exceedingly low voltages.
4. Low noise level.
5. Large to "great" optical sensitivity.
6. Small size.
7. High optical resolving power.
8. Simple associated circuitry.
9. Reasonable present cost and very low ultimate cost.
10. Ruggedness.
11. Long life.

Photodiodes and phototransistors at present have the following disadvantages.

1. Require moisture protection.
2. Temperature sensitivity.
3. Some lack of production uniformity.

A typical characteristic curve for a photodiode may look like the one shown in Fig. 6. The absolute light sensitivity is roughly 35 microamperes per millilumen. This quantity may vary from 15 to 70 $\mu\text{amp}/\text{millilumen}$. The dark current is usually specified to be less than 20 μamp at 40v. The ideal or theoretic dynamic dark resistance is nearly infinite. Such values are never achieved. A figure of 2 megohms is quite reasonable. Similarly, the light resistance should be nearly infinite but has values ranging like the dark resistance.

The maximum operating power level is approximately 60mw and is limited by the amount of internally generated heat (I^2R) which can be dissipated without significant temperature rise. It should be noted that the elements can be heated beyond the point of operation, allowed to cool, and return to normal working conditions. The minimum destructive power

level is approximately 400mw., beyond which there is no return. The maximum applied voltage depends on the dark current and the Zener potential. It is generally about 40v to 125v.

Theoretically the photodiode should respond to interrupted light up to frequencies above 100,000cps. They have been tested up to 8000cps by using a flashing neon tube.

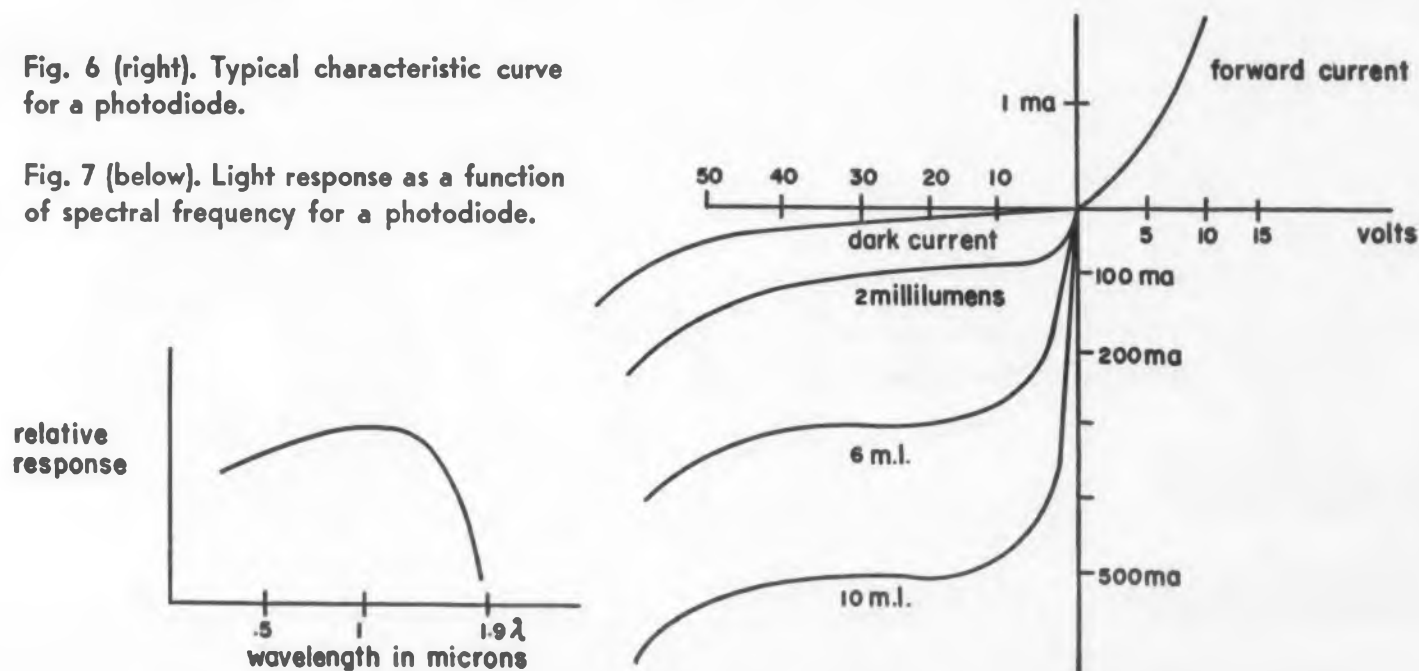
The elements are temperature sensitive. Much effort is being expended in reducing the sensitivity, and ultimately the problem will be either eliminated or greatly reduced. For the present, operation above 50°C is discouraged, and operation above 100°C may be destructive.

There is no reason why the life should not some day be infinite. Because the units are usually destroyed by some mechanism listed above, a figure for life is not available. Under proper care it is very long indeed.

The sensitive area is restricted to the region near the junction. It is thus exceedingly small. The overall junction bar may measure 1mm x 1mm x 4mm.

Fig. 6 (right). Typical characteristic curve for a photodiode.

Fig. 7 (below). Light response as a function of spectral frequency for a photodiode.



The sensitive area may be 0.1mm wide and the 1mm width of the bar. The light response as a function of spectral frequency is roughly shown in Fig. 7.

These comments with certain exceptions apply also to phototransistors. The main distinction is the enormously increased sensitivity which is of the order of $1/(1-\alpha)$ which may be from 50 to 500 times that available in photodiodes.

Device Applications

The photodiode or phototransistor can be used in almost any application which now employs other types of optically sensitive elements. A number of these are listed below.

1. Photoelectric controls.
2. Optical tape read out.
3. Punch card optical read out.
4. Telegraphic optical read out.
5. Infra-red burglar alarms.
6. Liquid level controls.
7. Automatic automobile headlight dimmers.
8. Moving picture variable density sound read out.
9. Automatic brilliance controls on TV receivers.

The authors have done some preliminary work on these devices and would welcome communication on the subject.

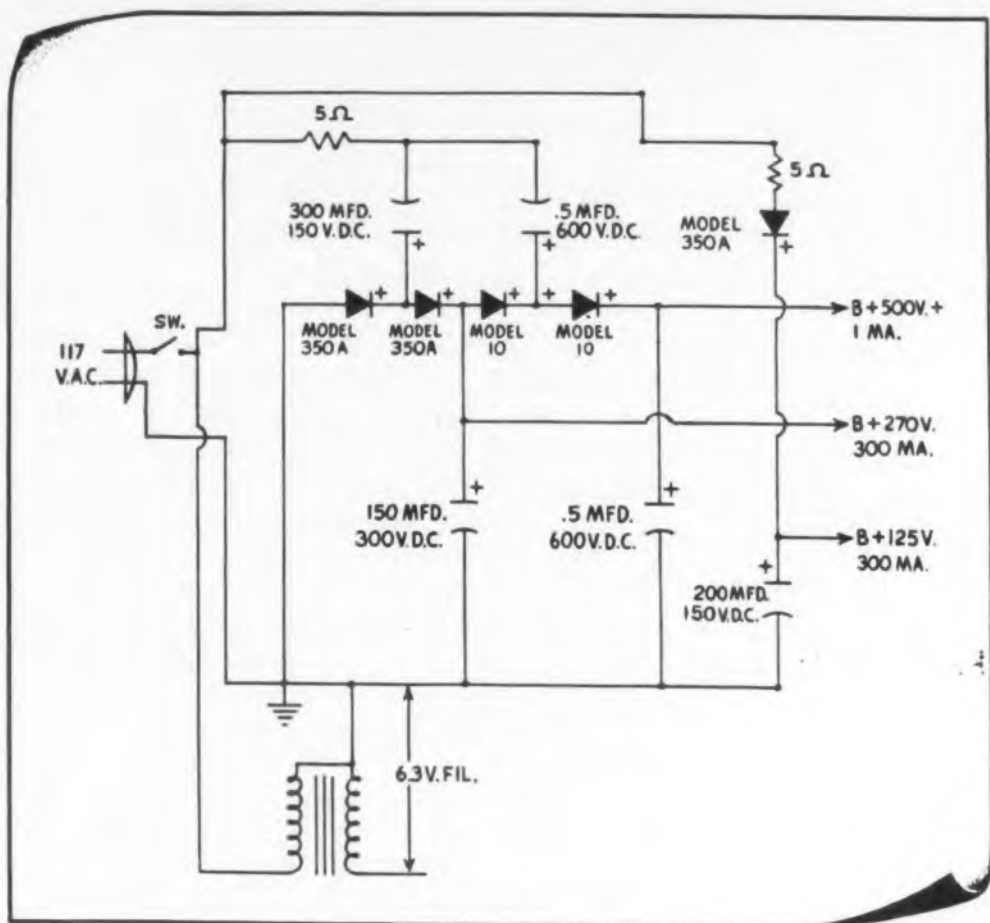
Conclusions

It should be mentioned that the number of possible photosensitive semi-conductor devices is myriad. The authors are familiar with at least half a dozen and have designs for several more. The absolute superiority of one device over another is not established and obviously will not be for considerable time to come. In fact, various separate devices may be used in separate applications. Meanwhile design and production must follow along simultaneous lines, for the economic advantages of the devices cannot be ignored.



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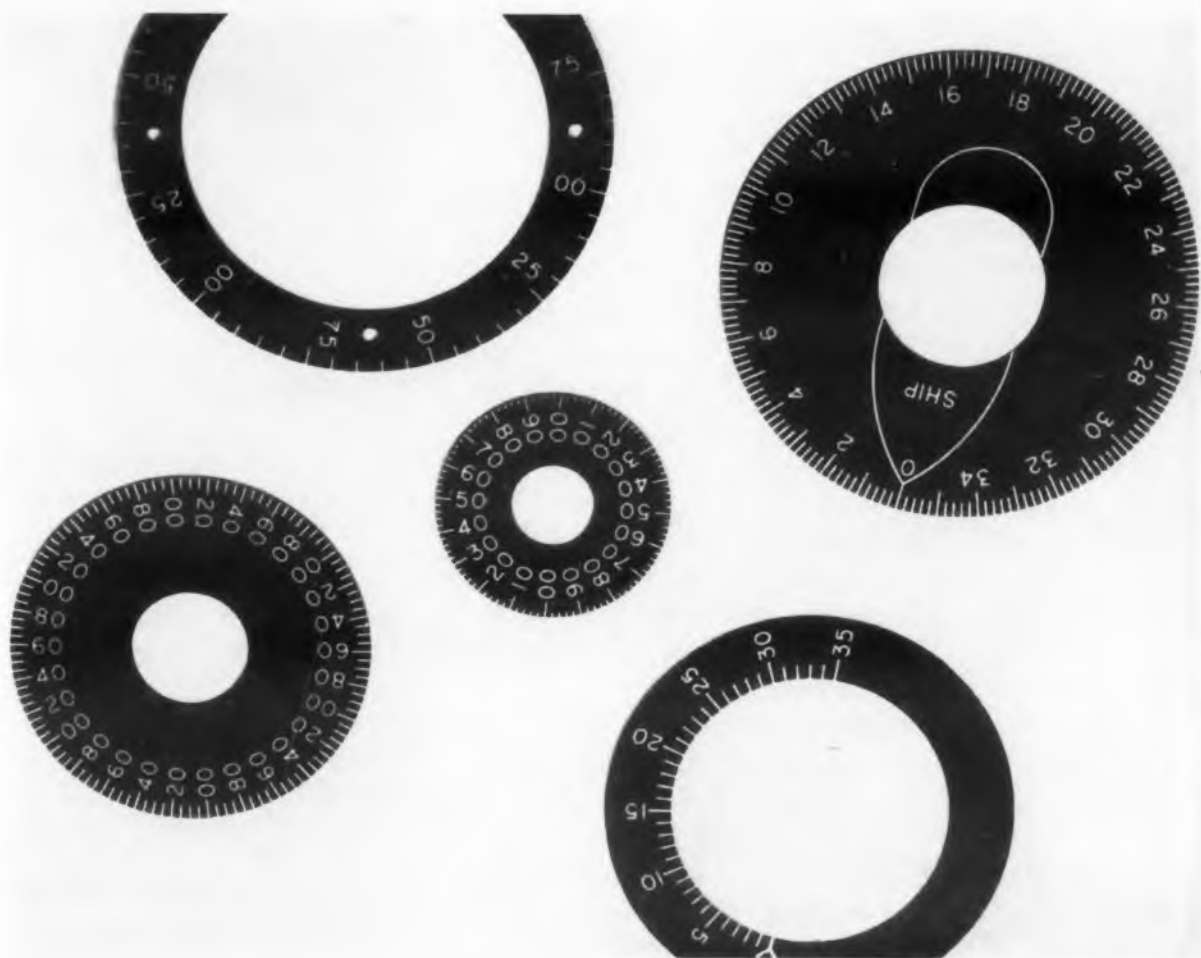
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Photographically Graduated Instrument Dials

Fig. 1. The various precision instrument dials shown here have been precisely calibrated by means of an optical-mechanical recording machine. Error in uniformity of spacing is eliminated because the machine generates the marking optically from a single-line master pattern.



DESIGNERS of precision electronic equipment such as measuring instruments, gun computers, radar and sonar devices, etc., are often faced with the problem of providing accurate scales or dials on which precise readings can be observed. Since precision instruments can only be as accurate as their indicating dials, this design factor is important.

To solve this important problem, Precision Photochemical Corp. (170 So. Van Brunt St., Englewood, N. J.) has developed an economical method of manufacturing precision instrument dials, scales, and other precisely produced calibrations by means of an optical-mechanical recording apparatus. The possibility of error in uniformity of spacing or character is eliminated because the machine generates the markings optically from a single-line master pattern.

Dial graduations can be made in any dimension from as fine as three microns (0.000120") in width for microscopic dials up to any desired size to meet commercial requirements. Graduations can be generated about a polar axis or around an elliptical axis, and spacings can be uniform, logarithmic, or follow any modified function; and the graduations can be radial, or slanted in any required direction (Fig. 1).

For scientific and industrial applications, patterns such as sine waves, square waves, sawtooth waves, or other types of waveforms can be recorded to any frequency as close as one cycle apart and of any desired amplitude. Most important of all, the process lends itself to economical short run production.

The master dial is generated on a glass plate which is ground optically flat before it is made light sensitive. Its dimensional stability therefore becomes that of glass. The center hole around which the graduations are generated is held to a tolerance of -0.0000 ", $+0.0002$ ". Photographically produced replicas are made by contact printing under vacuum, and dial blanks are printed from the master using a center hole of the master's tolerance.

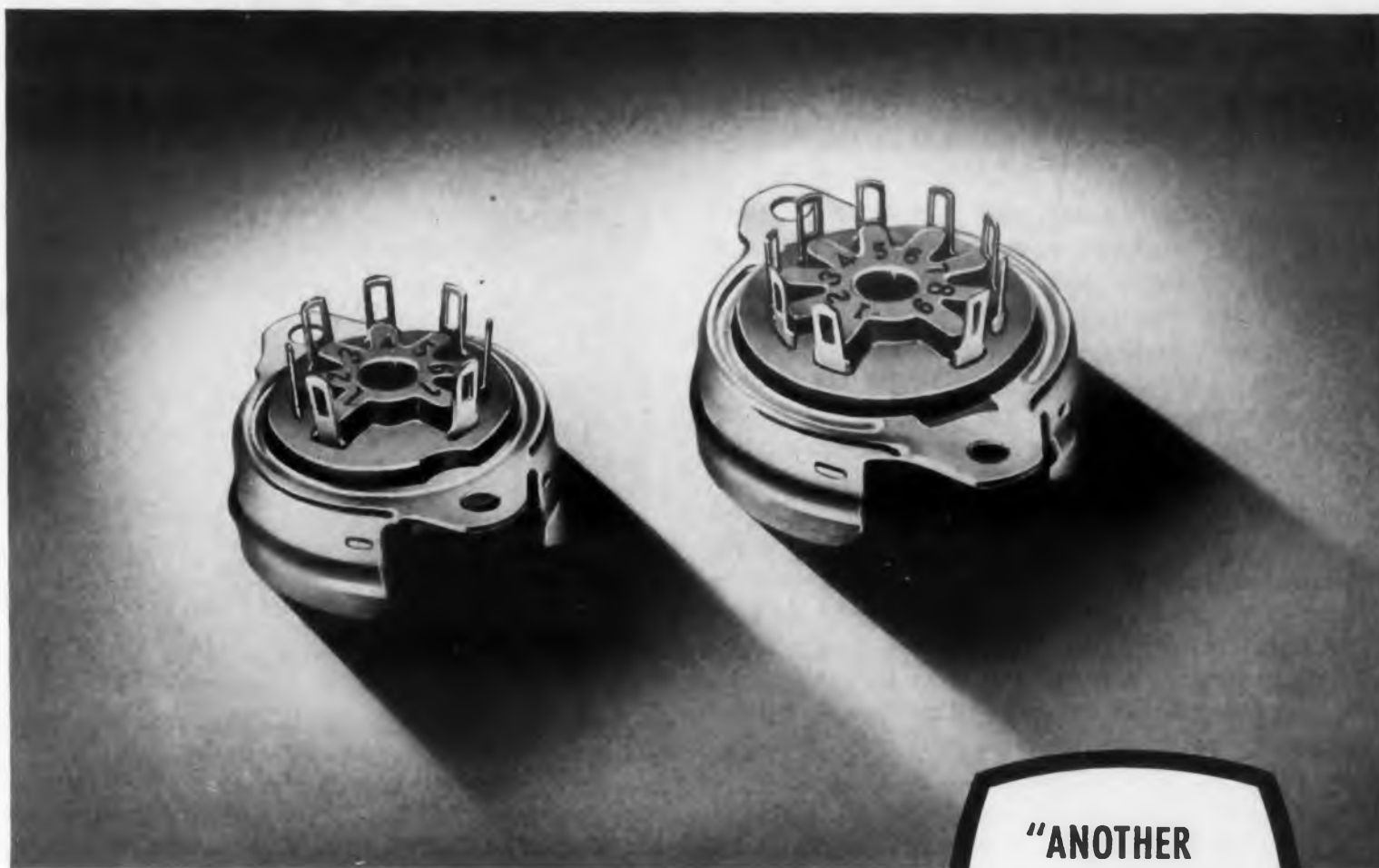
This procedure assures that eccentricity can be kept to less than 0.001". This means that precision of ± 1 minute can be attained on dials as small as 3" or 4" diam. With verniers of equal precision, the dials can be read to 1 second of arc. In dials of larger diameter, the precision improves linearly.

Dials can be produced on plastics such as "Lamicon", "Plexiglas", "Lucite", etc., and can be opaque, transparent, translucent, or reflective. Graduations may be white in reflected light and any desired color in transmitted light. The graduation colors are applied by coating the plastic with a thin film of a pigmented finish, which provides a permanent support for the photographic emulsion and also forms the required color background for the legend.

Because of its accuracy, and its adaptability to both short and long production runs, the process places at the disposal of precision electronic equipment designers a ready means of solving a difficult component problem.

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Electroforming In Electronic Design

S. G. Bart

Bart Laboratories Co., Inc., Belleville, N. J.

MANY difficult design and fabrication problems which frequently arise to plague both designers and production men often can be solved by utilizing the relatively new techniques which have been applied to the old process of electroforming. This process is economically feasible for the production of a wide variety of parts for electronic use, particularly when the piece requires a combination of fine finish, close tolerance and intricate shape. Development work in commercial applications of electroforming has been carried on since 1912. Highly specialized techniques have been developed, particularly in recent years, to meet unusual and difficult demands of electronic designers.

Electroforming is the process of creating an article by electrodeposition. In spite of the use of plating solutions, electroforming is essentially a mechanical operation. It involves factors which are similar to those encountered when planning any other type of metal forming operation. In actual operation, a removable mold or form (inverse in shape to the desired product) is plated to a predetermined thickness



Fig. 1. A round-to-rectangular transition tube is an example of the simplest type of electroforming.

and then separated from the deposited metal. Every contour of the original form is accurately reproduced to within millionths of an inch.

Since electroforming duplicates the surface on

which the metal is deposited, it therefore is possible to deposit metal on a surface having a fine finish (finer than 2 MRS) to obtain a fine finish on the electroformed piece. An extremely fine finish is relatively easy to get on a mandrel, but almost impossible to obtain by machining on the inside of a part. In addition to accomplishing minute duplication of surface, close dimensional tolerances ($\pm 0.0005''$) also are maintained.

Electronic Applications

Present applications where electroforming has found widespread electronic use are in the fabrication of precision waveguide components, including transition sections, tuning cavities, antenna horns, feed tubes, transformer sections, elbows and twists, and precision tubing. In the majority of these parts, intricate internal shape, where close tolerance and high finish are required, make them natural products for manufacture by the electroforming process.

Precision reflectors and reflecting surfaces, particularly those used in various types of delicate testing equipment, are other examples of the accuracy and high surface finish that can be achieved with electroforming. Outstanding example of this type of work was the reproduction of the Mount Wilson Observatory grating by the Bart "Lectroforming" process. Here an exact reproduction, in every detail, of 16,000 parallel submicroscopic lines to the inch was accomplished to an accuracy of a fraction of a millionth of an inch.

Most important point to be considered in determining whether a piece can, or should be electroformed is the shape of the piece. This determines the type of "mold" upon which the electroform can be made. The simplest type of electroforming can be accomplished where sufficient taper is available to allow easy separation of the electroformed part from the mold. An example of this type is the plating of a simple round-to-rectangular transition tube on a metal mold, where very little difficulty is met in separating the electroform from the mold (see Fig. 1).

A second type of mold is that in which there is no taper; for example, a straight section of rectan-



Fig. 2. Two piece taper molds, which can be screwed together (and reused), are employed to make this venturi.

Fig. 3. Waveguide tuning cavity with gold inner surface, copper center, and iron exterior.



Fig. 4. Cerro-alloy mandrels are used to electroform complex shapes like this double 90° bend.



silver, copper, and iron; or silver, iron, and nickel for specific purposes. This application has been particularly successful in the manufacture of cavities for waveguide tuning where the interior gold or silver surface provides good corrosion resistance; copper contributes to the conductivity and the nickel or iron makes up the strength of the piece (Fig. 3).

Fig. 4 illustrates the use of cerro-alloy mandrels when the shape of the part prevents withdrawing of the mandrel after forming. Nominal tolerances of ± 0.002 " can be maintained on the inside diameter of the double 90° bend shown, and the walls of the part are uniformly thick. Seamless, close-tolerance antenna horns, with a fine interior surface finish can be produced by electroforming. Size is no major problem (see Fig. 5), and distortion and surface irregularities are completely eliminated.

One of the newest possibilities which has received a great deal of consideration is the use of combinations of metal and rubber "sandwiches" for reducing or deadening electronic waves and insulating parts from one another. The bonds between these layers can be made unusually good.

Metals for Electroforming

Structural requirements of the finished part are an important point in the evaluation of electroforming. The electroformer has available a limited number of metals with which he can work. These are listed in Table 1.

The latter two types of nickel have opened up a tremendous field for electroforming parts that have high strength and are substantially stress free. In general a stress of less than 2,000psi is considered satisfactory for the most critical electroforming jobs.

regular waveguide tubing where close tolerances of ± 0.001 " must be held. In this instance it is possible to take advantage of two important methods.

One is to apply a lubricant to the mold such as wax or graphite, or a low melting metal like tin or lead, which with the application of a little heat will allow the electroform to be slipped from the mold. A second method is to use metals having different coefficients of expansion which will enable the electroform to expand more rapidly than the mandrel and allow space for separation without marring the interior surface. Cerro alloys, waxes, plastics, and other materials that have sufficient dimensional stability and yet are thermoplastic also can be used.

Combinations of the above methods can be used in cases where certain inserts are necessary. These can be cast into the cerro-alloy and electroformed right to the piece, becoming integral when the mold is removed by melting it. Two-piece taper molds which can be screwed together, permit forming of a venturi with a permanent mandrel that can be reused (see Fig. 2). The only limitations on this type of combination are economic in nature.

Special electrical requirements are an important consideration which frequently can be solved by electroforming. With this process, it is possible to produce bi-metal or tri-metal electroforms such as

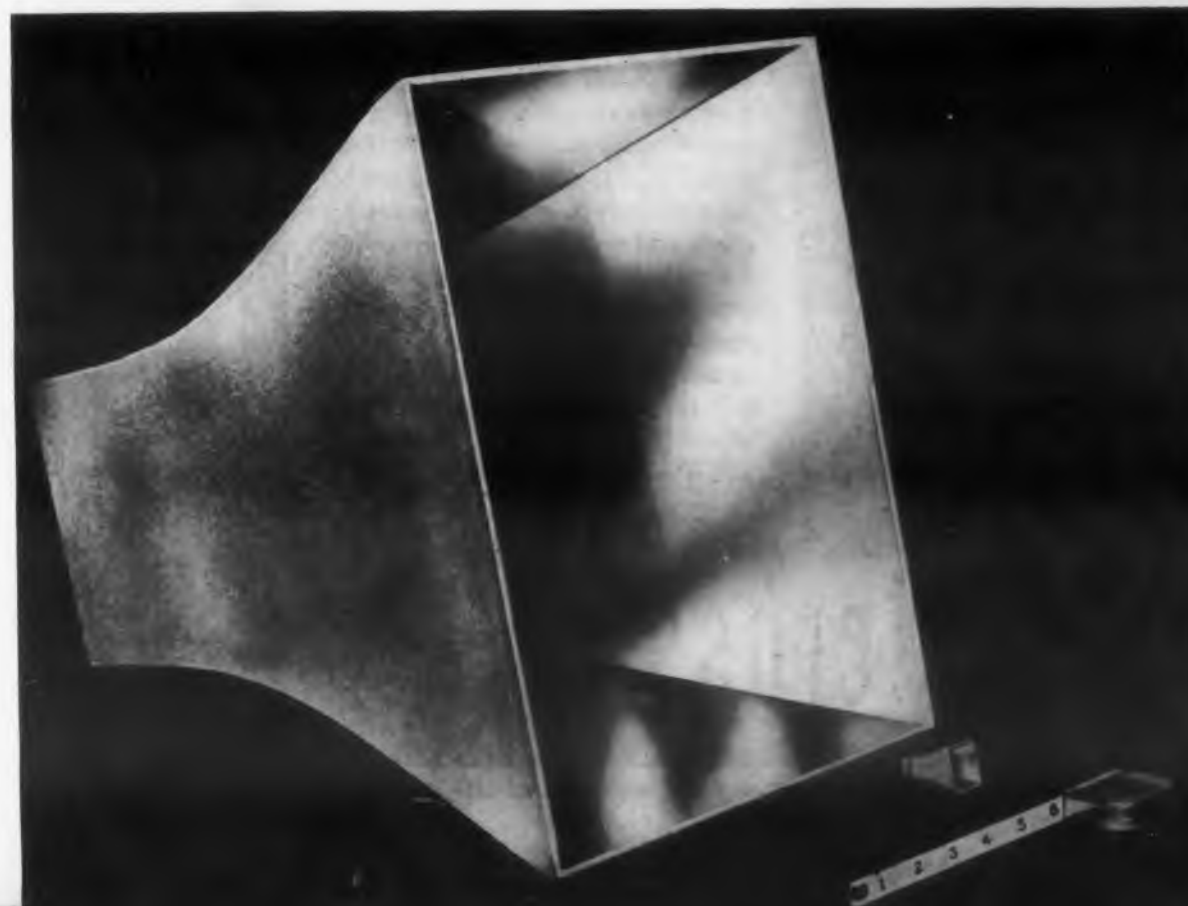
Table 1. Metals suitable for electroforming

Metal	Tensile Strength PSI	Hardness (Vickers)	Ductility (Elongation in 2")
1. Copper	20,000 to 40,000		
2. Iron	40,000 to 50,000	150-160v	40%
3. Nickel			
Watts Type soft	50,000	140-160v	30%
Chloride Medium	98,000	230-260v	21%
Wesley Hard	150,000	400-425v	6%
Low Stress-S	150,000	500-650v	4-8%
Low Stress-SF	60,000 to 80,000	200-400v	8-30%

Electroforming has unlimited possibilities for the electronic designer which are being further increased by a considerable amount of development work on the electroforming of such elements as tungsten, molybdenum, aluminum and titanium. In addition, considerable work is being done on the electroforming of alloys which will widen the scope of electroforming and enable it to keep pace with high temperature, high strength materials required in this industry.

In summarizing, electroforming is an excellent means of producing precision parts for many services. It is economically feasible for the production of a variety of electronic parts requiring fine finish and close tolerance, particularly when the quantity involved is small. It is not generally able to compete with other forming operations for the run-of-the-mill parts. Through study of parts to be formed and careful design of a mandrel, electroforming can become a real production process for the manufacture of precision parts, assuring close tolerances and high surface finishes, otherwise impossible to achieve.

Fig. 5. These seamless, close-tolerance antenna horns have a fine interior finish. As can be seen here, size is no major problem in electroforming.



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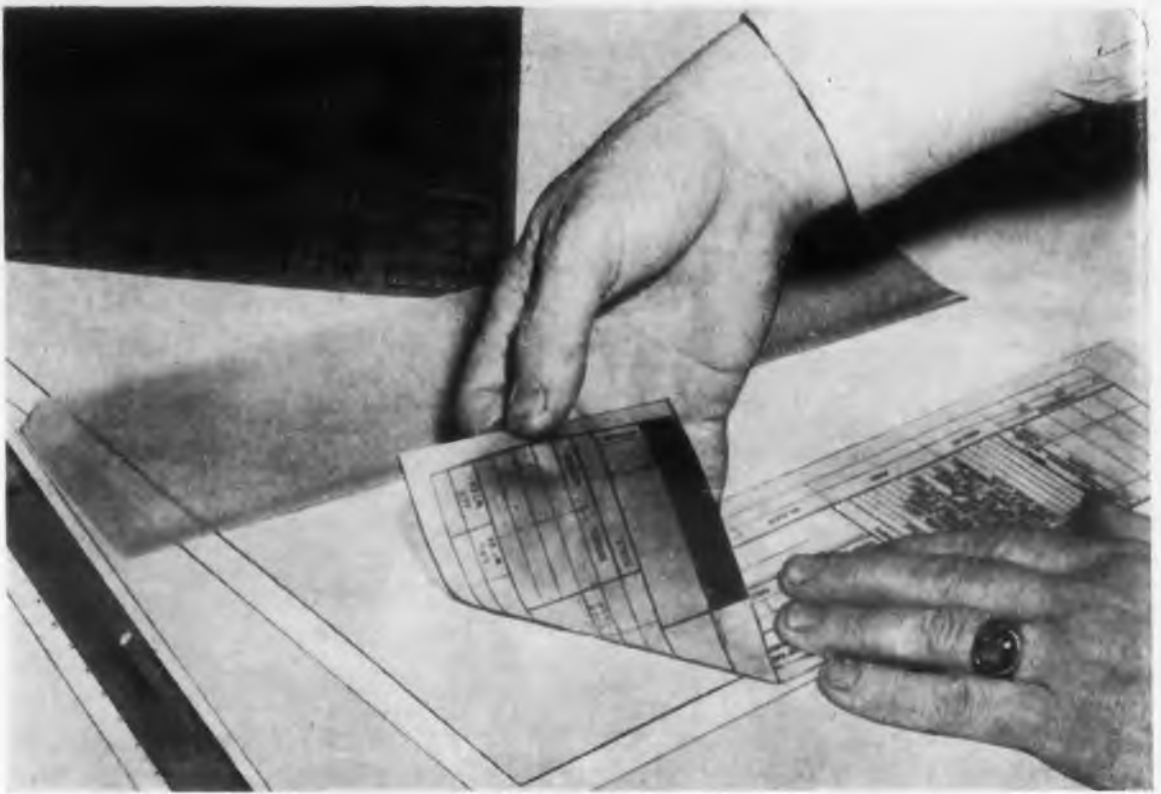
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MAGNETIC	
ALL DIMENSIONS SHOWN TO BE MET AFTER CADMIUM PLATING. THICKNESS OF PLATE .0003 MIN. TO .0005 MAX. MIN. THICKNESS TO BE .0005 ON THREADED AREAS. NO ALLOWANCE FOR PLATING IN HOLES.	
REMOVE ALL BURRS. BREAK ALL EDGES .012-.031	
125	HOLES PER A.S. 30 EXCEPT AS NOTED. INCLUDING REAMED SURFACE ROUGHNESS
TO BE FLAT WITHIN 1/32 ACROSS ANY FACE EXCEPT ENDS WITH DRAFT.	
ALL DIMENSIONS TAKEN TO THE POINT OF INTERSECTION. THUS	
ALL RADI OF .012 OR LESS TO HAVE TOLERANCE OF ± 1/2 THE RADIUS UNLESS OTHERWISE SPECIFIED.	
HOLES MUST BE KEPT FREE OF PLATING SOLUTION.	
IMMEDIATELY AFTER PLATING NEUTRALIZE AND IMMERS IN RUST PREVENTIVE OIL	

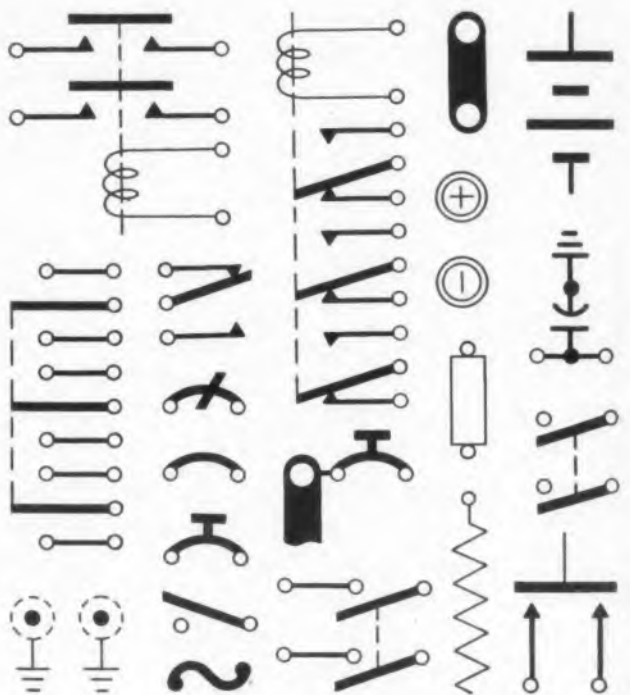


Fig. 1 (top). Designers can quickly apply "Transeals" on their drawings to save drafting time. Several types including a title block for application to the reverse side of a drawing and identifying numbers (below) are shown.

- | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|
| 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 |
| 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 |

A PERENNIALY disagreeable chore for many electronic designers is the task of drawing complex circuit diagrams for reproduction. This is especially true where complicated symbols, such as multicontact relays or identifying numerals on various parts of diagram have to be drawn. This problem has been recognized, and all sorts of drafting aids have been placed on the market, including lettering guides, symbol templates, symbol stamps, etc. The latest of these aids is a thin transparent printed plastic sheet known as a "Transeal", manufactured by the Johnson Research Corp., Bethpage, L.I., N.Y.

This plastic sheet has a pressure-sensitive adhesive coating that is protected by a removable wax paper sheet. On the plastic sheet are printed various electrical or electronic symbols which are used repeatedly in drafting work. Other repetitive items, such as identifying numbers, title blocks, and bill of material blocks, also can be included.

In use, the designer cuts out the symbols he wants to use in his drawing and removes the protective wax paper backing. Then the symbols are placed in position and, with a slight finger pressure (no heat is required), they are pressed down on drawing paper, vellum, or cloth (see Fig. 1). The connecting circuit lines are drawn in to complete the drawing. Title blocks and bill of materials columns also are placed in position, and the final drawing then can be photographed.

With these "Transeals" it is possible to take the drawing and run it through a blueprint machine for duplication without damage to the symbols.

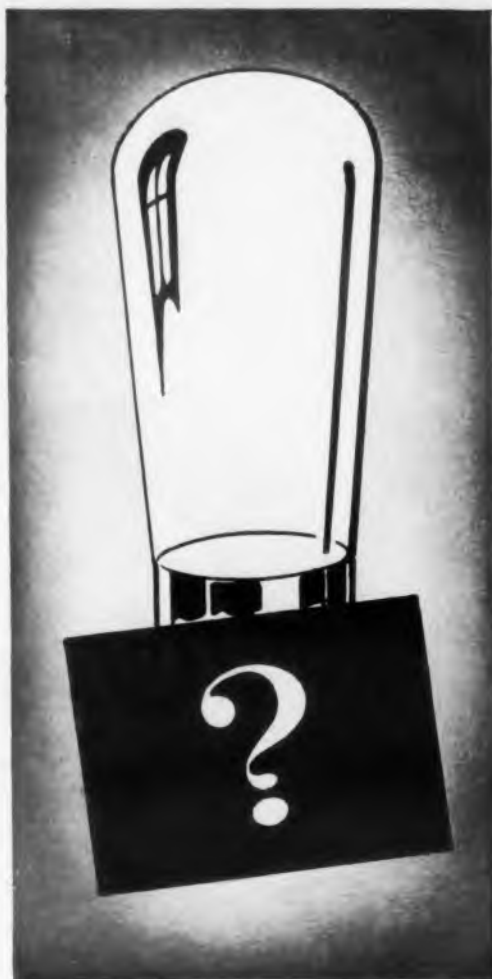
A wide variety of symbols (largely used in aircraft electrical systems) are available in stock sheets. Several are shown in the illustration at the left, and it is readily apparent that drawing these symbols by hand six or seven times on a diagram would be very time consuming.

Another feature of the "Transeal" symbols is that they can be removed easily and reused to make more than one diagram. They also simplify the problem of making corrections or changing the circuit arrangement. The symbols are merely removed and quickly placed in the new position. No erasure is required as is the case when using rubber stamp symbols or when drawing the symbols by hand.

Where a designer uses special symbols and special types of title blocks, these can be prepared to his specifications at a nominal cost. They also can be furnished for application to either the reverse side or the face of the drawings. One of the reverse types of "Transeals" is shown at the extreme left among the symbols shown in Fig. 1. Many other styles and arrangements are possible.

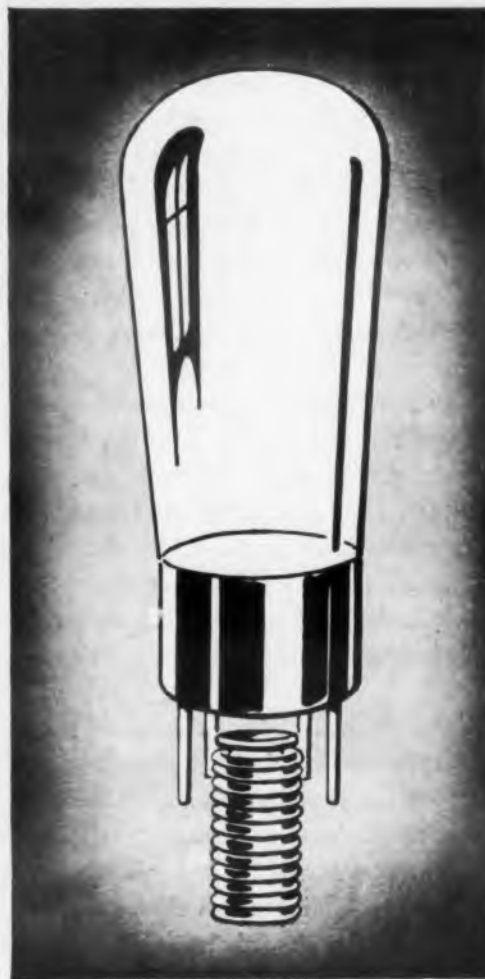
In electronic circuit diagrams where such items as tube, resistor, and capacitor symbols are repeated many times, "Transeals" will save the electronic designer much time and will add greatly to the uniformity and neat appearance of his circuits.

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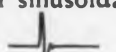
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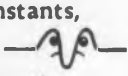

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THE PULSE-MARKET PULSE

Pulses are here to stay. In a few short years the pulse-forming network has replaced the grid-leak, the artichoke has superseded the slowpoke choke. Waveforms are no longer sinusoidal,  they're spinusoidal . (Ever been bit by radar? Very sharp pips in that there.)



The high-sounding term "Pulse Techniques" calls to mind a keen, up-to-the-minute, young engineer pawing at the threshold of tomorrow, but one of the oldest families in this business is the Pulse family. One of the early American graphic artists, a Mr. S. Finlay Breed Morse, amused himself by arranging a communication system based on a Pulse Code, the transmission of which was electrical and the reception magnetic. This was in the 1840's.

In communication, pulses are still very popular. An estimated 10^{63} of them are made and shipped annually. Many of them  get worn quite round  by distributed constants, some are split and distorted  and others are lost altogether. 

There is, of course, in any pulse communication system, an attempt to restore or reform tired pulses.  Moderately bad ones can be squared up by passage through a relay. By twisting knobs, either on the relay or on its bias supply, it is even possible to restore original width to a tired pulse. The trouble is, relays having cured amorphia, often give pulses schizophrenia, palsy, and Heaven knows what else. †



Considering how advanced the electronic side of the Pulse art is, and how good loud-speakers (and scopes) are, it's a wonder that the dirty telegraph relay hasn't been improved in 30 years. Of course, the English and the Germans

have some excellent models, but they probably only work on English  and German pulses. 

Aside from self-destruction, † there are three basic weaknesses in the usual telegraph relays which have largely limited the transmission rate and usefulness. First, the transfer time is stolen from the pulse, for which the 5% or 10% usually allowed is a nuisance. † Then there is bounce †, which hurts the relay contacts and robs more pulse time. Finally, there is a mechanical oscillation of the armature-contact system after make. † This has a very definite frequency which, in a common telegraph relay, is about 150 c.p.s. This persists so long that it introduces lead or lag at the leading edge of the following pulse, depending on the elapsed time between.

Obviously, in a long circuit, all the faults are cumulative if the relays all have similar characteristics. One very common American telegraph relay avoids reverberation at the expense of high frequency bounce and slow transfer, which minimizes the mischief, but it is an expensive monster. The foreign types, by intelligent design, have eliminated bounce and raised the reverberation frequency to about 1000 c.p.s., at the expense of contact capacity and life.

We have a prototype in development now which takes the reverberation frequency over 2000 c.p.s., doesn't bounce at all, and transfers .005" in .3 millisecond. This allows 75% efficiency at 400 c.p.s. pulse rate or 1000 words a minute. The contacts have limited life, but the ease of replacement and adjustment may well justify its use in the pulse-market.

† A basic feature of Sigma Type 7J0Z telegraph relay.

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Microwave Range Resonance Indicator



Fig. 1 (left). This resonance indicator with plug-in probes performs many of the functions of a grid-dip meter.

Fig. 2 (below). The small size of the probe permits ready access to a particular circuit for individual checking.



DEVELOPMENT engineers working on u-h-f circuits (up to 1000 Mc) will appreciate the unusual features of the Model 60 Resonance Indicator shown in Fig. 1. A product of Dynamic Electronics-New York, Inc. (73-39 Woodhaven Blvd., Box 188, Forest Hills, N. Y.), this new electronic measuring instrument is designed to perform all the functions of a grid dip meter over a wider frequency range, with greater accuracy, and more conveniently.

Primary purpose of the instrument is to measure parallel resonances of circuits over a frequency range from below 10Mc to above 1000Mc with an accuracy of $\pm 1/2\%$. It has a small probe for easy access to circuits in tight places, and a very low radiation compared to the grid dip meter.

As can be seen in Fig. 1, the instrument consists of a small, cylindrical metal housing ($1\frac{1}{2}$ "diam x $2\frac{1}{4}$ "") with a search probe plugged into one end. Two cables, each 3' long and terminated by suitable connectors are attached to the other end of the housing. One of the cables connects to a d-c microammeter or to a sensitive a-c voltmeter if the signal source is modulated. The other cable is a 50 ohm coaxial cable terminated by a BNC connector, and connects to a signal generator.

The resonance indicator is simple to use. The probe is held close to the circuit under test (see Fig. 2), and the output level of the signal generator is adjusted to provide about half-scale indication on the meter. Then the frequency control of the signal generator is varied until a sharp dip in the meter reading occurs. At this point, the frequency of the circuit under test equals that of the signal generator.

Using laboratory type signal generators, accuracies of $\pm 1/2\%$ can be obtained. The small probe size makes it possible to check and isolate a particular circuit even when many circuits are close to each other. The instrument can be used to check the self resonance of r-f coils, to locate parasitic resonances, to pretune r-f and i-f coils without having to energize the circuits, and it provides a means for making a quick check for shorted turns as well as the Q of coils. All these checks can be made without applying power to the circuit under test, and without disturbing the circuit environment.

The resonance indicator also can be used to measure the oscillation frequency of an oscillator.

When used with a signal generator, the resonance indicator can serve as a calibrated source of r-f signals, the probe acting as a small antenna.

Four probes are provided to cover the 10Mc to 1000Mc range, and two spare connectors also are included. These spares are furnished to permit the user to make probes for specialized applications.

The Model 600, with its versatility, simplicity, compactness, and low cost, will be a welcome addition to any development laboratory where high frequency measurements have to be made.

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A roster of all Eicor products, in their various types and sizes, shows an astonishing number and diversity. But of special interest to users of rotary electrical equipment is our ability to produce units unusual in design or performance . . . and do it quickly, accurately, and at reasonable cost.

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These highlights are an indication of what EICOR has done in the past. In the days to come our creative engineering will solve similarly difficult problems involving motors, dynamotors, and generating equipment for industry. Your inquiry is invited.



EICOR, INC. 1501 W. Congress St., Chicago, U. S. A.

WEST COAST OFFICE: 2661 South Myrtle Avenue, Monrovia, California
MANUFACTURERS of Dynamotors • D.C. Motors • Inverters • Converters
and a complete line of TAPE RECORDERS

CIRCLE ED-12 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Circuit Breakers

ALMOST as small as an ordinary fuseholder, these single Pole Thermally Operated Miniature circuit breakers are ideally suited for the protection of electronic equipment such as small transformers, TV sets, and instruments. They are sturdy, vibrationproof, compact (2.44" x 1.22" x 0.57"), and weigh about 1-1/2 oz.

Three of the styles available (from E-T-A Products Co., 915 W. Oakdale Ave., Chicago 14, Ill.) are shown in Fig. 1. Inside construction of these units is the same, and the cases are designed for different mounting arrangements. The unit at the right is provided with solder type connections, while the other two have pins

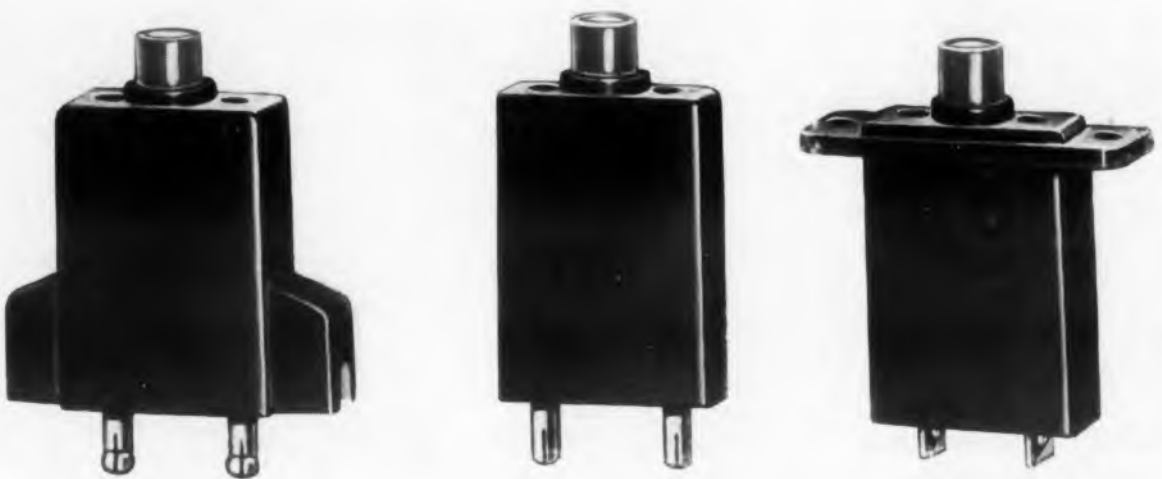


Fig. 1. These single-pole, thermally operated circuit breakers come in many styles, three of which are shown here. The units at the left and center are plug-in types, and the one at the right has solder tabs for making electrical connections. The inside construction of these units is the same, and the cases are designed for different mounting arrangement requirements.

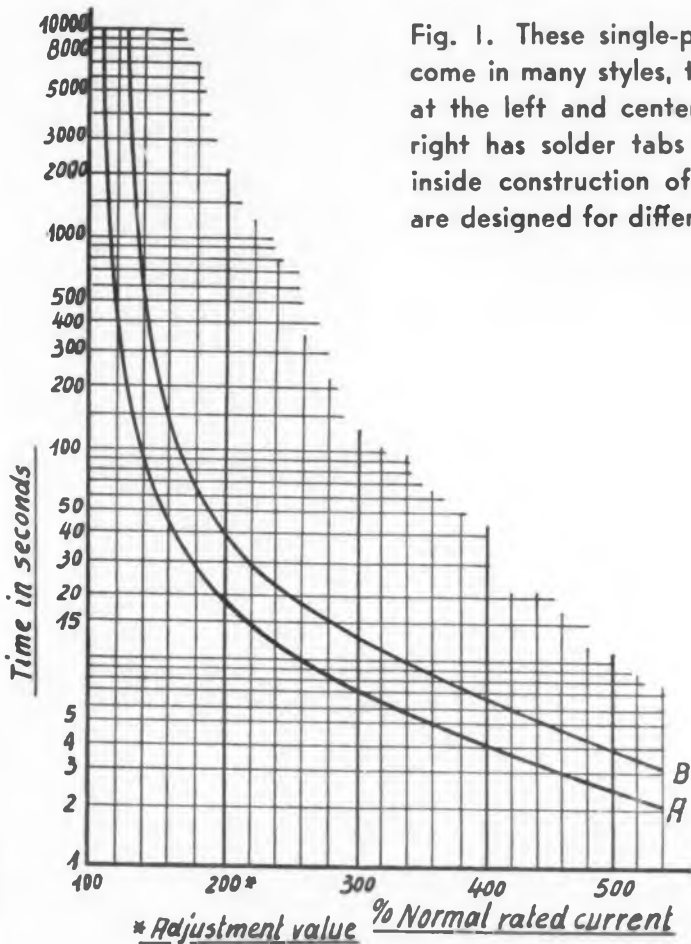


Fig. 2. Tripping characteristics of the miniature circuit breakers. A is the minimum curve and B is the maximum curve, both obtained with an ambient temperature of 20°C from a cold start for 24v d-c, 250v a-c, 0.1amp to 15amp units. If the anticipated short circuit current does not exceed 6amp, the breakers also can be used for 230v d-c applications.

Designed for plug-in type connections.

Tripping characteristics of the circuit breakers is shown in Fig. 2 which indicates the current-time curves obtained at 20°C ambient from cold start for 24v d-c, 250v a-c, 0.1amp to 15amp units. Maximum voltage ratings for the units are 250v a-c and 24v d-c; and current ratings range from 80ma to 25amp. (Units with ratings as low as 50ma are being made, and the company is experimenting with even lower current ratings). If the anticipated short circuit current does not exceed 6amp, the units also can be used for 230v d-c applications.

Starting currents up to five times rated current (from cold start) are passed without tripping the breakers, but short circuit overcurrents are interrupted almost instantaneously. Increase of the ambient temperature in which the circuit breakers operate decreases their operating time. This characteristic affords protection against temperature rises caused by incipient overload faults. The rated current is reduced 10% for every 10°C rise from 30°C to 100°C.

Mechanically, the unit is rugged, and unlike the ordinary rewirable fuse, it cannot be tampered with. It has a high grade steatite base, a high quality bakelite case, and the simple release mechanism is reliable in operation. A pushbutton is provided for closing the breaker, and units can be furnished with or without a release handbutton as required.

The wide range of current ratings available permits the selection of a circuit breaker to fit particular requirements within narrow limits. A margin in excess of the rating of the equipment to be protected in order to avoid overheating by overload is not necessary. This permits a saving in materials because the equipment can be designed to meet normal working conditions and the breaker will afford protection against overheating by overload.

These units also can be readily incorporated into a-c fractional horsepower motors such as are used in conjunction with many types of electronic equipment (recording motors, small blowers, etc.).



For recommendations on your problems, send sketches and complete details on operating conditions



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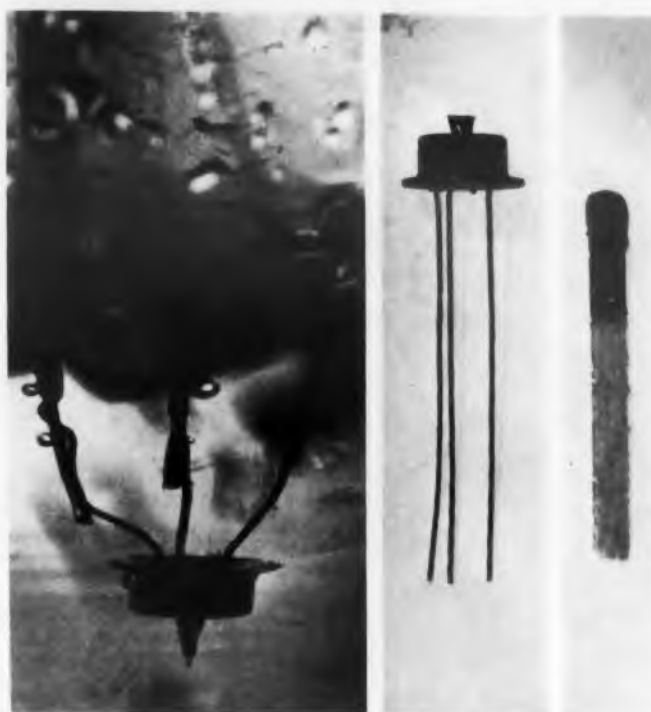


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CIRCLE ED-14 ON READER-SERVICE CARD FOR MORE INFORMATION

20

New Products . . .



Junction Transistors Have Increased Power Ratings

Shown here (and on the front cover) is one of three new Junction Transistors whose construction permits operation under extreme variations in temperature and humidity. Evacuated, and hermetically sealed, they incorporate all-welded construction which eliminates the aging effects of moisture and trapped solder flux fumes. In addition, the fused junction allows power ratings up to three times that of previous units. All are p-n-p types and are capable of dissipating 150mw in 25°C free air.

Maximum ratings of the units are —45v collector voltage, —10ma collector current, and 10ma emitter current. Type 2N43 is intended for high-gain, low-to-medium power applications; Type 2N44, for intermediate-gain, low-to-medium power applications; and Type 2N45, for medium-gain, low-to-medium power applications. In the common emitter connection, and with —5v collector voltage, 1.0ma emitter current, 600 ohms source impedance, and 30,000 ohm load impedance, the units have a power gain of 39db, 38db, and 36db respectively.

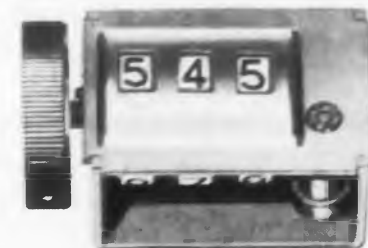
Because of the welded metal construction, power ratings of almost 1w can be realized with two units in a class B push-pull circuit. General Electric Company, Dept. ED, Electronics Park, Syracuse, N.Y.

CIRCLE ED-15 ON READER-SERVICE CARD FOR MORE INFORMATION

Indicator

Shows Position of Recorder Tape

The "Productimeter" Indicator is especially designed for tape recorders to indicate the position of the tape at any time during the recording or playback cycle. It enables an operator to locate quickly a certain portion of the tape.



The counter is a worm drive type with the drive shaft extending from the bottom. A spool is fastened to the shaft and is rotated by the tape. The counter indicates feet; it is easily reset to zero by a simple twist of the knob at the left. Size is only 1-3/4" long (including the reset knob) x 1" wide x 1-1/32" high. Durant Manufacturing Co., Dept. ED, 1993 N. Bufum St., Milwaukee 1, Wis.

CIRCLE ED-16 ON READER-SERVICE CARD FOR MORE INFORMATION

Power Supply

Regulated for 20% Changes



This High Voltage Regulated Power Supply operates with an input of 100v to 130v a-c at 50/60cy and supplies an output of 3kv or 6kv, well filtered, at a maximum current of 2ma. The output is regulated for 20%

line voltage changes. Any of the output terminals can be grounded; thus the available output combinations are ±3kv, or ±6kv, center tapped.

The unit is contained in a standard MIL T-27 size MA case with studs for easy mounting. It is designed to withstand military shock and vibration requirements. Alexander Milburn, Inc., Dept. ED, 1236 Ridgely St., Baltimore 30, Md.

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

ELECTRONIC DESIGN • September 1953

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SHOCK AND VIBRATION

NEWS



Complete Engineering Data on All-Metl Barrymounts

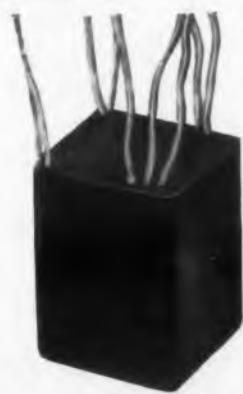
The first really comprehensive bulletins on knitted-wire vibration isolators, Barry Product Bulletins 534 and 536, are now available for distribution.

Full experimental data, all taken under explicitly stated test conditions and presented without alteration, cover the following important topics: transmissibility as a function of frequency, for all directions of motion; the effects of extremely high and extremely low temperatures on transmissibility; the effect of severe shock on isolation performance; variation of natural frequency and transmissibility with changing load; selection of identical isolators to carry asymmetrical loads. In addition, full information is given on dimensions, weights, construction details, load ratings, and catalog numbers.

Here, for the first time, is the complete story on JAN knitted-wire vibration isolators. For your FREE copies, write for Barry Product Bulletins 534 and 536, to The Barry Corporation, 775 Pleasant Street, Watertown 72, Mass.

CIRCLE ED-19 ON READER-SERVICE CARD FOR MORE INFORMATION

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Developed to withstand elevated and subzero conditions, ACME 2002 forms a hard, moisture-proof seal that will not crack or become brittle when subjected even to sudden changes in temperature. Exterior casings are not necessary.

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Acme Wire



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Magnet Wire • Coils • Varnished Insulations
Insulating Varnishes

CIRCLE ED-20 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1953

D-C Amplifier

For Low Frequency Applications



This Model 220 Wide Band D-C Amplifier has been designed specifically to increase the sensitivity of c-r oscilloscopes with extended low-frequency response. It also can be used to extend the range of vacuum-tube voltmeters, frequency analyzers, and other instruments when

unusually low frequencies are encountered. Use of the instrument eliminates long waiting time due to necessary coupling time-constants and increases the sensitivity of d-c vacuum-tube voltmeters.

The unit employs push-pull amplifications, and a special cross-coupled circuit achieves good stability and low drift. This circuit also provides excellent phase-inversion for equal results with balanced or unbalanced input signals.

Output impedance of about 250 ohms single-ended and 120 ohms push-pull is sufficiently low to obtain a single-ended signal across a low impedance load without unbalancing the output. For this connection a third terminal connected to the ground is located near the push-pull output terminals. Furst Electronics, Dept. ED, 3322 W. Lawrence Ave., Chicago 25, Ill.

CIRCLE ED-21 ON READER-SERVICE CARD FOR MORE INFORMATION

Silicone Rubber Insulation Has High Dielectric Strength

A Class H silicone rubber coated Glass Cloth Insulation has a very high dielectric strength and increased tensile strength and is available in both electrical and mechanical grades.

Both the electrical grade, E-944, and the mechanical grade, E-959, have a dielectric strength almost twice that required by specification MIL-C-2194A, which requires the material to withstand at least 500v/mil after conditioning of 96 hours at 25° C and 96% relative humidity. Both grades also possess excellent bending qualities and resistance to tearing.

The mechanical grade has a surface toughness three or four times greater than previously developed silicone rubber coatings, a factor which makes it good in the use of gaskets. The material also has a high resistance to moisture and dry heat. Mica Insulator Co., Dept. ED, Schenectady 1, N. Y.

CIRCLE ED-22 ON READER-SERVICE CARD FOR MORE INFORMATION

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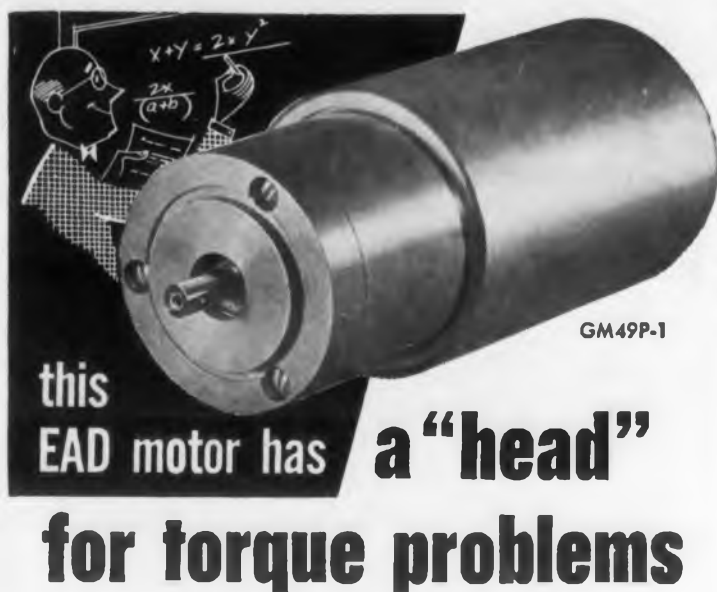
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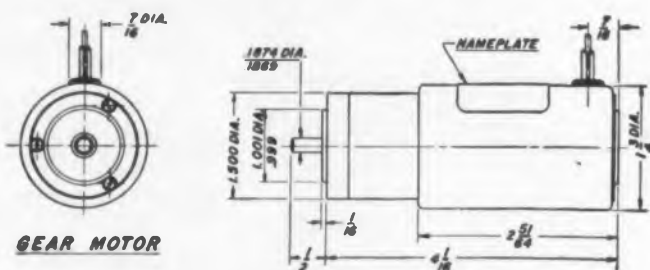


CIRCLE ED-24 ON READER-SERVICE CARD FOR MORE INFORMATION



this EAD motor has a "head" for torque problems

A precision gear head combined with a miniature motor gives you the answer to high torque at low speed. The motor can be 60 cycle, 400 cycle or variable frequency—in single, two or three phase—with non-cooled or self-cooled frame types. The gear head is arranged to provide the output speed you require, with standard timing ratios of 60, 3600 or 8000 to 1 possible. High output torques, to drive, actuate or control, in confined areas, make this line of tiny gear motors ideal for a wide variety of applications on the ground and in the air.



SPECIFICATIONS FOR MODEL GM49P-1 400 Cycle Capacitor Run Induction Gear Motor

115 Volts • 400 Cycles • 1 Phase • 0.5 Amps.
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Starting Torque: Over 100 Oz.-In.
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Intermittent Duty: 15 Minutes on, 15 Minutes off
Ambient Temperature: -55° to $+74^{\circ}$ C

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

New Products ...

Low-Voltage Power Supply Provides Precise Regulation



The Type 200 Low-Voltage D-C Power Supply features close regulation against line transients, low output impedance, negligible ripple, and minimum drift. A compact, stable unit with continuously adjustable voltage, it furnishes up to 1amp at 0 to 15v, for the excitation of strain gages and transducers in the measurement of pressure, displacement, vibration and many other variables, for sensitive filaments in d-c amplifiers and similar equipment, and for general laboratory use.

With the Type 200, a 10% line voltage change will cause less than 10mv change in output, typically about 5mv. Voltage drop from 0 to 1amp load is approximately 15mv. Ripple is less than 1mv peak-to-peak, and drift is normally less than 1mv per hour at constant temperature. With internal reference voltage, it has a temperature characteristic of less than 0.01% per degree F, near room temperature.

Also available as an accessory is the Type 201 Stabilizing Unit which serves to eliminate virtually all long-time instability or drift. Owen Laboratories, Dept. ED, 412 Woodward Blvd., Pasadena 10, Calif.

CIRCLE ED-28 ON READER-SERVICE CARD FOR MORE INFORMATION

Tantalum Strip

Up to 6" wide x 0.0005" Thick

Tantalum Strip, precision-rolled to very close tolerances and to thin gauge and foil, is available for use in the manufacture of electrical, electronic, and communications equipment. Typical uses include electronic tube components, anodes, grids, electronic controls, amplifiers, condensers, oscillators, timing devices, and signal and alarm systems.

An extremely magnetic and corrosion resistant metal, tantalum has tensile properties comparable to cold-rolled steel and is custom rolled in strips up to 6" wide and down to 0.0005", to tolerances as close as ± 0.0001 ". American Silver Co., Inc., Industrial Div., Dept. ED, 36-07 Prince St., Flushing, N. Y.

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

CIRCLE ED-30 ON READER-SERVICE CARD FOR MORE INFORMATION

BRIDGE MEASUREMENTS

for laboratory or production are made:

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more accurately
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BRIDGE INDICATOR
TYPE 615-A

The 615-A Bridge Indicator is an approximately logarithmic voltmeter which permits very rapid, precise balancing of measuring bridges. With accessory filters it may be used as a tuned detector. The approximately logarithmic response permits bridge balancing from far out of balance to exact null without changing ranges. The indicating meter shows the direction of bridge adjustment for a null, even when far from balance, because the instrument's 80 db (10,000 to 1) range prevents overload at high levels.

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

Engineering

WRITERS

ENGINEERS, E. E. or PHYSICS GRADUATES, for preparation of technical manuals...

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2 ENGINEERS EXPERIENCED in the writing and preparation of maintenance manuals for electronic equipment or guided missiles. These specialists will work step-by-step with the people designing, developing and manufacturing the products involved. Experience in the writing of engineering reports is of value.

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Research and Development Laboratories

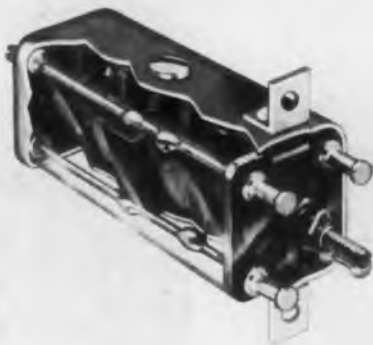
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A series of rigidly constructed single and double Tuned Circuits has been designed for stability and precise performance. The units are housed in a 3/4" x 3/4" x 2" aluminum container.

Features include a rigid coil form held under force fit in metal bushings, a heavy metal bracket to secure the entire structure, and grounding bushings and adjustment studs to the container. Coil frequencies range from 50kc to 100Mc. Standard units are offered with adjustable iron cores from top and bottom, and cup cores are available for high Q in special applications.

All transformers can be supplied fully encapsulated in "Coilguard", an embedding resin developed for protection against adverse effects of extreme temperature variations and high relative humidity (-65°C to +130°C, up to 100% relative humidity). Vanguard Electronics Co., Dept. ED, 3384 Motor Ave., Los Angeles 34, Calif.

CIRCLE ED-33 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Relays

Of High Shock Design



The Type HG-2 (dpdt) and Type HG-4 (4pdt) Miniature High Shock Relays are designed for such applications as aircraft, guided missiles, computers, and navigational and communications equipment. Hermetically sealed in metal cans, they will meet and surpass the requirements of MIL-M-5757B.

Temperature range is -65° to +500°F. Coil voltages range from 6v to 300v. Coil resistance is 8 to 20,000 ohms. Contact rating, resistance load, is 28v d-c, 4amp; and 115v, 60cy, 4amp. Breakdown voltage is 1000v at 60 cy. Shock resistance is 100g's plus. Sensitivity may be increased where shock requirements are below 100g's. Maximum size of the relays is 1-5/32" diam x 1-15/16" long. Weight is 3.2 oz. Two and three-hole mounting flanges are available. Hi-G Inc., Dept. ED, Windsor Locks, Conn.

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

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Miniature



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standard



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RT Series potentiometers are compact, rugged, metal-cased, and fully sealed. They exceed military requirements for

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Packed into 1/4 of a cubic inch are all these features:



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- 3 watts dissipation at 80 degrees C.
- 1000 volts dc dielectric strength.
- 1,000,000 revolutions rotational life.
- complete reliability.

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XXXP-26 plus .0015" aluminum	9 to 12
GB-112 Teflon plus .00135" copper	6 to 9

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

New Products...

Transistor Curve Tracer For Junction and Point Contact Types



The new Automatic Transistor Curve Tracer is recommended for designing transistor circuits; comparing, matching and selecting; detecting anomalies; studying the ef-

fects of temperatures, age, normal usage, overloading; and detecting failures and their causes. It tests n-p-n, p-n-p, junction, and point contact transistors and can accommodate new types as produced.

The curve tracer dynamically plots an entire family of curves simultaneously on standard laboratory d-c oscilloscopes. The calibrating axes (generated internally as an integral part of the display) are always in the proper quadrant. Operation is automatic or manual by means of a stepping relay. Curves are displayed in any quadrant, and the origin is always indicated.

Retrace is not blanked, and anomalies are easily seen. An accuracy of 3% is obtained, independent of scope drift and calibration. The instrument is compact and simple to operate. A transistor forming attachment is offered as optional equipment. Magnetic Amplifiers, Inc., Dept. ED, 632 Tinton Ave., New York 55, N. Y.

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

Fiberglas Tubing Insulation Coated With Silicone Rubber

"BH 1151" is the designation given to an improved line of Class H braided Fiberglas tubing and sleeving produced in 27 sizes. Coated with General Electric's tough SE-100 silicone rubber coating compound, it has unusual dielectric strength and can be twisted and bent without crazing or cracking or losing electrical strength. Electrical and physical properties are unaffected by continuous operation through a temperature range of -90° to $+400^{\circ}$ F.

The silicone coating gives "BH 1151" an average minimum electrical breakdown ranging from 7000v for NEMA Class H-A-1, to 1500v for Class H-C-2. Electrical resistance is 100,000 megohms after 48 hr tests at 25° C and 50% relative humidity. Bentley, Harris Manufacturing Co., Dept. ED, Conshohocken, Pa.

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

These compression seals are in addition to our regular and complete line of Kovar to hard glass seals.



CONDENSER END SEALS

Our complete line of special END SEALS assures a stabilized atmosphere, thus making them especially adaptable to capacitors, filters, delay lines, and precision resistors. Special finishes available.



TRANSISTOR MOUNTS

CONSTANTIN TRANSISTOR MOUNTS assure dependable, long-life transistor service for all types of electronic instruments. Glass-to-metal sealing allows the germanium block to be permanently sealed in a vacuum or inert gas. This prevents aging and gives lasting protection against variations due to moisture, dirt, and changing atmospheric or light conditions.



TERMINALS

Constantin's extensive line of HIGH COMPRESSION TERMINALS is available in all combinations of hooks, eyes, tubes and pierced flats. Standard units of the complete line have test ratings from 1,000 to 15,000 volts R.M.S. and 5 to 25 amperes.



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The new vacuum tight, HIGH COMPRESSION glass to metal seal makes CONSTANTIN HEADERS ideal for use in the manufacture of practically any product which demands a stabilized atmosphere, and protection from moisture. Ingenious seal engineering and flexible manufacturing methods permit numerous additional configurations and the adaptation of CONSTANTIN HEADERS to any requirement.

L. L. Constantin & Co.

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



Quick Circuit Hook-Ups! Fast, Accurate Readings!
Many Laboratory and Classroom Uses!
THE NEW LABORATORY MODEL **Helipot**



Widely used in industrial, academic and electronic laboratories, the new Laboratory Model T-10A HELIPOT—incorporating the MODEL RA PRECISION DUODIAL—provides new speed, simplicity and accuracy in setting up all types of potentiometer circuits. Ideal for experimental and educational work, this compact unit has many unique advantages...

- ▶ It can be set to a known resistance in 1/5th the time required by a 5 dial decade box.
- ▶ It can be used as either a potentiometer or rheostat for calibrating meters, amplifiers, oscilloscopes and other equipment.
- ▶ It can be quickly inserted in many types of DC and low-frequency AC bridge circuits where it is immeasurably faster than a series of decade resistors.
- ▶ It can be used for controlling servos, computers, triggering, positioning and many other types of circuits.

The Laboratory Model HELIPOT consists of a 10-turn MODEL A HELIPOT and an RA PRECISION DUODIAL unitized into a compact walnut case with satin-finished metal panel. It provides a resolution of 1/5,000 to 1/15,000, depending on resistance values, with guaranteed linearity of $\pm 0.1\%$.

Stock resistance values—100, 500, 1,000, 5,000, 10,000, 20,000, 50,000, and 100,000 ohms.

Write today for details on this time and labor-saver! Ask for Data File 924

THE Helipot CORPORATION • SOUTH PASADENA, CALIF.
A subsidiary of Beckman Instruments, Inc.

CIRCLE ED-41 ON READER-SERVICE CARD FOR MORE INFORMATION

RESINITE gives you the **HIGHEST RESISTIVITY** of any **INSULATED PRODUCT**

Resinite Coil Forms are laboratory tested and field proven. Their operating characteristics—volume resistivity... power factor... thermal properties... low moisture absorption... and resistance to voltage breakdown—represent a new achievement in basic components for electronic application.



Resinite Coil Forms are available with inside or outside threads, slotted, punched or embossed. Axial pressure in excess of 25 lbs. is accomplished through a special three row threaded design. Torque can be controlled to + or - 1 in. oz.

RESINITE 8104: for coil forms requiring very high dielectric properties under extreme humidity.

RESINITE "AC": for applications requiring very high dielectric strength. Electrolytic corrosion is impossible.

RESINITE 104: for stapling, severe forming, fabricating. Send today for full details and technical information.

RESINITE CORPORATION
DIVISION OF PRECISION PAPER TUBE

2035C W. Charleston St., Chicago 47, Ill.
79 Chapel St., Hartford, Conn.

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

ELECTRONIC DESIGN • September 1953

Retractable Cord

For Use on Movable Relay Racks



This 37-conductor Retractable Cord for electronic equipment mounted on movable relay racks, has been designed for signal circuits in special applications where a large number of conductors is required. Because of the cord's retractile feature, it is possible to maintain electrical contact while the mounting shelves are pulled out and rotated for inspection.

Conductors are No. 23 AWG tinned bronze insulated with synthetic rubber and are cabled in three layers of 7, 12, and 18 each around a center conductor. For circuit identification a repeated sequence of seven colors is used. The cable is covered with a neoprene jacket about 0.750" OD. Koiled Kords, Inc., Dept. ED, Box K, New Haven 14, Conn.

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

Miniature D-C Relay

Exceeds MIL-R-5757B Specification



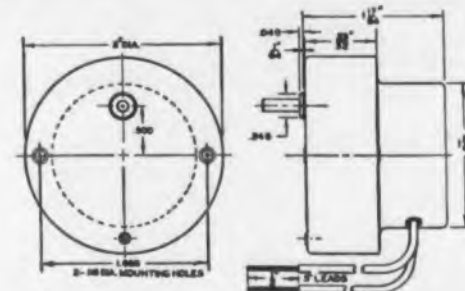
The Type DC-33 dpdt d-c Relay is a miniature, hermetically sealed, low weight unit that exceeds the severe service requirements of MIL-R-5757B specification. It is designed to operate under 70G's acceleration and continuous vibration from 10cy to 600cy without mechanical resonance, when mounted in each of three mutually perpendicular planes.

Ambient temperature range of the unit is -65°C to $+125^{\circ}\text{C}$, and the device passes life tests of 100,000cy operations with contacts operating under rated load at 12cy min. Contact bounce is held to 250 μsec , and contact rating is 2amp with a 26.5v d-c resistance load. Required input coil power is less than 0.325w, and the unit is available in any coil resistance up to 25,000 ohms and with spade lugs, turret, or wire loop terminals. Deltronic Corp., Dept. ED, 9010 Bellanca Ave., Los Angeles 45, Calif.

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

SYNCHRONOUS MOTORS 2 INCHES IN DIAMETER



"CIRCLE B" TIMING MOTORS — Provide exceptional power. Up to 16 in. oz. torque continuous duty, and 84 in. oz. intermittent duty at 1 r.p.m. Compact — 2" diameter by 1 17/64" deep. Speeds from 1/6 r.p.m. to 1800 r.p.m. Operate in any position.

ELAPSED TIME INDICATORS — For industrial or laboratory applications. 2" diameter by 2 1/8" deep.

LOW SPEED MOTORS — Ranging from 10 revolutions per hour to 1 revolution per month. 2" diameter by 1 5/8" deep.

Bristol Motors are available for 24, 110, or 220 volts, 50-60 cycles. They are widely specified for timing devices, motion displays, defrosters, clocks, washers, ranges, dryers, time delay relays, general control equipment, and many other applications.

Write for folder B-1
BRISTOL MOTOR DIVISION
VOCALINE COMPANY OF AMERICA, INC.
255 Coulter St., Old Saybrook, Conn.

CIRCLE ED-45 ON READER-SERVICE CARD FOR MORE INFORMATION

NEW! PERKIN

Magnetic Amplifier Regulated

POWER SUPPLY

MODEL MR532 15
5.32 Volt, DC @ 15 Amps

1%

REGULATION
AND RIPPLE

From 5.32 Volts DC
From 1.5 to 15 Amps DC
From 105-125 Volts AC Input

NO TUBES!

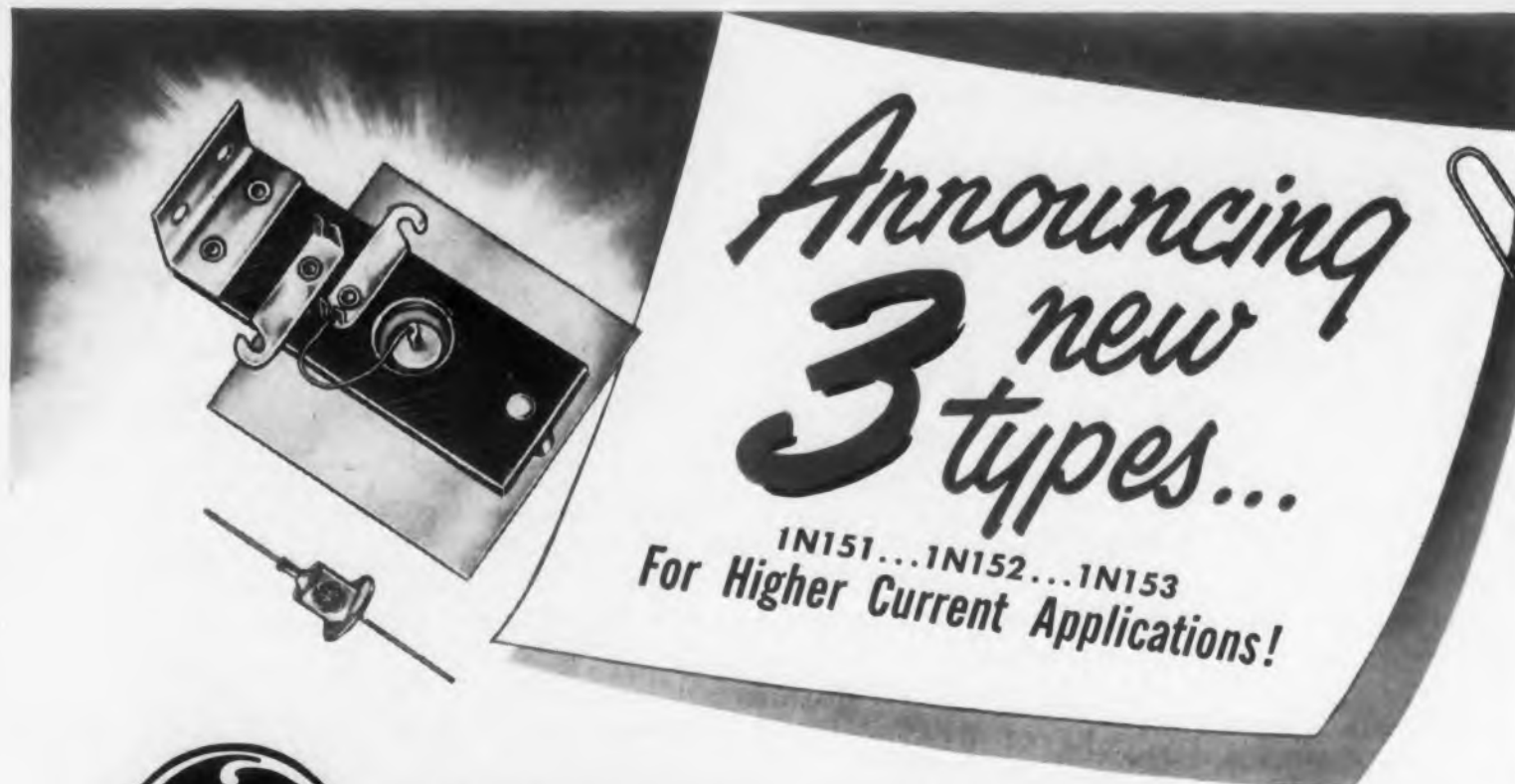
RESPONSE TIME 1/10 SEC.!



Write the factory
for literature
and quotations

345 Kansas Street
El Segundo,
California

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



DIFFUSED JUNCTION GERMANIUM RECTIFIERS

ABSOLUTE MAXIMUM RATINGS - T. 55° C - RESISTIVE LOAD							
DIFFUSED JUNCTION RECTIFIER	1N91	1N92	1N93	1N94	1N151	1N152	1N153
RMS INPUT VOLTAGE (V _{RI})	—	—	—	130	35	70	105
PEAK INVERSE VOLTAGE* (V _{PIV})	100	200	300	380	100	200	300
PEAK FORWARD CURRENT (A _{FM})	0.47	0.31	0.25	1.57	1.57	1.57	1.57
D.C. OUTPUT CURRENT* (A _{DC})	150	100	75	500	500	500	500
D.C. OUTPUT CURRENT (CAPACITIVE LOAD) (A _{DC})	—	—	—	350	350	350	350
D.C. SURGE CURRENT (A _{SM})	25	25	25	25	25	25	25
FULL LOAD VOLTAGE DROP (Volts peak)	0.5	0.5	0.5	0.7	0.7	0.7	0.7
LEAKAGE CURRENT (A _{RL}) (at rated P.I.V.)	2.7	1.9	1.2	0.8	2.4	1.9	1.2
CONTINUOUS REVERSE WORKING VOLTAGE (V _{WR}) (D.C.)	30	65	100	185	30	65	100
OPERATING FREQUENCY (Kc)	50	50	50	50	50	50	50
STORAGE TEMPERATURE (°C)	85	85	85	85	85	85	85

*Typical absolute maximum ratings. For other combinations refer to Fig. 1

- **VERY LOW LOSSES** when used for power supplies, battery chargers, filament supplies and switching circuits.
- **HERMETICALLY SEALED** against deteriorating elements. Glass-to-metal seals throughout.
- **MINIATURE SIZE** to facilitate use in all electronic equipments, yet heat losses are dissipated efficiently.
- **DESIGNED** to meet all military humidity tests and shock and vibration requirements.
- **MULTIPLE ARRANGEMENTS** can be made for full wave or bridge circuits up to tens of amperes. Send us your requirements—our engineers will furnish a complete recommendation.

Send for complete specifications: *General Electric Co., Section 7493, Electronics Park, Syracuse, New York.*

News FROM OUR ADVANCED DEVELOPMENT LABORATORIES

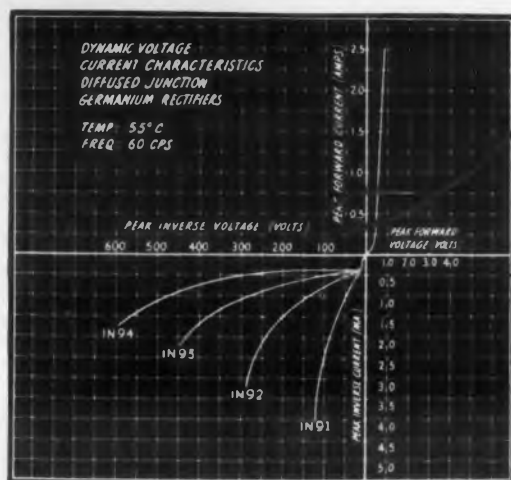
Silicon junction diodes have been successfully operated above 400°F (more than 200°C). This is hotter than the melting point of the lead-tin solder ordinarily used to wire these signal diodes into circuits.



GENERAL ELECTRIC

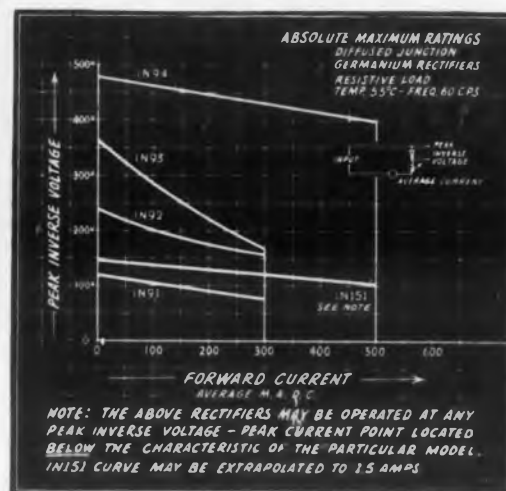


CIRCLE ED-47 ON READER-SERVICE CARD FOR MORE INFORMATION



Note: THIS IS ONLY ONE OHM!

Fig. 1



New Products . . .

Electronic Relay Of Ultra-Sensitive Design



Relay action of the Ultra-Sensitive Electronic Relay is initiated by external contact as high as 1/2 megohm with current as low as 1/10,000-amp. This design is adaptable to a wide range of uses,

including liquid level controls, stop motions, safety alarms, drop wire detection, and many others.

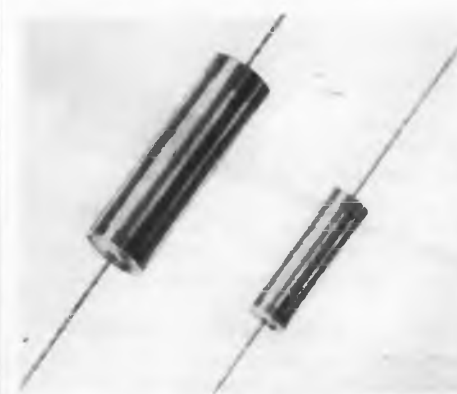
The relay mounts on a standard 4" connector box. It has a simplified circuit, plus silver relay contacts. A cold cathode tube eliminates power consumption during "off" cycle. High contact pressure on contacts allows a conservative rating of 4amps, with a choice of either opening or closing a circuit, or simultaneously opening one and closing another.

An automatic hold circuit is provided, permitting either conventional relay action or a momentary contact to energize the relay and cause it to remain energized until manually released by a "Reset" switch. Power input is 115v, 25-60cy, single phase; and other voltages or frequencies are available. Servo-Tek Products Co., Inc., Dept. ED, 1086 Goffle Rd., Hawthorne, N. J.

CIRCLE ED-48 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubular Capacitors

Withstand Temperatures to 100°C



The "Glassmike Jr." Tubular Capacitors have been designed for TV filter and bypass use. They can be furnished in 400v, 600v, and 1000v d-c ranges and in capacitance from 0.001mfd to 1mfd,

and also in size ranges from 0.390" x 1" to 1-1/4" to 2-1/2".

Features include a tubular glass case, oil impregnation, and a plastic dielectric section good for temperature requirements to 100°C. Condenser Products Co., Dept. ED, 7517 N. Clark St., Chicago, Ill.

CIRCLE ED-49 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1953

Tensolite

MINIATURE
SUPER-FLEXIBLE

PLASTIC
INSULATED
WIRE and
CABLE

TENSOLON HOOK-UP WIRE

Teflon insulated for continuous use up to 250°C, "Tensolon" is available in 14 solid colors and features a free-stripping, thin wall covering with high dielectric strength.

TENSOLEX JAN-C-76 HOOK-UP WIRE

Types WL, SRIR, and SRHV available in small wire sizes in all standard colors including spiral stripping. Nylon jackets can also be supplied for greater resistance to abrasion.

SUB-MINIATURE WIRE AND CABLE

Thin wall vinyl insulation over flexible stranded conductors (AWG sizes down to #40) meets many requirements for small space factor. Available in all standard colors with or without wire braid shields.

SUPER-FLEXIBLE CABLES

Tensolite super-flexible cables, featuring the patented tensulation process, solve many problems calling for limpsness and long flex life. Phonograph pick-up cables, hearing aid cordage, and telephone tinsels are regularly being supplied.

TENSOLITE WIRE KITS

For laboratory and prototype requirements, the following convenient desk size wire kits are now available from stock: Teflon Kit, SRIR Kit, Sub-miniature "1482" Kit, Flexible Cable Assortment.

SPECIAL CONSTRUCTIONS

Tensolite's engineering and development facilities are also available for collaboration in the solution of many special cable problems. Simple or complex, Tensolite will welcome an opportunity to estimate on your requirements.

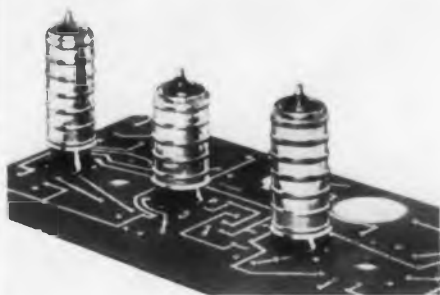
WRITE FOR OUR COMPLETE CATALOG

TENSOLITE
INSULATED WIRE
COMPANY • INC

TARRYTOWN • NEW YORK

CIRCLE ED-50 ON READER-SERVICE CARD

Miniature Tube Shields For Printed Circuit Application

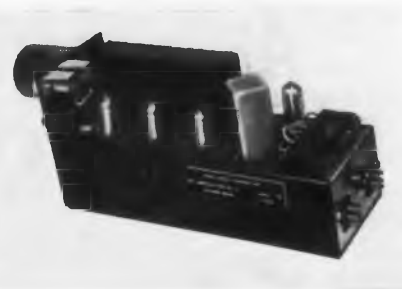


This new series of "Mini-Shields" is especially designed for shielding miniature tubes in printed circuits. Known as the 400 Series, the shields are constructed to mini-

mize vibration, provide cooler operation and present a neat appearance. The principle design feature is a flared bottom which allows the shield to pass easily over the ground lug of the printed socket. This holds the shield firmly and assures contact between shield and ground. The Staver Co., Inc., Dept. ED, 41-51 N. Saxon Ave., Bay Shore, L. I., N. Y.

CIRCLE ED-51 ON READER-SERVICE CARD FOR MORE INFORMATION

Memory Unit For Installation in a Computer



Model 3C1-384 is a Memory Unit designed as a complete package ready for installation in a computer. Composed of a solid acoustic delay line and associated

circuitry, the unit is especially fitted for airborne use and is insensitive to shock.

The design includes the entire memory circuit in one plug-in type chassis. Groups of these units can be used in a computer for sufficient memory, and a complete memory circuit can easily be removed for servicing and a spare unit plugged in to keep the computer operating. The unit stores 384 bits at a pulse repetition rate of 1Mc, and a self-contained heating element and thermal control give temperature stability to the quartz line. Inherent accuracy of delay control greatly exceeds design requirements.

All germanium diodes are grouped in a single plug-in type sub-unit, and all five tubes are 6AN5's operated 80% below manufacturers' design center. Input voltage requirement into write-erase gate is 10v. Further specifications include a reshaped output signal level of 15v into a 100 ohm impedance load; a carrier frequency of 20Mc; and a temperature coefficient for the quartz delay line of -123 parts per million per degree C. Computer Control Co., Dept. ED, 106 Concord Ave., Belmont 78, Mass.

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

Holding 3×10^{11} ohms within 1%
depends on

**PRECISION AMBIENT
COMPENSATION**



The Beckman Model V Micro-Microammeter—for the precise measurement of extremely small electrical currents. Beckman Instruments, Inc., South Pasadena, California.

TO MEASURE ELECTRICAL CURRENTS as small as *three-tenths of a trillionth* ampere within 5%, the Beckman Model V Micro-Microammeter depends on precision ambient compensation by an EDISON sealed-in-glass thermostat.

IN OPERATION, the Micro-Microammeter conducts the current to be measured through a very high input resistance—from 3×10^7 to 10^{11} ohms. The voltage produced across this resistance charges a vibrating reed capacity modulator, oscillating at 120 cycles per second, which converts the voltage to an alternating signal. After passing through a four-stage amplifier, the signal is converted back to direct current for measurement.

WITHOUT THE PROTECTION of an EDISON thermostat to control the temperature of the input compartment, the precise, 1% reproducibility could be destroyed through variation of the temperature with input resistance or contact potential of the vibrating reed.

EDISON THERMOSTATS feature stability measured in years, control within $\pm 0.1^\circ$ F and capacity to 115 volts, 8 amperes d.c. or 1000 watts. EDISON temperature control engineers will be glad to work with you on the solution of your ambient protection problems. Just call or write to:

Thomas A Edison
INCORPORATED

Instrument Division • Dept. 55, West Orange, New Jersey



TIME has no apparent effect on Edison Sealed-In-Glass Thermostats.

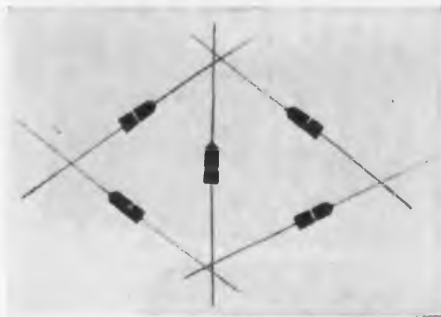


**YOU CAN
ALWAYS RELY
ON EDISON**

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

New Products . . .

Small-Area Junction Diodes With 0.360"(max) Capsule Length



The "Union" line of small-area Junction Diodes is designed to fill the need for devices having: ratios of back - to - forward-resistance of an order of magnitude greater than

conventional point-contact diodes; extremely small size; relatively high dissipation ratings; and capability of withstanding high temperature-humidity ambient conditions.

Rectifying action is performed by a small-area junction which gives the diode rapid switching action and good high frequency characteristics. The protecting capsule is thermo-setting plastic, molded into place after the diode is fabricated, providing a rugged, miniature unit which will withstand bending of the leads without extraordinary precautions.

Three types of diodes are currently available: one with a high back-voltage characteristic, another having a high forward current, and a third classed as general purpose. All are rated at continuous dissipations up to 150mw. Maximum operating voltages are 300v, 10v and 50, respectively. Transistor Div., National Union Radio Corp., Dept. ED, Hatboro, Pa.

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

Linear Potentiometer Compact, Noise-Free Design



The Humphrey Linear Potentiometer is a rugged, lightweight unit designed to give noise-free performance when sub-

jected to vibration, dither, and other conditions. Dual-element construction gives precision linearity, with clear, sharp signal. This compact unit has 1/2" diam for strokes up to 3", and 3/4" diam for strokes over 3", with resistance values up to 13,000 ohms/inch, with higher values in special units.

The unit is suitable for use in military applications. Pacific Scientific Co., Dept. ED, 1430 Grande Vista Ave., Los Angeles, Calif.

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

A NEW TERMINATION TECHNIQUE FOR . . .

- COMPUTERS
- SWITCHBOARDS AND INSIDE PLANT EQUIPMENT
- RELAYS, SWITCHES, AND MULTI-CIRCUIT COMPONENTS

AMP

FLAT* TAPER

If you are concerned with the wiring of close spaced equipment, investigate the new AMP Solderless TAPER TAB RECEPTACLE for flat relay or switch tabs shown at right. It is self locking when installed on a male tab with matching $3\frac{1}{2}^\circ$ taper, yet can be removed and reconnected any number of times without solder or special tools. These terminals are supplied on reels in continuous strip. Customer crimps them on wires using AMP automatic machines at speeds up to 4,000 per hour!

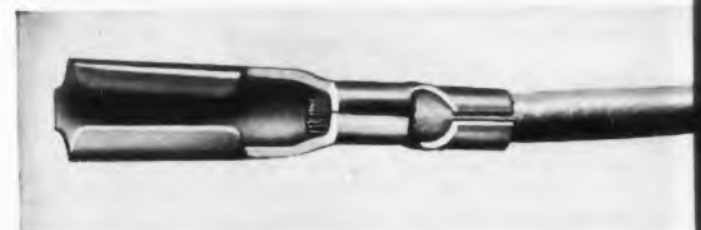
Performance of these miniature connectors meets exacting requirements for millivolt drop, corrosion resistance, and vibration. They are suited for critical low level circuits or power circuits up to several amperes.

Write to AMP Electronics Division for complete information concerning AMP TAPER TAB RECEPTACLES . . . you will receive data and samples by return mail.

An example of the savings possible with Taper Tabs and Receptacles. This disconnect block in Remington Rand's new electronic computer had more than 1,000 wires soldered to tabs in a space approximately 5" x 9"—an assembly operation requiring two weeks' time. After tabs were modified to taper shape (See picture insert), the same operator can now assemble two blocks per day—a 20 to 1 increase—using A-MP's Taper Tab Receptacle No. 41355. There are neither loose wire ends nor drops of solder in the assembly to cause shorts nor cold or rosin joints to open up in the field. Installation is simply a mechanical operation requiring little operator skill, resulting in greater uniformity.

*For connector plugs and other applications where a round pin is more adaptable, see AMP taper pins.

PHOTO AT RIGHT SHOWS AMP SELF LOCKING TAPER TAB RECEPTACLES BEING APPLIED TO MATING TABS ON A STEPPING SWITCH. LOCKING ACTION GIVES MAXIMUM ELECTRICAL AND MECHANICAL SECURITY . . . CONNECTIONS ARE SUITABLE FOR CRITICAL LOW LEVEL CIRCUITS.

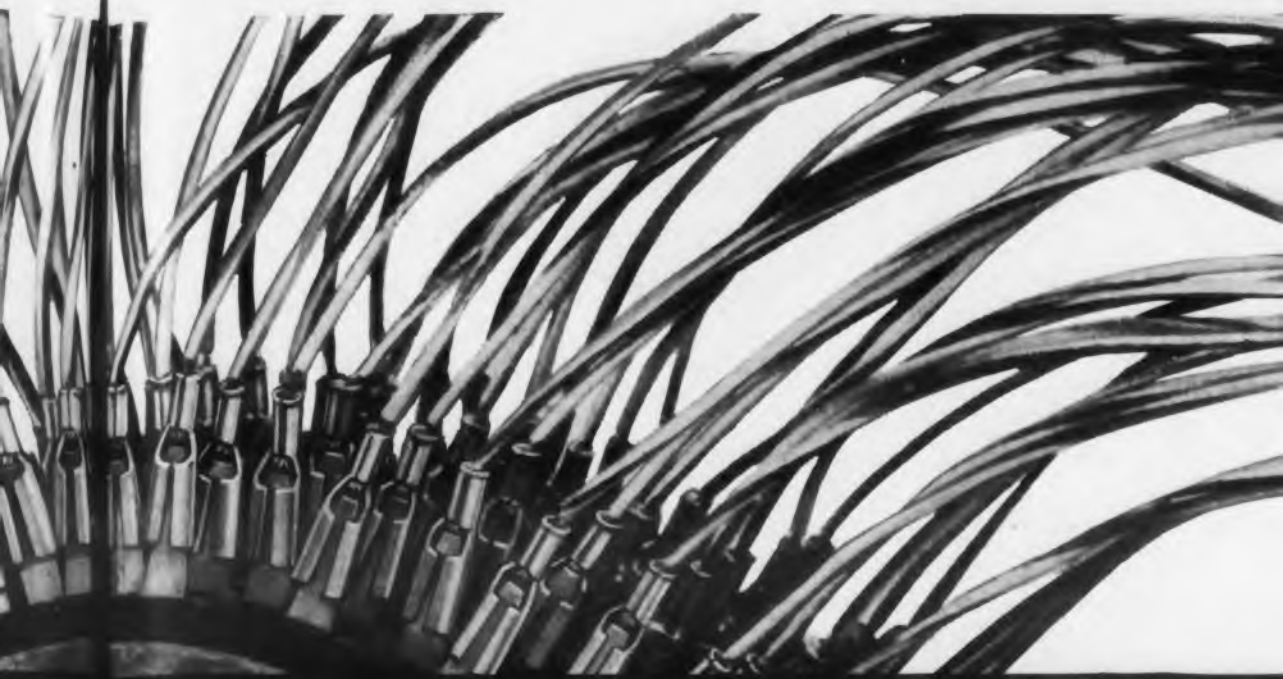


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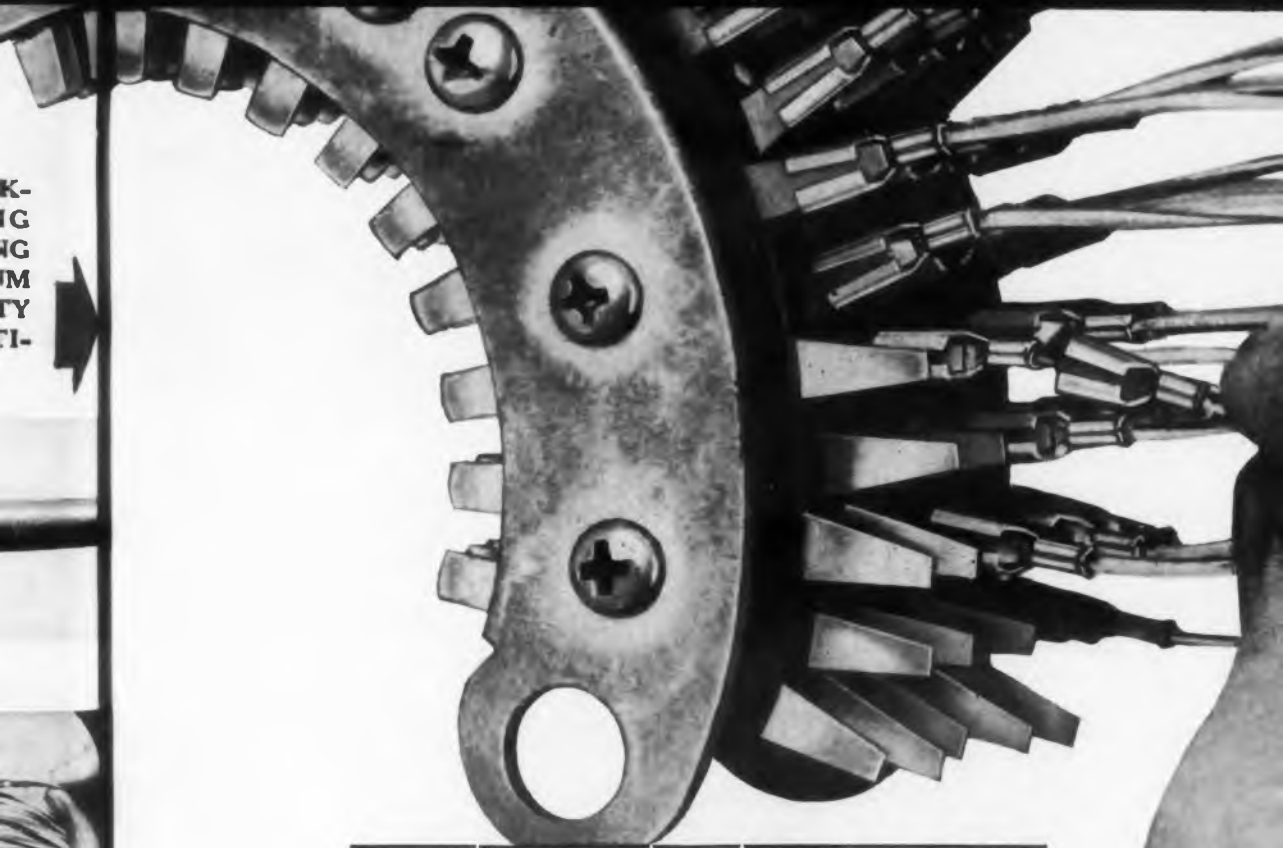
AMP Trade-Mark Reg. U. S. Pat. Off.

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

ELECTRONIC DESIGN • September 1953



TAB RECEPTACLES



AAMP

AIRCRAFT-MARINE PRODUCTS, INC.

2100 Paxton Street, Harrisburg, Pa.

Aircraft-Marine Products of Canada, Ltd.

1764 Avenue Rd., Toronto 12, Ontario, Canada

Pat. Off.

1953

ELECTRONIC DESIGN • September 1953

Metal-Clad Plastic Laminates

For Printed Circuit Application

Type T-725 and Type T-812 Metal-Clad Plastic Laminates, for use in high-frequency applications, have been added to the company's line. The material is bonded with copper or aluminum sheet to one or both surfaces and has special printed circuit applications. Known as Metal-Clad "INSUROK", the material has good stability under repeated temperature and humidity cycling, high physical strength and low cold flow, and the ability to be punched into intricate shapes. Richardson Co., Dept. ED, 2682 Lake St., Melrose Park, Ill.

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

Log Linear Converter

Permits Recording up to 100db



Model 86 Log Linear Converter produces a true logarithmic relationship between any 50kc output or i-f and the Model 86 meter reading. This provides a means of recording up to 100db on conventional linear recorders. Any portion of this 100db range may be quickly expanded by push-button selection to give a full scale reading of 20, 40, 60, 80, or 100db.

The instrument operates as an adjunct to the company's Model 100 bolometer amplifier by producing a true logarithmic reading in decibels of the amplifier's 50kc i-f. Pickard & Burns, Inc., Dept. ED, 240 Highland Ave., Needham, Mass.

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

Printed Vinyl Tape

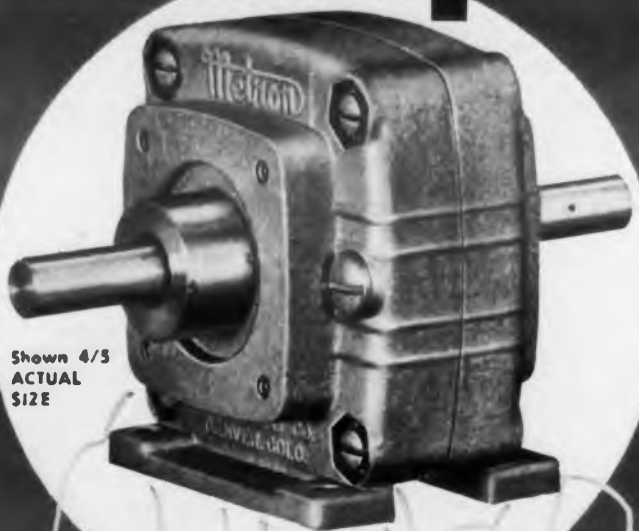
For Wire Identification

A new, printed, pressure-sensitive Vinyl (self-adhesive) Tape has been made available for wire, cable, and conduit identification. Known as "Pee-Cee" Vinyl Tape No. 471, it is extremely thin with 100% dead stretch on itself. It is inert to fungi and most solvents. The ink is sealed into the vinyl backing, thus providing an abrasion-resistant marker. Also available is a dispenser for high-speed marking with this tape. Printed Cellophane Tape Co., Dept. ED, 521 N. La Brea, Los Angeles, Calif.

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

NEW!

THE **Metron**
BANTAM
SPEED CHANGER



Shown 4/5
ACTUAL
SIZE

SAVE SPACE
READILY AVAILABLE
SEALED OIL-BATH LUBRICATION
OPERATE IN ANY POSITION
COMPACT, RUGGED OPERATION
LOW POWER LOSS

Metron INSTRUMENT COMPANY
Lincoln Street • Denver, Colo.

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

New Products...

Wire-Wound Potentiometer Miniature, Lightweight Design



The AP-1/2 Potentiometer is a linear, wire-wound unit designed to meet requirements for small space and light weight. The case measures only 1/2" diam x 5/8" deep. The standard model illustrated weighs less than 1/2 oz. The fully sealed, rugged construction of the AP-1/2 permits it to be used where military requirements for resistance to humidity, salt spray,

shock, vibration and fungus must be met.

The potentiometer will operate between -55 and +85°C. At +25°C, its dissipation is approximately 5w. It also features soldered electrical connections, precious metal contacts to windings and slip rings, coin silver tabs to protect end turns, and gold-plated forked terminals to facilitate wiring. Resistances range from 10 ohms to 10,000 ohms. Shaft locks, rotational steps, special shafts, and bushings are available on order. Aerohm Corp., Dept. ED, 282 Moody St., Waltham 54, Mass.

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

Spectrum Generator

Useful From 1kc to Above 1,000Mc



The Model 1232 Spectrum Generator is designed to meet laboratory needs for frequency comparison, measurement and synthesis. Its even-controlled crystal and special

oscillator circuit provide an accuracy that is better than one part per million. The unit provides self-contained, crystal-controlled interpolation, permitting fast, direct measurement of frequency. Range is from 1kc to above 1000Mc.

Harmonics delivered are strong and uniform in amplitude. Standard harmonic intervals are 1, 2, 5, 10, 50 and 100ke. Output level for 100ke harmonics is: 100mv from 100ke to 5 Me; 50mv to 75Me; 25mv or more to 85Me. Servo Corporation of America, Dept. ED, 20-20 Jericho Turnpike, New Hyde Park, N. Y.

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

AMGLO
DC
MOTOR

— provides
phenomenal
speed accuracy!

Proved the only solution
to many military,
industrial and
research requirements.

Magnetic Reed Drive—secret to speed accuracy over wide voltage and load variations.

Low Current Drain—long operation from small batteries or other DC supply.

High Torque—(200 in. oz. at 1 RPM) Operates from 1 to 30 cams and switches to provide circuit closure at specified sequences and duration.

Speed—1 Rev. per day to 900 RPM.

Voltages—3 to 110 volts. Custom-built to specifications.



AMGLO
CORPORATION

2037 WEST DIVISION STREET
Chicago 22, Illinois

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

multiple headers
& sealed leads by



One Source of Supply

One Source of Supply for hermetically sealed terminals for every electronic and electrical requirement. The bulletins below list hundreds of economical standard types. Write for copies, today!



BULLETIN 949-A — Covering standard and special hermetically sealed terminals.

BULLETIN 950-A — On hermetically sealed multiple headers with many optional features.

BULLETIN 953 — On individual, color-coded hermetically sealed terminals by E-I.

BULLETIN 954 — Featuring end seals for condensers, resistors and other tubular components.

BULLETIN 960—Describing super-rugged compression type headers of revolutionary design.

ENGINEERING ASSISTANCE — Special types can be designed for unusual applications. Recommendations will be made promptly on receipt of data.

DIVISION OF
AMPEREX
ELECTRONIC
CORPORATION

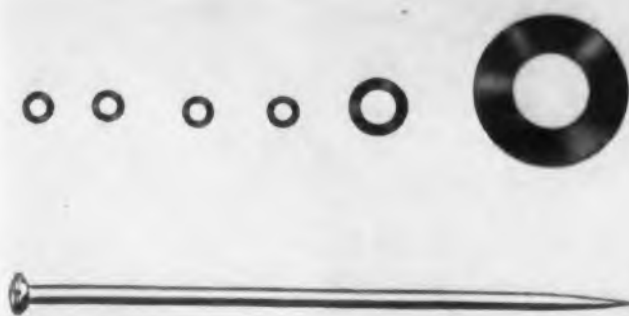


**ELECTRICAL
INDUSTRIES**
44 SUMMER AVENUE, NEWARK, N. J.

CIRCLE ED-64 ON READER-SERVICE CARD FOR MORE INFORMATION

Magnetic Cores

Provide Square Hysteresis Loops



These Ferramic Cores, for use in digital computers, are molded of "Ferramic MF 1118," a soft magnetic material featuring square hysteresis loops, high volume resistivity, and a low loss factor.

The cores have a switching time of less than $1\mu\text{sec}$. Magnetic properties include an initial permeability of 43, a maximum permeability of 700, a saturation flux density of 2350 Gauss, a residual magnetism of 2130 Gauss, and a coercive force of 1.5 Oersted.

Since the material has a high internal resistance, it is formed in solid sections without the necessity of lamination for high frequency application. The properties are stable and not affected by rough handling or ageing. The cores are available in small, medium, and large sizes and are shown alongside an ordinary straight pin. General Ceramics and Steatite Corp., Dept. ED, Keasbey, N. J.

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

Subminiature Relay

Withstands 100G's Shock



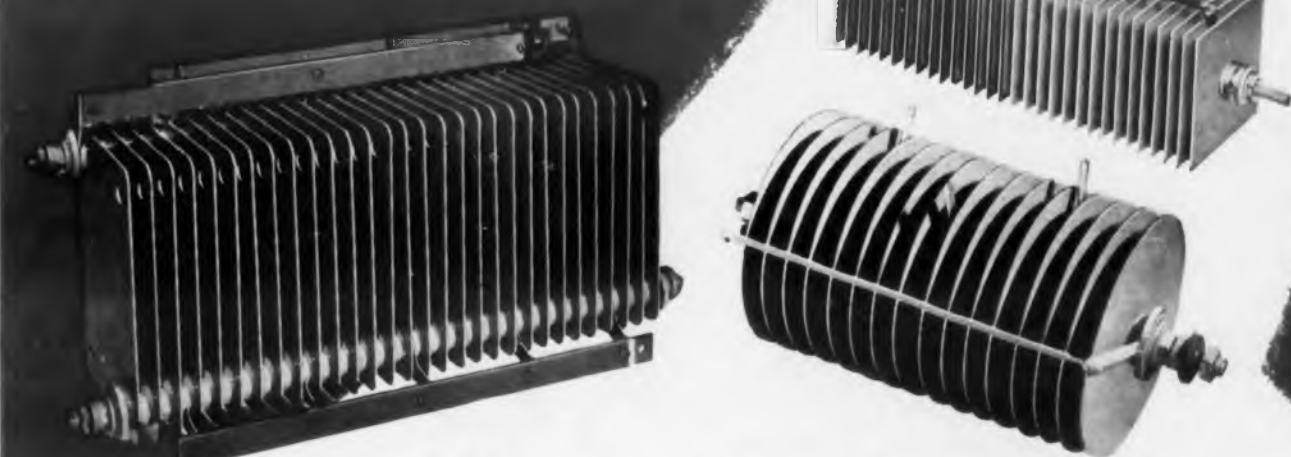
The PE5A hermetically sealed Subminiature Relay has been designed for applications where size and sensitivity are major factors. Measuring only $1\text{-}9/32$ " long x $3/4$ " diam, the device will withstand 100G's shock.

Built to meet standard military specifications, the unit is sealed in a metal can and uses a standard 7-pin miniature plug-in base. It has an operating voltage of 24v to 28v d-c and uses Palladium silver contacts, which are rated up to 2amp inductive load. The unit can be furnished with coil resistances from 400 ohms to 1000 ohms. Polytron Engineering, Inc., Dept. ED, 32 W. Biddle St., Baltimore 1, Md.

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

ELECTRONIC DESIGN • September 1953

From
SUBMINIATURE
to **HEAVY DUTY**
From
MILLIWATTS
to **KILOWATTS**



Whatever the DC requirement

there's a *Federal*

SELENIUM RECTIFIER

to do the job!

Now
Federal Offers
ENCAPSULATION
OF SELENIUM RECTIFIER STACKS
—plus other components



Another Federal "First" . . . a unique development in component-sealing that expands the application range of rectifiers and opens to industry a new concept in Military Equipment Design.

Applications range from tiny rectifiers to sub-assemblies and complete power supplies.

FOURTEEN years ago Federal introduced the selenium rectifier to America's electronic engineers and product designers.

Today, *tens of millions* of these versatile AC-to-DC power conversion units are at work in almost unlimited fields of application . . . from subminiatures with milliwatts of output to heavy duty stacks for the biggest DC-operated equipments.

Here's *proof* of the *high quality* built into Federal's compact, economical, long-life, fully inert selenium rectifiers . . . here's *proof* of their *efficiency* and *dependability* in consumer, industrial and military power conversion jobs!

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"America's first and largest manufacturer of selenium rectifiers"

Federal Telephone and Radio Company



100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

CIRCLE ED-67 ON READER-SERVICE CARD FOR MORE INFORMATION



MOTOR & CONTROL



ROTARY



MIDGET



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16 Page Catalog

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Over 1000 Types
24 HOUR DELIVERY
FROM OUR STOCK!

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- Priced to Your Advantage

Our relay stock, which is the world's largest, has been carefully built up over a period of several years. Nothing but first run, professionally selected items are carried.

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You will receive immediate quotations.

samples on request.

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CHICAGO 44, ILLINOIS

CIRCLE ED-68 ON READER-SERVICE CARD FOR MORE INFORMATION

Another **FLASH-O-LENS** at work
...checking soundness of welds at
INTERNATIONAL HARVESTER



By lighting and magnifying welded parts with **FLASH-O-LENS**, International Harvester Company's Memphis Plant guards against the most minute cracks in the welds.

FLASH-O-LENS offers a quick, simple way of detecting defects—of maintaining product quality. Built-in bulb brightly illuminates the inspection area—accurately ground lenses give sharp, detailed enlargement.

Battery and plug-in models from \$10.65. Write for free literature on applications, types, prices.

E. W. PIKE & COMPANY

492 NORTH AVENUE

ELIZABETH 3, N. J.

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

New Products . . .

Adjustable Protractor With Built-In Magnifier



With the "Tractograf", any number of angles, from 0 to 180°, can be drawn without moving the protractor out of position. This is done

simply by swinging the upper rule arm to the desired angle and locking the adjusting knob. A magnifier, built-in over the registration mark, gives clear, hairline adjustment. The easy-to-read white dial is sharply defined in 1° and 5° divisions, up to 180°. A 5" rule is provided on the lower arm, and often-needed mathematical formulae are printed on the reverse side of the dial.

The "Tractograf" is made from clear, durable plastic with smoothly machined and bevelled ruling edges. It measures 2" x 7" when set at zero, and it can be carried in a shirt or coat pocket. Way-Mac Mfg. Co., Dept. ED, 8118 Melrose Ave., Los Angeles 46, Calif.

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

Phase Meter

Sensitive, Accurate Unit



The "Phazor" Phase Meter, Model 200A, is designed to provide accurate phase shift measurements even though the input signal is complicated by noise and harmonic voltages. It

measures phase shift in transformers, amplifiers, filters, and phase displacement networks. It also can be employed to measure either in-phase or quadrature voltage components. Phase shifts as small as 0.01° can be measured under certain conditions.

The meter measures from 0 to 360°. It has a self-calibrating action which assures a high accuracy. Other features include: high input impedance, wide input voltage range, broad frequency range, and electronic limiting to prevent instrument overload. Power input is 105v to 125v. 60cy, 25w. Dimensions are only 9" x 15" x 8" deep. Industrial Test Equipment Co., Dent. ED, 55 E. 11th St., New York 3, N. Y.

CIRCLE ED-71 ON READER-SERVICE CARD FOR MORE INFORMATION



Sorry! **A. W. Haydon Company**
Can't Help Your Timing Here.

Only a "pro" and practice can straighten you out!

But . . .

We are the "pro's" for precision timing. Come to us with these timing problems. You'll find that we have solved more complex A.C. and D.C. timing problems than just about anybody else. Maybe we have already solved yours. It costs you nothing to find out. Write for catalog.



Design and Manufacture of Electro-Mechanical Timing Devices

CIRCLE ED-72 ON READER-SERVICE CARD FOR MORE INFORMATION

(Advertisement)

HANDLES FROM C.T.C.

Telescopic and standard models



X2066

Approximately 1/2 size

C.T.C.'s new telescopic model adjusts in length from 4 1/2" to 6 5/8". Maximum height, 1 5/8" with hand clearance between handle and mounting of 1 1/8". This handle, X2066, mounts by means of two 10-32 screws. Adjustable ends grooved to match set screws in body of handle to prevent rotation. Brass, either nickel-plated or black oxide finish.

Standard handles available in several

sizes including 1965 (6 7/16" long by 1 3/4" high), X1075 (4 7/16" long by 1 1/2" high) and X1252 (3" long by 1 3/16" high). These three sizes come in nickel-plated brass or brass with black oxide finish.

Handle X1884 is of aluminum with black aluminite finish and measures 4" long by 1 7/8" high.

Both standard and custom-made handles available with painted, lacquered or electroplated finishes. Cambridge Thermionic Corporation, 457 Concord Avenue, Cambridge 38, Mass.

CIRCLE ED-73 ON READER-SERVICE CARD FOR MORE INFORMATION

ELECTRONIC DESIGN • September 1953

Miniature Potentiometer High Precision Unit



The miniature, Microfriction, Microtorque Potentiometer, designated as a "Telepot", is designed for aircraft, guided missiles, remote control, telemeter, servo-circuits, and similar applications. Imported from Switzerland,

the unit is available with resistance values from 100 ohms to 5 megohms, and with various multi-top connections.

Specifications include a torque of 0.1gr/cm; a tolerance of 0.2 to 3% of total value; a linearity of 0.1%; a dynamic electrical noise of $10\mu\text{v}$ to $30\mu\text{v}$; a power dissipation of 0.5w (max), or 10ma through the slide contact; and an extremely long operational life. F. H. Paul & Stein Bros., Inc., Dept. ED, 100 Gold St., New York 38, N. Y.

CIRCLE ED-74 ON READER-SERVICE CARD FOR MORE INFORMATION

Heat-Resistant Varnish Withstands 356°F Temperatures

A Heat-Resistant Insulating Varnish, designed to provide outstanding service even under high temperature conditions, has been added to the company's line. This No. 180 varnish has undergone extensive tests, which indicate no adverse effects on numerous electrical applications when operated at elevated temperatures as high as 356°F. It has a clear color, excellent oil and moisture resistance, and a dry dielectric strength of 2100v/mil. Irvington Varnish & Insulator Co., Dept. ED, Irvington, N. J.

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

Rosin Core Solder Active but Noncorrosive

The RTS 200 is a Rosin Core Solder which is active, yet noncorrosive, and has many electronic applications. Despite the exceptional activity of the material flux at soldering temperature, there is no harmful corrosion residue when tested under the high humidity conditions of specification MIL-S-6872. The flux in the new solder is just as active after standing for long periods as when used immediately.

The material is available in a wide variety of wire sizes, compositions, and quantities. Federated Metals Div., American Smelting and Refining Co., Dept. ED, 120 Broadway, New York, N. Y.

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

When you test— USE THE BEST!



The PRD line of RF Test Equipment is the most complete line available today covering the entire frequency range from .01 to 40 kilomegacycles per second. Every unit in the line is rigorously engineered and meticulously manufactured to the highest standards attainable. The excellence of PRD equipment, in quality, dependability and accuracy is well attested by use in the leading laboratories throughout the world. For consultation on the application of standard or special PRD equipment to your problems call or write our skilled staff of engineers today, without obligation.



a direct reading noise source permits measurements of noise factors up to 20 db for r-f amplifiers and receivers operating in the range from 10 to 1000 mc/s. A TT-1 coaxial diode with a nominal input impedance of 50 ohms is used. VSWR is approximately 1.25, housed in handsome steel cabinet.

THE NEW EXPANDED PRD LINE OF RF TEST EQUIPMENT INCLUDES—
Frequency Measuring Devices, Signal Sources and Receivers, Attenuators and Terminations, Transmission Line Components, Impedance Measurement and Transformation Units, Bolometers, Detection and Power Measurement Equipment.

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HOLLYWOOD 38, CALIFORNIA

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



Don't waste valuable engineering time and talent designing routine circuits that you can pull off the shelf and plug in! Estimate the cost of producing any item described below; include design time, labor, laboratory overhead, parts cost, and debugging time. The cost will consistently run from 20% to 50% higher than our price. Our fast delivery will produce the finished product in the same time required to obtain the parts. "Unitized" Plug-Ins are attached by an octal plug; they are permanent laboratory tools. These units in your lab are worth money! Write for low quantity prices.

Model 112A Variable Output DC Voltage Regulator Output: 240 to 325 volts DC 200 ma. maximum 1/2% regulation Input: DC input must exceed output by 100 volts. 6.3 volts @ 1.5 amps 2 1/2 x 2 3/4 x 5 3/4 inches \$34.50	Model 113A Variable Output DC Voltage Regulator Output: 285 to 470 volts DC 350 ma. maximum 1/2% regulation Input: DC input must exceed output by 100 volts. 115 volts AC 60 cycles No filament voltage needed! 3 1/4 x 3 1/2 x 6 1/2 inches \$52.00	Model 115 Subminiature Voltage Regulated Power Supply Output: 150 volts DC @ 12 ma. 1/2% regulation 5 millivolts ripple 6.3 volts AC @ .9 amps Either polarity may be grounded. Input: 115 volts AC 60 cycles 2 1/2 x 2 3/8 x 3 1/4 inches \$36.00	Model 116 Subminiature Voltage Regulated Power Supply Output: 108 volts DC @ 12 ma. 1/2% regulation 2 millivolts ripple 6.3 volts AC @ .9 amps Either polarity may be grounded. Input: 115 volts AC 60 cycles 2 1/2 x 2 3/8 x 3 1/4 inches \$36.00	Model 117 Fixed Output DC Voltage Regulator Output: 235, 285, 300, 350 volts DC fixed. 125 ma. maximum 1/2% regulation Input: DC input must exceed output by 200 volts. 6.3 volts @ 1.2 amps 2 1/2 x 2 1/2 x 5 3/4 inches \$22.00
Model 118 Fixed Output DC Voltage Regulator Output: 160 to 350 volts DC fixed. 175 ma. maximum 1/2% regulation Input: DC input must exceed output by 90 volts. 6.3 volts @ 1.5 amps 2 1/2 x 2 1/2 x 5 3/4 inches \$28.00	Model 119 DC Filament Supply Output: 12.6 volts DC 0.9 amps maximum 2% ripple Input: 115 volts AC 60 cycles Multi-tapped primary 3 x 3 1/4 x 3 3/4 inches Net Weight 2 lbs. \$34.00	Model 120 Subminiature Power Supply Output: Unregulated 310 volts DC @ 5 ma. 230 volts DC @ 20 ma. .006% maximum ripple 40 mf. shunt capacity 6.3 volts AC @ .9 amps Input: 115 volts AC 60 cycles 2 1/2 x 2 3/8 x 3 1/4 inches \$30.00	Model 121 Subminiature Power Supply Output: Unregulated 170 volts DC @ 5 ma. 100 volts DC @ 35 ma. 0.2% maximum ripple 40 mf. shunt capacity 6.3 volts AC @ .9 amps Input: 115 volts AC 60 cycles 2 1/2 x 2 3/8 x 3 1/4 inches \$31.00	Other "Unitized" Plug-Ins: Regulated Photo-multiplier Supplies 400 cycle Instrument Power supplies <i>We also build "Unitized" Plug-Ins to specifications in large or small quantities.</i> Write for further information.

C. J. APPLGATE & CO.
 1816 Grove St. Dept. ED-78 Boulder, Colorado

CIRCLE ED-78 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Electronic Standard Cell Also Serves as Power Supply



This Electronic Standard Cell can be used either as a reference voltage in bridge circuits or for supplying current continuously as a power supply. Unlike electrochemical cells, it is not subject to freezing and can be used

over a wide temperature range.

When used intermittently, the 28v cell has less than $\pm 0.15\%$ change in output, and the unit also shows less than 0.1% total output change when used continuously. Another feature includes an a-c ripple of less than 1mv. With this stability, the device can be used for those applications that require a stable output within the range of 0 to 100v and 0 to 30ma. Output voltage can be set anywhere within this range according to specifications.

Because of its low output ripple, the unit may be used with all types of recording oscillographs. It serves as an accurate power source for instruments which measure temperature, power, motion, strain, velocity, and mass flow. The cell can be used in laboratory work and is small enough to be readily adapted as a built-in power supply for large instruments. Hastings Instrument Co., Inc., Dept. ED, Super Highway at Pine Ave., Hampton, Va.

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

Identification Markers Easy to Apply and Read

"Speedy Marx" Identification Markers are prepared on durable adhesive stock in a clear, easy-to-read type style. They are used to make quick, permanent identification of wire, cable, and similar products. Standard codes are stocked for immediate delivery on stock cards.

These cards include solid numbers, solid letters, combinations of solid numbers and letters, sequence numbers, sequence letters, and standard electronic and electrical terms. Standard cards are available in black and white; they also may be ordered in any of the standard NEMA colors. Special codes can be made to order. North Shore Nameplate Co., Dept. ED, Glenwood Landing, L. I., N. Y.

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

FORD INSTRUMENT COMPONENTS

Ford Instrument Company makes the finest precision instruments and mechanisms for industry and the armed forces.



FORD MECHANICAL DIFFERENTIALS with single spider gear—available in 3/16," 1/4" and 5/16" shaft diameters—high accuracy, low friction.



FORD TELESYN UNITS are available in wide selection of sizes—proved precision accuracy, corrosion and fungus resistance mean better synchros when you specify Telesyn.



FORD SERVO MOTORS (60 and 400 cycles) for extremely low inertia and high frequency response. 1/5; 1/2; 1 1/2; 2 1/2; 5; 10-watt models in both low and high voltage, including magnetic amplifier controlled types.



FORD ELECTRICAL RESOLVERS available in sizes 23 and 31—interchangeability, temperature compensation—60°F to +160°F, highest accuracy, adaptability, 400 cycle frequency.

Ford Instrument also makes magnetic amplifier systems, computers, converters, mechanical integrators and other instruments and equipment. Write for more details.



FORD INSTRUMENT COMPANY
 Division of The Sperry Corporation
 31-10 Thomson Ave., Long Island City 1, N. Y.

CIRCLE ED-81 ON READER-SERVICE CARD

CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION

**COMPACT
DEPENDABLE
EFFICIENT**

Rotary Power
by **Carter**



THE NEW

Custom

DC-AC CONVERTER

These latest of all Carter DC to AC Converters are specially engineered for professional and commercial applications requiring a high capacity source of 60 cycle AC from a DC power supply. Operates from storage batteries, or from DC line voltage. Three "Custom" models, delivering 300, 400, or 500 watts 115 or 220 V. AC. Wide range of input voltage, 12, 24, 32, 64, 110 or 230 V. DC. Unequaled capacity for operating professional recording, sound movie equipment and large screen TV receivers. Available with or without manual frequency control feature.



MAIL COUPON FOR CATALOG

Carter Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. **MAIL COUPON NOW** for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

Carter MOTOR CO.
2664 N. Maplewood Ave.
Chicago 47



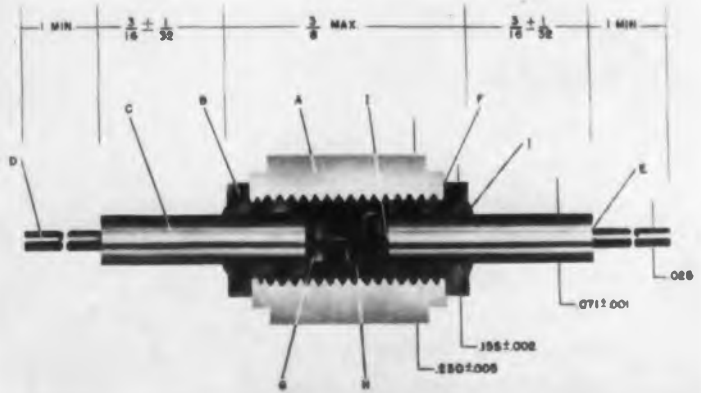
Carter Motor Co.
2664 N. Maplewood Ave., Chicago 47
Please send new catalogs containing complete information on Carter "Custom" Converters and other Rotary Power Supplies.

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Address _____
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CIRCLE ED-82 ON READER-SERVICE CARD

Germanium Diodes

Have Vacuum Tight Ceramic Seals



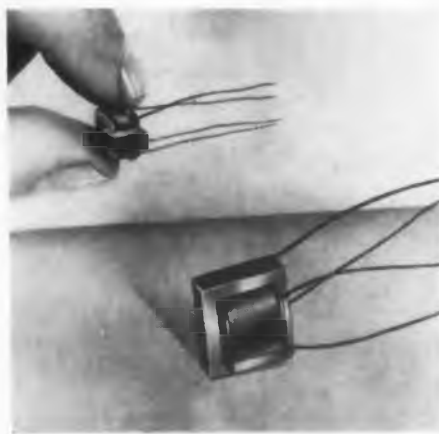
This new line of Germanium Diodes features vacuum-tight moisture-resistant seals, plus extreme mechanical stability. A ceramic case is used to insure stable electrical characteristics and complete isolation from adjacent circuitry. Case surfaces are metallized to permit vacuum-tight ceramic-metal seals to be made.

Components of this precision design are shown in the above illustration: *A*—steatite ceramic base; *B*—end cap; *C*—nickel fin; *D*—tinned copper-clad wire; *E*—welds; *F*—ceramic to metal solder seals; *G*—germanium pellet; *H*—tungsten whisker; and *I*—solder seals. The use of nickel terminal pins and flexible, tinned leads permits the unit to be either clipped into spring holders or soldered directly for circuit applications. Bomac Laboratories, Inc., Semi-Conductor Department, Dept. ED, Salem Rd., Beverly, Mass.

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

Ultra-Miniature Transformer

For Transistor Audio Applications



An Ultra-Miniature Transistor Transformer has been added to the company's line. Designed primarily for transistor audio applications, the device also can be used wherever low power is involved.

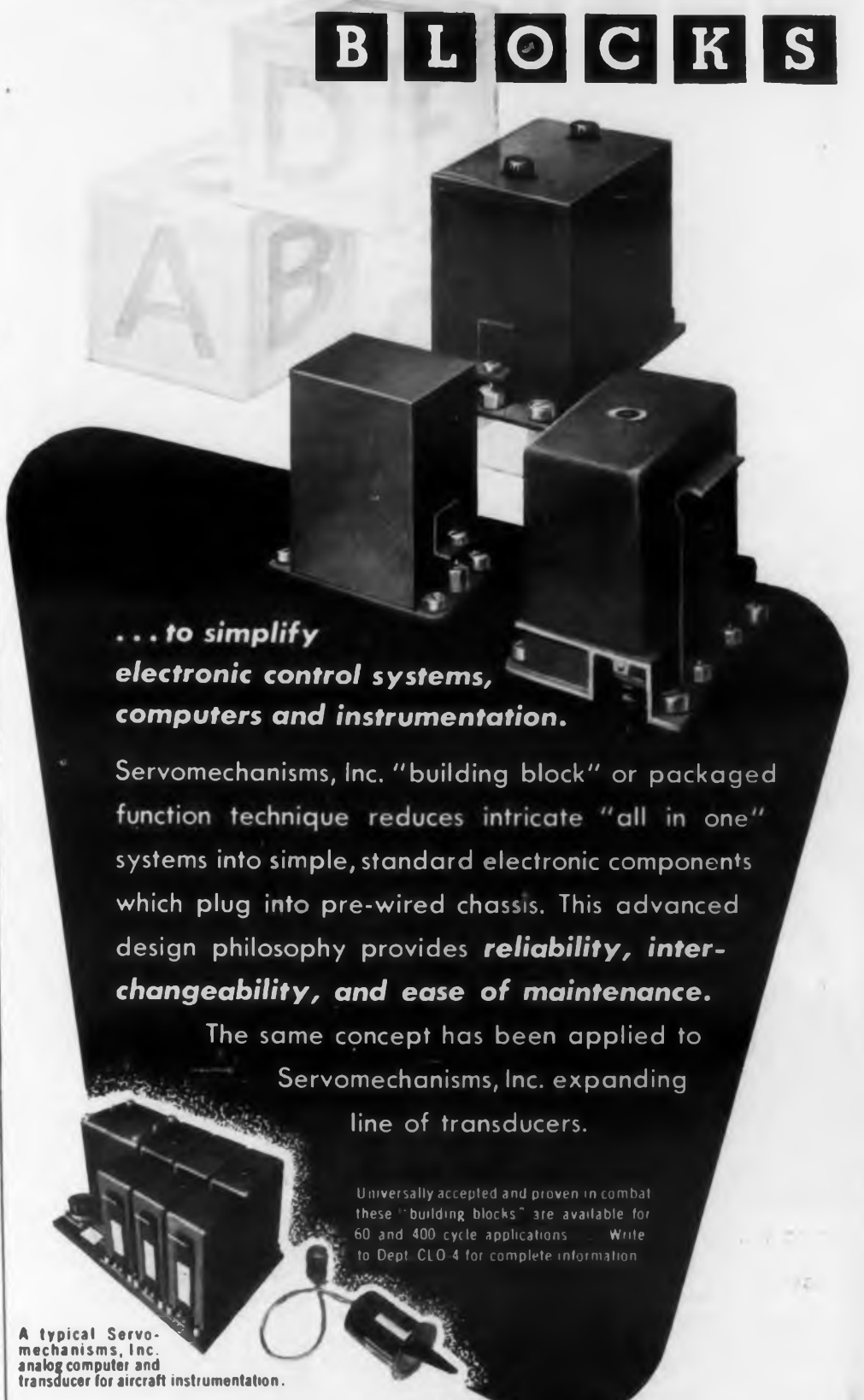
Weighing less than 1/10 oz, the unit measures 1/4" x 3/8" x 3/8" and is about the same size as the transistor it is designed to power. Useful below 1mw level, it is constructed of extremely fine wire and wound on molded nylon bobbins, with special nickel alloy steel laminations. Standard Transformer Corp., Dept. ED, 3580 Elston Ave., Chicago 18, Ill.

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

CIRCLE ED-10 ON READER-SERVICE CARD FOR MORE INFORMATION

Electronic

BUILDING BLOCKS



... to simplify
electronic control systems,
computers and instrumentation.

Servomechanisms, Inc. "building block" or packaged function technique reduces intricate "all in one" systems into simple, standard electronic components which plug into pre-wired chassis. This advanced design philosophy provides **reliability, interchangeability, and ease of maintenance.**

The same concept has been applied to
Servomechanisms, Inc. expanding
line of transducers.

Universally accepted and proven in combat these "building blocks" are available for 60 and 400 cycle applications. Write to Dept. CLO 4 for complete information.

A typical Servomechanisms, Inc. analog computer and transducer for aircraft instrumentation.

SERVOMECHANISMS INC.

Westbury Division
Post and Stewart Aves., Westbury, N. Y.

El Segundo Division
316 Washington St., El Segundo, Calif.

POSITIONING MECHANISMS • SERVO AMPLIFIERS • MODULATORS • POWER SUPPLIES
SERVO MOTORS • ADAPTERS • TRANSDUCERS • MECHANICAL DEVELOPMENT APPARATUS

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

THE IDEAL SOURCE OF
D-C VOLTAGE FROM
A-C LINES

VARICELL



STABILIZED and REGULATED
Output voltage is unaffected by variations in a-c line voltage or output load current. Stabilization and regulation is ± 0.25 volts. R.M.S. ripple voltage is less than 0.1 volts.

CONTINUOUSLY ADJUSTABLE
Any desired output of d-c voltage from 0 to 30 volts is achieved by simply rotating the handwheel on the front panel.

CONVENIENT, EASY TO USE
The VARICELL is connected by simply plugging into any handy a-c voltage source supplying a nominal 115 volts, 60 cycles, 1 phase. The load is connected to either of two pairs of SUPERIOR 5-WAY Binding Posts.

GET COMPLETE INFORMATION NOW. Send today for your free copy of VARICELL Bulletin V1051

WRITE TO:
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Bristol, Conn.

THE SUPERIOR ELECTRIC CO. 
BRISTOL, CONNECTICUT

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

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OUR NEW COMBINATION BLOWER/TURBINE FOR COOLING NEW GE POWER TETRODES

ONLY ONE SINGLE DRIVING MOTOR INDUCTION TYPE—3400 RPM—1 ϕ , 3 ϕ

COMPACT

SIMPLE

QUIET



SPECIALLY DESIGNED BLOWERS FOR EACH TYPE OF TUBE

GE TUBE	ROTRON PART # (ABBREVIATED)	TURBINE SECTION		BLOWER SECTION	
		CFM	SP	CFM	SP
#6183	A4-6502/505	14	6"	60	1.5"
#6283	K3-6503/404	3	4.5"	20	0.75"
#6182	A5-701	35	5"	NONE	
#6019	K5-6502	15	6"	NONE	

WRITE FOR DESCRIPTIVE BULLETINS

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WOODSTOCK, N. Y. SCHOONMAKER LANE

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

New Products...

Pulse-Forming Networks Miniaturized, Sealed Units



The NC-34 Series Miniature Pulse-Forming Networks are hermetically sealed units with molded ceramic bushings. Their small size is due to careful coil winding and construction of the integral capacitor. The network is especially constructed to eliminate breakdown and pulse irregularities due to expansion of components or to vibration.

The NC-34-644-9 unit illustrated measures only 1-1/16" high (1 3/4" over bushings) x 1 1/4" long x 3/4" wide. It has a pulse width of 0.5 μ sec at 70%, a rise time of 0.12 μ sec, and a pulse repetition rate of 1000/sec. Rating is 3kv, d-c, 0.005mfd, 50 ohms impedance, and up to 90°C maximum ambient temperature. Average life is 30,000hr. National Capacitor Co., Dept. ED, 585 Washington St., Quincy, Mass.

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

Hermetically Sealed Capacitors For Ambient Temperatures to 150°C



These hermetically sealed "Ambi-rite" Capacitors have been designed for long and satisfactory operation in ambient temperatures up to 150°C. They are available with single and dual sections in standard capacitance values and voltage ratings in various case sizes.

These capacitors can operate throughout the temperature range of -55°C to +150°C because a special dielectric material is employed in their construction. Capacitance change with temperature is small. The solder sealed terminals have the mechanical and electrical characteristics necessary to withstand severe thermal conditions to which military equipment is exposed. Micamold Radio Corp., Dept. ED, 1087 Flushing Ave., Brooklyn 37, N. Y.

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

Shocking News About Super Davohm Resistors



Only Daven uses a stranded lead wire to connect the resistance wire to the solder terminal of the Super Davohm Precision Wire Wound Resistor.

Result: Super Davohm Resistors are more rugged, can withstand more vibration, rougher treatment and abnormal shocks because all stress, strain, heat or pressure, applied to the solder terminal, is absorbed by the heavy lead wire so that the resistor is not adversely affected in any way.

This is only one of the many exclusive features which make DAVEN the leader in the resistor field.

EXCELLENT DELIVERIES • Write for detailed bulletin

THE DAVEN CO. 169 Central Avenue
Newark 4, N. J.

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

New DEE PRINTED CIRCUIT SOLDER POT

Gives Precise Control of Surface Temperature of Solder



This Solder Pot features a copper panel, submerged 5/8" below surface of solder, that operates as a thermal condenser to provide even distribution of heat at all points in the controlled area.

Thermostat coupled thermally to the panel—responds to temperature variations and operates the panel's heating element.

DEE
SOLDER
POTS

Heating elements affixed to the crucible to provide minimum operating temperature.

Temperature range 300° to 600° F., or as required. Write for bulletin.

DEE Electric Company

1648 W. HADDON STREET
Chicago 22, Ill.

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

ELECTRONIC DESIGN • September 1953

Here's Help with AN Connector Performance and Assembly Problems



Solid Shell AN. Snap-in retaining sleeve (exclusive with G.E.) cannot work loose, yet releases quickly with a screw driver and insert removes for inspection or soldering. Design permits use in tight places normally requiring split shell connectors. Meets MIL-C-5015.



Split-Shell 90° Angle AN. Top removable for wire inspection without unmatting or disassembling from conduit or cable. Split-shell ease of wiring with advantages of solid shell construction. Meets MIL-C-5015.



Split-Shell Straight AN. Reduced number of metal parts and weight — plus — improved connector performance. Full length split permits rapid and complete disassembly. Meets MIL-C-5015.



Hermetically Sealed. Extremely rugged. Withstand the mechanical shock of 100G's, thermal shock from -300°F. (liquid air) to +500°F. (in oil), high potentials of over 1000V., operating pressures up to 7000 p.s.i. (depending on applications) and brazing temperatures as high as 1500°F.

For complete catalog showing all shell styles and insert arrangements send this coupon.

WIRING DEVICE DEPARTMENT N-9
GENERAL ELECTRIC COMPANY
95 Hathaway Street, Providence 7, R. I.
Please send Monowatt Catalog D-1

Name.....
Title.....
Company.....
Address.....
City..... Zone..... State.....

CIRCLE ED-92 ON READER-SERVICE CARD

ELECTRONIC DESIGN • September 1953

Ceramic Magnets Contain No Critical Materials



"Magnadur", a ceramic permanent magnet material contains no critical materials. It is made by a powder metallurgy process from a mixture of barium and iron oxide, pressing or extruding the mixture into shape and sintering in

furnaces at very high temperatures. The resultant product is a very hard, rather brittle, black, pottery-like substance with excellent permanent magnet qualities when magnetized.

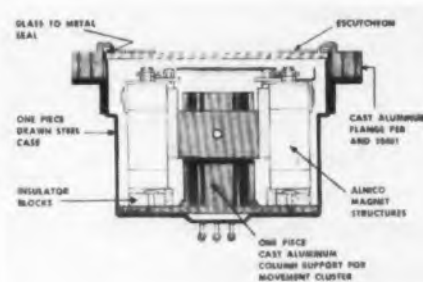
The material has extremely high coercive force and unusually high resistance to demagnetization, as well as excellent magnetic stability. The high resistance permits the use of "Magnadur" magnets in the presence of high frequency fields without losses.

Illustrated is a TV focusing device using two ring magnets of "Magnadur". Adjustment of the relative position of the two toroids reduces stray fields to a minimum and provides a highly symmetrical field of maximum sharpness and spot symmetry. Ferroxcube Corp. of America, Dept. ED, 97 Marshall St., North Adams, Mass.

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

Aircraft Instruments

Sealed, Multi-Element Types



This series of improved multi-element aircraft dial instruments consists of single seal glass-to-metal hermetically sealed types which incorporate ruggedized

D'Arsonval movements. A unique columnar construction provides rigidity and precise alignment of the elements. The instruments are available as two element (Model AN32E), three element (Model AN-33E), and four element (Model AN34E) types.

Applications include ammeters, voltmeters, radio navigational types (such as Omni-range and ILS), temperature indicators and others. They meet AND 10401 dimensional requirements for 2-3/4" dial instruments. Marion Electrical Instrument Co., Dept. ED, Manchester, N. H.

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

new Berkeley PRINTED READOUT

for ELECTRONIC COUNTERS



* DIRECT READING * RAPID CYCLING * LOW COST

PRINTED READOUT for high speed electronic counters is now available at low cost as a standard BERKELEY product. This Digital Recorder provides a direct means of permanently recording sequential count information in arabic numeral form on a standard adding machine tape. It is designed to operate from electronic counters, Time Interval Meters, Events-per-Unit-Time Meters, nuclear scalars, and other electronic totalizing devices. Most standard BERKELEY instruments now in use can be readily adapted for operation with the BERKELEY Digital Recorder, thus eliminating the need for purchase of new counting equipment.

THE DIGITAL RECORDER is composed of a Digital Scanner and a Digital Printer. The first unit consists of a bank of readout decimal counting units essentially paralleling the totalizing function of the basic counting instrument from which they operate, and a selecting relay matrix to channel information from the counting circuit to the Digital Printer. This second unit presents a sequence of total counts in direct reading digital form on a standard adding machine tape.

A COMPLETE SYSTEM of Electronic Counter and Digital Recorder then consists of three elements: a suitable electronic counting device, Digital Scanner, and Digital Printer. The latter two elements comprise the complete Digital Recorder. Modification D, a standard modification of the system, will permit original count information to be channeled directly into the Digital Scanner, thus eliminating the need for a separate electronic counter.

SPECIFICATIONS Minimum counting period determined by the characteristics of the basic counting instrument. Maximum cycling rate: 1 printout every 3/4 second. Indicating capacities 3, 4, 5 or 6 columns. Digital Scanner—20 1/2" x 10 1/2" x 15" cabinet, wt. 70 lbs., standard 19" relay rack panel. Digital Printer—7 1/2" x 8 1/4" x 14 1/2" cabinet, wt. 20 lbs. Price, Digital Recorder, Model R-3 (3-column), \$1050; Model R-4 (4-column), \$1125; Model R-5 (5-column), \$1200; Model R-6S (6-column, 100 kc), \$1275; Model R-6 (6-column, 1 mc) \$1325. Modification D (not available on 1 mc unit) \$145.00. Prices f.o.b. factory.

M-5

Please request Bulletin D-9

Berkeley

division

BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVE., RICHMOND, CALIF.

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

Only **-COLE-** has this RANGE of METERS



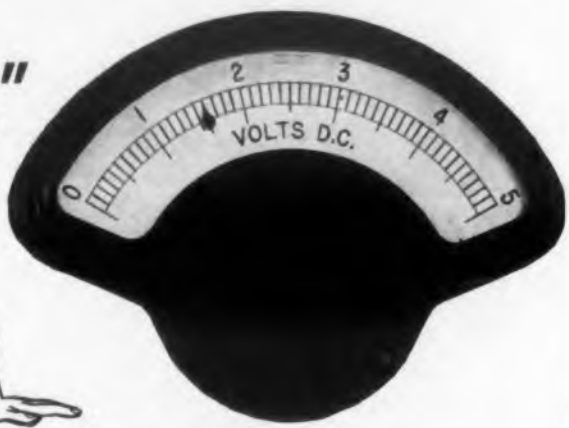
1 3/4"

MINIATURE

This mighty mite of a **-COLE-** 1 3/4" Meter combines maximum accuracy with surprising readability. It is available in all ranges and scales, and in hermetically sealed cases.



12"



— OR GIANT!

The big face of this 12" **-COLE-** Meter shouts its readings from remote positions, even in uncertain light. This giant is particularly suited to many production installations requiring quick and accurate readability.

Between the miniature and the giant, many other **-COLE-** Meters meet the needs of defense, industry, and science. A quarter of a century of fine custom building has established their ruggedness and quality. **-COLE-** has combined the finest of materials and workmanship to produce standard meters with accuracies as high as 1/2 per cent.

Best of all, these highest-quality **-COLE-** Meters can be delivered immediately. Special orders take just a little longer.

You may wait longer, but you will not get a better meter than a **-COLE-**.

Be sure to see our exhibit, Booth 903, at the Western Electronics Show and Convention, Civic Auditorium, San Francisco, August 19-21.

Fill in and mail the coupon for quick information on **-COLE-** Meters.



Instrument Company

1320 SO. GRAND AVENUE
LOS ANGELES 15, CALIF.

Yes, I want more information on **-COLE-** Meters.

D-18

NAME _____ TITLE _____

COMPANY _____

STREET ADDRESS, OR BOX NUMBER _____

CITY _____ ZONE _____ STATE _____

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

New Literature . . .

Transistor Manual 97

Transistor theory, data, and applications are covered in this 8-page "Transistor Manual" (Bulletin E-212). It includes specifications on the company's point contact and junction transistors, and includes circuit application information on sine wave oscillators, frequency multipliers, pulse generators, audio amplifiers, microphone preamplifiers, voltage amplifiers, crystal oscillators, radio receivers, and hearing aids. CBS Hytron, Dept. ED, Danvers, Mass.

Germanium Diode 98

The construction and advantages of the Hughes subminiature Germanium Diode are described in detail in this 4-page, 2-color bulletin. Of one-piece construction and fusion sealed in a glass envelope, the unit has an enclosure approximately 1/4" long and less than 1/8" dia. Electrical specifications for the various diode types available are also included. Hughes Aircraft Co., Culver City, Calif.

Design Facilities 99

An 8-page booklet describes the facilities of this firm for the design and production of electronic and electro-mechanical instruments for laboratory and industrial use. Numerous products are described and illustrated, including power supplies, pulse generators, a tube checker, modulator, velocity-of-propagation meter, and other equipments. Manson Laboratories, 207 Greenwich Ave., Stamford, Conn.

Electron Tubes 100

A 16-page catalog contains many performance data and specifications on a wide variety of gas switching tubes, hydrogen thyratrons, series spark gap, semi-conductors, and pressuring windows. Outline drawings and tuning and frequency curves are provided, as well as numerous illustrations. Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.

Pressure Sensing 101

Issue No. 25 of "Instrument Notes" is a 4-page paper by J. D. Humphreys of Northrop Aircraft, Inc., titled: "Pressure Sensing Calculations for Aircraft and Guided Missiles." Illustrated with diagrams and graphs, it shows how the difference between signals transmitted by the sensing capsule and the signals applied to a pressure sensing system can be predicted. Statham Laboratories, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif.

Sub-Fractional HP Motors 102

Binder contains 20 pages of data on rugged, sub-fractional horsepower motors, fans and blowers. Specifications, graphs of performance characteristics and dimension drawings are provided on a wide variety of units. A section is devoted to end applications and selection of the motors. Air Marine Motors, Inc., 3939 Merrick Rd., Sea Ford, L.I., N.Y.

R-F Filters 103

A 12-page, 2-color catalog (NB-148) contains technical data on about 135 of the company's wide line of "Quietone" r-f attenuation filters. Included in the listing are filters for r-f attenuation in almost every type of electronic and electrical equipment. Outline drawings, physical characteristics data, circuit diagrams, charts, and photographs also are included. Cornell-Dubilier Electric Corp., South Plainfield, N. J.

Varistors 104

Catalog Data Bulletin SR-3 provides performance curves on IRC Varistors (non-linear resistors), which are offered in five convenient cell sizes. These units conform with MIL and JAN specifications on humidity, shock, vibration, temperature cycling, solder pot, fungus resistance, etc. A graph showing typical temperature characteristic, and data on typical applications are included. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Relative Humidity Testers 105

4-page, 2-color bulletin covers the H Series of relative humidity testing units. The chambers described are designed to simulate all conditions of relative humidity above freezing. Sizes range from 10 to 30 cu ft. The units feature close tolerance and will automatically maintain humidity conditions from 20% to 95%. Complete specifications and performance data are provided. Bowser Technical Refrigeration, Terryville, Conn.

Selenium Rectifiers 106

The Type K "Magamp" selenium rectifier is the subject of this 8-page bulletin (Td-52-650). This rectifier was developed especially for magnetic amplifier circuits and sensing devices, but may be used in many other applications. Tables, formulas and examples are provided to aid in the selection of physical dimensions for any particular cell size and cell combination. A section of the brochure is devoted to a definition of selenium rectifier terms and electrical characteristics. Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Glass Textiles 107

A 32-page, 2-color brochure, "Glass Textiles for Industry," discusses three basic fiber glass textile forms: broad fabrics, tapes, and parallel strand reinforcements. It contains a series of charts illustrating end-uses of these textile forms, together with the properties prompting the use for each end-product listed. The brochure also includes charts of specifications for each of the three textile forms. Industrial Products Div., Hess, Goldsmith & Co., Inc., 1400 Broadway, New York 18, N.Y.

Aircraft Connections 108

This 32-page "Aircraft Instruction Manual" (No. 53Y1) describes, illustrates and provides instructions on how to install and use the company's products designed for aircraft. It covers crimp type terminals and links, installation tools and die sets, current limiters, terminal blocks, disconnect panels for pressurized bulkheads, and solderless terminations for shielded wire. Information on aluminum terminals, connector, and cable also is provided. Burndy Engineering Co., Inc., Norwalk, Conn.

Electronic Products 109

Photographs and descriptive details on glass-to-metal seals, steatite and other ceramics, printed circuits, and ceramic-metal assemblies are included in 4-page Bulletin No. 653. A section also provided includes a description of the characteristics of Kovar Glass-Sealing Alloy. Stupakoff Ceramic & Manufacturing Co., Latrobe, Pa.

Glass-Bonded Mica 110

This 24-page booklet on the machining of Mycalex glass-bonded mica is an illustrated reference and operation manual. It tells how this material can be machined so as to retain full advantage of its properties: radiation resistance, ability to withstand temperatures up to 950°F, high dielectric, and permanent electrical and mechanical stability. The many grades available are described. Mycalex Corp. of America, 30 Rockefeller Plaza, New York 20, N.Y.

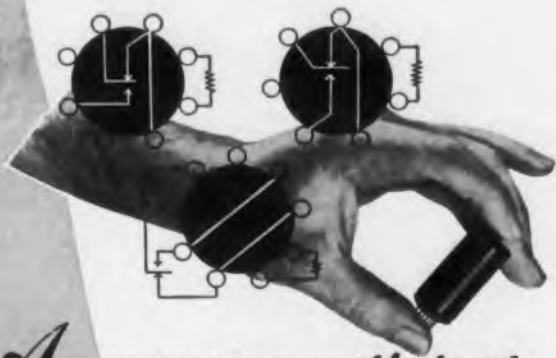
Transformers 111

Catalog 530 is a 22-page brochure describing the company's transformers, reactors, and filters. Many types of units are included: low impedance to grid transformers, mixing transformers, interstage audio transformers, high level matching transformers, modulation reactors, wide range amplifiers, ounce audio units, and auxiliary high fidelity equipment. Specification data are provided for each of the many instruments, and graphs, photographs, curves, and charts provide additional information. United Transformer Co., 150 Varick St., New York 13, N. Y.

Vacuum Impregnation 112

A 24-page brochure, No. 760, describes the nature and advantages of Vacuum Impregnation, a process by which voids in porous materials are filled in with a desired impregnant after air and moisture have been evacuated. Among the many applications described are improvement of dielectric efficiency in electrical components, and the potting of transistors. The line of Stokes equipment for vacuum impregnation is covered, with specifications provided. F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.

CIRCLE ED-113 ON READER-SERVICE CARD ➤



*Announcing with pride
the development of the*

NEW EUREKA "SNAPPER"

THERMAL TIME DELAY RELAY

FEATURES . . . SNAP ACTION. Single Pole Double Throw. Light-weight. Low operating temperature. Operates in any position. High contact rating. Gas filled. Low heater current. Durability and long life.

EUREKA PRESENTS POSITIVE

SNAP ACTION

The ELIMINATION of CHATTERING is accomplished with the incorporation of "POSITIVE SNAP ACTION" in the EUREKA "SNAPPER" . . . LEADING ELECTRONIC MANUFACTURERS have acknowledged the new EUREKA "SNAPPER" as a major advancement in this field, and have already accepted this relay as a standard component of their latest equipment.

Voltage . . . 6.3, 26.5, 115 volts (A.C. or D.C.) or as required.

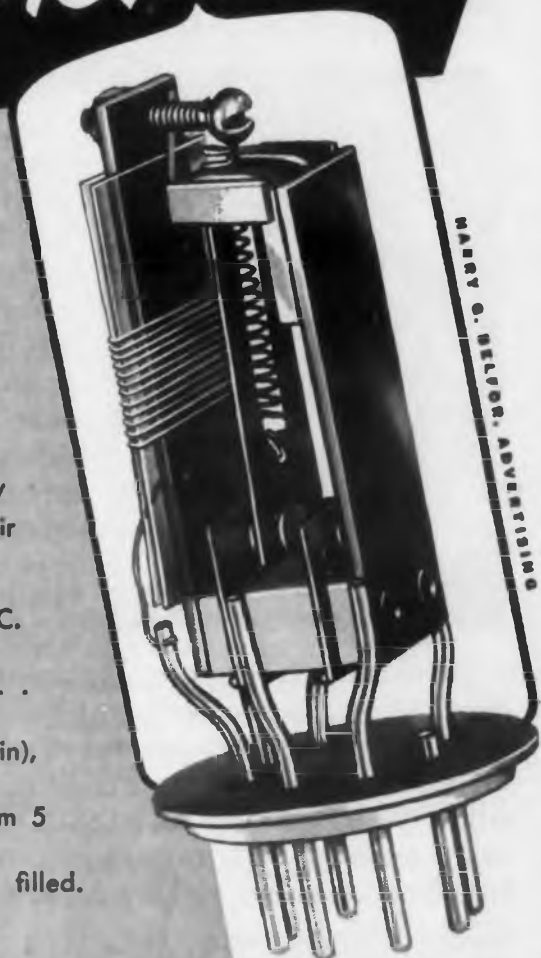
Ambient Temperature Range . . . -60°C. to + 80°C.

Envelope . . . Miniature (7 and 9 pin), or octal (8 pin) metal.

Time Delay Periods . . . Preset from 5 seconds up.

Vacuum . . . Evacuated, inert gas filled.

Height . . . 1 $\frac{3}{4}$ " maximum seated.



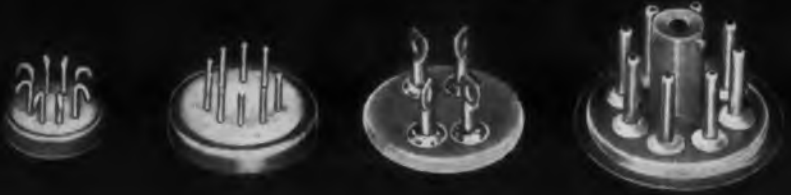
MARY G. BELSER, ADVERTISING

Inquiries are invited . . . send for our "Bulletin Number Snapper"

EUREKA TELEVISION AND TUBE CORPORATION

Manufacturers of Cathode-Ray Tubes and Electronic Products
69 FIFTH AVE., HAWTHORNE, N. J. • TEL. HAWTHORNE 7-5800

BRING US YOUR HEADER PROBLEMS!



SIMPLE OR COMPLEX

— We make them all, ranging from 2- and 3-electrode crystal holder bases and standard octal headers, to 14- and 18-terminal headers for sealed Transformer and Relay applications — with a wide selection of styles and sizes in our series of basic designs.

SPECIAL DESIGNS

— We also manufacture Sealed Headers and Terminals to meet special requirements, and will be glad to quote upon receiving your specifications.

COMPLETE ASSEMBLIES

— We have facilities for handling the complete assembly of many units — including wiring, evacuating and pressure-filling enclosures.

NEW CATALOG

— Just off the press, a new Hermaseal catalog, with descriptions and specifications of some of our standard Sealed Headers and Terminals. Write for your copy today!



THE HERMASEAL CO, Inc.

Elkhart 45, Indiana

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

(Advertisement)

Compact, Coaxial High-Power, High-Frequency Triodes



The Machlett ML-5681, ML-5682 coaxial terminal design provides compact, high-efficiency, water-cooled triodes for high-power, high-frequency application. Equipment power output for the ML-5681: in excess of 75 kW up to 30 mc, 50 kW to 110 mcs. Equipment power output for the ML-5682: in excess of 150 kW to 30 mc, 100 kW to 88 mc. Unique in size for the power obtained, these tubes are each 8" in diameter. Lengths, including integral water jacket, are 19 $\frac{3}{4}$ " for the ML-5681 and 23 $\frac{1}{4}$ " for the ML-5682. Tube replacement time is 5 minutes, made possible by simple 60° twist bayonet socket.

These tubes are used in practically all classes of high power amplifiers and oscillators. Operating ranges: 35 kW to 1 megW in power, and from under 1 mc to over 100 mc in frequency. Eminently suited to cavity circuitry, readily fitted with conventional connectors, either the ML-5681 or ML-5682 offers the designer a tube of uniform characteristics, high transconductance and low plate impedance with broadband response and low driving power.

Machlett Laboratories, Inc., 1063 Hope Street, Springdale, Conn.

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

New Literature ...

Transformers 116

Complete electrical and physical specifications on almost 500 Stancor transformers for radio, TV, high fidelity, amateur, military and other electronic applications, are provided in this 24-page catalog. There are 25 new units listed, including 13 TV components and five transistor transformers. The high fidelity section has been expanded to include new miniature audio transformers and more detailed information on the Stancor-Williamson amplifier. Chicago Standard Transformer Corp., Standard Div., Elston and Addison, Chicago 18, Ill.

Electron Tube Picture Book

This 16-page booklet is an educational compilation of photographs, cutaway drawings, and exploded views showing structural details of electron tubes used in home entertainment, industrial and military electronic equipment. Tubes shown include typical glass, metal and miniature types; a subminiature triode; a thyatron; a high-voltage rectifier; a power triode; TV picture tubes; TV camera tubes; a multiplier phototube; and an electron gun. The booklet is priced at 25¢. Write direct to Commercial Engineering, RCA Tube Dept., Harrison, N.J.

Paper Capacitors 118

"Hy-Mets" Metallized paper capacitors are detailed in this 4-page, 2-color bulletin (AB-19). Illustrations, descriptions, engineering performance characteristics, and test specifications are provided. Four capacitor types are covered. Astron Corp., 255 Grant Ave., East Newark, N.J.

Silicone Rubber 119

An 8-page, 2-color bulletin (AD-147) describes many of the Silicone rubber products made by this firm, including: diaphragms, gasketing, sheet packing, oil seals, rings, insulation tape, and molded shapes for many industrial uses. The bulletin points out the heat-resistant and aging-resistant features of silicone rubber and gives examples of typical applications. Garlock Packing Co., Palmyra, N.Y.

Wire Formings; Stampings 120

Many examples of what this firm can do in wire forming and intricate stampings are illustrated and described in a 16-page, 2-color brochure. Typical dimensions and materials are given. Such formings as radio tube parts, electric terminals, electrical cord clamps, springs, tube clamps and special rivets are shown. Eyelets, grommets, crystal bases, enclosure contacts, cable clamps, end caps and enclosures are a few of the stampings shown. Pix Manufacturing Co., Inc., 22 Bedford St., Newark 3, N.J.

Silicone Resin 121

A 6-page bulletin describes the properties and applications of the company's Silicone Resin 2105. This material has many applications in the design and manufacture of electronic equipment such as in transformer coil forms. Physical properties are described, as well as other topics including how to use it, impregnation and precure, lamination, properties of the laminates, and typical properties of glass laminates bonded with this material. A chart indicates the thermal life of silicone laminating resins. Dow Corning Corp., Midland, Mich.

Diode Chart 122

Bulletin No. 1003 is an interchangeability chart for germanium type diode crystals to aid engineers in determining what diode types may be used as replacements or as substitutions in TV and electronic equipment. Outlines of the various styles of diodes are shown to scale. Also available is Bulletin No. 1001, which provides the electrical characteristics for 19 point-contact germanium diodes in the company's line. National Union Radio Corp., Hathoro, Pa.

Electronic Instruments 123

Catalog J devotes 40 pages to detailed descriptions, specifications and illustrations of a variety of precision electronic instruments. Included are instruments for the measurement of circuit components, f-m/a-m signal generators, aircraft navigation and landing system signal generators, and such accessories as inductors, coupling units, adapters, attenuators, and constant voltage transformers. Boonton Radio Corp., Boonton, N.J.

Kel-F Data

A 6-page technical bulletin (1-3-53) is devoted to the physical, electrical, chemical, and mechanical properties of Kel-F, a polymer of trifluorochloroethylene. Some of its many applications include: insulation and wire coating; molded, extruded or machined insulating parts; condenser for corrosive conditions at extended temperatures in motors; transformers; control instruments; signal devices; radio; and radar. Many tables and curves are provided to show the characteristics of this material. Also available is a 20-page "Buyers Guide" which lists sources for molded and fabricated materials and products made of Kel-F. Chemical Manufacturing Div., The M. W. Kellogg Co., P.O. Box 469, Jersey City 3, N.J.

TV Picture Tubes

This 8-page bulletin is a Substitution Chart for TV tubes. It includes all electromagnetically deflected tubes, regardless of make. An index leads to the proper substitution group, listing all readily interchangeable types. CBS-Hytron, Danvers, Mass.

Polymer-Epoxy Resins

Preliminary formulas and applications for "Thiokol" liquid polymer-epoxy resin combinations, a new development in the potting, adhesive, and coating fields, have been assembled in a portfolio. Formulas and physical characteristics are given for combinations of "Thiokol" with such epoxy resins as Bakelite's BRR 18794, Ciba Company's "Araldite," CN 503, and Shell Chemical's "Epon" 828. Thiokol Chemical Corp., Dept. E, Trenton 7, N.J.

Electronic Tubes

A 22-page condensed catalog contains descriptions, specifications and operating data on a wide variety and number of electronic tubes. It includes power tubes, rectifier diodes, hydrogen thyratrons, mercury vapor and inert gas thyratrons, magnetrons, u-h-f triodes, sub-miniature tubes (screen grid types), vacuum capacitors, radiation counter tubes, and tube accessories. Also provided are power tube and vacuum capacitor replacement guides. Ampere Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y.

124**Toggle Switches**

Toggle switches designed and produced to meet Government Specifications JAN-S-23A and MIL-S-6745 are illustrated and described in this 4-page, 2-color bulletin. Design features, data on electrical characteristics, dimensions, and other valuable information are provided. Network Manufacturing Corp., 213 W. 5th St., Bayonne, N.J.

Washers and Stampings

A 16-page, 2-color catalog shows the company's line of washers and metal stampings. It contains useful information on tension, friction, and finishing washers; wire terminals; flat and dished blanks; standard gages; general stampings; and dies available for producing washers and blanks. The Quadriga Manufacturing Co., Dept. E-12, 213 W. Grand Ave., Chicago 10, Ill.

Electronic Components

A 60-page catalog (No. 553) lists and describes more than 2200 items, including list prices. Precision electronic and electric components which are shown in the catalog represent the products of the battery, capacitor, rectifier, resistor, switch, tuner, and vibrator divisions of the company. P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind.

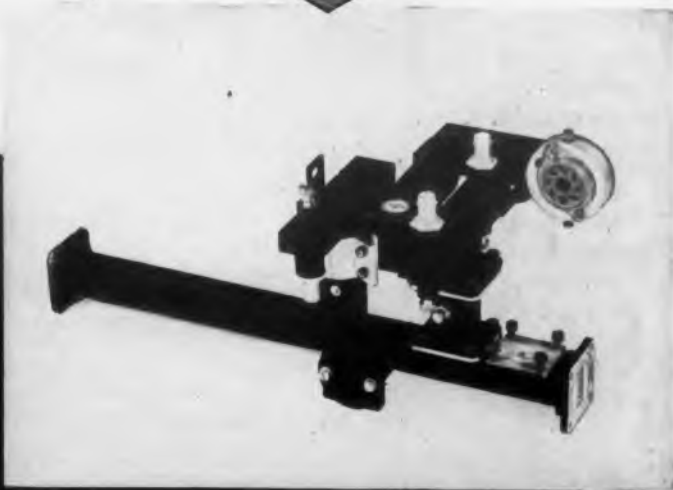
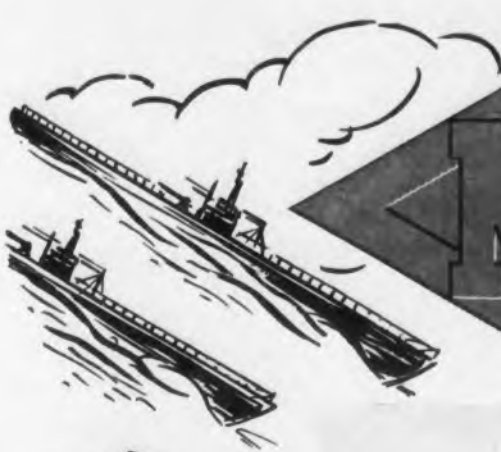
Line and Slide Switches

This 16-page, 2-color bulletin (RC-9B) contains specifications, illustrations, dimensions, application information and other data on: line switches for use with variable composition resistors, volume and tone controls, potentiometers, etc.; and slide switches for radios, TV sets, appliances, small motors, instruments, and similar equipment. Electronic Components Div., Stackpole Carbon Co., St. Marys, Pa.

Flexible Shaft Data

This 12-page, 2-color bulletin (No. 525) contains many engineering data on flexible shafting. Sections include application data; flexible shaft terminology; types of cores; core selection; casings; core fittings; remote control applications; and illustrations of a variety of uses. Stow Manufacturing Co., 79 Shear St., Binghamton, N.Y.

128**129****130****131****132**



Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.

N.R.K. MFG. & ENGINEERING CO.

4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPing 7-2970

CIRCLE ED-133 ON READER-SERVICE CARD FOR MORE INFORMATION

the only practical gold plating process for electronic use!



Bright Gold Process



NOW . . . all the advantages of gold plating for precision components without the common faults of ordinary gold. Here is the first real advance in industrial gold plating. Components that require surface or sliding contacts can be gold plated to any desired thickness without altering the finish or contour of the basic metal.

SEL-REX gold produces mirror-like deposits regardless of thickness . . . without scratch brushing or buffing. Its exceptional hardness resists abrasion, wear and galling . . . affords far greater corrosion protection. Less gold is required to secure minimum specified thickness, yet has unusually good "throwing power" to plate interior surfaces and deep recesses without the need for auxiliary anodes.

No special equipment is required for plating with SEL-REX BRIGHT GOLD for either barrel or still plating operations. The SEL-REX BRIGHT GOLD BATH operates at room temperature and is simple to maintain. Solution is stable. Packaged in 1, 5 and 10-ounce bottles.

Send for impartial comparative test chart between conventional and SEL-REX BRIGHT GOLD.

SEL-REX PRECIOUS METALS, INC.
 Dept. ED-9, 229 Main St., Belleville 9, N.J.

Send FREE literature and comparative chart specifications on SEL-REX BRIGHT GOLD PROCESS.

Name

Company

Address

City Zone . . . State

CIRCLE ED-134 ON READER-SERVICE CARD FOR MORE INFORMATION

Replaces a Chain of 10 to 20 Relays!



KELLOGG Magnetic Impulse Counter

... A SEQUENTIAL RELAY THAT COUNTS, STORES AND "REMEMBERS"!

FULLY MEETS THESE RELAY SERVICE REQUIREMENTS

- ON-OFF
- DIFFERENTIAL
- INTERLOCKING
- SELECTOR
- STEPPING
- SEQUENCE
- LATCH-IN
- COUNTING
- MARKING

Small! . . . Simple! . . . Saves money! The Kellogg *Magnetic Impulse Counter* provides an ingenious and reliable answer to a host of electro-mechanical switching problems. Readily performs the counting and marking function of 10 to 20 relays or a two-magnet ten-point stepping switch—at a lower cost! Rapid operation—up to 30 pulses per second. Occupies the space of only two telephone relays. Never needs lubrication—service life is virtually unlimited. Delivers top performance in a wide variety of industrial and commercial applications where service, speed, size and price are vital factors. Get the facts—write for complete information today!

KELLOGG

A Division of International Telephone and Telegraph Corp.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY
Dept. 68-1, 79 WEST MONROE STREET, CHICAGO 3, ILLINOIS

CIRCLE ED-135 ON READER-SERVICE CARD FOR MORE INFORMATION



Select an
AMERICAN ELECTRIC "Packaged Unit"

Complete, ready to connect to
60 cycle mains.

FIXED FREQUENCIES: from 250 to 2400 cycles; (up to 4000 cycles in lower ratings).

VARIABLE FREQUENCIES: 380 to 1200 c.p.s., and 1200 to 2400 c.p.s.

OUTPUT RANGES: ½ to 15 KVA, single phase—½ to 30 KVA, three phase—other designs to 75 KVA.

Built with the exclusive American Electric Inductor-Alternator design... no springs, no slip rings, no brushes... as maintenance-free as its grease-sealed ball bearings!

Stationary installation, vee belt drive, resilient mounted for laboratory h.f. test equipment.



Engineering Representatives:
TRAYCO ENGINEERING CO.
Silver Spring (Md.)
Los Angeles, Chicago, New York



Stationary installation, direct connected drive, for inspection and test of high frequency components and completed assemblies.



Stationary installation, 2-bearing common shaft motor drive, for inspection and test of high frequency components and completed assemblies.



Variable frequency installation for research test work.



4811 Telegraph Road,
Los Angeles 22,
California

New Literature ...

Electronic Hardware 137

A complete line of Standardized Electronic Hardware is covered by this 42-page catalog. Each item is illustrated, by sketch and by dimensional drawing, and data on material of construction and finish are provided. The hardware line now includes insulated lugs, both hand and wrench tightening shaft locks, standard and specially designed terminal boards, chassis bushings, stand-offs, and spacers. U.S. Engineering Co., 521 Commercial St., Glendale 3, Calif.

Selenium Rectifiers 138

Illustrated 4-page bulletin (GEA-5935) contains data on the applications, construction features, and electrical characteristics of miniature selenium rectifier stacks for electronic circuits. Included are tables of ratings and dimensions, plus graphs on the effect of temperature and life expectancy of the various types of stacks. General Electric Co., Schenectady 5, N.Y.

Solid Copper Enclosures 139

Complete application and performance data on solid copper enclosures for suppressing r-f interference are provided in this 4-page, 2-color bulletin (No. 1). The portable, weatherproof enclosures are valuable when making tests on sensitive equipment and also can be used to suppress radiation from industrial equipment that would otherwise cause serious radio or TV interference in the community. Standard and special sizes, service facilities, and air-conditioning are also fully discussed. RFI Shielded Enclosures Corp., 3634 N. Lawrence St., Philadelphia 40, Pa.

Molded Capacitor 140

This 4-page bulletin (AB-20A) provides complete data on "Blue-Point" Molded Plastic Paper Capacitors. Performance characteristics and test specifications, available ratings, design features and other valuable information are included. A cut-away photo shows features of construction. This capacitor is designed to provide absolute protection under an extremely wide range of adverse conditions. Astron Corp., 255 Grant Ave., East Newark, N.J.

Wave Analyser 141

This 24-page brochure, "Vibration Measurement and Waveform Analysis With the Muirhead-Pametrada Wave Analyser," describes a multitude of applications of this instrument. Specifications, principles of operation, characteristics, performance curves, and descriptions of accessories are all provided. Muirhead & Co., Ltd., Beckenham, Kent, England.

High Vacuum Pumps 142

A 36-page catalog (No. 750), "Stokes Microvac Pumps for High Vacuum," includes valuable tables of formulas, constants, and conversions frequently used in vacuum processing; solutions to problems of pump selection for typical vacuum systems; and many other data. Installations of the pumps include metallizing of both metal and plastic parts, evacuation of high altitude testing chambers, and impregnation of electrical and electronic equipment. F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.

Instruments 143

This 34-page brochure, "Instruments for Modern Measurements," is a 2-color publication which describes and illustrates over 37 different instruments. It includes several new units as well as improved models. The instruments are especially engineered and produced for electrical measurements, physical measurements, resistance-welding measurements, ultrasonic energy applications, electro-acoustical measurements, and other applications. Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Microwave Components 144

A 16-page bulletin shows many typical microwave components that can be made from "Polyiron", a powdered metal material which is easily molded to any shape. With "Polyiron" it is possible to attain attenuation up to 300db per inch. It also results in lower standing wave ratios, allowing a greater transfer of energy. Many data are provided on the material, and illustrations of numerous fabricated parts, with dimensions, are included. Henry L. Crowley & Co., 1 Central Ave., West Orange, N.J.

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Taper Terminals 145

An 8-page, 2-color brochure describes and contains many facts on new self-locking taper connectors developed especially for the electronics and communications fields. The terminals combine miniature size and self-locking action. They are used primarily as connectors for individual wires. The taper design gives them high tensile strength. The terminals can be applied at high speed by Automatic Wire Terminators, also described. Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa.

Wire Thread Inserts 146

This 2-color, spiral-bound, 22-page catalog (No. 652) uses photographs, line drawings, text, and tables to explain the uses of wire screw thread inserts in all materials to provide higher loading strengths and greater resistance to wear, seizing, stripping, galling, and corrosion. New specifications for Heli-Coil inserts covering Class 2, 2B, 3 and 3B fits are provided, along with many other data. Heli-Coil Corporation, 1360 Shelter Rock Lane, Danbury, Conn.

Laboratory Instruments 147

This 40-page, 2-color catalog (M) covers a wide range of instruments, including: sealing units, counting systems, area monitors, personnel protection devices, portable survey instruments, educational instruments, radiation detectors, shields and mounts, timers, and varied accessories. A section is devoted to help the user of radioactivity select the correct type of equipment for the particular type of counting work he is doing. Nuclear Instrument & Chemical Corp., 229 W. Erie St., Chicago, Ill.

Vibration Isolators 148

Complete engineering data on "All-Metl" knitted-wire type vibration isolators are given in an 8-page, 2-color Bulletin 534. Performance data are given without alteration, from measurements made under stated JAN conditions. The bulletin is designed to meet the needs of engineers concerned with vibration isolation of airborne equipment in military service. The Barry Corp., 875 Pleasant St., Watertown 72, Mass.

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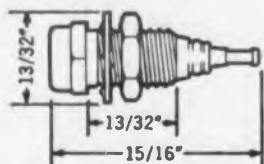
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Patents . . . By John Montstream

Television Receiver . . . Patent No. 2,642,491. A. Cotsworth III. (Assigned to Zenith Radio Corporation).

A TV receiver of the "inter-carrier sound" type has a carrier amplitude modulated with the video signal and a second carrier frequency modulated with the sound signal and frequency displaced by 4.5Mc from the video carrier. With this type of receiver a common i-f amplifier is used and a highly stable heterodyning oscillator is not required.

The receiver of the patent provides a single stage in the tube (23) and its associated circuit elements for detection of the video portion of the signal and separation of the video modulation components from the sound-modulated intercarrier signal as well as selective amplification thereof. Other advantageous

results are also secured by the receiver whose schematic circuit arrangement is shown in Fig. 1.

The signal from the intermediate signal amplifier (12) is applied directly between the control electrode (21) and the cathode (22) through a coupling capacitor (24) which is shunted by a series connected grid leak resistor (25) and video peaking coil (26), so that there is no degeneration and an amplified detected video signal appears across the video load impedance provided by the series connected video peaking coil (27) and load resistor (28) which are connected between the cathode (22) and a reference potential. The second detector (15) also develops an inter-carrier signal which is frequency modulated with the sound components. The inter-carrier signal is amplified by the tube (23), selected by a circuit (34, 35),

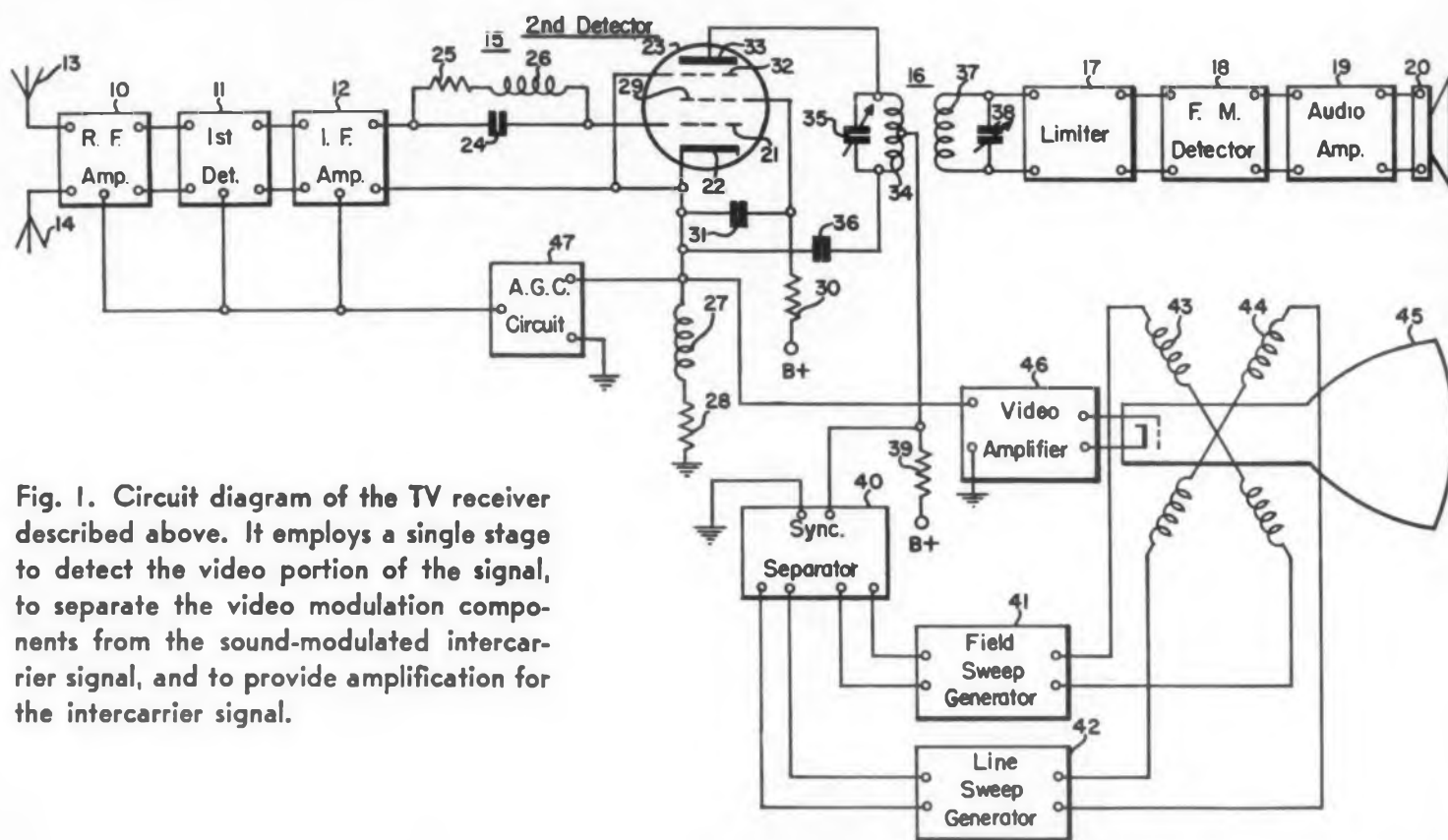


Fig. 1. Circuit diagram of the TV receiver described above. It employs a single stage to detect the video portion of the signal, to separate the video modulation components from the sound-modulated intercarrier signal, and to provide amplification for the intercarrier signal.

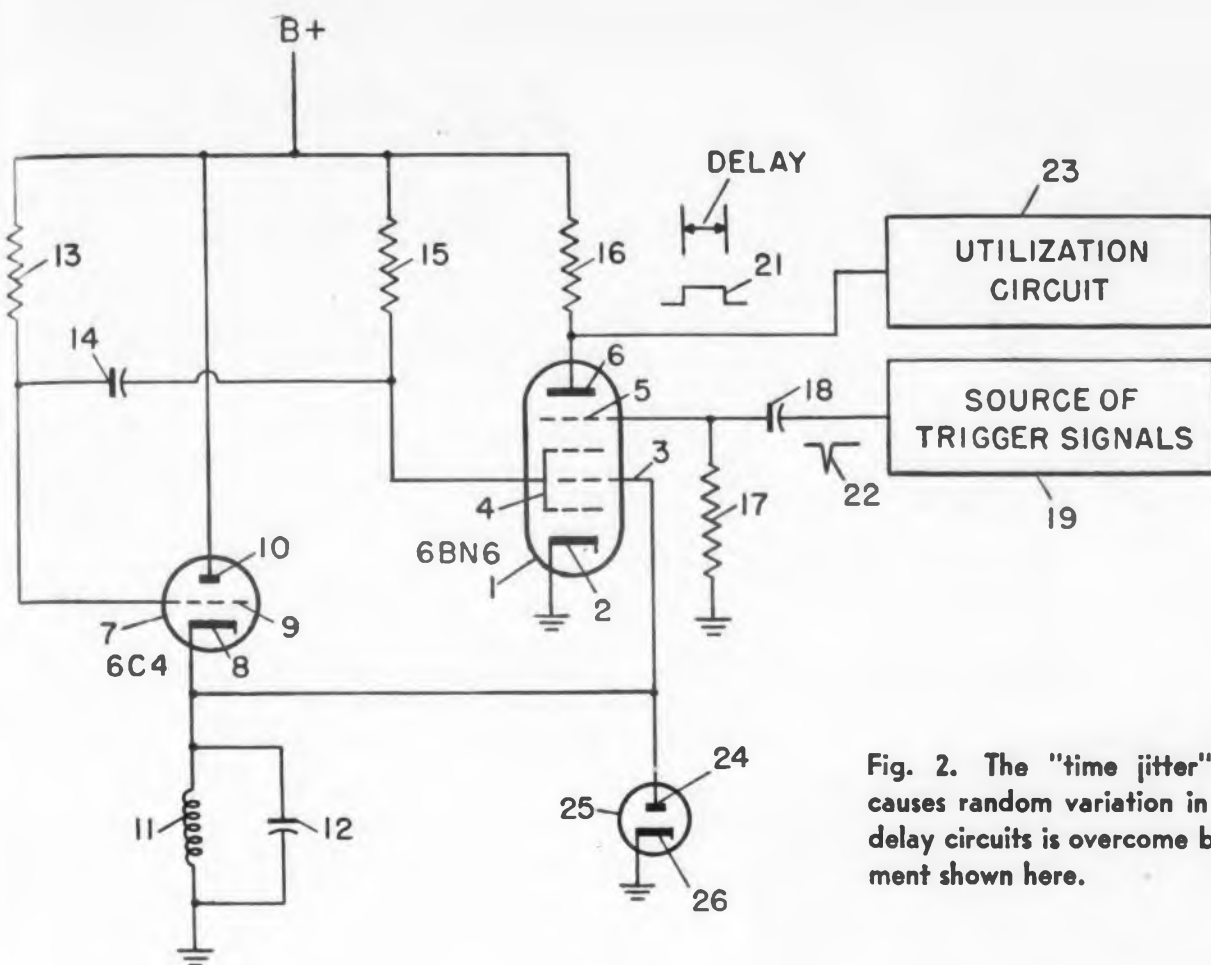


Fig. 2. The "time jitter" phenomenon which causes random variation in the time of delay in delay circuits is overcome by the circuit arrangement shown here.

which is tuned to the mean frequency of this signal, and applied to the sound channel. The capacitor (36) connected between the tuned circuit (34, 35) and the cathode (22), is given a value corresponding to the anode (33)—cathode (22) capacity and forms a balanced bridge network with the tube and the tuned circuit (34, 35). A synchronizing signal impedance (39) forms a diagonal of the bridge network, and the circuit (34, 35) may be tuned without disturbing the frequency response characteristics of the synchronizing and video channels.

Delay Circuit . . . Patent No. 2,635,185. R. F. Casey, Pompton Plains, N.Y. (Assigned to Allen B. DuMont Laboratories, Inc.).

The circuit shown in Fig. 1 overcomes the "time jitter" phenomenon which causes random variation in the time of delay in delay circuits. Such variations are caused by several factors such as the voltage supply, and thermal agitation which vary the voltage on the control grid of the tube forming a part of the circuit and cause its operation to be erratic.

The control tube (1) of the circuit is a "gated beam tube", such as a 6BN6, having a limiter grid (3), an accelerator (4), a quadrature grid (5) which is connected with a source (19) of negative trigger signals and with ground through a resistor (17). A pulsed or shock-excited oscillator formed by an idler tube (7) and the inductor (11) and capacitor (12)

in the cathode circuit of the tube is connected with the limiter grid (3). Tube 7 is normally conducting a substantial current because of the positive bias on its grid and the inherent resistance of the inductor maintains the cathode (8) and hence the grid (3) of the control tube positive so that the latter is conducting. When a negative trigger pulse is applied to the grid (5) of the control tube (1), the latter becomes non-conducting and the anode voltage rises. Also the anode current through the control tube is diverted to the accelerator (4) and its voltage drops to produce a negative pulse on the control grid (9) of the idler tube (7). This cuts off current in tube 7 and through the inductor (11). Collapse of the field of the inductor produces a high negative pulse at the cathode (8) which cuts off this tube and the oscillation started is damped out after the first half negative cycle by the diode (25). The negative half cycle pulse is applied to the limiter grid (3) to cut off the current through the control tube for the duration of the pulse.

Since current flow in tube 7 is cut off, variations in positive potential are ineffective so far as its cathode circuit is concerned and because the cathode circuit has very little resistance, thermal agitation cannot introduce any voltage variations. A rectangular positive pulse is produced at the plate (6), the leading edge of which is timed by the circuit elements of the oscillator and particularly by the period of oscillation of the inductor (11) capacitance (12) circuit.

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AEC Patents Released to Industry

Descriptions of a number of U. S. Government owned patents held by the Atomic Energy Commission have been transmitted to the U. S. Patent Office for registry and listing in the official register of patents. The Commission will grant non-exclusive, royalty-free licenses on the listed patents upon application. Of the 28 patents released, those listed below are of particular interest to electronic design, development, and research engineers:

Stabilized Pulse Circuit: (Patent No. 2,632,103); M. W. Horrell, inventor. This patent relates to an electrical circuit for providing stabilized output pulses having a predetermined width and a substantially rectangular shape. The circuit is particularly adapted for use where it is desirable to obtain output pulses having a substantially uniform characteristic regardless of any changes in circuit parameters.

Torque Compensated Galvanometer: (Patent No. 2,640,866); W. M. Powell, inventor. This invention relates to galvanometers and fluxmeters and specifically covers an improved means for compensating for the normal restoring torque of the usual torsional coil suspension employed in apparatus of this type. The compensating means of the patent employ the introduction of a current into the moving coil which is proportional to the angular deflection of the coil and is of such a polarity as to effectively neutralize the restoring torque for all positions of deflection range of the moving coil.

Electron Source: (Patent No. 2,640,949); L. J. Cook, inventor. This patent describes an improvement in electron sources and is particularly concerned with an improved method and means for producing an intense electron beam emitted in a controlled direction with a minimum power expenditure. The electron producing means comprises in part an activating material disposed about a heater. The heat caused by the heater causes a part of the activating material to volatilize and pass through apertures in its envelope. The activating material forms a layer of mono-atomic thickness on the wall of the envelope, which layer is electron emissive. An example of a suitable combination is an activating material of barium aluminate and a face formed of zirconium.

Point Electron Source: (Patent No. 2,640,950); L. J. Cook, inventor. This patent relates to an improvement in electron sources and is particularly concerned with improvements in "point electron sources". The apparatus comprises a surface having a concave face with an aperture in its center, an electron emissive element disposed within the aperture, an activating material about the electron emitting element and means to volatilize the activating material.

Radiation Current Source: (Patent No. 2,640,953); H. H. Rossi, inventor. This invention relates to a variable source of minute current which may be varied reproducibly. The source

is comprised of a container having a gas therein ionized by emanations from an axially disposed radioactive source, a potential impressed on electrodes in the container to cause the ions to move, a collector electrode interposed in the path of the moving ions, and a movable shield disposed adjacent to the collector electrode to collect at least a portion of the ions which move toward the collector electrode.

Multichannel Analyzer: (Patent No. 2,642,527); G. G. Kelley, inventor. This patent describes a pulse analyzer of the multichannel type employed in the precision sorting of pulses according to magnitude, and is especially useful in connection with the scintillation spectrometer or proportional counter.

Radio-Frequency Oscillator: (Patent No. 2,642,531); W. R. Baker, inventor. This patent describes a radio-frequency oscillator for a cyclotron. The oscillator circuit is of a floating construction and has a low-impedance capacitive drive to supply a radio-frequency voltage which is free from parasitic oscillations.

Voltage Supply Regulator: (Patent No. 2,643,360); E. Fairstein, inventor. This invention relates to a voltage supply regulator which may be inserted in either the positive or the negative lead of a d-c supply line and produce effective regulation. The invention is especially useful in the regulation of high current negative voltage supplies.

Magnetic Flux Direction Determining Apparatus: (Patent No. 2,644,922); D. C. Sewell, inventor. This patent describes a simple, rugged, and portable apparatus which is useful to determine quickly and accurately the direction of magnetic lines of force with extreme precision in the presence of an electrostatic field.

Automatic Temperature Regulator: (Patent No. 2,646,544); M. L. Sands, inventor. This invention relates to a very sensitive control system having the capability of maintaining a selected temperature within a minute fraction of a degree. The device utilizes a Wheatstone bridge circuit including two high-temperature and two low-temperature coefficient resistors. A departure in temperature from the desired amount unbalances the bridge. The potential derived from the bridge is mixed with the applied potential thereby giving the resultant algebraic sum or difference in accordance with the direction of drift. The resultant potential is utilized to control a temperature restoring heat source.

Electric Integrator: (Patent No. 2,646,925); M. Bevis, inventor. This invention relates to an electronic circuit for integrating the intervals of duration of electrical pulses. Specifically, the apparatus may be employed for indicating the outage time due to sparking which has occurred in a run of an isotope separating unit of the electro magnetic type.

Ultra-Wide Band Amplifier Tube: (Patent No. 2,647,175); C. Sheer, inventor. This patent describes a method and apparatus for amplifying electrical impulses with an exceptionally short resolution time. A preferred embodiment of the apparatus includes, in general, the combination of an elongated cathode, an elongated anode, and at least one elongated control electrode disposed in parallel relationship and with the control apportioned into a propagating portion for the impulses to be amplified and a non-propagating portion. Suitable input and output connections are provided for the electrical impulses to be amplified.

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. Copies of these patents may be obtained from the U.S. Patent Office.

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	1N68A	130	100	3.0	0.625 @ -100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ -5 v; 0.050 @ -50 v
	1N99	100	80	10.0	0.005 @ -5 v; 0.050 @ -50 v
	1N100	100	80	20.0	0.005 @ -5 v; 0.050 @ -50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ -5 v; 0.100 @ -50 v
	1N97	100	80	10.0	0.008 @ -5 v; 0.100 @ -50 v
	1N98	100	80	20.0	0.008 @ -5 v; 0.100 @ -50 v
High Back Resistance	1N116	75	60	5.0	0.100 @ -50 v
	1N117	75	60	10.0	0.100 @ -50 v
	1N118	75	60	20.0	0.100 @ -50 v
General Purpose	1N90	75	60	5.0	0.800 @ -50 v
	1N95	75	60	10.0	0.800 @ -50 v
	1N96	75	60	20.0	0.800 @ -50 v
JAN Types	1N126**	75	60	5.0	0.050 @ -10 v; 0.850 @ -50 v
	1N127†	125	100	3.0	0.025 @ -10 v; 0.300 @ -50 v
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*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.

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Synchros, Self-Synchronous Devices, and Servomechanisms . . .
by Leonard R. Crow. 222 pages. Scientific Book Publishing Company, 530 South Fourth Street, Vincennes, Ind. \$4.20.

The basic fundamental principles underlying the operating theory and application of synchros and allied self-synchronous electrical mechanisms are discussed in this book. Written on an extremely practical level with simple explanations of the important ideas and concepts involved in self-synchronous electrical systems, it covers all the basic as well as many of the special synchros that have evolved from the fundamental forms.

Subjects include single-phase synchronous drive devices, synchro control transformer, differential synchros, two-speed synchro drives, d-c synchros, the phase rotation indicator, the step-by-step motor, electrical gearing, the power synchro and the synchro tie, magnesyns, and other saturable-core electrical servomechanisms. A large number of excellent diagrams and illustrations are used to indicate construction and wiring arrangements of these devices, and to help explain their operation.

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Ferroelectricity . . . By E. T. Jaynes. Paper bound, 112 pages. Princeton University Press, Princeton, N. J. \$2.00.

This work is No. 1 in a series of monographs published under the general title of "Investigations in Physics" and edited by Eugene Wigner and Robert Hofstadter. It is an extensive revision of a doctoral thesis in which errors in the original version have been corrected, detailed calculations have been shortened, and the material has been brought up to date.

The book is intended to serve as a general introduction to the subject of ferroelectricity and as a guide to the literature with a review of various theories of barium titanate behavior that have been published. The subject matter is treated from the physicist's point of view and is largely mathematical.

Handbook of Noise Measurement . . . By Arnold P. G. Peterson and Leo L. Beranek. 120 pages (paper covers, plastic bound). General Radio Company, Cambridge 39, Mass., \$1.00.

The problem of noise in industrial, commercial, and consumer equipment has been receiving increasing attention in recent times. Noisy appliances are hard to sell, noisy working areas cause worker fatigue, and aircraft manufacturers are continually

striving to reduce propeller and jet engine noise.

However, before these and many other noise problems can be solved, the noise must first be located, measured, and evaluated. In this book, the authors have gathered together information on many aspects of the noise problem, and presented it in a clear logical manner, that truly makes this a "handbook".

After a brief introduction to the general problem, the authors cover the following topics: the decibel; the mechanism of hearing as a noise-measuring instrument; a description of the General Radio sound-measuring system; applications for the system; measurement of sound level and sound-pressure level; loudness, speech interference, and hearing damage; noise source characteristics; and noise control.

The book is illustrated with many charts, curves, and nomographs, as well as photographs of measuring equipment in use. The appendix includes a table for converting decibels to power and pressure ratios, and one to convert pressure ratios to decibels, as well as a catalog of the company's noise measuring equipment and accessories.

Because of its detailed and comprehensive treatment of noise measurement and analysis (including definitions, standards, measuring equipment, procedures, and interpretation of results), this book will be appreciated by many designers who may have a poor background in the subject.

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Filterette No. 1613 1000 volts DC 5 amperes



This wide-band radio-noise filter is designed for connection in series with any single line that may be carrying radio interference. Hermetically sealed in a metal case, it is built to make use of the shielding afforded by metal bulkheads or firewalls. Installed in a 1-5/32" hole in the bulkhead, Filterette 1613 has a mounting flange that completes the filter circuit to ground. External-tooth lockwashers are recommended between the mounting flange and the metal bulkhead to maintain low-resistance contact. This unit conforms to applicable military specifications, and is suitable for use at high altitudes.

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- Size — 1 1/8" x 2 7/8" x 5 1/2"
- Volume — less than 18 cubic inches
- Output — up to 14 hp
- Dirt Clearing Force — up to 150 lbs.
- Power Amplification — 5000 times
- Input Power — less than 2 watts
- Input Current — 15 ma.
- Flow — up to 12 gpm
- Pressure — up to 3000 psi
- Leakage at Zero Signal — 60 cc/min.
- External Leakage — none
- Response — flat to 150 cps (flow vs. current)
- Life — 4,000,000 cycles minimum
- Typical Closed Loop Response Using Pentode Type Amplifier — flat to 70 cps

SPECIFICATIONS

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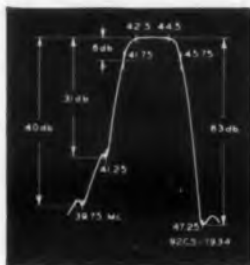
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