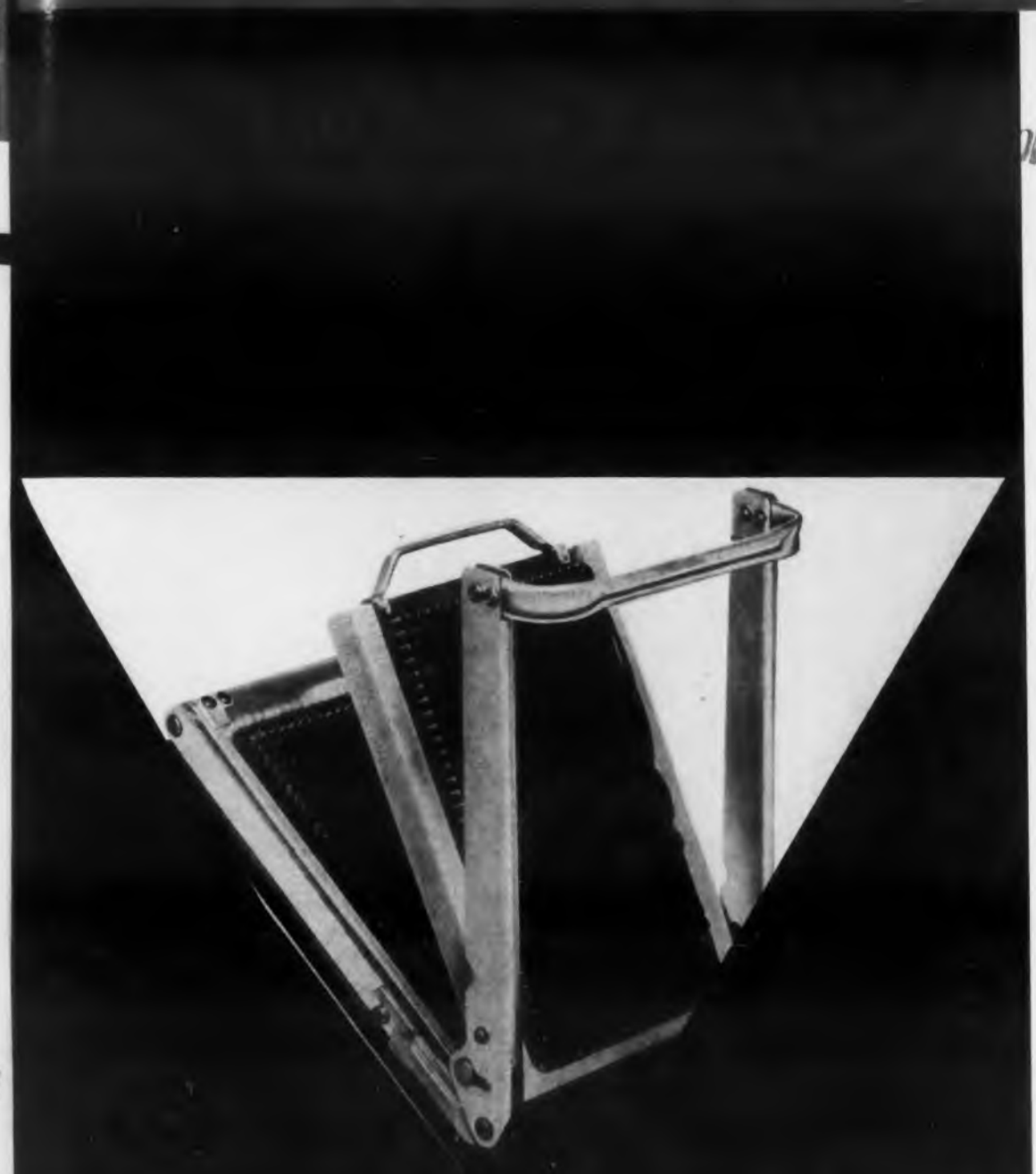
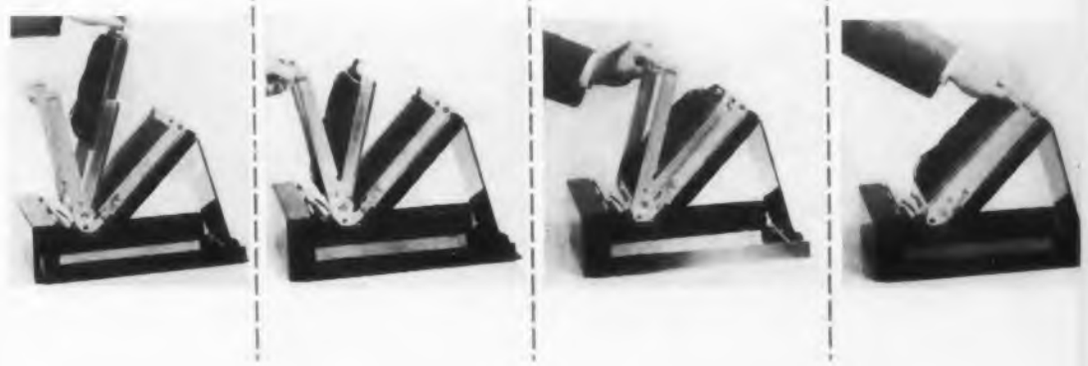
ELECTRONIC *design*



Solderless "Taper Terminals", convenience, and simplicity are features of this compact patchcord system. Designed for programming computers, business machines, testing operations, etc., it consists of program boards, patchcords, and a frame into which a board with a program setup is inserted to make wiping contact with knife-like connectors as shown below.



May 1954

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

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

Los Angeles: Robert E. Ahrensdorf, 1140 Wilshire Blvd., Los Angeles 17, Calif., MAdison 9-2811

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ELECTRONIC DESIGN is circulated **only** to qualified electronic design engineers of U. S. manufacturing companies, industrial consultants, and government agencies.

If design for manufacturing is your responsibility, you qualify for a subscription without charge provided you send us the following information on your company letterhead: your name and title; your company's name, address, and main product. Electronic, research, development, project, electrical, and chief engineers are typical qualifying titles.

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Any job change requires requalification.

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ELECTRONIC design

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Contents

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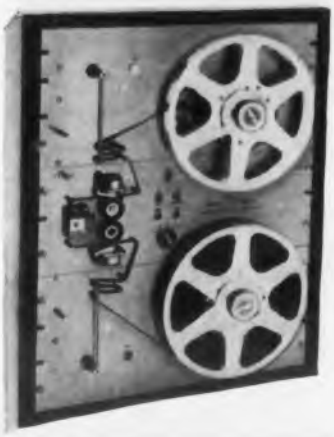
NOW

HIGHER TAPE SPEEDS
WIDER TAPE WIDTHS
HANDLES TELETYPE TAPE



0 TO 60 INCHES/SEC.

IN 5 MILLISECONDS

WITH THE NEW

Potter

DIGITAL MAGNETIC-TAPE HANDLERS

SPECIFICATIONS

Model Number	901A	901B	902
Tape Speeds (in./sec.)	30/15	30/15	60/15
Tape Widths	1/2"	1/4"	1/4", 1/2", 5/8"
Number of Tracks	6	2	2 6 8
Start-Stop Time	5 msec	5 msec	5 msec
Reel Capacity	2,400'	2,400'	1,200'
Reel Size	10 1/2"	10 1/2"	8"

High-speed magnetic-tape recorders having low start-stop times give a new dimension to data handling by absorbing digital information *when and where it is made* and making it available *when and where it is needed.*

●

Digital information corresponding to any phenomenon can be recorded as the phenomenon occurs, continuously or intermittently, fast or slow, and later fed at optimum speed into reduction devices such as computers, punch cards and printers.

●

Speeds of 60 inches per second with 5-millisecond start-stop times permit digital techniques to be applied to jobs that previously required more expensive but less reliable methods. Typical applications include business machine problems, control of machine tools and other high-speed industrial processes, study of fast-moving missiles and telemetering.

●

Potter Magnetic Tape Handlers offer, in addition to the new higher tape speeds mentioned, wider tape widths for more channels with lower tape tension controlled by photoelectric servos. And, the price is but a fraction of that of much less versatile recorders. Other data handling components and complete systems are also available for special problems.

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POTTER INSTRUMENT CO., INC.

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CIRCLE ED-2 ON READER-SERVICE CARD FOR MORE INFORMATION

Editorial . . .

Help the Reader

One of the great weaknesses in many engineering articles is their apparent lack of purpose. The author carefully explains how to measure, calculate, or design something, and includes tables, charts, or equations to illustrate his points. Too often, however, he fails to tell the reader why this particular method is important or what are the possibilities of the device he is describing.

Engineers are aware that the function of a technical article is to present information. The mere recital of facts, however, is not the whole story. The most important part of the article from the reader's point of view is not what is said, but what the information means to him.

Why should I take time to read this article? What can I do with this knowledge? How can I adapt it to help solve my problem? Can I go a step further and extrapolate from the author's results? . . . These are some of the questions in the reader's mind when he looks at an article.

It is up to the author to provide the answers clearly and forcefully. Failure to do so can result in losing the reader's interest, because the really interesting implications inherent in many stories are not apparent at first glance—or even after the first casual reading.

In these days of many publications and other demands on a potential reader's time, many articles get only a glance or a quick first reading. If the author has not made the importance of his information apparent, the reader will skip to the next story in the magazine. It takes a lot of hard work to write an article. A little care, thought, and imagination in bringing out the significance of the information being presented will help prevent the author's efforts from being wasted.

Ideas for Design

The article called "3-D Printed Circuits" that appears on pages 26 and 27 in this issue is labelled "Ideas for Design". It is the first in a series of stories that will appear from time to time on new techniques or variations in old methods that can be used by electronic design engineers.

The present story tells how designers can save chassis space and permit the use of high-speed production for individual stages in a TV receiver. This is done by employing printed circuits in three planes instead of two as in conventional printed circuitry. Greater ease of servicing is also gained.

The technique, a combination of old and new methods, shows promise for many mass produced electronic devices. It represents an "idea for design".

Engineering Review . . .

Solar Battery . . . A light-powered solar battery, another approach to utilizing the vast, unused power of the sun, has been developed by the Bell Telephone Laboratories. Essentially a p-n silicon junction device with a junction area many times the size of the one in a transistor, the solar battery produces 50w per square yard of sunlight surface.

As shown in the photograph at right, the battery consists of rectangular wafers of silicon. On exposure to light, each wafer produces a steady voltage of about 1/2v, with current varying directly proportional to the area of the wafer and the intensity of the sun's rays. The wafers may be connected in parallel or series as required. The speed of response to light is instantaneous, and the wafers will generate current over a wide ambient temperature range.

With a theoretical top conversion efficiency of 22%, the batteries are presently able to convert sunlight to electricity with an efficiency of 6%. This compares favorably with the efficiency of steam and gasoline engines, in contrast with other photoelectric devices that have never been rated higher than 1% efficient.

The principle of operation of the battery is shown in the illustration at the right.

The solar battery was developed by G. L. Pearson, physicist, C. S. Fuller, chemist, and D. M. Chapin, electrical engineer, all of the Bell Telephone Laboratories, Inc., New York, N. Y. In an initial demonstration of the battery, it powered a transistor-equipped transmitter that broadcast a voice message a few hundred yards.

Nothing is consumed or destroyed in the energy conversion process as in standard or atomic batteries (see *p. 10*), so the battery should theoretically last forever. The atomic battery, which has a long, but not theoretically infinite useful life, produces very small amounts of power in comparison to the solar battery. However, the latter requires regulation.

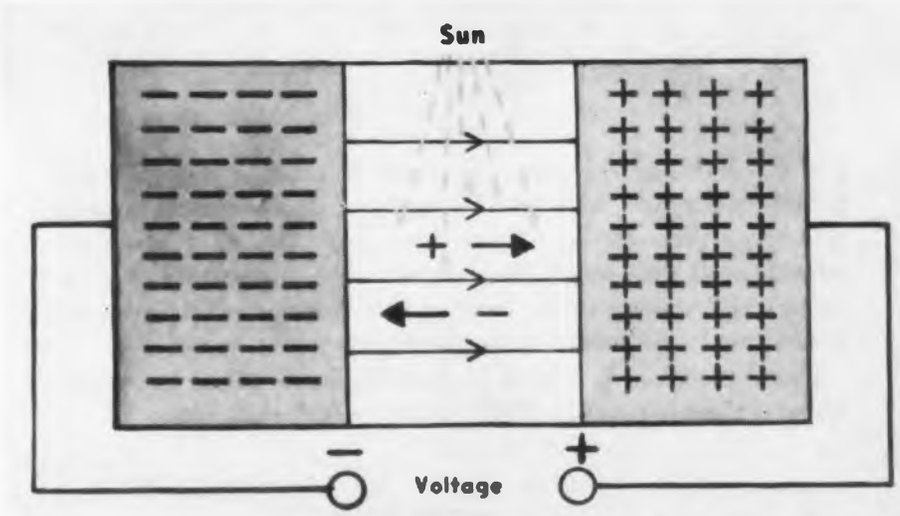
Other devices that convert the sun's energy into electricity are the photoelectric cell, a European power plant that uses the sun's heat to produce steam to drive turbines, and the thermocouple. A recently developed experimental device utilizing banks of thermocouples (*ED, March, '54, p. 5*) develops 60w per sq yd of heated surface. Unlike the solar battery, it could not operate in cold climates.

As in the manufacture of semiconductor materials for transistors and diodes, minute quantities of an impurity are introduced into one surface of the battery silicon to a depth of less than 1/10,000". This process is accomplished at high temperature in a gas atmosphere. The wafers do not have to be much thicker than the above depth, but are actually 40 mils thick. Connections to the wafer may be made in various manners.

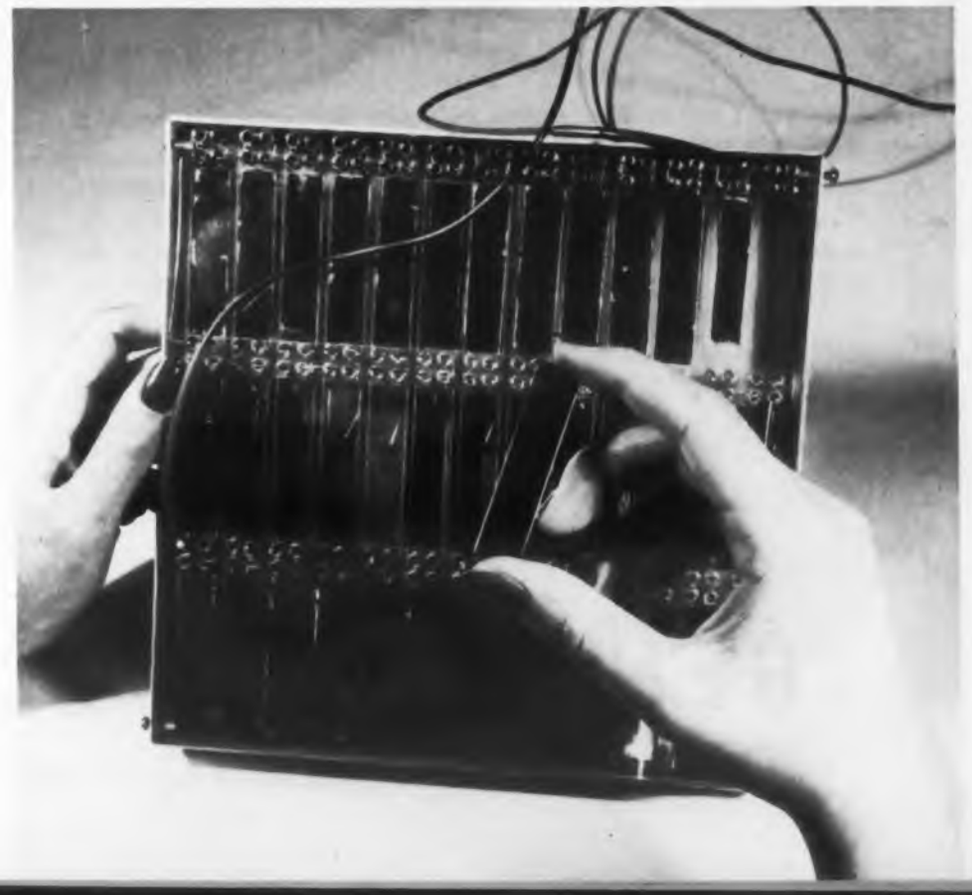
An obvious application of the battery is to supply the low power required by transistor-equipped devices. The Bell Laboratories are considering applying the battery as battery-chargers for transistorized amplifiers used on an experimental rural telephone line (see *ED, April, 1954, p. 6*). It has many military applications, particularly in portable equipment.

Firefighting by TV . . . Small TV cameras equipped with telephoto lenses and mounted on fire control towers are being used for forest firewatching. Rotating once every two minutes, the cameras and their transmitters are connected by microwave relay to a central firefighting headquarters 50 miles away. The cameras' bearings are also transmitted, providing a means of pinpointing any fire by cross-bearings from two separate cameras.

The first installation was made in Alexander State Park in Louisiana. The system was conceived by Carl Le Blanc and Bill Maser, Baton Rouge, La., television distributors utilizing new equipment produced by Raytheon Manufacturing Company, Waltham, Mass.



The principle of operation of the solar battery illustrated in the photograph is shown in this diagram (above) of a p-n junction. When light is absorbed, electrons and positive charges are liberated in the barrier region. The built-in electric field at the barrier forces the positive charges to the p-side, making it positive; and forces the electrons to the n-side, making it negative. This charge displacement results in a potential difference between opposite sides of the crystal. Each wafer produces 1/2v, current varying with light intensity. To meet any given power requirement, the wafers may be arranged in series or series-parallel, as shown at the right. The battery is essentially a low-impedance source.



Engineering Review . . .

Simplified Voice Transmission . . . A system of coding the human voice in a form that is considerably simpler than the original speech, transmitting it, and then reconstructing it in a receiver is under development at the Rutgers Bureau of Engineering Research, New Brunswick, N. J.

By reducing the voice to the minimum number of linguistic elements that can be incorporated in a high-speed, interference-free system of radio and telephone communications, the proposed system would overcome static and other noises, even deliberate jamming, and increase channel capacity by decreasing the required frequency bandwidth. Proposed for military uses, the system would prove invaluable for intercontinental radio-telephone, long-distance telephone, and even police car radio systems.

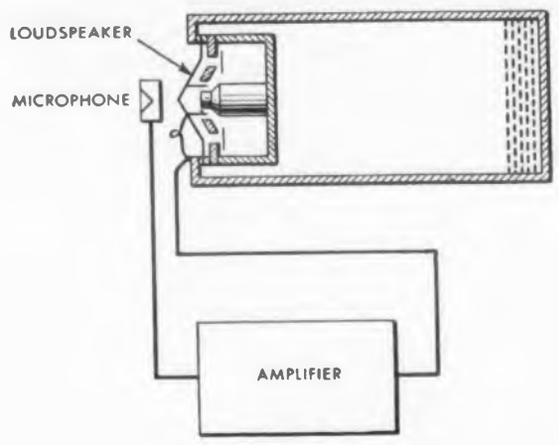
The problem of simulating the sender's voice or, for that matter, characterizing the "average" voice is extremely difficult. The simplest word is pronounced in many ways. Charts showing the dominant voice frequencies and analyzing its sounds in detail are now being recorded at Rutgers. The tests are progressing from letters to syllables to words seeking to establish the basic linguistic elements—such as larynx frequency or pitch.

Electronics Sells Electronics . . . Television replaced an expensive exhibition hall and enabled visitors to "visit" booths without the usual fatigue resulting from walking about a crowded hall at a recent Special Conference on "Integrating the Office for Electronics." At the conference, sponsored by the American Management Association, various electronic office "automation" equipment was demonstrated in one room, scanned by closed-circuit TV, and projected on a large screen before a 1000 industrial leaders in a nearby auditorium. The demonstrator then answered questions from the audience by two-way wire.

The conference dealt with the necessary conditions preliminary to automation of the office. In order to use electronics there, standard methods of presenting information to the machines must be agreed upon. The five-channel punched tape is the likeliest candidate. Methods of linking machines in remote offices must be designed for existing communications and communication equipment.

The conference also considered devices for converting one form of coded information to another, i.e., punched tape to punched card. This transformation is necessary in order to integrate presently used valuable machines into an automation system. Mechanization of the office could halt the trend towards an increasing proportion of office workers to production workers resulting from increasing automation of factories and refineries.

Electronic Soundproofing . . . By creating counter-waves that reduce or cancel noise sound waves, a newly developed electronic sound absorber can eliminate low-frequency sound waves that are not absorbed by conventional porous material soundproofing. The units can either be placed near the source of sound or near the person who is bothered by the noise.



The sound absorber consists of three parts: a special electronic microphone, an amplifier, and a specially designed small speaker. The signal produced in the microphone by the noise waves is amplified and applied to the speaker, where sound waves are produced of equal amplitude but opposite phase to that of the noise. The effect, within a few feet of the speaker, is a substantial levelling of the changes in air pressure and hence a reduction or even elimination of the oncoming sound.

The speaker is mounted directly behind the microphone, as shown. Since the loudspeaker must operate in an enclosed space, a speaker with a cone of only 3-1/2″ diam was designed to keep the enclosure small. The microphone utilizes a subminiature tube called a "mechano-electronic transducer" that contains a rod connecting one element of the tube through the tube enclosure directly to the diaphragm of the microphone. The vibration of the diaphragm by the noise waves is transferred directly to one of the tube elements, thereby developing the signal.

The unit was developed by Dr. Harry F. Olson of the RCA Laboratories Division, Radio Corporation of America, Princeton, N.J. The sound absorber can operate on either batteries or house current.

The absorber also can be used in the same manner as conventional wall materials in a room to handle the low-frequency waves. Three of them placed at the intersection of two walls with a ceiling, for example, would catch oncoming low-frequency sounds before the waves could reach the surface to rebound as echoes. To absorb the low-frequency noise produced by motors, etc., conventional soundproofing must be very thick and often is impractical. The absorber solves this problem very neatly.

A month or so ago we ran this advertisement. We've had a lot of replies – a lot of dollar bills and 5 dollar bills. Yet, we've had a certain amount of confusion that we'd like to straighten out.

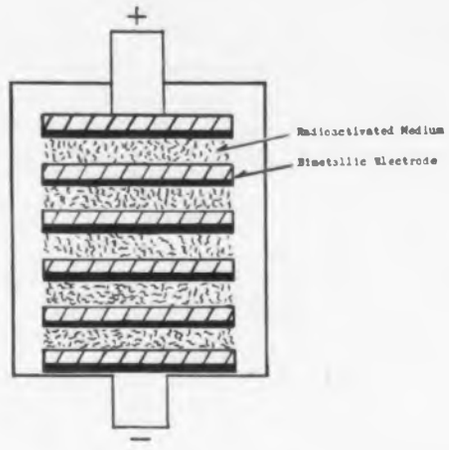
In the first place, we don't require that you pay five dollars for the privilege of buying a Sigma relay. The manual is designed to make available all we know about our products and their application. It is a basic user's manual for Sigma relays (not relays in general – we had to give one man's money back on that one). If you do have use for such a manual, the price includes one year's subscription to whatever additional pages are issued. After the first year, renewal is one dollar.

For those that don't know how interested they are in our products, we have a free four page bulletin highlighting the basic Sigma relay types. The next step from this is that, in response to a specific inquiry we will send, also free, the specific manual pages that we believe will apply to your problem.

The "Ink" offer stands. You get for one dollar a collection of our favorite correspondence which easily outdoes anything in the ads. (We get the opportunity to expose you to our ads again.) So far, no one's asked for his dollar back.

SIGMA INSTRUMENTS, INC., 91 PEARL ST., SO. BRAINTREE, BOSTON 85, MASS.

CIRCLE ED-6 ON READER-SERVICE CARD FOR MORE INFORMATION



The cross section above illustrates the simple construction of the atomic batteries shown below.

Engineering Review . . .

Atomic Battery . . . Radioactive tritium is the source of beta rays in a newly developed atomic battery shown below. Producing up to 400v at very low currents, the batteries have an optimum useful life of 18 years. During this time a constant circuit voltage would be generated, although the current would gradually decline at a known rate.

The simple construction of the battery utilizes pairs of metal plates surrounded by the tritium isotope, all enclosed in cylindrical containers. The plates attract the electrons produced by the radioactive material, and the voltage produced is proportional to the difference in the surface electrical characteristics of the plates. The amount of tritium

The mutual-inductance type micrometer used to detect thrust bearing wear.

contained in the batteries ranges in cost from $1.00 to $100 at present prices, and will produce 0.01μw to 1.0μw of power.

Developed by Alexander Thomas of Tracerlab, Inc., Boston, Mass., the batteries could conceivably be used in transistorized hearing aids, alarm devices, and other sensitive instruments requiring a low-level, long-life power supply. There is practically no danger from the tritium used in this battery, because the beta rays it gives off are so weak they can be completely absorbed by a piece of newspaper. Although the battery has an optimum useful life of 18 years, it can be designed for a useful life of from 10 to 30 years.

While working on the project, Mr. Thomas found that a radioactive battery apparently had been made and demonstrated in 1924 by J. B. Cramer, an English scientist, who followed a line of experiments that had previously been performed by the noted English scientists Faraday, Kelvin, and Lodge. Strontium-90 is employed in another recently announced atomic battery (see *ED, Feb. '54, p. 15*).

Noncontacting Distance Gage . . . A new noncontacting distance gage employs a mutual inductance-type micrometer to indicate the longitudinal movement of a high-speed rotating shaft, such as might be caused by failure or wear of the thrust bearing of a turbine. When the displacement exceeds a prescribed limit, the indicator actuates an alarm, warning operating personnel of imminent machine failure. Since the instrument also gives a direct indication of the amount of bearing wear, a bearing may now be used for its full useful life and need not be replaced too soon. The detecting element is shown at the left, below.

The mutual inductance micrometer was developed by M. L. Greenough of the National Bureau of Standards, Washington 25, D. C. A transducer probe, consisting of two coils wound on a dielectric core, is mounted on the turbine frame near the shaft. A brass disk on the turbine shaft changes the mutual inductance between the windings when the shaft moves longitudinally, thereby actuating an alarm that receives an amplified signal from the secondary coil.

The instrument can also be applied to indicate the relative positions of oscillating, reciprocating, or quasi-stationary members over a wide range of displacements, since the micrometer will measure lengths from 50 microinches to several inches with an accuracy of 3%.

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

Engineering Review . . .

New AIEE Secretary . . . Nelson S. Hibshman of Brooklyn, N. Y., has been appointed Secretary of the American Institute of Electrical Engineers. He succeeds H. H. Henline, who held the post since 1932. Mr. Hibshman, who has been assistant secretary since January 1, 1953, was formerly Dean of Engineering at Pratt Institute of Technology, Brooklyn, N. Y.

Transistor Course . . . Transistors and their applications will be the subject of a special, two-week summer program offered at the Massachusetts Institute of Technology from 19 to 30 July. The program will aim to help engineers evaluate transistors in relation to electronic circuit problems.

The course will cover physical principles, general performance and equivalent circuits, ending with specific applications. Laboratory sessions demonstrating both physical principles and circuit applications of the transistor will supplement each lecture topic.

Leading transistor experts from industry will assist the Institute's research staff in the instruction. Tuition for the course is $160. Full details and application blanks may be obtained from the Summer Session Office, Room 7-103, M.I.T., Cambridge 39, Mass. Academic credit will not be offered.

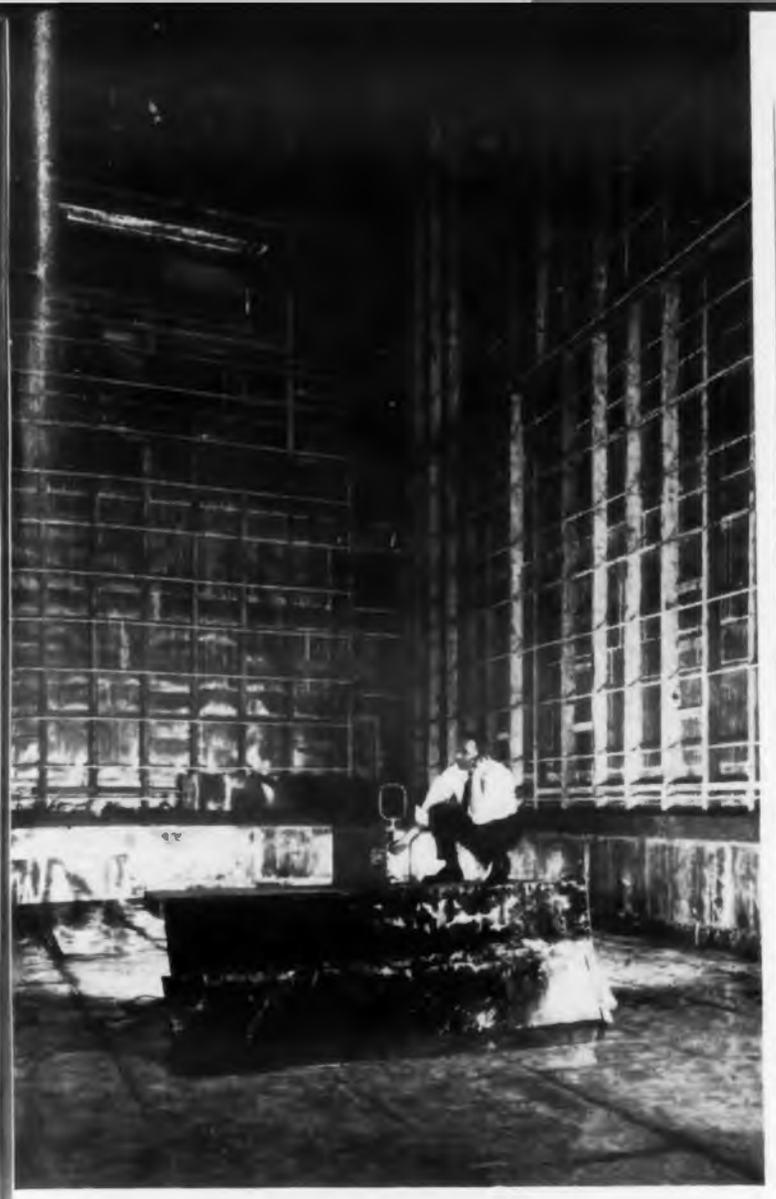
Sterilization by Radiation . . . High-voltage or cathode rays, X-rays, and radiation from atomic fission products are being studied extensively for their sterilization qualities as a means of replacing the traditional method of sterilization, application of extremes of temperature, according to a report from the Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

Radiation sterilization has the advantages of not weakening materials or causing drugs to lose their potency, sterilizing after packaging in plastics, and ease of application to a continuous production-line.

A number of problems must be solved before radiation sterilization becomes commercially practicable. Changes in flavor, color or texture may result from irradiation of foods, for example.

Tubes Replaced Needlessly . . . A survey of 80,000 tubes rejected by technicians maintaining military equipment revealed that approximately 25% had no defects when tested on a tube tester. This figure indicates poor training of these technicians, according to a paper ("The Effect of Maintenance on Reliability of Complex Military Electronic Equipment") by J. B. Arnold of Aeronautical Radio, Inc., 1520 New Hampshire Ave., N.W., Washington 6, D. C., presented at the recent IRE Convention in New York.

The unnecessarily high replacement rate was ascribed to two factors. First, because of the complexity of some present military equipment, technicians re-



Huge Shielded Room

This completely copper-lined room with its four-foot thick walls was built to test transformers and other equipment for the noise they create as well as for radio and TV interference produced. Constructed at the General Electric Company transformer plant at Pittsfield, Mass., the room is 68 ft by 58 ft and 60 ft high, and it is lined with 20,900 lb of copper. Noise can be measured to ½ db.

sort to wholesale tube replacement to remedy failures. The replacement may only mask the real trouble, so that tubes soon fail and the equipment is again out of service. Secondly, maintenance procedures often call for testing large numbers of tube periodically or as a means of trouble-shooting. Continual removal of tubes from their sockets can damage many tubes. In addition, reliance is placed on the tube checker to determine whether the tube will operate in the circuit, when, actually, performance in the circuit itself should be the criterion.

To correct this wasteful situation, Mr. Arnold urged that the gap between equipment complexity and the educational level of the technician be narrowed. Greater use of subchassis design is another solution. The subchassis would be repaired only by a few highly trained technicians, with actual replacement performed by relatively unskilled personnel.

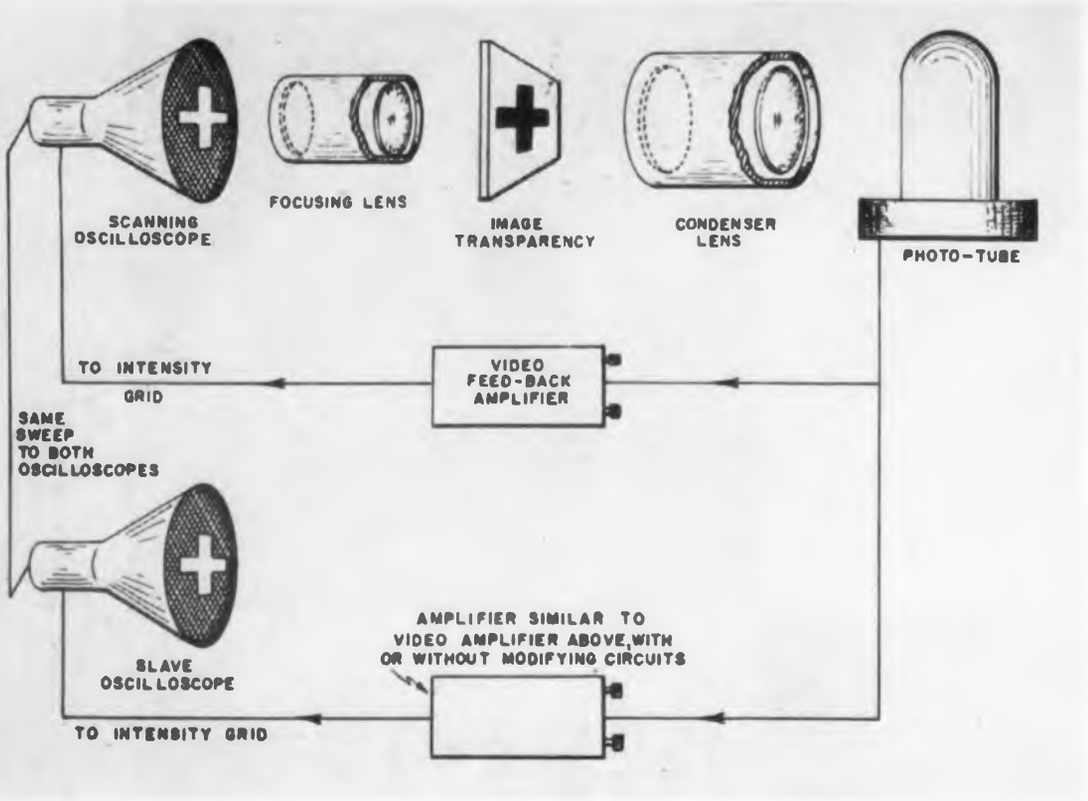


Image enhancement or pattern recognition is accomplished by the optico-electronic system whose block diagram is shown at the left.

Engineering Review . . .

Image Improvement Device . . . A recently constructed optico-electronic system may have many commercial possibilities in TV, photo transmission, and medical research. The experimental device can clarify blurred images or produce outline pictures or line drawings from photographs. A block diagram of the system is shown above.

This image processing system was developed by H. M. Joseph of the National Bureau of Standards, Washington 25, D. C., and Dr. L. S. G. Kovasznay, Johns Hopkins University, Baltimore, Md., who suggested the basic design. The system operates on patterns in the form of photographic transparencies placed as shown. The signals resulting from scanning the picture are amplified and fed back to the intensity control of the cathode ray tube and produce a picture on its screen.

The negative feedback obtained in this way improves the tonal rendition of the picture. The same signal is also applied to another amplifier and the resulting signal is used to control a monitor cathode-ray tube that reproduces the same image. Altering the monitor for image processing is accomplished by introducing modifying circuits between the phototube and the monitor. This freedom to modify the picture on the monitor is the essence of the system.

Any scanning pattern may be used, but it greatly simplifies the electronic circuits if the scanning velocity is the same in two orthogonal directions.

The system has been used to date in the study of the enhancement of contours in photographs and to make outline pictures from photos. The process of contour enhancement is essentially that of increasing the abruptness of tone transition at contour lines. A similar phenomenon occurs in the "brightness contrast" in human vision.

The outlining process may be used for automatic production of sketch maps from terrain photos or the display of contours on X-ray pictures. In picture transmission where line drawings are acceptable, economies in bandwidth are possible through reduction in the information that must be transmitted. Contrast enhancement may also be used in TV to reduce the effects of low transmission bandwidth. The suggestion has been made that the system would be useful in anolog computers as an aid to the solution of some types of differential equations.

Movies on Magnetic Tape . . . By extending the top frequency at which magnetic tape recorders can operate, the recording of TV pictures on magnetic tape has been brought close to commercial use. A newly developed Video Tape Recorder can "film" a 20-minute monochrome TV program on ordinary size reels of 3/8" Mylar tape at 100" per second.

The tape is divided into 12 channels. The top channel carries the horizontal and vertical synchronization signals. The next 10 channels carry the video signal broken down into bits of information. The last channel carries f-m sound.

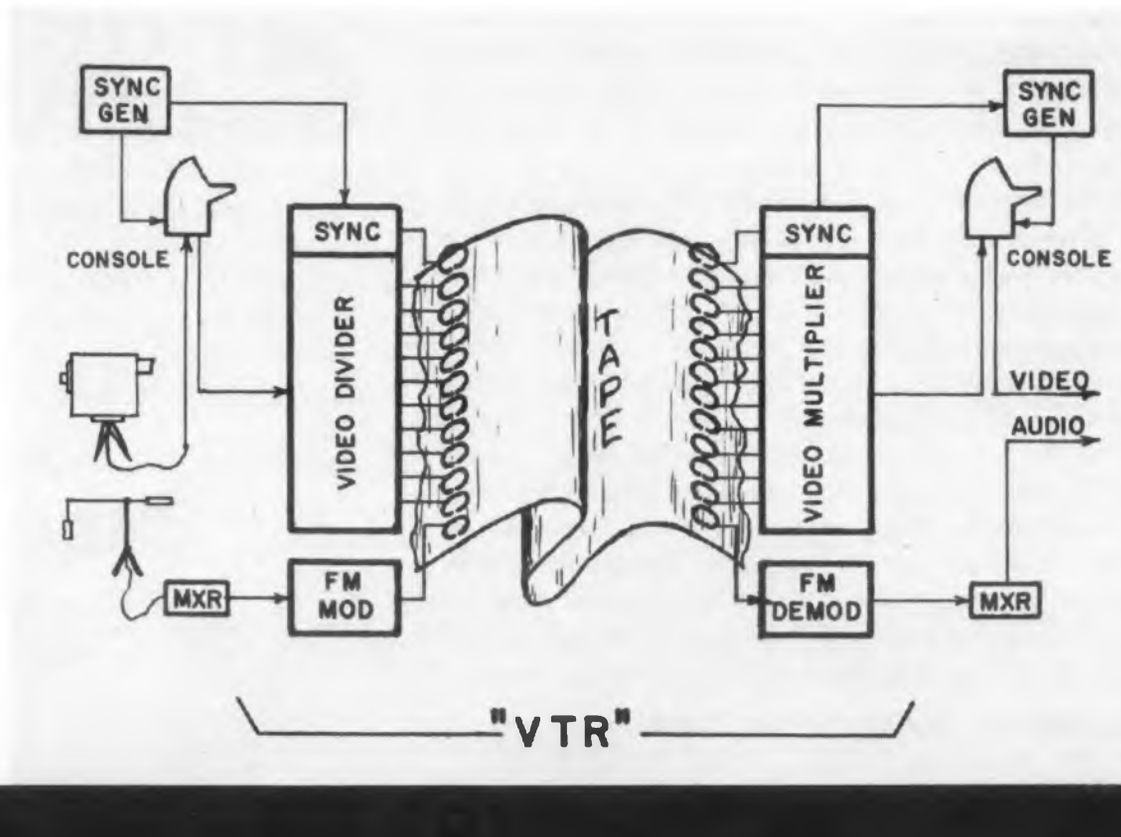
Ten magnetic recording heads of special design record 339,000 bits per second each on their respective channels for a total of 3,390,000 bits per second. The picture is divided for presentation to the 10 heads by a pulse-forming, delay line and electronic switch circuit. On playback the picture signal is reassembled by a similar circuit.

Another method of recording pictures on magnetic tape (see *ED, December, '53, pp. 8-9*) uses two channels on 1/4" tape for monochrome and five channels on 1/2" tape for color recording.

Developed by the Electronic Division of Bing Crosby Enterprises, Los Angeles, Calif., the Video Tape Recorder has been offered for military use. It may eventually replace photographic methods in the making of motion pictures and kinescopes. It can provide a recording and many simultaneously produced copies all of which are ready for immediate playback without further processing. Unlike film, the magnetic tape can be erased and reused.

Considerable flexibility in motion picture making could be gained by use of the system, since several TV cameras could be employed simultaneously, with the director continuously choosing the best image for recording on the one reel.

A color recorder based on the same principles as the monochrome unit is now under construction.



This simple block diagram of the Video Tape Recorder shows the functions of the 12 tape channels in recording images on magnetic tape.

Meetings

May 17-20: *Basic Materials Conference and Exposition:* International Amphitheatre, Chicago, Ill. For information contact Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

May 17-20: *Electronic Parts Show,* Conrad Hilton Hotel, Chicago, Ill.

May 24-26: *Conference on Telemetering.* Morrison Hotel, Chicago, Ill. This gathering is under the joint sponsorship of IRE, AIEE, Institute of Aeronautical Sciences, and the Instrument Society of America. Subject matter will be of wider scope and deeper interest as a result of the considerable amount of telemetering and remote control recently developed. General Chairman, W. J. Mayo-Wells of the Applied Physics Laboratory of Johns Hopkins University. Contact AIEE, 33 West 39 Street, New York 18, N. Y.

June 7-10: *National Plastics Exposition and Technical Conference.* Public Auditorium, Cleveland, Ohio. For information contact E. L. Frantz, Society of the Plastics Industry, Inc., 67 W. 44 Street, New York, N. Y.

June 16-18: *High Vacuum Symposium.* Sponsored by Committee on Vacuum Techniques. Berkeley Carteret Hotel, Asbury Park, N. J. For information write to P. O. Box 1282, Boston, Mass.

June 21-25: *AIEE Summer and Pacific General Meeting.* Los Angeles, Calif. Contact AIEE, 33 West 39 Street, New York 18, N. Y.

June 21-July 2: *Seminar on Analog Computers.* Conducted by the Dept. of Electrical Engineering, Pennsylvania State Univ., in cooperation with various industrial organizations. State College, Pa. For information, write to Engineering Seminar Registration, General Extension Bldg., Pennsylvania State Univ., State College.

June 23-25: *IRE Symposium on Global Communications.* Washington, D. C.

June 23-26: *Acoustical Society of America, 25th Anniversary Meeting.* Hotel Statler, New York, N. Y. For information contact W. Waterfall, 57 East 55 Street, New York 22, N. Y.

September 1-16: *Golden Jubilee Meeting of the International Electrotechnical Commission,* University of Pennsylvania, Philadelphia, Pa.

September 13-24: *First International Instrument Congress and Exposition,* Commercial Museum and Convention Hall, Philadelphia, Pa.

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Circuit Breaker Considerations

Richard S. Kurtz

Heinemann Electric Company, Trenton, N. J.

HYDRAULIC-MAGNETIC circuit breakers offer electronic designers an excellent means of providing extremely close protection for electronic components without causing unnecessary power interruptions. They can also be used to perform many auxiliary control functions, permitting great design flexibility.

Essentially, the problem of applying protective equipment is three-fold: (1) to provide circuit interruption fast enough and at a sufficiently low current value to protect the circuit and components; (2) to prevent unnecessary power interruptions; and (3) to use the protective device most economically in terms of the additional functions it may perform. While these are the overall objectives, the design engineer will be aided in matching protective equipment to the application by considering each of the following essential factors:

a. Proper ratings
b. Inrush characteristics and overload tolerances
c. Ambient temperature effect
d. Frequency considerations
e. Most advantageous circuitry
f. Special mechanical and physical features

The hydraulic-magnetic circuit breaker meets these six considerations. Fig. 1 illustrates its construction. A solenoid-type, over-current sensing element with either instantaneous or time-delayed response is the entire electrical phase of the circuit breaker. Through an armature, it connects with the mechanical phase

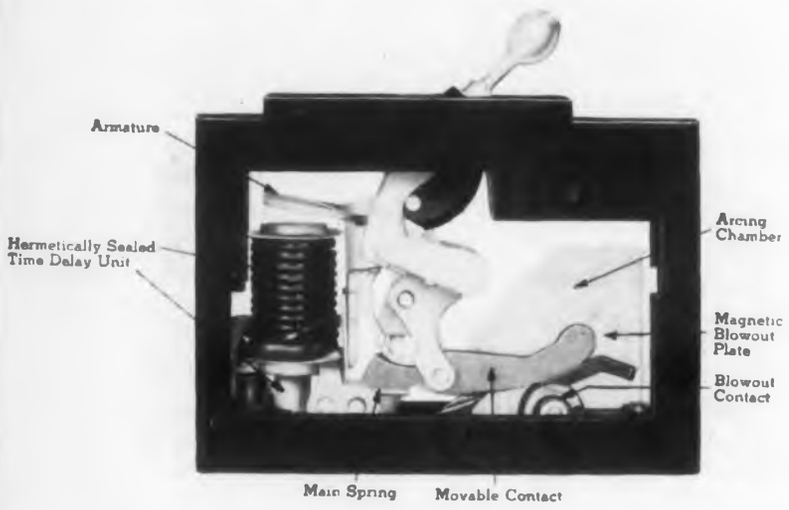

Fig. 1. Exposed view of a hydraulic-magnetic circuit breaker.

which is essentially a toggle link with a high-speed latch, a moving contact and a stationary contact equipped with a magnetic arc-blowout assembly.

For time delayed response, the sensing element has a hermetically sealed, nonmagnetic tube instead of the solid core characteristic of most solenoids. The tube extends through and beyond the coil and contains a spring-loaded movable iron core, shown in black in Fig. 2, as well as a silicone damping liquid. Under normal loads, the core does not move (A, Fig. 2).

When an overload occurs, the movable core is drawn into the magnetic field, but the silicone liquid slows down its travel (B). This provides the time delay to allow for inrush or harmless overload conditions. As the core moves into the coil, it reduces the air gap, thus reducing the reluctance in the field.

When the core touches the pole piece, the magnetic circuit is complete and the armature is actuated, tripping the circuit breaker (C). On overloads of greater magnitude, the magnetomotive force will be sufficient to actuate the armature before the core reaches the pole piece. Thus, inverse time delay characteristics are provided. On short circuits and extreme overloads of ten times the circuit breaker rating or more, the movable core is not a factor and tripping is instantaneous.

Proper Ratings and Inrush Effects

A good basic principle is to rate the protective device as close as possible to the current capacity of the circuit. Electronic circuits have very slight ability to withstand overloads. Due to the critical nature of electronic components, use of so-called standard ratings is impractical. Take a circuit, for example, that should be rated at 16.5amp. Obviously, 15amp circuit protection will not suffice, but neither will the next "standard" rating of 20amp since more than a 20% overload would have to occur before the current even reaches the rating of the protective device. Under such conditions, not only would circuit interruption be too slow on large overloads, it would also permit continuous small overloads with excessive heating and long-range deterioration. In this case, the circuit breaker should be rated actually at the 16.5amp value.

In establishing the rating one should simply take the maximum normal operating current of the circuit or any particular component that limits the circuit. Hydraulic-magnetic circuit breakers are available with precise ratings, even fractional ratings, for any continuous current value from 10ma to 150amp, and precise ratings should be specified if adequate protection is to be attained.

Since the hydraulic-magnetic type of circuit breaker does not employ thermal elements, it is not necessary to employ any derating factor to compensate for changes in ambient temperature.

It is readily apparent that on large, harmful overloads and short circuits maximum speed in circuit interruption is important. In some circuits where there are no surge currents with which to contend, instantaneous circuit breakers are used. In most circuits, however, there are inrushes or high initial pulses and there are harmless, temporary overload conditions that should not needlessly interrupt service by tripping the circuit breaker. For this reason, inverse time delay is provided.

An important specification that the electronic design engineer must provide pertains to time delay. Time delay must be long enough to prevent unnecessary service interruptions and short enough to protect critical electronic components. Several variables in hydraulic-magnetic circuit breakers, including the viscosity of the silicone fill and the movable core construction, allow the response curve (time vs. percent load) to be varied. A selection of response curves is available for each model of circuit breaker so that the response characteristics may be matched to the equipment being protected.

Fig. 4 shows a typical set of time delay curves for 60cy a-c operation. The difference among the curves is the time delay provided for a given value of overload. Curve 1 allows for a long inrush or overload period. It is designed principally for motor protection where the circuit breaker is rated at the full-load current of the motor. Curve 2 represents a shorter time delay, generally used for mixed circuits consisting of motors, lights, etc. Curve 3 has been developed especially for electronic applications. It passes the larger, flash inrushes characteristic of electronic circuits. At the same time it is an extremely fast response curve which does not tolerate any degree of prolonged inrush or overload. Protection of some electronic components, particularly instruments, is so critical that a special breaker with a response curve, not shown but designated as Curve 3X, is used. It has t-d characteristics about one-half of Curve 3.

Temperature Effects

The manner in which ambient temperature should and should not be compensated for in the overload protection device is often misunderstood. There are three fixed characteristics that should not change with temperature. They are: the current carrying capacity; the minimum current value at which the circuit breaker must trip with time delay; and the instan-

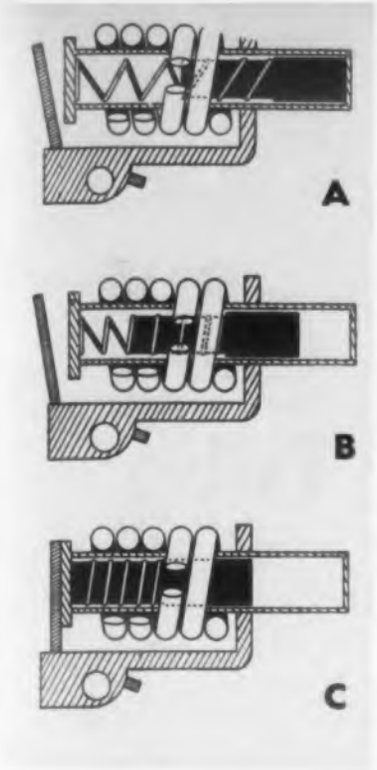

Fig. 2. Operational sequence of the circuit breaker. The magnetic core is in black.

without damage to circuits or equipment. The variation in time delay is provided in hydraulic-magnetic circuit breakers by the change in viscosity of the liquid fill within the time delay tube. The effect over a temperature span of —30 to 150°F for a fixed overload condition (250% load) is shown in Fig. 3. This chart shows how ambient temperature affects the 250% load point on Curves 1 and 2 in Fig. 4.

Silicones are the standard liquid fill for the time delay tube and they are relatively stable in viscosity with respect to temperature. There are applications, however, where a greater temperature-time variation is highly desirable. For these applications, hydraulic oils may be used instead of the silicones, increasing the variation manyfold as shown in Fig. 3.

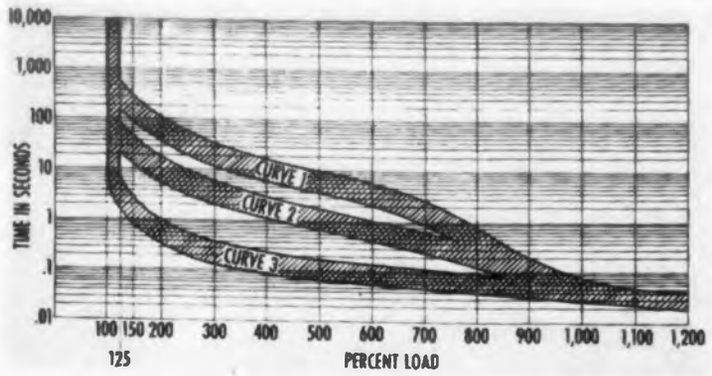

Fig. 4. Time-delay characteristic curves for a long inrush for motors (curve 1), shorter overload (2), and quick closing for electronic units (3)

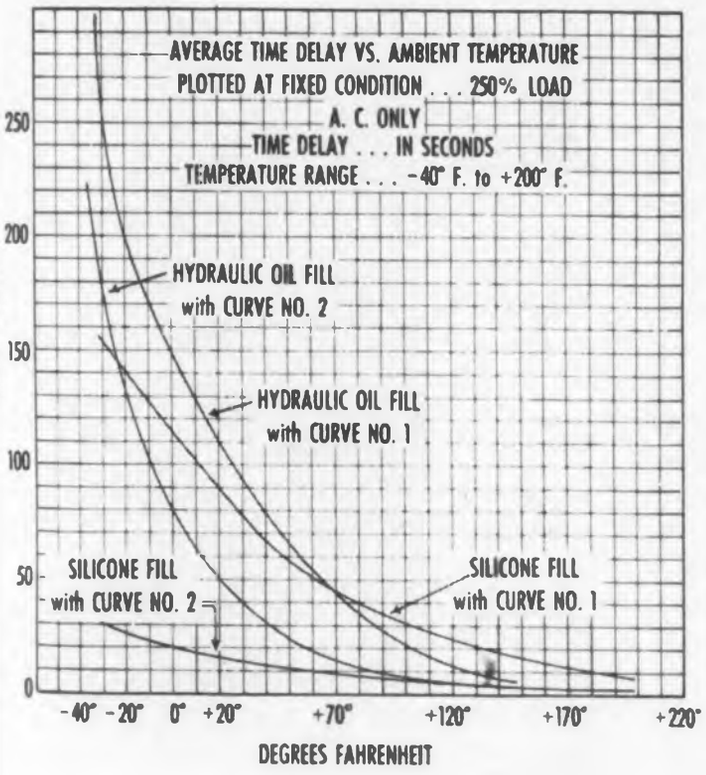

Fig. 3 (below). These curves illustrate how the time-delay characteristics of the breaker vary with different hydraulic fluids.

taneous trip value. With these definite characteristics, there is no danger of the circuit breaker tripping needlessly when hot, or not tripping when cold.

It is some times desirable, however, to compensate for a change in temperature by adjustment of the time delay. At higher ambient temperatures, it is still necessary to carry the rated load, but overloads cannot be tolerated for as long a period. With lower ambient temperatures, overloads can be more prolonged

Frequency Considerations

Very common errors in the application of circuit breakers are due to a failure to consider frequency effects or a failure to differentiate in specifications between direct current and rectified direct current. The circuit breaker solenoid for d-c operation requires a greater ampere-turn ratio than for alternating current. When a circuit breaker is tripping on alternating current, the power acting on the armature is pulsating at a frequency twice as great as the frequency of the current. Thus, a series of strikes are applied by the armature against the latch to effect tripping. In the tripping process on direct current, there are no pulsations of power and, therefore, tripping must be accomplished in one stroke.

Since the magnetic circuit is more efficient on 60cy a-c, it might be supposed that the same or greater efficiency would be achieved at 400cy. This is not the case due to additional losses which are proportional to the frequency, namely, hysteresis, eddy-currents, and "skin effect." Circuit breakers for higher frequencies must incorporate design modifications such as lower latch loadings to compensate for these losses.

When circuit breakers are specified for d-c operation, they are calibrated for battery or generator sources of supply, not rectified direct current. Experience has shown that rectified d-c is entirely different in its action as far as tripping is concerned. Half-wave rectified d-c is actually a series of pulses resembling the effect of alternating current. Variations in design and calibration of the circuit breaker can meet these special current conditions. Specify ripple factor for rectified current applications.

Circuitry and Special Features

Adaptability of the circuit breaker goes beyond precise ratings and a variety of response characteristics. They also lend themselves to unique circuit arrangements and permit economical use of a single breaker for several functions in a circuit. It is quite common for a single circuit breaker to serve as the power switch, as overload and short circuit protection, and as the means of control interlock.

Aside from the virtually unlimited special forms, which are beyond the scope of this article, there are four standard circuits which can be arranged in any combination in one, two or three-pole circuit breakers. These circuits, with explanations, are given in Fig. 5.

In making circuit calculations, the circuit breaker should be considered in exactly the same manner as other components. Circuit breaker manufacturers will furnish data on voltage drop, impedance, wattage loss and other pertinent factors as well as the minimum voltage required for circuit breaker operation.

Among the special features that should be considered in specifying circuit breakers are some that are similar to other components such as fungus and moisture-proofing and some that apply particularly to circuit breakers such as non-trip-free construction. Use of alarm contacts, vibration-resistant constructions and other special features, as well as the most suitable physical design, should be planned with the circuit breaker manufacturer.

Fig. 5. Circuit setups.

Series Trip. The conventional arrangement in which over-current sensing and circuit interruption are in the protected circuit. Can protect supply voltage wiring or individual components.

Shunt Trip. For control interlock. The shunt circuit through the solenoid connects with high- or low-limit safety switches. Shunt trip breakers trip at the rated circuit voltage.

Relay Trip. The solenoid and the switching element are in separate circuits. Useful for control interlock applications, with the control circuit at a different (usually lower and more economical) voltage, a-c or d-c.

Calibrating Tap. Provides additional tap between switching element and coil. Shunting the coil with a resistor, raises the trip point of the breaker. Also permits two loads from same power source to be controlled by overcurrent in one.

A New Indicator Tube

ANY NUMBER from 0 to 9 can be made to appear on the "Inditron", Type G10, a new indicator tube shown in Fig. 1. A gas discharge device similar to ordinary glow lamps, the tube can be operated at high speeds to serve as a read-out device for computers, electronic counters, game machines, electronic clocks, and many other applications. In computer indicating registers, it can replace the array-of-ten glow lamps commonly used in these devices.

The Type G-10 Inditron is a 10-element tube containing the decimal numeral forms 0,1,2,3,4,5,6,7,8 and 9, stacked one behind the other with close spacing. Any interference to the display of a character in the rear of the stack by those in front is minimized by making all the character forms of extremely fine wire. The cathode glow completely surrounds the selected character with a brilliant illumination several times the diameter of the wire form. Viewed at a distance of several feet, there is no apparent change in depth and there is very little difference in clarity with the changing levels.

A product of National Union Radio Corp., 350 Scotland Road, Orange, N.J., the tube employs a T-6-1/2 bulb and has a seated height of about 2". The 10-pin base fits into any standard 9-pin miniature tube socket having a center shield element. Pin No. 10, located in the center of the tube's base, is equipped with a side spring which makes contact with the center shield element of the standard socket.

A given character is caused to glow by lowering its potential with respect to all

Fig. 1. The "Inditron", an indicator tube which can display numbers from 0 to 9.

other elements by the value of the breakdown voltage. A basic operating circuit is shown in Fig. 4. Switch *SW* can bring any selected element to B— potential while all the other elements remain at B+ until ignition starts. Then the potential of all the remaining elements adjusts to the natural tube drop. The discharge current distributes itself equally across the resistors and therefore each resistor is nine times the value for a single resistor setup.

The switch can be any manually or mechanically operated rotary switch, or any vacuum tube switching circuit capable of delivering the required voltage change and operating current. The power supply for the circuit in Fig. 4 can be used to operate up to 10 Inditrons.

Fig. 2. (left). This is the way the numbers look when different elements of the indicator tube are energized.

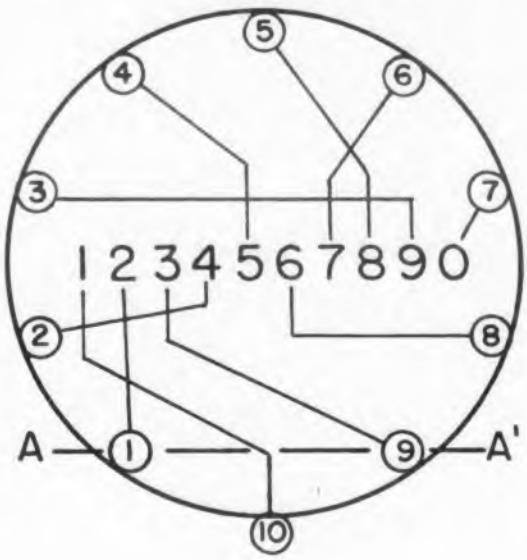

Fig. 3. Basing diagram of the "Inditron". The number 10 pin is connected to a center prong on the tube's standard 9-pin miniature base.

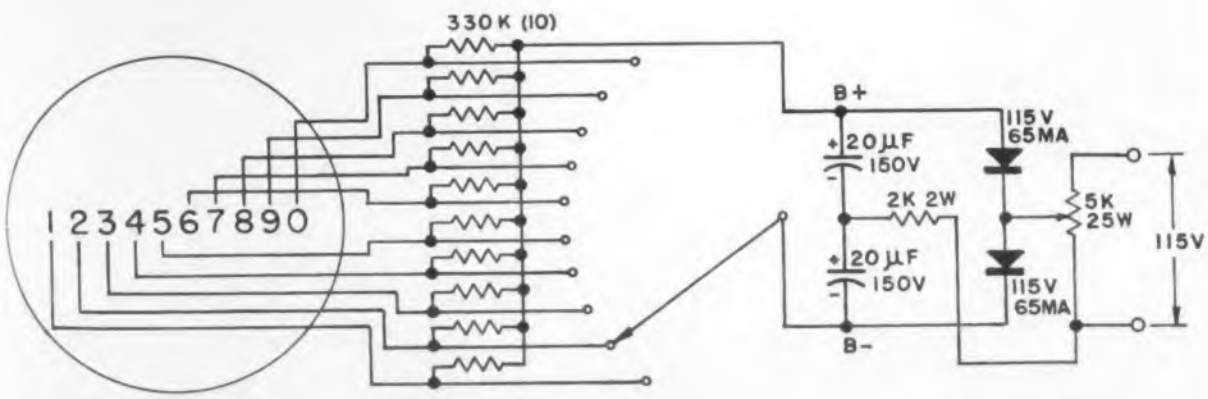

Fig. 4. Circuit for operating the indicator tube. The power supply shown is capable of operating 10 "Inditrons".

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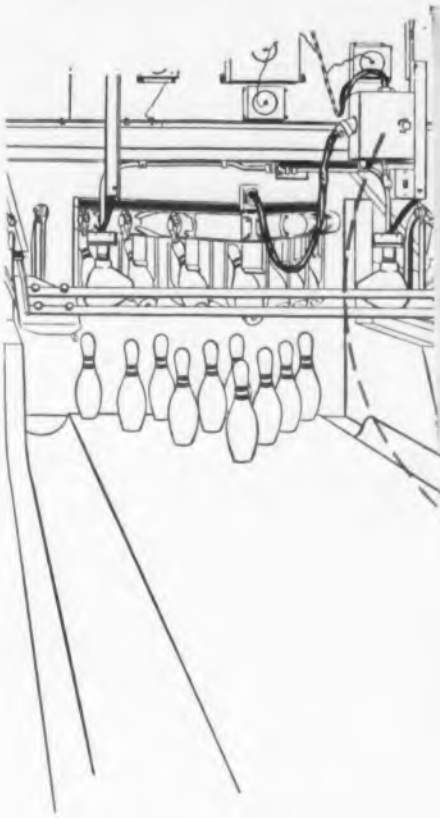

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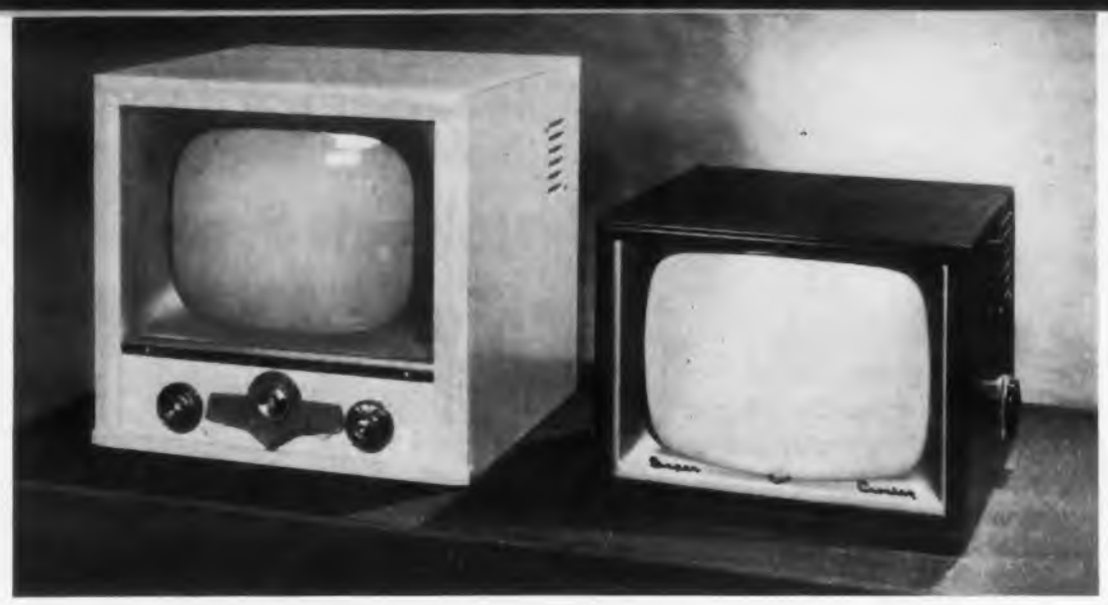


Fig. 1. The "Super V" Receiver (right) compared with a conventional set.

Vertical-Chassis TV Receiver

MERCHANDISING advantages, small size and weight, and ease of servicing are the results of the clever thinking that went into the design of the Crosley "Super V" TV Receiver shown in Fig. 1. A 17″ receiver, it occupies about 1/3 less cabinet space and weighs about 40% less than conventional models.

By employing a vertical chassis arrangement instead of the conventional horizontal box, and by placing the controls at the side instead of at the front of the cabinet, the designers were able to produce a set whose front is practically "all screen". This feature provides the manufacturer with many merchandising advantages—a cabinet that occupies only 2.5 cu ft (14″x18″x19″), low weight, "portability", "an uncluttered cabinet", a perfect "second set", etc.

The most spectacular advantage of this radical departure in TV chassis design is the ease of servicing the set. It is really designed for service. For example, by removing the back of the set, all the tubes are made easily accessible for rapid checking and replacement, as can be seen in Fig. 4. If the serviceman needs to replace a capacitor or resistor in a conventional receiver, he has to remove a chassis weighing about 50 lb or so from the cabinet to get at the damaged component. To get at the entire chassis in the "Super V" receiver, the serviceman removes four screws, lifts off the bonnet-type cabinet, exposing all the components for quick service or rapid replacement of the faulty parts. Fig. 4 also shows the front or underside of the chassis with the picture tube removed to expose the component arrangement. Note that the vertical chassis also supports the focus and deflection coils for the picture tube.

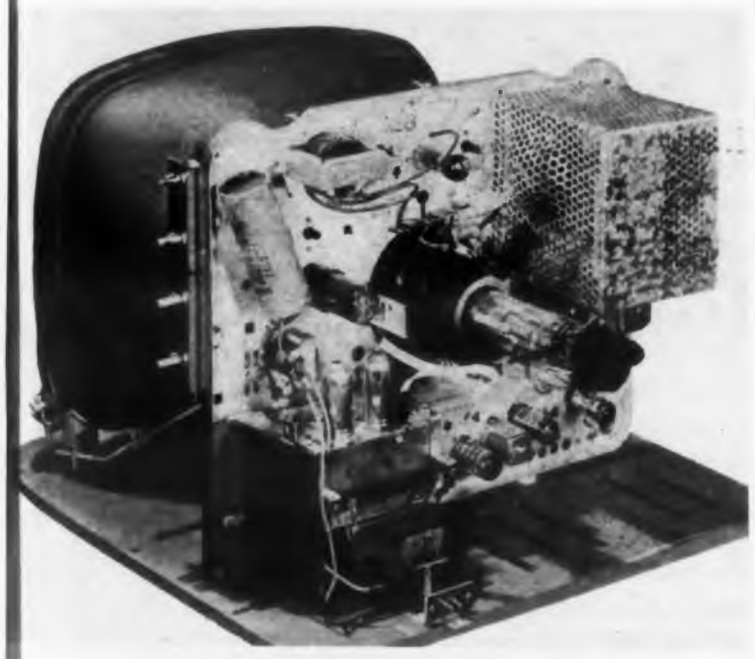
Another unusual feature of the set is that it employs only 15 tubes (including the picture tube), instead of the 18 to 22 tubes used in most receivers. Seven of these are dual purpose tubes. The tube complement includes: 6*BC*5 (r-f amplifier), 6*J*6 (v-h-f oscillator and mixer), 6*CB*6 (1st i-f amplifier), 6*BC*6 (2nd amplifier), 6*AM*8 (3rd i-f amplifier and video detector), 6*AN*8 (video amplifier and sync clipper), 6*U*8 (4.5Mc i-f amplifier and sync amplifier), 6*BN*6 (limiter-discriminator and audio amplifier), 6*SN7GT* (horizontal afc and horizontal oscillator), 25*L6GT* (audio output), 25*BQ6GT* (horizontal output), 12*BH*7 (vertical oscillator and vertical output), 12*AX4GT* (horizontal damper), 1*X2B* (high voltage rectifier), and 17*HP*4 (picture tube).

The tube heaters are connected in series, and a resistor is used to limit the initial current surge, thereby reducing tube failures caused by filament heat shock. This arrangement also eliminates the need for a filament transformer or heavy filament windings on the power transformer and reduces weight, heat, and cost.

Fig. 2. The unique chassis construction and component arrangement of the unit compared with a standard receiver.

Fig. 3. To service the receiver, the cabinet is lifted off the chassis instead of pulling the chassis out of the cabinet.

Design Forum



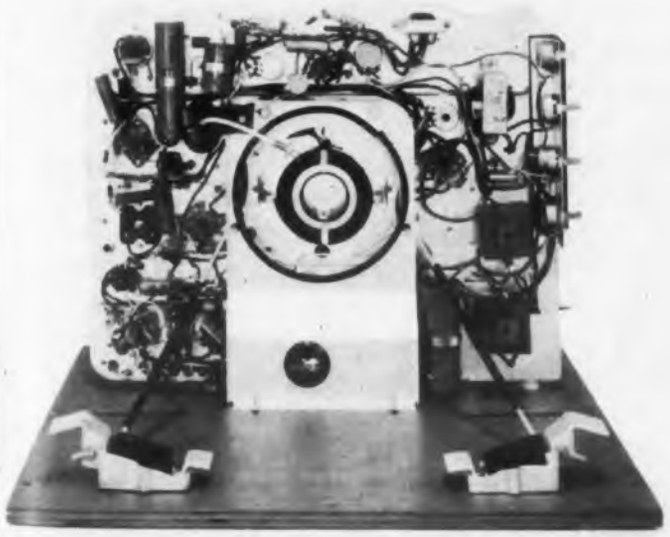


Fig. 4. All components are easily serviced as shown by these front (below, with picture tube removed) and back views.

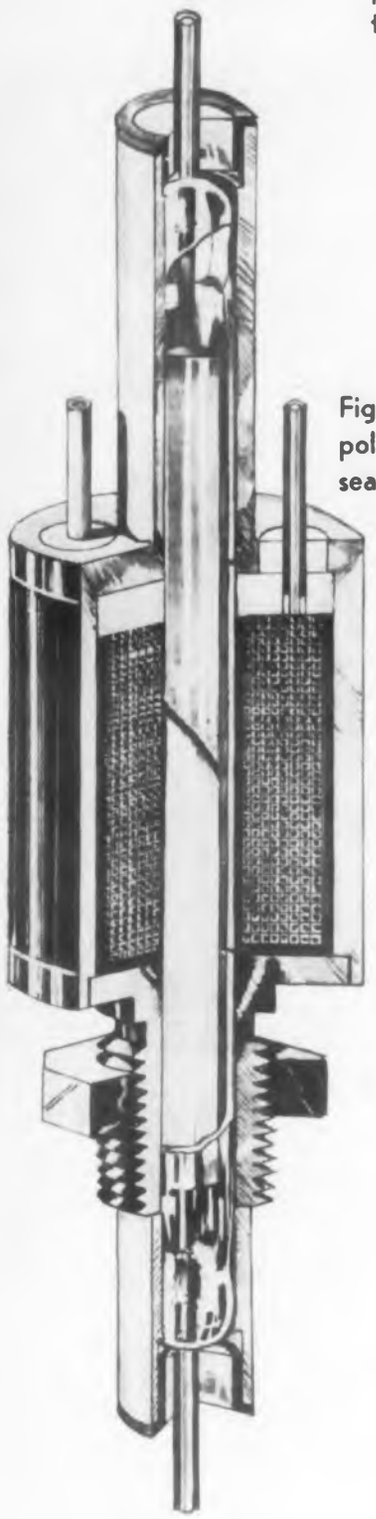


Fig. 1. Cutaway of a single-pole Magseal exposing the sealed motor element.

Fig. 2. The three models of single-pole sealed-contact relays.

Fig. 3. Multi-pole units in 7- and 61-pole models.

Miniature Sealed—Contact Relays

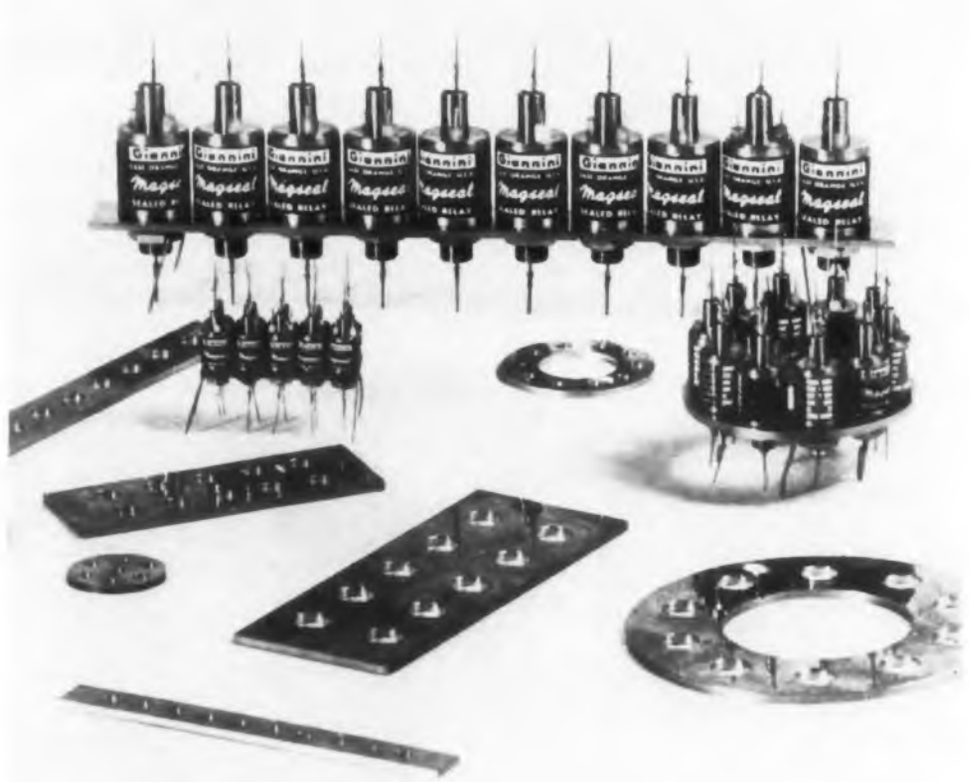


Fig. 4. Various "feedthrough" mounting arrangements for single-pole Magseals.

HIGH operating speed and sensitivity, low contact resistance and capacitance, and a mechanical life of more than one billion cycles of operation are outstanding features of the "Magseal" hermetically sealed contact relays shown in Figs. 2 and 3. These characteristics, combined with the unusual construction of the units affords electronic designers a wide range of circuit and space-saving possibilities. For example, as many as 1296 of the smallest relay in Fig. 2 can be mounted in an area only one foot square.

The relay consists of a standard contact and motor element assembly hermetically sealed in a glass envelope and a core and coil. As shown in the cutaway view illustrated in Fig. 1, the motor element consists of two equal-sized magnetic alloy cylinders separated by a narrow gap, and rigidly attached to flexible rods extending outside the glass envelope. The circuit to be controlled is connected to these rods. The envelope fits inside a hole in a metal core around which the coil is wound. Application of current to the coil produces a magnetic field which brings the magnetic cylinders together and closes the gap betweeen them.

In multiple-pole types, such as those shown in Fig. 3, a larger core with many holes to accommodate up to 109 motor elements for the largest model is employed. Current in the coil closes all contacts together.

The contact and motor element is sealed in a gas atmosphere, affording protection from the effects of

corrosion, dirt, and moisture. The units are designed for single-hole mounting in any position.

The Type 5 spst Magseal (center unit in Fig. 2), a typical relay in the series, measures 1/2″ diam x 2″, weighs 0.5 oz, and requires a 1/2″ diam mounting hole. Contact rating is 0.5amp at 30v; switching rate is 60cps; and operating time is 2 milliseconds. It has an 8000 ohm coil rated 63v, 1/2w max, 100mv min.

It will withstand 50g shock in any plane without damage, and withstand 10g without causing failure. Operation is satisfactory to 60,000 ft without reduction of any rated values. Operating temperature range of the relays is −65°C to 125°C.

The multipole units can be operated with as many motor elements as are required by the circuit to be controlled up to the maximum number for each model. Single or double coil construction is available, affording great circuit flexibility including biased or differential operation of the relays.

Operation and release of all contacts in the multiple-pole models is simultaneous within a fraction of a millisecond. Motor elements, however, made of different types of wrought iron for different sensitivities can be used, affording operation at several current levels in one relay structure. Operating ampere-turns is about the same for any number of motor elements.

Manufactured by G. M. Giannini and Co., Inc., Eastern Division, 39 Main Street, East Orange, N. J., these long-life relays should find uses in all types of switching devices, including computers, business machines, totalizers, relay amplifiers, and signaling devices.

A three-stage multibranch selecting tree for selecting one of a thousand outputs with a decimal digit selecting circuit is shown in Fig. 5. It uses single-pole, 10-pole, and 100-pole Magseal relays. The assembly consists of 30 relays with a total of 1,110 contacts. The first, second, and third stages require 0.1w, 0.3w, and 1w, respectively. The whole assembly requires a mounting surface of only 85 sq. in.

1st Stage	2nd Stage	3rd Stage
10 Relays	10 Relays	10 Relays
1 Make	10 Makes	100 Makes
Per Relay	Per Relay	Per Relay

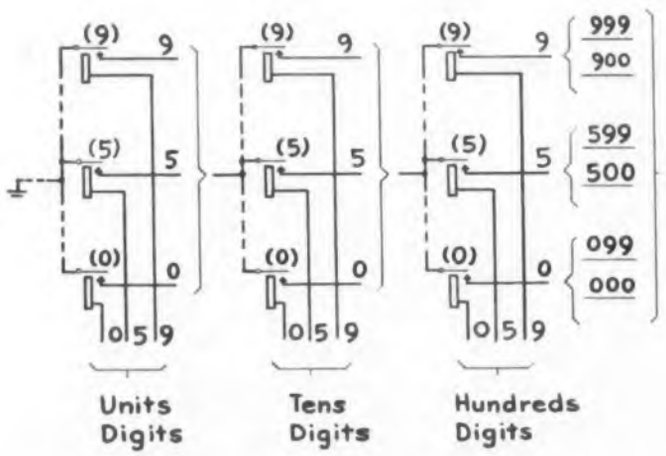


Fig. 5. Only 1.4w is needed to operate this Magseal circuit that selects one of 1000 outputs.

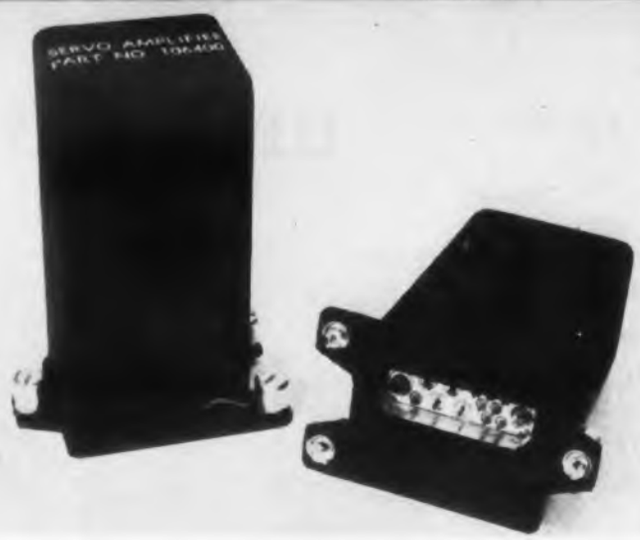
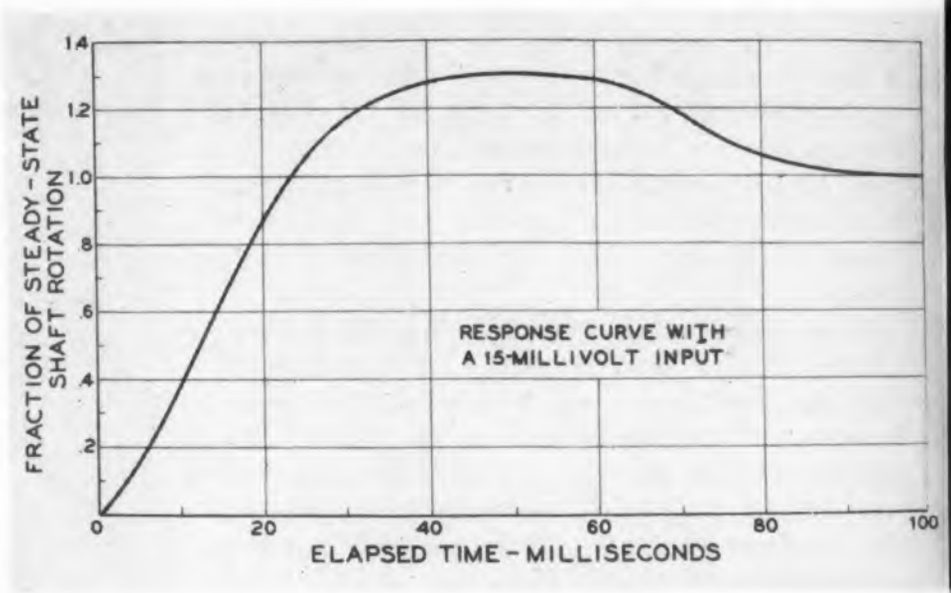


Fig. 1. The fluid-filled, hermetically-sealed Type SA118H Servo Amplifier showing its plug-in base.

Miniature Servo Amplifier



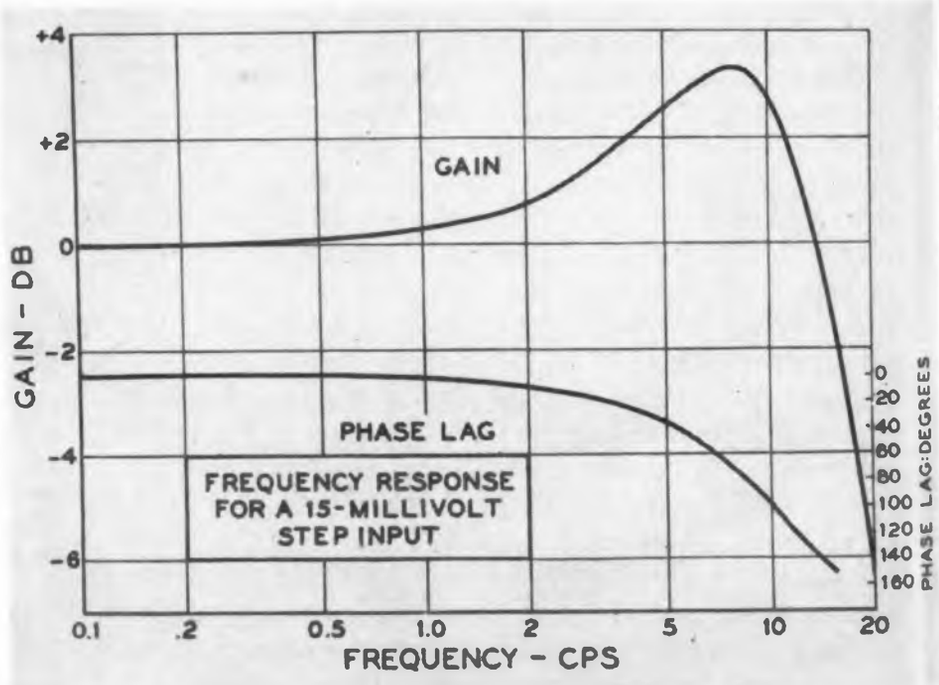


Fig. 2. The various response characteristics of the Amplifier shown in these two graphs demonstrate its high efficiency.

WEIGHING less than a pound, the miniaturized, hermetically sealed, plug-in Servo Amplifier Type SA118H, shown in Fig. 1, is designed for analog-computer servo loop applications. It will deliver up to 2w to a 400cy, 2-phase servomotor and operates directly from the output of a tapped transformer. No external d-c supply is required. The amplifier can also drive servos employed in military aircraft.

The sealed enclosure is filled with fluid for greater heat dissipation and consequent elimination of hot spots. Fig. 2 shows various response characteristics of the unit, which is manufactured by Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y. It has three stages of voltage amplification and a power output stage.

Designed to operate between 380 and 420cy, the amplifier has a gain of 7300 ±25% and an input impedance of over one megohm. Maximum output is 100v. Filament power requirements are 2.1amp at 6.3v, 400cy, for its one *6112*, one *5687*, and two *5641* tubes. A tuning capacitor is provided as an

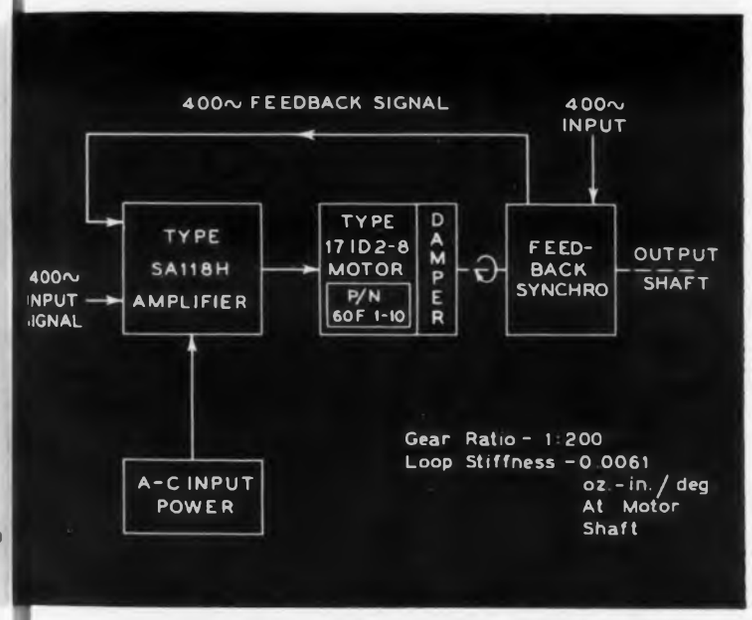


Fig. 3. Typical servo loop block diagram.

integral part of the amplifier for power-factor correction. The unit is 2″ x 1-1/2″ x 4-1/8″ in size.

The high-voltage power input requirements of the amplifier are 5 to 17ma d-c from either side of a 580v, 400cy supply, center-tapped to ground. A single input-power winding is sufficient to supply multiple amplifiers.

Special consideration has been given to saturation conditions in the design of the amplifier. No phase shift or distortion, which reduces motor torque, will occur for input signals up to 10v. The input signal should not exceed 30v. The unit meets the requirements of specification MIL-E-5400.

A Power Supply, the Type PS134, and a Damped Control Motor, the Type 171D2-8, have been designed to operate with the Type SA118H Amplifier, as shown in the block diagram in Fig. 3.

Circuit Design With Controllable Inductors—II

By Arthur L. Kaufman, Project Engineer
C.G.S. Laboratories, Inc., Stamford, Conn.

BECAUSE of its unusual characteristics, which were discussed in Part I of this article last month, the "Increductor" Controllable Inductor can be used for a wide range of applications. A number of these uses are illustrated in the circuits shown on the opposite page.

Fig. 2 shows the Increductor in a typical high frequency Colpits oscillator circuit with associated control tube circuitry for sweep frequency or f-m applications. Fig. 3 shows an alternate oscillator circuit for use at lower frequencies. Here R_2 and R_3 in conjunction with C_3 and R_1 can be adjusted to give a flat output amplitude characteristic over an extended frequency range. This is required when the Q of the Controllable Inductor no longer rises with frequency and tank impedance, therefore, begins to drop. For applications where some sacrifice in range can be tolerated to gain increased stability, an oscillator may be used where the Increductor unit is tapped across a section of a fixed tank coil.

Another common application of the Increductor is in tuned amplifier stages. Fig. 4 shows a typical wide-band tuned circuit. Constant gain and bandwidth over the frequency range can be achieved by operating the unit in the upper right-hand region of the Q map and appropriately loading the tank circuit. Several similar stages can be cascaded into a tuned r-f receiver or used in conjunction with an Increductor-tuned oscillator stage for a superheterodyne receiver.

Typical control circuitry necessary to track the above tuned amplifier stages to each other and the local oscillator is shown in Fig. 5. Note that additional bias resistors are sometimes necessary to prevent an effective short from appearing across this winding. If this occurs, it would act as a shorted secondary to the associated control winding with consequent loss in control current sweep. The capacitors C_t in Fig. 5 are used to raise or lower their associated tank frequencies. The inductances L_s and the control circuit potentiometers are used as independent parameters to adjust the high end of the frequency range. The bias potentiometers and the inductance L_p are most effective for tracking at the low-frequency end.

In any application where it is desired to make static adjustments of control current and to achieve up to 10 to 1 reduction in hysteresis and temperature drift, an appropriate, low-frequency "Bellwether" circuit shown in Fig. 6, may be employed. In this circuit the output voltage of the oscillator is integrated by the 100K resistor and the 82mmfd capacitor combination and then rectified by the following diode to give a direct voltage inversely proportional to the oscillator frequency. The oscillator voltage is also sampled by the upper diode and a portion of the resultant direct voltage is then added in series with the integrated signal. The portion to be added is determined by the position of the slider on the 250K pot.

This resultant votage drives the grid of the control current tube after going through a high-gain amplifier stage. The control current rapidly arrives at a value such that the oscillator frequency produces an error voltage at the grid of the amplifier just sufficient to maintain itself. It may be seen that the position of the potentiometer determines the voltage at the grid of the current driver and hence the current through

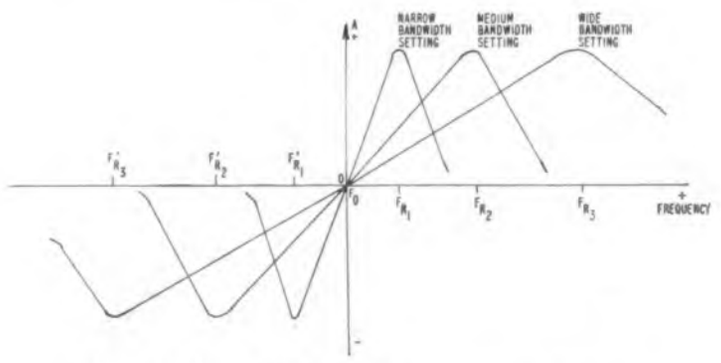


Fig. 1. F-m discriminator response curves.

the control winding. Since there can be only one such frequency for each setting of the potentiometer, the closed loop has acted to eliminate frequency hysteresis effects encountered when approaching a given value of control current from different directions. If control windings of other Increductors are connected at the "Current Out" terminals they will all follow the lead of this "Bellwether" oscillator unit having only one value of signal winding inductance for any setting of the 250K pot. It may easily be seen that these other units could be tuned stages of the receiver, sections of a filter, etc.

In swept applications where linearity of frequency versus control current is desirable, a circuit such as that shown in Fig. 7 is often helpful. The sawtooth sweep voltage may be divided into as many portions of discreet slopes as is necessary to produce the required frequency linearity. The tube characteristic of rapidly increasing plate current with less negative grid voltages helps in making the frequency of the output signal versus time more linear.

A means of temperature compensation is given in the circuit shown in Fig. 8. Here a temperature sensitive resistor network is shunted across the bias (or control) winding. It is necessary that its temperature coefficient be equal and opposite to that of the Controllable Inductor over the range of operation.

Automatic frequency control characterized by wide pull-in range can be adapted to an oscillator by a circuit such as that shown in Fig. 9. In this circuit the Increductor has a balanced control winding that may be driven from the discriminator circuit in addition to the bias winding. The latter may now carry direct current to adjust operation of the unit to the point of zero temperature coefficient, the center of the linear region, or to the region of maximum sensitivity for frequency-modulation use. If sufficient gain is not available, it may be desirable to directly couple the discriminator voltage to the grid of the current driver tube along with the modulating signal.

One application of the Increductor has been in variable bandwidth f-m receivers where a variable sensitivity discriminator tracked to the bandwidth adjustment of the receiver makes it possible to increase discriminator gain at narrow bandwidth settings. Fig. 10 shows a typical discriminator circuit of this type, which can be operated for wide, medium and narrow receiver bandwidth settings. Fig. 1 shows a plot of frequency response vs. amplitude for these three different settings. When the receiver bandwidth is narrower, a wide-band discriminator is no longer necessery. Hence, the resonant peaks can be brought closer together to give the steeper slope at the center. It should be mentioned that either a band-pass filter or overlapping low-and-high-pass filters of standard design can be used to vary the receiver's bandwidth. If Increductors are employed in these filters, their control windings as well as those of the variable bandwidth discriminator can all be controlled by the "Bellwether" circuit illustrated in Fig. 6.

Other uses of the Increductor not described here include phase modulators, antenna tuners, delay lines and magnetic switches. In all these applications the advantages of ruggedness, long-life and having a remotely tuned component are available.

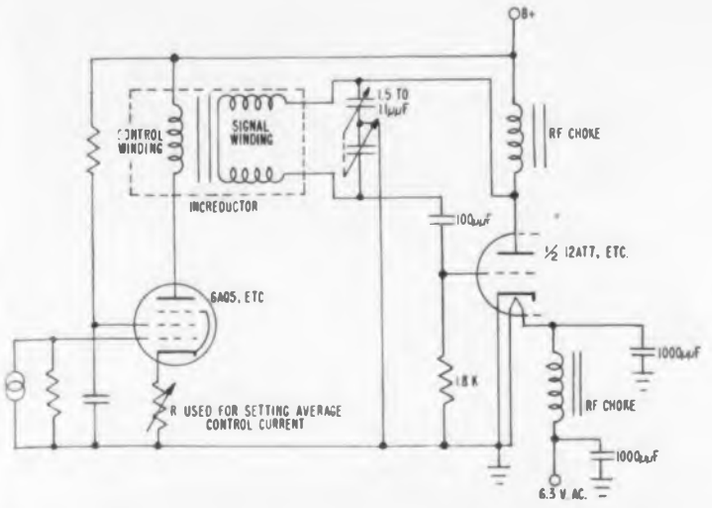


Fig. 2. High-frequency oscillator and control.

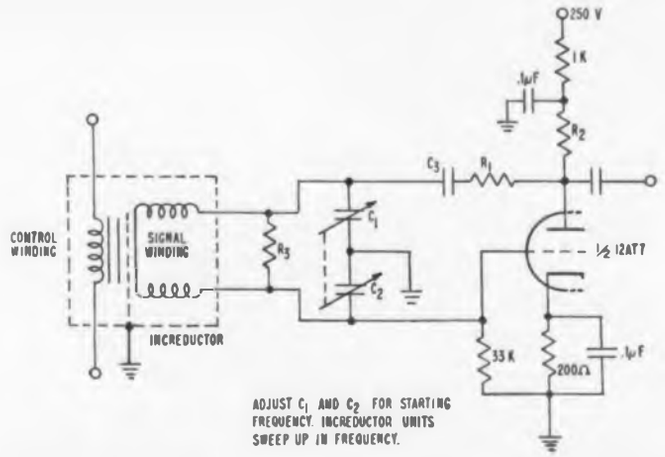


Fig. 3. Low-frequency oscillator.

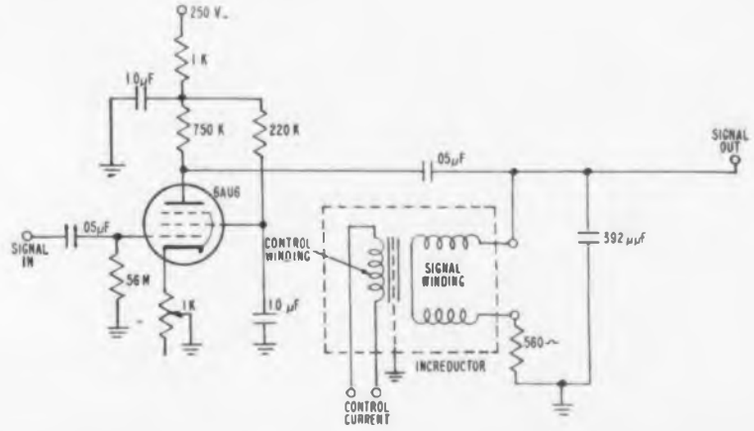


Fig. 4. Wide-band tuned amplifier stage.

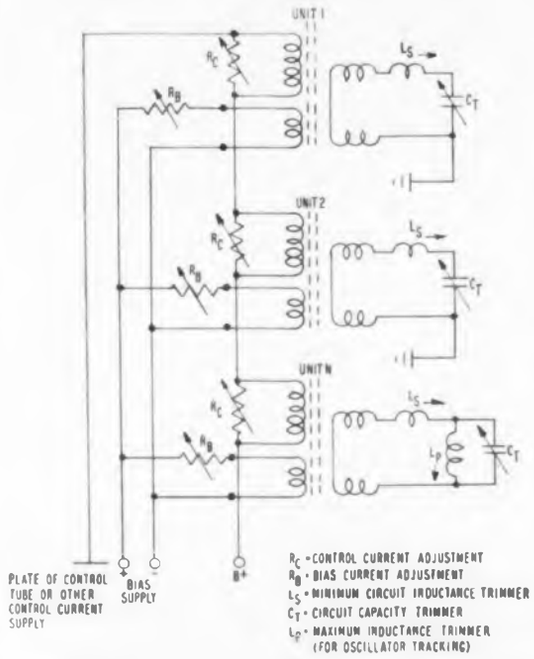


Fig. 5. Tracking circuit.

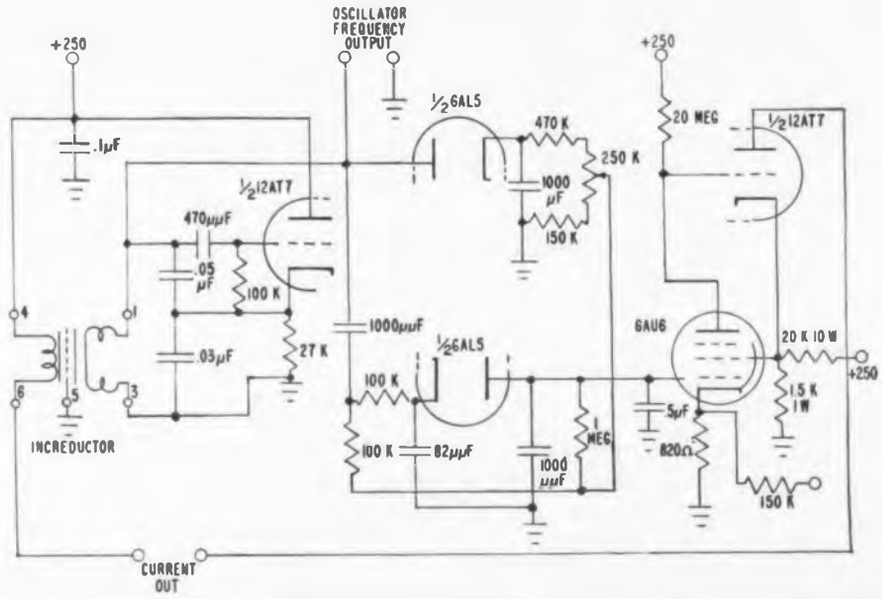


Fig. 6. Low-frequency, closed-loop deflection control.

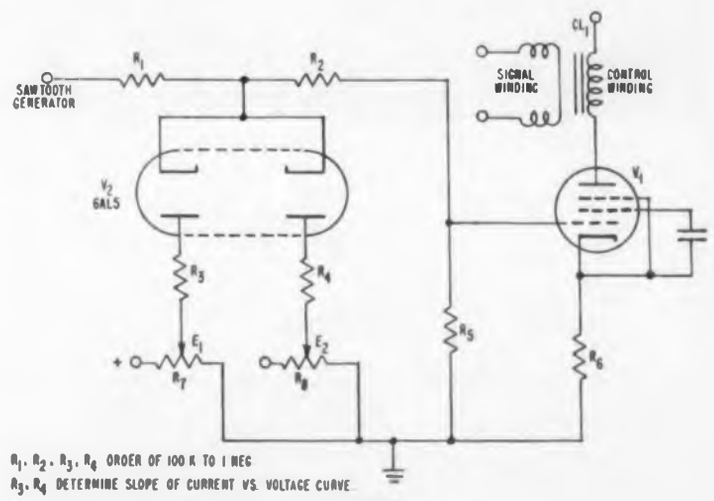


Fig. 7. [illegible]

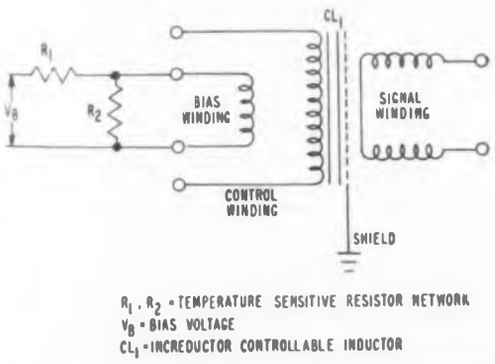


Fig. 8. Temperature compensating network.

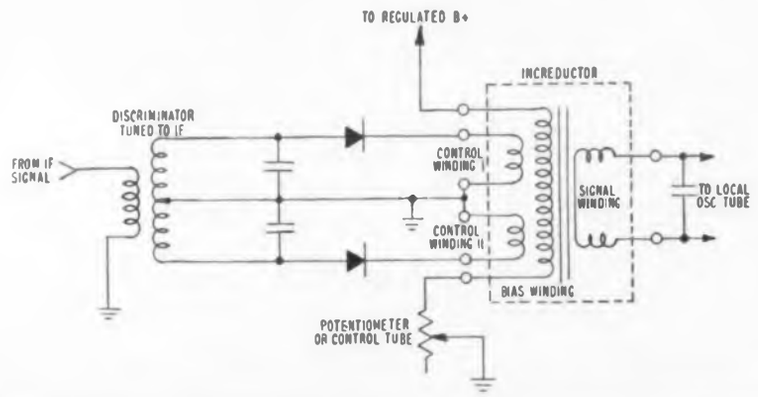


Fig. 9. Automatic frequency control.

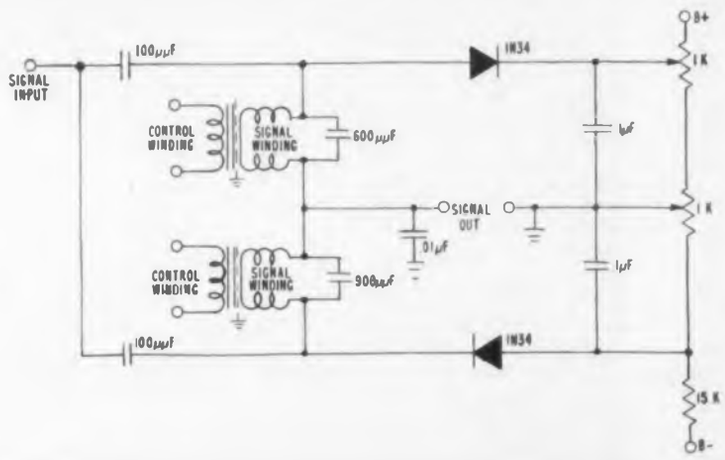
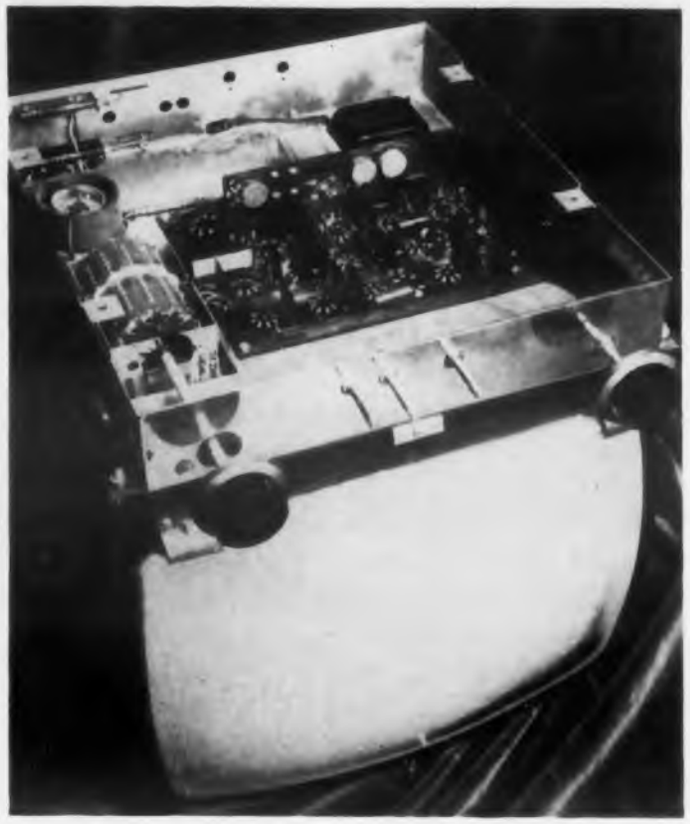


Fig. 10. Frequency-modulation discriminator.

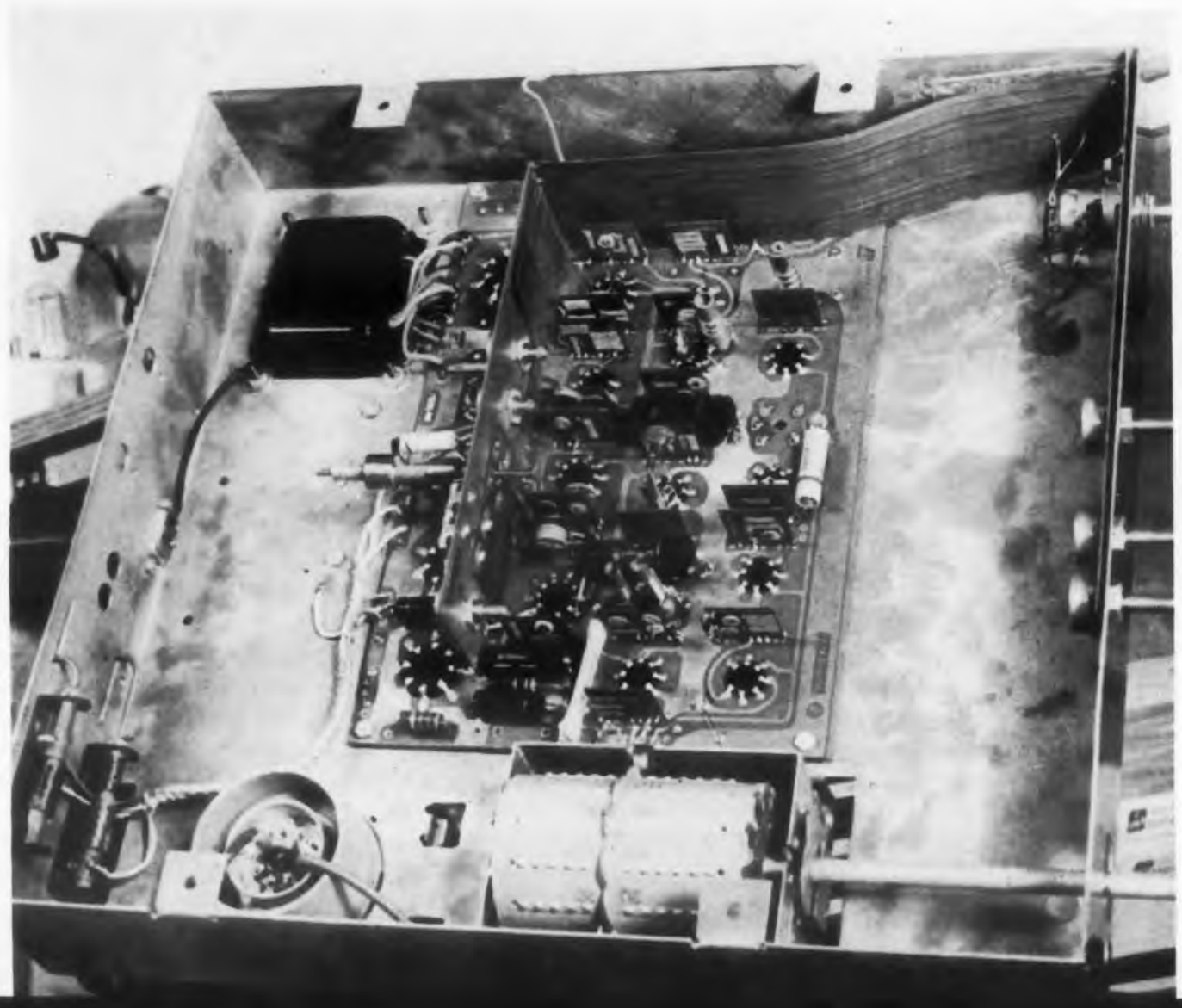
Fig. 1. The standard circuit of this 21" TV set was replaced by "Reliaplates."



3-D Printed Circuits

ADDING A THIRD DIMENSION to printed circuits by means of "Reliaplates" is an important new concept in electronic design and construction. Its significance to the electronic design engineer is demonstrated by the 21" TV monochrome receiver shown in Fig. 1, which is composed entirely of printed circuits assembled by the new technique. Among the advantages are space savings, lower production costs compared with conventional type construction, ease of servicing, and a nominal cost to the manufacturer adopting the new technique. "Reliaplates" were developed by Sanders Associates, Inc., Nashua, N. H.

Fig. 2. Space-saving effected by using three-dimensional printed circuit construction.



Essentially the technique involves the use of small panels called "Reliaplates" which are about one inch square. These panels, containing printed or conventional circuits, have small comb-like teeth plugged into a row of mating holes on the master etched circuit. Connection and mounting of the panels is effected by only one dip-soldering operation.

The panels can use either tape or conventional resistors, and either ceramic or conventional capacitors, as shown in Fig. 4. They are suitable for large-scale production because many "Reliaplates" can be printed on a standard size sheet of copper clad plastic or laminate. For example, a 3 ft square sheet can be cut into almost 1000 panels. The 21" set shown in Fig. 1 requires only 19 panels, and therefore a standard-size sheet could furnish enough material for over 50 such receivers. After printing the circuitry on the sheet, the components can be added at high speed.

Initial cost studies indicate savings of from $5.00 to $10.00 at the manufacturer's level for a 21" TV set. Another production advantage is the elimination of handling of hundreds of individual components and many soldering operations. Repair of the receiver is quickly effected by simply soldering a new panel in place of the defective one.

The space savings afforded by the new technique permit the set designer to either reduce the size of his chassis, or standardize on a relatively small sized chassis for several receivers using different size picture tubes. It is conceivable that with development, the printed circuit might even constitute the entire chassis itself. The space savings will be especially important in color TV sets. Using "Reliaplates", a color TV receiver with over twice the circuitry of a monochrome TV set can be built on the same size chassis.

The technique, now available to manufacturers, can be installed at a nominal cost, with full-scale production being realized within a few months using standard components, and in a little over 12 months using the more economical nonconventional components. It is adaptable to a wide range of electronic equipment. The designer can take advantage of the space-saving possibilities for portable equipment, or the mass production possibilities for other devices, TV sets, portable receivers, and kitchen radios, where space and high-speed production are both important.

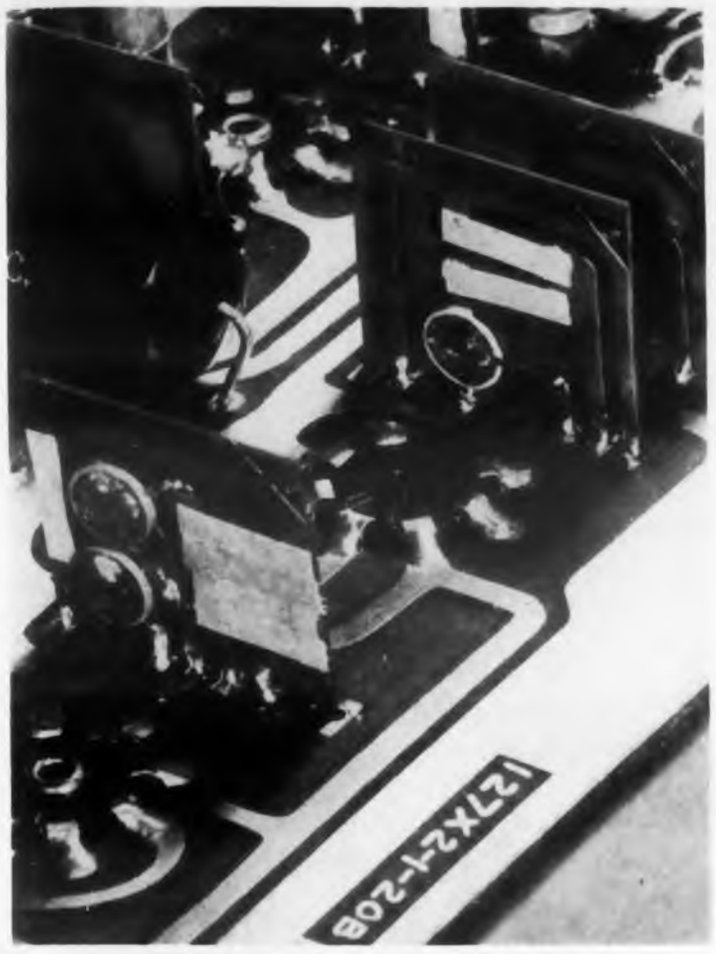


Fig. 3. Closeup of the mounted "Reliaplates," which are easily replaced by soldering.

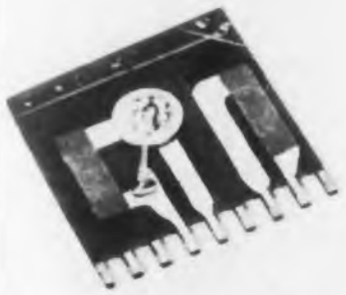
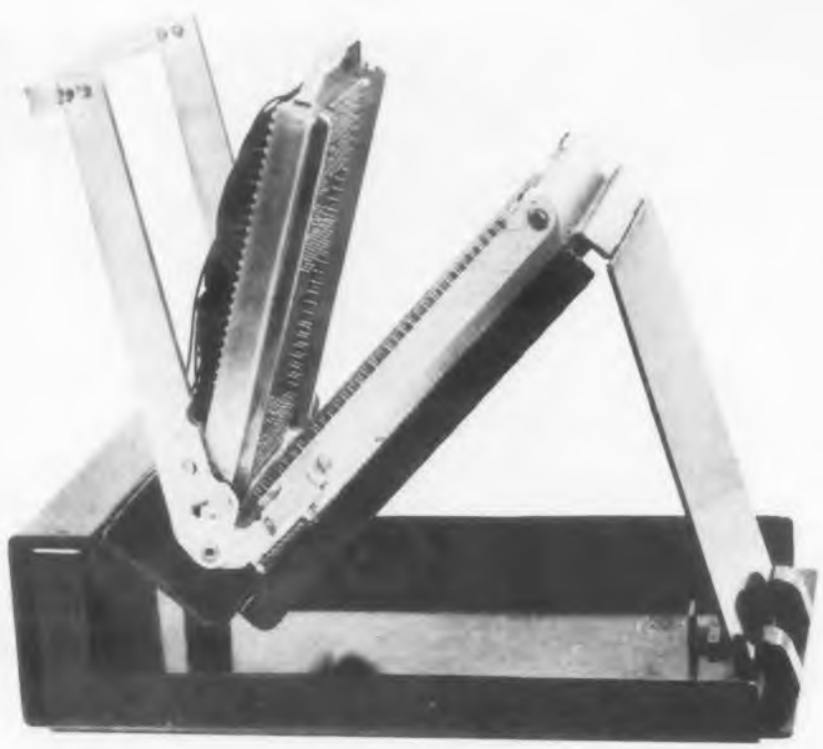


Fig. 4. Either nonconventional components (top) or standard components (bottom) can be used.

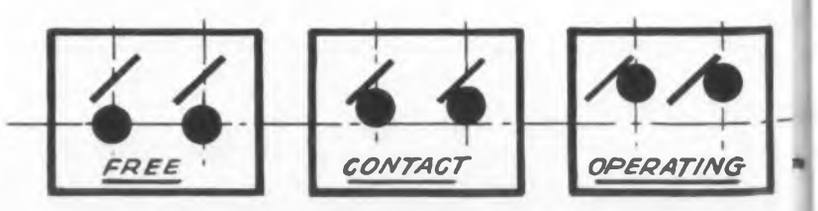
A Versatile Patchcord System

The removable problem patchboard mounted in the frame.

The prepared patchboard is inserted in the frame (right) and all the contacts are made at once by closing the frame by its handle (right, below). The back of the patchboard showing the contact pins sticking through it is illustrated below. The frame is mounted on a demonstration stand.

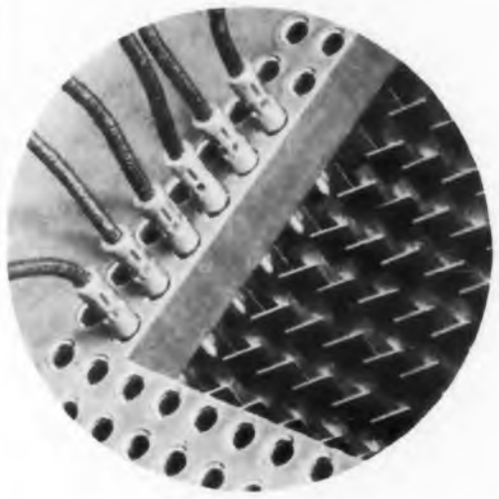


In cross-section, this sequence shows two pairs of contacts before contact, making contact, and in contact.



SIMPLIFIED design and operation, ease of installation, and the use of solderless connections are features of the complete patchcord system shown on these pages. The system permits a unitized arrangement from standard 680 hole program boards, which can receive "AMP Taper Terminals" for lead off, thereby eliminating time-consuming and expensive soldering operations.

The system is made up of a removable program board with a handle, shown at the left, above, the permanent board with 680 wiping contacts, the frame with its cam mechanism, and 340 patchcords. The entire assembly is manufactured by Aircraft-Marine Products, Inc., 2100 Paxton Street, Harrisburg, Pa.



Closeup of the patchcord pins in contact with the mating connectors below.

The prepared program board is inserted in the slotted frame, as shown at the left. All the contacts are made at once by simply closing the frame. Other problems can be set up on additional program boards while the machine utilizing the system is in operation. The board is made of BM 120 phenolic bakelite.

The sequence of three drawings at the left illustrates the mechanical contact action between the tapered contact pins and the knife-like mating connectors. Note the physical displacement of the female connector that insures thorough wiping and results in a low-resistance contact of 6 to 8 oz pressure. The rolled-steel pins travel 0.90" on contact.

New Products . . .

Indicating Amplifier

Measures Low D-C Signals

This Type 2H-LA-3 D-C Indicating Amplifier will amplify very low d-c signals sufficiently to drive a pen recorder or galvanometer. By using a second-harmonic magnetic converter instead of mechanical choppers, the unit achieves high linearity and low drift. The amplifier is useful for null detection and for operation off photocells, strain gages, or ionization chambers.

Ranges for direct indication on the unit's voltmeter are 1, 3, 10, 30 and 100mv. Gain is 10^4 divided by full-scale range in millivolts. Zero drift is less than 1% of full scale on all ranges after a 10-minute warmup. There is no drift for line variations from 105 to 125v or 50 to 70cy.

Input impedance is one megohm per volt, and amplifier linearity is ±1% of full scale on all ranges. Frequency response is from d-c to +20cy. The amplifier is 12″ x 7-3/4″ x 9-3/4″ in size and weighs 20 lb. Doelcam Corporation, Dept. ED, 1400 Soldiers Field Road, Boston 35, Mass.

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

Ultrasonic Delay Lines

3.051 or 6.102μsec Delay

These solid ultrasonic delay lines, provide precise delay intervals: Type SDL-15, 1000 yards, 3.051μsec; and Type SDL-16, 2000 yards, 6.102μsec. Each unit is in an hermetically sealed case.

Carrier frequency is 30Mc. Attenuation is 26db into 1000 ohms. The bandwidth is 8Mc. Bliley Electric Co., Dept. ED, Union Station Bldg., Erie, Pa.

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

Non-Linear Dielectrics

Have Wide Application Range

These non-linear dielectric materials are available in thin sheets from 0.002″ to 0.025″ thickness, or as finished units complete with electrodes, leads, and protective coatings. Narrow loop materials have low losses and are suitable for high frequency applications. Square loop bodies have high remanent polarization necessary for memory work.

Typical applications include dielectric amplifiers, memory devices, modulation, voltage tuning, frequency doubling, sweep circuits, and variable filters. Glenco Corp., Dept. ED, Metuchen, N. J.

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

Power Triodes

3kw and 6kw Ratings

Two power triodes have been made available for use in new equipment designed for the electronic heating, broadcasting, and communications fields. The F-6366 (illustrated) is an industrial oscillator with a 3kw output and filament characteristics of 11v, 29amp. The F-6367 is a 6kw tube designed for use as a modulator, amplifier, and oscillator; it has a filament voltage of 13v and filament current of 36amp.

Both tubes feature thoriated tungsten helical-type filaments, and kovar grid and filament seals, contributing to ruggedness and more dependable operation. Relatively wide spacing between elements makes the tubes especially suitable for industrial applications, presenting high protection against filament-grid shorts.

Rated filament voltage may be applied to cold filaments, eliminating step starting and the need for high-resistance transformers. Maximum d-c plate voltage ratings of 5500v for the F-6366 and 6200v for the F-6367 apply up to 30Mc. Operation up to 50Mc is permissible at reduced ratings. Both types may be operated anode up or anode down. Federal Telephone and Radio Co., Dept. ED, 100 Kingsland Rd., Clifton, New Jersey.

CIRCLE ED-23 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Wheatstone Bridge

Five Scales from 0.05—50,000 ohms

The Normameter Model 185R is an inexpensive portable d-c Wheatstone Bridge. It measures resistances from 0.05 ohms to 50,000 ohms in five ranges with built-in multipliers. Accuracy on three scales (0.5-50 ohms, 5-500 ohms, 50-5000 ohms) is +0.5%. On the 0.05-5 ohm scale, accuracy is +2%. On the 500-50,000 ohm scale is +5%. The null indicating galvanometer has a sensitivity of 4μamp per scale division. To operate, push button switch to connect the voltage source across the bridge.

The unit, made in Austria, operates on a replaceable 4.5v battery from an external source of 4v, or with adapter, on 115v, 60cy. Size is only 6-7/8" x 3-15/16" x 2-5/32". Weight is 1.5 lb. United Optical Manufacturing Corp., Dept. ED, 202-4 E. 19th St., New York 3, N. Y.

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

CRO Electronic Switch

For Viewing Two Patterns

This portable Electronic Switch makes possible simultaneous observation of two patterns on the screen of a single cathode-ray oscilloscope. The relative positions of the patterns may be varied so that they are either superimposed or separated, as desired. Direct comparison of amplitudes, waveforms, frequencies, and phase relationships are thus possible.

A square wave voltage of variable frequency and amplitude is available at the output terminals for use as a test signal in studying the transmission characteristics of vacuum tube amplifiers and other circuits. The switch incorporates direct-coupled amplifiers which are alternately operative and inoperative at a rate determined by the selected chopping frequency. The instrument is therefore effective for chopping a d-c signal, making it suitable for transmission through the oscilloscope amplifiers.

Switching rate is continuously variable from 10 times to 2000 times per second. The instrument is entirely self-contained in a metal cabinet measuring 13" x 8-3/4" x 10". Chatham Electronics Corp., Dept. ED, Livingston, N. J.

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

New Products . . .

Helium-Filled Switch

Hermetically Sealed Button-Type

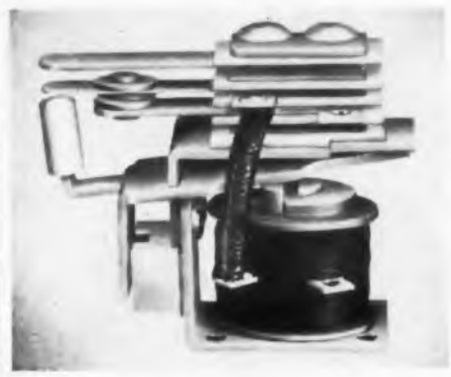
This hermetically sealed switch "button" consists of a set of movable contacts in an accordion-like diaphragm enclosure filled with helium under pressure. The switch can be produced in any size. It will reduce arcing and pitting and will perform at any altitude and in a vacuum. It is also useful where ordinary exposed contacts are likely to be affected by dirt and dust, and in applications where combustible materials are present.

The product can also be used in solenoid-actuated contactors, replacing the usual silver contacts. The high pressure helium gas cuts down ionization and oxidation, thereby reducing arcing and pitting. Slater Electric & Mfg. Co., Inc., Dept. ED, Woodside, N.J.

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

Compact Relay

For Small Split-Phase Motors



The type "MS" relay is for use with fractional horsepower split-phase motors. Voltage operated, it can be used in certain applications where operating conditions make undesirable the conventional centrifugal switch. When mounted in a dust-tight, gas-tight enclosure, it precludes interference from foreign matter and reduces the hazard of explosions from centrifugal switch arcing.

Characteristics include: cut-out nominal operating range 120-130v a-c; cut-back nominal range 50-70v a-c; positive toggle provided by an Alnico magnet; low loss (approximately 3v a-c); and operation in any position. Mounting is by two or four No. 6-32 tapped holes. Overall size is 2-3/16" x 1-13/16" x 1-1/8". Weight is approximately 4 oz.

The relay can be supplied with coils for other voltages or for d-c. It is also available as a conventional relay with 1 Form C spring assembly. For general relay applications, it can be furnished without the toggle magnet for increased sensitivity. Sterling Engineering Co., Inc., Dept. ED, Laconia, N. H.

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

Phenolic Stampings

On Low-Cost, Short-Run Basis

Phenolic stampings to meet requirements for radio of electronic frames, insulators, panels, socket bases, mechanical gaskets and spacers, or cams, are offered on a low-cost, short-run basis by this firm. Any size or shape up to 9″ x 12″ x 1/8″ can be produced for experimental projects, pilot runs, or limited quantity production.

Stampings are die-cut to client specifications by methods holding tolerances to ±0.002, under standard condition. Other non-metallic materials, such as vulcanized fibres, plastics, and insulation paper (fish paper), can also be used. Federal Tool & Manufacturing Co., Dept. KP, 3600 Alabama Ave., Minneapolis 16, Minn.

CIRCLE ED-31 ON READER-SERVICE CARD

Rust-Proofing Treatment

Provides Extreme Protection

"Endurion" is a chemical immersion treatment for the rust-proofing of iron and steel articles. It provides a rust proofing durability on both oiled and un-oiled surfaces so great, as measured by the salt-spray test, as to reach into the range of protective values previously covered only by electro-plated coatings. Products withstand standard salt-spray tests from 12 to 24 times as many hours as those treated by standard phosphate-coating methods.

The treatment provides uniform protection on every surface the fluid can reach. Protection is provided without "building up", an advantage in the rust-proofing of threaded parts and close-fitting assemblies. The surface provides a superior base for bonding paint, permitting one coat to provide the protection of several coats. It also can be applied in integral colors, ranging from gray and black through blue, green, and olive drab—of value for articles too complicated to paint. Rust-Proofing and Metal Finishing Corp., Dept. ED, 75 Commercial Ave., Cambridge, Mass.

CIRCLE ED-32 ON READER-SERVICE CARD

CIRCLE ED-33 ON READER-SERVICE CARD ➤

New Products . . .

Hermetically Sealed Pots

5- and 10-Turn Types

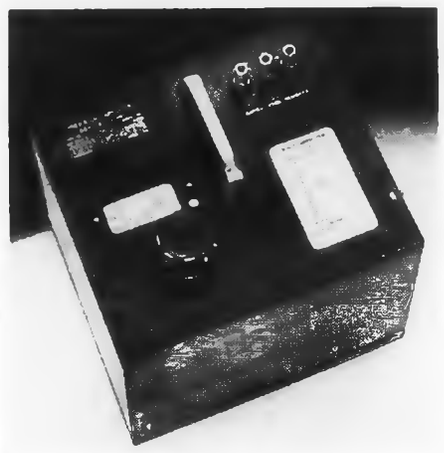
This 10-turn, nitrogen-filled potentiometer, 1" in diameter and weighing only 1-3/4 oz, has been tested at 100 psi at −55°C, 100°C and after 100,000 revolutions. The rear header is solid metal with glass inserts through which the tin dipped terminals project, and all static metal-to-metal joints are solder sealed.

The new series "II" potentiometers have a power rating of 4w at 40°C and a maximum torque between 0°C and 100°C of 2 oz-in. Five-turn units, 1/4" shorter than the 10-turn units, are also available. Ford Engineering Co., Dept. ED, 129 East "A" Street, Upland, Calif.

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

Precision Capacitors

For Substitution Measurements



Intended for use in substitution methods of measurement, the Types 722-MD and 722-ME Precision Capacitors are calibrated in terms of capacitance difference rather than terminal capacitance. For convenience in use, the scales read directly in capacitance removed from the circuit. Each model has two sections, one section having 1/10 the range of the other. The type 722-MD has capacitance-difference ranges of 0-1050mmfd and 0-105mmfd, while the 722-ME has 0-105mmfd and 0-10.5mmfd ranges.

The assembly is mounted in a cast aluminum frame for rigidity. Plates and other parts are also made of aluminum so that all parts have the same temperature coefficient of linear expansion. A worm drive is used to drive the rotor. Low-loss steatite stator insulation or silicone treated quartz insulation is available. Where extreme accuracy is required, a worm-correction calibration can be supplied at extra charge. General Radio Co., Dept. ED, 275 Massachusetts Ave., Cambridge 35, Mass.

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

All-Purpose Dolly

Makes Test Equipment Portable

The basic Model OD-1 Dolly consists of two steel shelves 24" x 24" (19-3/4" between shelves) rigidly mounted on a framework of chrome-plated tubular steel. Four 3" casters, two with brakes, provide mobility.

A number of accessories make the dolly readily adaptable to a wide variety of laboratory requirements. They include: a rugged drawer assembly (with provision for lock) which is easily attached to either or both shelves; a five position lift bar which tilts the scope or other equipment for easier observation, and a power outlet strip with four outlets. The dolly has a green crackle finish. Browning Laboratories, Inc., Dept. ED, Winchester, Mass.

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

Microwave Frequency Multiplier

Output Up to 12.5 KMc

The Model FM-4 Microwave Frequency Multiplier measures and generates stable frequencies in the microwave region as high as 12,500Mc, with continuous coverage. The basic fundamental range is 500-1000Mc. Utilizing harmonics of the basic fundamental oscillator, frequencies up to 12,500Mc can be measured and generated. Frequencies as low as 100Mc can also be measured by dividing by harmonic numbers.

If the external reference standard included in the unit is used, the FM-4 contributes a maximum error of 0.000005%. If an external reference is used, error contribution of the FM-4 is zero. It can be driven from any source which generates frequencies within the 500-1000Mc range, or generates harmonics within that range, or has sufficient output to generate harmonics (within the FM-4) in that range.

Completely self-contained, the unit can be operated directly from a 105-27v, 60cy line. It is enclosed in a 16" x 12" x 21-1/2" aluminum carrying case. Weight is 40 lb. Gertsch Products, Inc., Dept. ED, 11846 Mississippi Ave., Los Angeles 25, Calif.

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

WIDE BAND POCKETSCOPE

by Waterman

MODEL S-14-B

DC COUPLED
REPETITIVE OR TRIGGER
1.8 μs RISE

ANOTHER EXAMPLE OF Waterman PIONEERING...

The WIDE BAND POCKETSCOPE, model S-14-B, hits a new high in frequency response for light, compact, truly portable oscilloscopes. The response extends all the way from DC to 700 KC within —2 db without peaking. Thus providing a pulse rise time of 1.8 microseconds. Furthermore, sensitivity has not been unduly compromised in order to accomplish such fidelity. The vertical sensitivity is 50 millivolts rms/inch. The sweep is operated in either a repetitive or trigger mode and covers a range from 0.5 cycles to 50 KC with synchronization polarity optional. Other essential vertical and horizontal amplifier characteristics include non-frequency discriminating attenuators and gain controls as well as individual calibration voltages. Additional provisions for direct access to all the deflection plates, the second anode, and the amplifier outputs help to make the S-14-B a standout instrument of flexibility and utility. All this plus portability! The incredibly small size and light weight of the S-14-B now permits "on-the-spot" use of the oscilloscope in all industrial, medical, and electronic fields. Its rugged construction assures "laboratory performance" regardless of environment.

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

MEMO... Write for details today!

WATERMAN PRODUCTS

WATERMAN PRODUCTS INCLUDE

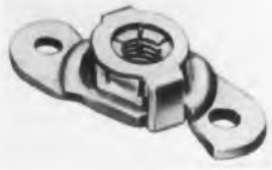
S-4-C SAR PULSESCOPE®
S-5-A LAB PULSESCOPE
S-6-A BROADBAND PULSESCOPE
S-11-A INDUSTRIAL POCKETSCOPE®
S-12-B JANized RAKSCOPE®
S-14-A HIGH GAIN POCKETSCOPE
S-14-B WIDE BAND POCKETSCOPE
S-15-A TWIN TUBE POCKETSCOPE
RAYONIC® Cathode Ray Tubes
and Other Associated Equipment

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

New Products . . .

Anchor Nut Assembly

Meets AN366 Specs



Composed of a steel self-locking hex nut, a spring clip and an aluminum retainer base, this assembly meets all AN366 envelope dimensions. This series was developed when conventional anchor nuts suffered damages during the cleaning process on aircraft sub-assemblies prior to painting.

The bottom anchor plate is welded or riveted to the sub-assembly before cleaning. After painting, the nut and spring are snapped into place in the anchor plate. This unit allows the removal of the nut without necessitating removal of the rivets from the anchor plate. Available in thread sizes 8-32 NC-2, 10-32 NF-3, and 1/4-28 NF-3. Nutt-Shel Co., Dept. ED, 811 Airway, Glendale 1, Calif.

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

R-F Relay

Low Inter-Contact Capacitance

The "MC" Relay is especially applicable to r-f circuitry where inter-contact capacitance losses are critical. It is made with high dielectric ceramic insulation and has an inter-contact capacitance in the order of 1.5mmfd. It is available with a maximum of three movable and three fixed arms which permit many arrangements. Contacts are pure palladium, rated 1amp, 28v d-c, or 115v, 60cy, non-inductive load. Gold alloy contacts can be supplied on order to handle low-voltage, light-current loads.

Coil windings can be provided for operation from 50/60cy a-c or d-c with a maximum 22,000 ohms resistance. The power requirement is 150mw minimum per movable pole.

Contacts will not chatter under 10G vibration up to 300cps and 25G shock with coil power of 500mw or more per movable pole. The relay is insulated to withstand 1000v rms between open contacts, contacts to coil, and contacts to frame; and 500v rms from coil to frame. Hermetically sealed units are also available. Maximum dimensions of open units are 25/32" x 1-1/2" x 1-5/16". Sealed units are 1-13/32" x 1-5/8" x 2-3/32" in size. Potter & Brumfield, Dept. ED, Princeton, Ind.

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

Hook-Up Wire

For Class H Service or Better

"Temprone" stranded copper, silver-plated, hook-up and lead-in wire is supplied in 11 solid colors and over 100 combinations of striped insulation. Standard sizes range from 10AWG to 28AWG, in both thin and heavy wall thicknesses.

Insulated with Teflon, the wire is capable of continuous duty at —100° to +260°C without deterioration. Dielectric strength is 1000v/mil; volume resistivity is 10^9meg/cm. The dielectric constant is 2.0 to 2.05 at frequencies from 60cy to 30,000Mc. There is no known solvent for the insulation. It is non-flammable, will not support fungus growth, and has zero water absorption rate. The wire conforms to the requirements of MIL-W-16878 (ships).

More than 20 combinations of stranding are available as standard, depending on the gauge required. Other strandings and wall thicknesses can be supplied on request. This firm will also furnish hook-up wire with shielding or Teflon impregnated glass fiber braids. Hitemp Wires, Inc., 26 Windsor Rd., Mineola, L. I.

CIRCLE ED-47 ON READER-SERVICE CARD

Silicone Enameled Wire

For High Temperature Use

This silicone enameled wire is intended for use in electrical equipment operating at temperatures of at least 130°C. It has good abrasion resistance, is smooth, and is not attacked by common solvents. The enamel will not craze when exposed to solvents, and will not crack when subjected to temperatures as low as —65°C.

Dielectric strength is 1500v/mil. Wires insulated with the varnish are furnished in single and heavy grades. The film is easily removed by "chemical strippers" such as those used for "Formvar", or by wire brushes. In general, the wire has much the same appearance as other synthetic resin insulated wires. Anaconda Wire & Cable Co., Dept. ED, Muskegon, Mich.

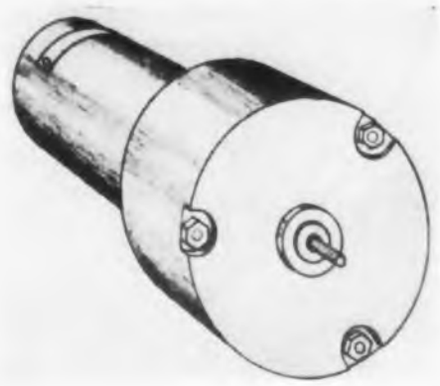
CIRCLE ED-48 ON READER-SERVICE CARD

CIRCLE ED-49 ON READER-SERVICE CARD ➤

New Products . . .

Instrument Servo Gear Train

Has Slip Clutch and Limit Stops



This stock item gear train can be supplied for any practical ratios from 1:1 to 7200:1 for applications in fire control, simulation, analog computers, and automatic systems. It features integral housing of the gearing, a slip clutch, and rotational stops.

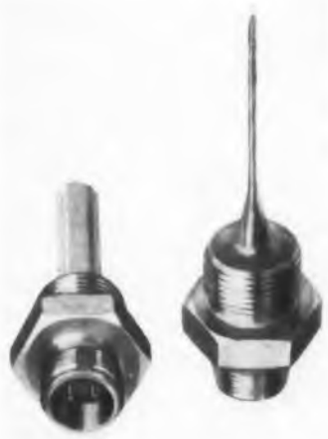
The slip torque may be varied from 1/2 in-oz to 20 in-oz. The limit stop may be set for data shaft rotation from 10° to 40° turns. Backlash is less than 10 minutes and maximum starting torque is less than 0.05 in-oz.

Ball bearing construction is used throughout although bushings may be used in the larger ratios. The housing may be mounted on any servo requested. Feedback Controls, Inc., Dept. ED, 503 Rhode Island Ave., N.E. Washington 2, D.C.

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

Temperature Detector

Has Fast Response



This hermetically sealed electrical Resistance Temperature Detector Model 221 N90A has an exponential time-constant of 0.8 sec or better in an agitated water bath. Designed for use with temperature recording, indicating and control equipment, its useful temperature range is from −70°C to +200°C. Temperature accuracy is +1.0% or better in mid-scale region.

The sensing element is a nickel winding having a basic resistance or 90.38 ohms at 0°C. Sealed in a stainless steel housing with a glass-to-metal sealed base thru which the connection is made, the new detector offers maximum resistance to corrosion and is not affected by most forms of destructive radiation. Thomas A. Edison, Inc., Dept. ED, West Orange, N.J.

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

Custom-Made Templates

Made of Plexiglas

These custom-made templates should save time for designers required to draw the same unusual shape over and over again. The templates are made according to specifications from original blueprints, and are cut in 0.030 plexiglas with a 15° bevel for the tracing pencil. Hermes Engravers, Inc., Dept. No. 88, 13-19 University Place, New York 3, N.Y.

CIRCLE ED-55 ON READER-SERVICE CARD

Connector Insulation

Meets Military Specifications

A new connector insulation material known as Diall 51-01 is manufactured in gray to blend with gray cabinet finishes. It will be used on this company's plugs.

It is a diester material, and meets Specification MIL-P-14D, type MDG. Its arc resistance is 135sec and its dielectric constant at 1kc is 5.2. It has high resistance to moisture, chemicals, fungus, and thermal shock. Cannon Electric Company, Dept. ED, 3209 Humboldt St., Los Angeles 31, Calif.

CIRCLE ED-56 ON READER-SERVICE CARD

Transparent Plastic

Immune to Chemical Action

"CR-39", a clear, transparent scratch and abrasion resistant material developed from thermosetting resins offers high optical and mechanical properties not generally available in glass or the more common clear plastics. The plastic has surface characteristics comparable to polished plate glass in smoothness, lustre and clarity. It is immune to chemical action and has high resilience.

The material is readily machined, drilled, threaded, or routed, and has special "light-piping" and "edge-lighting" qualities. The product accepts permanent printing by a special process other than engraving and filling, which should make it useful and economical for panels and instrument faces. The Homalite Corporation, Dept. ED, 14 Brookside Drive, Wilmington, Del.

CIRCLE ED-57 ON READER-SERVICE CARD

CIRCLE ED-58 ON READER-SERVICE CARD ➤

on SWITCHES by DAVEN

DAVEN not only supplies switches from its hundreds of standard units, but can also effect *quick changes* from standard units to special switches by using components at hand.

As a result, you are able to select, from thousands of variations, the right switch for your particular requirements.

And . . . here's a *new switch* for problems that defy solution with standard components. If your prototype is that of an unusual piece of equipment and requires a switch not yet developed, DAVEN will engineer it for you.

This is a service which DAVEN is singularly well qualified to perform by reason of its skilled engineering staff and exceptional facilities. For more than a generation, DAVEN has built up a Development Department that is second to none in solving difficult switch problems.

Furthermore, because only DAVEN has the patented "knee-action" rotor, units can be produced with a greater number of switch positions and poles in a smaller space than was ever possible before.

Why not call on DAVEN today to assist with your development project, especially if you need switches that must render maximum performance in minimum space.

It's FREE **Write for your copy of DAVEN's new, 28-page brochure on SWITCHES.**

BIG STRAY ROUNDUP

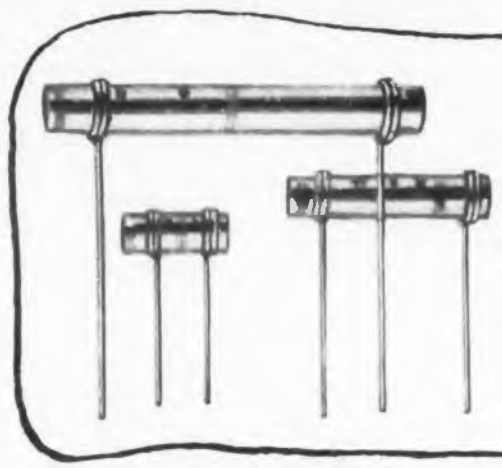
for balky r.f. frequency drift

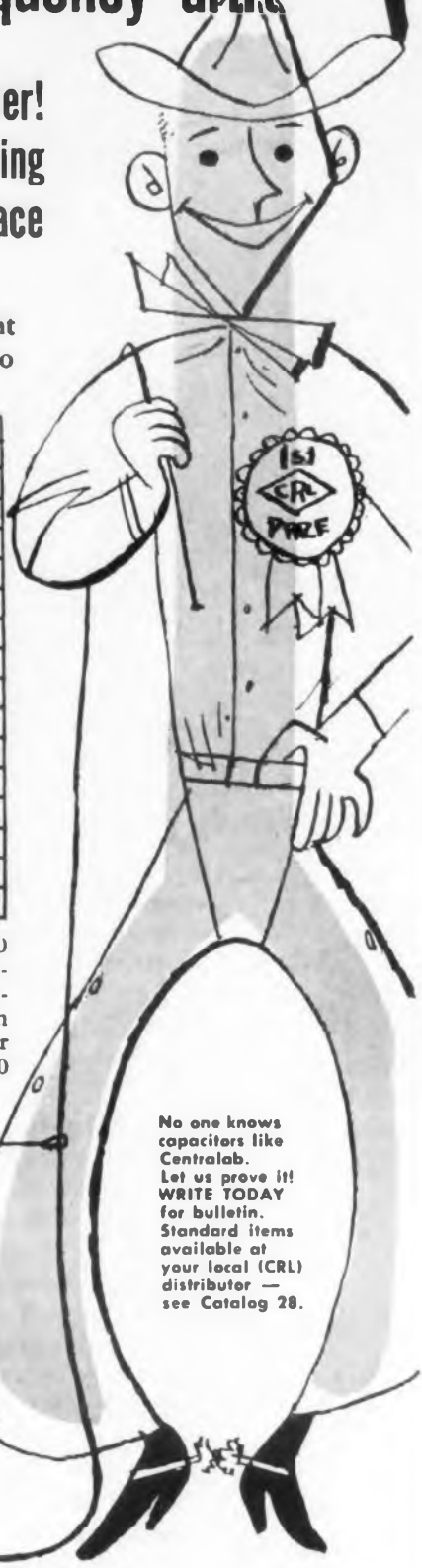
Pard: you've roped yourself a winner! Centralab Temperature Compensating HI-KAPS put the strays in their place ...for keeps!

Use this size-capacity chart to pick the right Centralab TC HI-KAP® tubular capacitors to stabilize your circuits.

	CC20		Tube Size				
T.C.	Min.	Max.	CC25	CC30	CC32	CC35	CC45
P120	4.5	22	60	45	99	199	301
PO30	4.5	22	60	45	99	199	301
NPO	1	22	60	45	99	199	301
NO30	1	22	60	45	99	199	301
NO80	1	22	60	45	99	199	301
N150	1.5	22	60	45	99	199	301
N220	1.7	31	81	60	152	263	399
N330	2.5	36	94	69	152	304	461
N470	3.6	44	114	84	185	369	558
N750	4.2	63	163	120	275	550	795
N1500	9.5	95	244	120	396	791	1197
N2200	24.5	133	343	170	558	1113	1685
N3300	37	204	524	259	852	1699	2572
N4700	59	323	832	412	1352	2695	4080
N5250	73	401	1031	510	1675	3340	5055

Capacities shown are in mmf and (except for CC20 size) are the maximum values obtainable on the respective size tubular. All capacitor bodies are standard construction and price. Lower capacities than minimum shown can be obtained by special capacitor bodies (at extra cost). *Extended range from* N1500 to N5250 available only at Centralab.





No one knows capacitors like Centralab. Let us prove it! WRITE TODAY for bulletin. Standard items available at your local (CRL) distributor — see Catalog 28.

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D-7

Industry's greatest source of standard and special electronic components

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

New Products . . .

Thermistor Kits

With 18 or 104 Units

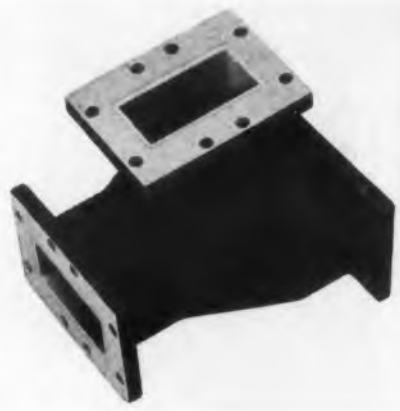
These two special kits enable research and design engineers to conduct exploratory studies in adapting thermistors for temperature detection uses, and for applications in electrical and electronic circuits. Kit No. 1, the smaller of the two, includes 18 thermistors, two each in three styles and three sizes.

Kit No. 2 contains 104 thermistors, including four styles and 26 sizes. This larger kit also contains an assortment of steel, lead, and fiber washers as well as tubing to facilitate building assemblies. Carboloy Dept., General Electric Co., Dept. ED, Detroit 32, Mich.

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

Folded Hybrid Junctions

For 2.8 to 35 KMc



"Guideline Standard" Folded Hybrids are essentially a modification of the familiar "tee" outlet in that the two side arms have been folded back to share a common wall. Further compactness is attained by the use of miniaturized contact flanges at the series and shunt arms, and a dual contact flange for the outlet arms.

These hybrid junctions, by permitting design of more compact mixers, power splitters, and phase shifters make possible simpler equipment layout, construction, and servicing. Sizes are available covering useful frequencies from 2800Mc to 35,000Mc. All types feature a bandwidth of 12% around the design center frequency, terminated vswr's less than 1.30, and a minimum 30db isolation of the E and H plane arms.

Units are available in silver-plated brass or in iridited aluminum finished in zinc chromate and black enamel. Optional for the complete series are E and H plane adapters consisting of dual contact flanges in the inputs, with standard AN flange outputs. Airtron, Inc., Dept. H, Linden, N. J.

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

Servo Lubricant

Corrosion Resistant

Wear and "striction" problems for aluminum gearing are reduced with "Servo Lube", an anti-corrosive lubrication prepared for low-inertia servo applications. A formulation of purified molybdenum sulfide, Servo Lube is brushed on and then air dried in a few minutes.

Surfaces treated remain absolutely dry with a surface layer of lubricant chemically bonded to aluminum components. The product is available in test kit quantities. Electronic Products Co., Dept. ED, 1315 Jericho Turnpike, New Hyde Park, N.Y.

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

Oscilloscope Adaptor

For Observation of TV Signals

The Type 124 Adaptor adapts any triggered wideband oscilloscope to the observation of the TV composite video signal. The unit's delayed-trigger output is continuously variable from 0 to 25millisec after receiving a vertical sync pulse. By adjusting the delay, an oscilloscope can be triggered at the start of any desired line in a field. A panel pushbutton provides instant shift to the opposite field. Triggering occurs at half the TV vertical rate. Duration of the output pulse is less than 1μsec, and amplitude is 2v positive. Triggering may be accomplished by the composite video signal of either polarity, 0.5v minimum to 20v maximum, peak-to-peak, or a 60cy sine wave.

The time-marker generator requires a gate of 20v minimum to 60v maximum, peak-to-peak. Markers are supplied for the duration of the gate. Time marker intervals are 1μsec, 0.1μsec, 0.05μsec, and 0.005H (200 per TV line). Amplitude is continuously variable from 0 to 30v. Phase control permits positioning the markers on the trace.

To make use of the time-marker output, the oscilloscope should have a positive gate output and a CRT cathode terminal. Size is 6-3/4" x 12-3/4" x 12-1/2". Weight is 20 lb. Tektronix, Inc., Dept. ED, P. O. Box 831, Portland 7, Ore.

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

Microwave TEST COMPONENTS

PRD offers a complete line of test equipment for precise measurements in the Microwave region. This equipment, the finest obtainable anywhere, includes Frequency Measuring Devices, Signal Sources and Receivers, Attenuators and Terminations, Impedance Measurement and Transformation Devices, Detection and Power Measurement Equipment, Bolometers and Accessories.

n you test,
e the best–

PRD

QUALITY
DEPENDABILITY
ACCURACY

TYPE 250-A BROADBAND PROBE – Frequency range of 1 to 12.4 Kmc/s; two tuning knobs permit precise adjustment for maximum power transfer from the probe tip to the crystal or bolometer detector; third knob controls depth of probe tip insertion.

SLOTTED SECTIONS—The mechanical and electrical design of PRD slotted sections emphasizes these important features: Instrument accuracy assured indefinitely by virtue of three bearing carriage suspension to minimize wear; waveguide section machined from solid aluminum alloy stock, to avoid warpage no castings are used.

TYPE 275 VSWR AMPLIFIER – Featuring high gain; A.G.C. to maintain output constant for slow variation in r-f power source; low input noise level of 0.03 microvolts; wide VSWR ranges of 1:1.3, 1:3, 3:10, 10:30, and 30:100; greater accuracy because VSWR scale on meter is linear.

Polytechnic RESEARCH & DEVELOPMENT COMPANY• Inc

55 JOHNSON STREET, BROOKLYN 1, NEW YORK
WESTERN SALES OFFICE:
741½ NO. SEWARD ST., HOLLYWOOD 38, CALIF.
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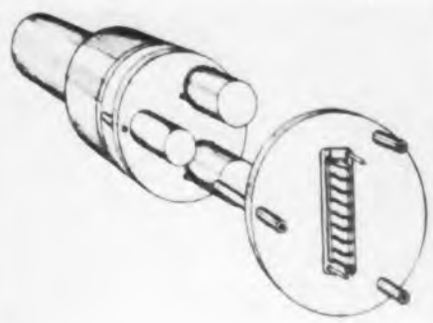
1 SO. NORTHWEST HWY., PARK RIDGE, ILL.

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

New Products . . .

Instrument Servo Package

Gear Train, Clutch, Limit Stops, etc



Simplification of servo instrumentation is made possible by utilizing this Instrument Servo Package, which includes a gear train, slip clutch, limit stop and data output units. Its construction permits components to be mounted on the servo to allow data elements of varying rotational speeds to be combined for desired solutions. It may be supplied with a motor-generator set and amplifier. Feedback Controls, Inc., Dept. ED, 503 Rhode Island Ave., N.E., Washington 2, D. C.

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

Resonant Relays

Operate at 60 to 442cy

A 60cy model has been added to this firm's line of Resonant Relays, which includes 11 other relays operating at standard frequencies from 153cy to 442cy. These relays use a vibrating reed mechanism adjusted at the factory to respond to a narrow band of frequencies and to reject all others. The contacts in turn are connected in series between the power supply and the circuit to be controlled. When the relay operates, the current is delivered to the circuit in pulses at the resonant frequency of the relay. In "on-off" applications, a conventional slow acting relay is used as an auxiliary. In electronic applications, the grid of a thyratron is triggered directly from the vibrating contacts.

The design makes remote control possible at low costs wherever there are existing wires to permit transmission of carrier current frequencies or where there is a radio circuit. At the normal operating level of 3v, band width is ±1% minimum. Only 20mw are required to operate a relay at this normal level. Contact rating is 110v d-c, 1/4amp maximum. Contacts are closed 5% of the time or 1/20th of a cycle.

The relays are enclosed in a standard metal radio tube envelope with an octal base; seated height is 2-3/4". Stevens-Arnold, Inc., Dept. ED, 22 Elkins St., South Boston, Mass.

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

Miniature Sealed Relay

Withstands 50G Shock

For aircraft and missile applications, the type "MRH" relay has dimensions approaching those of miniature tubes. Useful at 50G shock and 20G vibration up to 500cy, it provides 2amp contacts in dpdt combination. It is available for use at ambients of 85°C or up to 200°C for special purposes.

All contact insulation is ceramic and glass, making the relay valuable for high frequency switching applications. It occupies a volume of 0.75 cu in, and weighs 1.4 oz. Coil resistances up to 10,000 ohms are available. The relay can be supplied in a plug-in arrangement as well as a new ferrule mounting. Branson Corp., Dept. ED, Boonton, N. J.

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

Motor-Driven Commutator

For Telemetering, Sampling, etc.

The Model 85562 multi-channel motor-driven telemetering commutator has many applications in radio and wired telemetering, automatic programming, sampling, and monitoring. It incorporates such features as rhodium-plated printed circuits to meet individual customer requirements, and high speed sampling with as many as 1800 contacts per second. Switching can be "break-before-make" or "make before-break", with a phase adjustment feature provided on the 2-pole model.

Special features are dust proof construction and a unique contact cleaning system that keeps the switch free of noise throughout the design life of the instrument. The commutator is currently in production using two drives with gear reducers, a constant-speed governor-controlled motor, or a variable speed motor in which the speed varies linearly with the applied voltage. Rated voltage of both drives is 24-29v d-c. G. M. Giannini & Co., Inc., Dept. ED, 39 Main St., East Orange, N. J.

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

New Products . . .

Latching Relays

Positive Action Despite Wear

Designed for electronic and electrical control applications, these compact lightweight relays are resistant to vibration and shock, and incorporate angle mounting of the coil mechanism. A new wedge action feature insures positive action regardless of wear or play in the armature hinge joints. They are designed to give dependable action in any position.

Contacts in these relays are rated at 8amp, 115v a-c, or 8amp, 29v d-c. The coil is capable of continous or intermittent duty with resistance to 10,000 ohms. Maximum voltage is 120v a-c, or 120v d-c. The relays measure 3-11/16"x1-7/8"x1-11/16". Leach Relay Co., Dept. ED, 5915 Avalon Blvd, Los Angeles 3, Calif.

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

Electronic Counter

Counts up to 10,000 digits/Min

The model RC precision, direct readout cold cathode electronic counter operates at speeds up to 10,000 counts per minute and has a total counting capacity of 9,999,999. It consists of an electronic decimal unit preceding a six digit electromagnetic register. Complete independence from line voltage variations and fluctuations is featured. Illumination of the direct reading decimal scale is derived directly from the associated cold cathode tubes rather than from the auxiliary light circuit. Decimal unit numbers are large for easy reading.

The counter is used for such applications as totalizing linear footage, timing, and life testing. It can be used in conjunction with photoelectric or capacity operated equipment, and can function with practically any transducer pick-up. Haledy Electronics Co., Dept. ED, 57 William St., New York 5, N.Y.

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

Soldering Iron

Weighs only ½ oz.

Weighing only 1/2 oz, the "Oryx" soldering instruments should be valuable to the designer as well as the production engineer. Only 6" long, these robust units have no ceramic or mica formers to break or flake. They require only 20 or 30sec to heat.

A wide variety of operating voltages is available as well as tips for precision soldering. The units are imported from England. Television Accessories Co., Dept. 1, Box 6001, Arlington 6, Va.

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

Cathode-Ray Oscillograph

Wide-Band, General-Purpose Unit

The Type 323 Oscillograph features high precision measurement of both time and amplitude over the entire range of general laboratory applications. Its direct-coupled 10Mc (3db down) vertical amplifier enables display of very-low-frequency phenomena, as well as high speed pulses, together with their d-c level. Sweeps are directly calibrated by means of a front-panel dial; recalibration, if ever needed, is easily accomplished. Sweep range extends from 1 sec to 0.1μsec per inch.

The scale of the Type 323 may be calibrated to read directly in volts by means of internally generated voltage standards. Eleven ranges, from 0.2v to 400v full-scale. Other features include a new type cathode-ray tube based upon the mono-accelerator principle which minimizes spot and field distortion; and electronic regulation of all power sources, including critical heaters. Allen B. DuMont Laboratories, Inc., Dept. ED, 760 Bloomfield Ave., Clifton, New Jersey.

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

New Products . . .

Self-Generating Accelerometer

Sensitive to ±0.003G

Comparable to a walnut in size, this Self-Generating Accelerometer is especially designed to determine frequency and amplitude at high voltages. Power output is as high as 2v, without external excitation. Sensitivity is as low as ±0.003G, and frequency response is from 2 to 350cy. The unit operates with extreme accuracy at temperatures up to 550°F.

Produced in a wide range of ratings, it can be used for many types of impact acceleration studies, vibration analyses, and a range of other applications for aircraft, guided missiles, and general industry. General Scientific Corp., Dept. ED, Los Angeles, Calif.

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

Voltage Standard

Also Provides Regulated Power

This "Regatron" series provides in one unit a variable d-c voltage standard, a high-powered super-regulated power supply, and a research voltage source with small signal modulation—in a single chassis, standard relay rack, or table models. D-c voltage is 0-600v vernier calibrated on a 10-turn precision potentiometer to 0.25% (or better where required).

Current ratings available are 0-600ma or 0-1000ma. Regulation is 0.05% or better where required. Usefulness of low voltages for transistor work is increased by a 0.3v electrical vernier and an injection circuit for small signal modulation of the output. Auxiliary bias and filament potentials are included. Electronic Measurements Co., Inc., Dept. ED, Lewis St. and Maple Ave., Eatontown, N. J.

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

Low-Noise Transistors

For Use in Hearing Aids

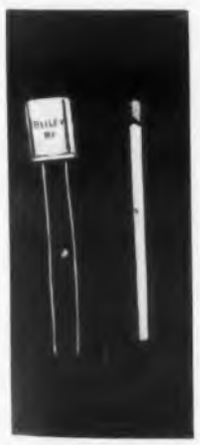
Designed for use in hearing aids, the compact HA-1, HA-2, and HA-3 junction transistors are tested to meet the low-noise requirements of hearing-amplifiers. The HA-1 and HA-2 are high-gain units for the low-level stages. The HA-2 was designed for the power output stage. The three units together provide sufficient gain and output for a three-stage hearing aid amplifier.

The units are impregnated with a moisture-resistant compound. They are contamination-proof, light-proof, and humidity-proof. CBS-Hytron, Dept. ED, Division of the Columbia Broadcasting System, Danvers, Mass.

CIRCLE ED-87 ON READER-SERVICE CARD

Subminiature Crystal

For 15-100Mc Range



The "Bantam BX" Crystal provides a subminiature crystal unit for precision frequency control. Hermetically sealed with wire leads, it has a 15-100Mc range. It has the same performance characteristics as MIL types CR-23 or CR-32.

The unit can be applied wherever precision performance is required, for example, in multi-channel communications operations. It may be wired into a miniature socket or soldered to a printed circuit terminal board. Bliley Electric Co., Dept. ED, Union Station Bldg., Erie, Pa.

CIRCLE ED-88 ON READER-SERVICE CARD

CIRCLE ED-89 ON READER-SERVICE CARD ➤

New Products . . .

Instrument Cabinet

For Vertical or Horizontal Stacking

Constructed of cold rolled welded steel, this instrument cabinet is finished with a two-tone metallic gray finish. Top, bottom, back, and both end panels are easily removed with a screwdriver, allowing complete accessibility.

Cabinets can be stacked vertically or horizontally and locked together in minutes by Tinnerman Speed Nuts with a screwdriver. The design accommodates chassis with 8-3/4" x 19" front panel and 15" depth. Chassis guide supports are adjustable to any chassis up to 17" wide. Standard RETMA and WE mounting holes are on front, back, top, and bottom for fastening panels. Four rubber feet are included. There is a choice of three different ventilating panel systems. Elgin Metalformers, Corp., Dept. ED, 906 N. Liberty St., Elgin, Ill.

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

Electric Counter

Operates Switches

A valuable automation component, the Model "SP" Predetermined Electric Counter is actuated by electrical impulses and closes or opens at any preset count from 1 to 99,999. The unit is available in two models with four or five figures for counts of 1 to 9999 or 1 to 99,999, respectively. A metal hinged cover provides quick access to the predetermined count wheels for easy setting.

Switch capacities are 5amp at 125v or 250v a-c, 0.5amp at 110v or 200v d-c, noninductive load, and 0.3amp at 110v or 220v d-c, inductive load. Standard operating voltage is 105 to 120v, 60cy. Other operating voltages are available on request. Switch contacts are normally open in the standard counter. Normally closed contacts can be supplied.

The counter is 4-3/8"x2-1/8"x2-5/8" in size, and weighs 1-3/4 lb. Top counting speed is 600 counts per minute. Durant Manufacturing Company, Dept. ED, 1993 N. Buffum St., Milwaukee 1, Wisc.

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

RMS Voltmeter

Measures Complex Waves

The Model 320 True RMS Voltmeter is an instrument of the ultrasensitive type to measure true root-mean-square values of highly complex wave forms in addition to sinusoidal waves. It operates over a range of 100μv to 320v and in a band of 5cy to 500kc. Accuracy is better than 3% between 15cy and 150kc for any reading regardless of scale position.

Other features include a 10 megohm input impedance, a provision for simultaneously observing the voltage reading and monitoring the amplified signal with phones or CRO, and a built-in calibrator unit for correcting the effects of advanced aging of tubes. Accessories are available for extending voltage range to 20μv and 10kv, and for measuring rms currents from 0.1μamp to 10amp. Ballantine Laboratories Inc., Dept. ED, Boonton, N.J.

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

Miniature Magnetic Amplifiers

For Voltage or Current Measurement

These miniature, Low-Level Magnetic Amplifiers, Models M-21 and M-22 were designed for current and voltage measurements, respectively. Inexpensively priced, they feature high gain, fast response and high stability. The Model M-21 is suitable for current measurement from high impedance sources such as photomultiplier tubes, photovoltaic cells, etc. It includes a half-wave rectifier. An input current of 50μamp d-c produces a linear output of 5ma with a 100 ohm load.

The Model M-22 is suitable for voltage measurement from thermocouples, strain gages, resistance thermometers, etc. It is of the self-balancing type, and includes a full-wave bridge rectifier. The dynamic impedance of the control loop is as high as 100 to 500 times the actual d-c resistance. An input voltage of 10mv d-c produces a linear output of 5ma d-c with a 1000 ohm load. The supply voltage for both models is 50 $\pm$10v, 60cy. Dimensions are 2"x2-1/4"x2-1/2", with the rectifier outside the can. Magnetic Controls, Inc., Dept. ED, 119 West 63 St., New York, N.Y.

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

New Products . . .

Precision Resistor

Tolerances of 1%, ½% or ¼%

This highly compact precision resistor is simply a pure noble-metal film coated on the inside of a rugged, heat-resistant glass tube. The resistor is hermetically sealed. Characteristics include high stability, low temperature coefficient, negligible effective resistance change to frequencies as high as 10Mc. The typical 1w size measures 1" long x 5/16"diam.

Ratings of 1/2w, 1w, and 2w are available in values from 10 ohms to 100,000 ohms (higher values on special order), with tolerances of 1%, 1/2%, 1/4%. The resistors exceed the requirements of MIL-R-10509A. Balco Research Laboratories, Dept. ED, 49-53 Edison Pl., Newark, N.J.

CIRCLE ED-101 ON READER-SERVICE CARD FOR MORE INFORMATION

Dual Cathode Follower

Output Impedances of 100 ohms

The Type M1523 Dual Cathode Follower is specially designed for coupling low-output impedances with high input impedances. It utilizes the properties of the Type 5687 tube to provide two independent cathode followers within a single unit. Miniature and resin encapsulated, it is designed for plug-in operation.

The unit is valuable for joining high-impedance sources, such as flip-flops, oscillators, and voltage amplifiers, with low-impedance devices, such as transmission lines, matrices, filters, or capacitive circuits where fast rise times are desired. The input grids, provided with 100K return resistors, may be connected to an external bias source or left floating. In the latter case, the input can be coupled directly to the grids.

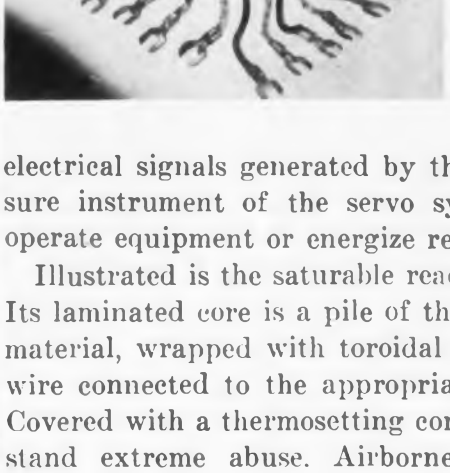
Each cathode output impedance is 100 ohms, tapped at 1000 ohms, with the signal amplitude at the tap approximately 65% of the cathode signal amplitude. Output impedances of approximately 50 ohms and 500 ohms are available by paralleling the two sections.

Size of this unit is only 1-1/4"diam x 3-7/8" seated height. It is based on an 11-prong, octal-style plug, with the tube accessible. The Walkirt Co., Dept. ED, 145 W. Hazel St., Inglewood, Calif.

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

Magnetic Amplifier

For Flight Control Systems



This magnetic amplifier was developed especially for flight control systems using artificial "feel". It affords simple, reliable means of amplifying feeble electrical signals generated by the dynamic air pressure instrument of the servo system sufficiently to operate equipment or energize relays.

Illustrated is the saturable reactor of the amplifier. Its laminated core is a pile of thin rings of magnetic material, wrapped with toroidal windings of magnet wire connected to the appropriate number of leads. Covered with a thermosetting compound, it will withstand extreme abuse. Airborne Accessories Corp., Dept. ED, Hillside 5, N. J.

CIRCLE ED-104 ON READER-SERVICE CARD FOR MORE INFORMATION

Precision Timer

Measures 0.01-999μsec Intervals

The Model 432 Interval Timer is a precision instrument for measuring short time intervals. Three ranges are provided: 0.01-9.99μsec, 0.1-99.9μsec, and 1-999μsec. In addition the instrument serves as a high-speed totalizing counter with a count capacity of 999, and as a secondary frequency standard with outputs of 100kc, 10kc, 1kc, 100cy, 10cy, and 1cy.

In making a time-interval measurement, three electronic decades count the number of time-base pulses occurring during the unknown interval. A choice of three different time-base frequencies is provided: 100kc, 10kc, and 1kc.

Control of start and stop for time-interval measurements may be achieved by any of the following: positive pulse, negative pulse, contact closure, contact opening, or any combination thereof. Counters may be reset at the end of each interval measurement or allowed to accumulate a number of intervals for averaging. Counts are indicated by neon lamps that show through transparent numbers from 0 to 9 arranged in vertical columns, one column for each digit. Potter Instrument Co., Inc., Dept. ED, 115 Cutter Mill Rd., Great Neck, N.Y.

CIRCLE ED-105 ON READER-SERVICE CARD FOR MORE INFORMATION

CUSTOM-ENGINEERED TRANSFORMERS

produced under

ONE RESPONSIBILITY

from copper wire to final test...

- Wheeler transformers are custom-engineered to meet your specific requirements. Your needs come first with us.
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- Wheeler uses the most modern winding techniques and equipment.
- Wheeler's facilities for the production of intricate coils and assemblies are unexcelled.
- Wheeler affords fullest protection to its transformers with latest techniques in wax and varnish impregnation and FOSTERITE® encapsulation.
- Wheeler transformers are subject to specially devised engineering and test procedures throughout manufacture, and must individually undergo a final comprehensive test before shipment.

To learn what these advantages can mean to you, write:

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CIRCLE ED-106 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Sensitive VTVM

Lowest Scale 0-1mv D-C

This series of redesigned vacuum-tube volt and ampere meters for a-c and d-c measurements includes the Model MV-17C d-c millivoltmeter which has a 0-1mv sensitivity (illustrated); the Model MV-11B d-c micromicroammeter; and several a-c voltmeters.

The Model MV-17C has 13 ranges from 0-1mv to 0-1000v, d-c. Its accuracy is ±3% of full scale. Dimensions for all models are 7″ wide x 12″ high x 7″ deep.

The units feature an improved re-tunable d-c modulator, and redesigned amplifiers assure higher accuracy and stability. Millivac Instrument Corp., Dept. ED, 444 Second St., Schenectady 6, N. Y.

CIRCLE ED-108 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistance Analyzer

Measures 1k to 111meg

This Resistance Analyzer accurately measures the voltage coefficient of a wide range of resistances. Primarily a high-precision, general-purpose, resistance measuring laboratory instrument, it measures over the range of 1000 ohms to 111Meg to within 0.1%. The voltage coefficient of any resistor up to a capacity of 1.5w can be determined down as low as 0.0002%/volt.

The voltage across the measured resistance is continuously variable in two ranges from 0 to 500v by a self-contained regulated power supply. Sensitivity of balance is within 0.04% on all ranges. The unit is designed for 115v, 60cy operation. The Kuljian Corporation, Dept. ED, Broad and Gerard Streets, Philadelphia, Pa.

CIRCLE ED-109 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Blower

Supplies 24cfm

An unusually compact miniature type motor-blower assembly, designed to occupy a space no larger than 2-1/4″ x 2-1/4″ x 4″, supplies 24cfm free air under continuous duty. Blower or suction operation is afforded by the unit's two-blade propeller-type fan, powered by a powerful permanent magnet motor rated at 6v to 115v d-c.

Speed is 10,000 to 13,000rpm, with 0.50amp current consumption. The housing of the assembly is made of cast aluminum, and it can be supplied with a radio noise filter. Pioneer Electric and Research Corp., Dept. ED, 743 Circle Ave., Forest Park, Ill.

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

Fixed Frequency Oscillators

From 300 to 10,000cy

These fixed frequency, low-distortion Model DK-1 audio oscillators feature zero impedance output of 10v at 2w, and a variable voltage output at low impedance. The Model DK-1 provides an inexpensive source of essentially pure, highly stabilized sine wave power for general lab use and production testing. Amplitude and frequency stability under difficult load and line conditions make this model an ideal a-c power supply for magnetic amplifiers and precise measurements at simulated line frequencies.

In stock are frequencies from 300cy to 10,000cy, in increments of hundreds; or, on special order, from 301cy to 9999cy, without additional cost. Harmonic content is less than 0.08% total, and amplitude shift between no load and full load or line voltage variation of 10v is less than 0.18%. Frequency shift between load and no-load is less than 0.16%, shift due to 10v of line fluctuations is zero, and frequency drift is negligible after warm-up. Housed in a ventilated case 4-3/8″ x 3-3/4″ x 8-1/2″, the circuit is an L-C, bridge type, incorporating a high Q toroid, a mica capacitor, and an air trimmer, combined with a self-balancing feedback amplifier. The Nuclid Corp., Dept. ED, 45 West Union Street, Pasadena 1, Calif.

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

New Products . . .

Multiple Headers

With Hermetic Silicone Terminals

Series 2M1 Multiple Headers are available with two hollow tube, turret head, or slotted head type terminals. These hermetic silicone terminals are supplied attached and ready for use. The headers also have two 6-32 x 1/4" steel studs. All metal parts are hot tin dipped to assure good soldering to cans.

Diameter of this type cover is 0.950". Electrical specifications are the same as the firm's No. "0" Hermetic Terminal. Strat-O-Seal Manufacturing Co., Dept. ED, 3039 W. Fullerton Ave., Chicago 47, Ill.

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

Frequency Meter

Counts Electrical and Mechanical Events

The Model DS-660 Frequency Meter is an economical lightweight unit designed for portability and accuracy. It will count and display an electrical or mechanical event that can be converted into a varying voltage of sufficient amplitude. It counts 20 to 100,000 events per second. It derives its time base from the 60cy line, which in turn determines the accuracy of approximately 0.1%.

Features include automatic and manual reset; self-checking; basic unit read-out to 10kc (four decades); and a new decade plug-in unit. Size of the complete unit is only 7-1/2" x 9-3/4" x 14-1/4", with a weight of only 16 lb. Accessories offered include a tachometer pickup and a photo cell, both available at slight extra cost. Additional decade units to increase count capacity are also available. The Detectron Corp., Dept. ED, 5420 Vineland Ave., North Hollywood, Calif.

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

Bonded Germanium Diodes

With High Back Resistance

The CK739 and CK742 are gold bonded germanium diodes designed for magnetic computer and similar applications where extremely low forward resistance and high reverse resistance characteristics are important. The flexible terminal leads may be soldered or welded directly to the terminals of the computer components without the use of sockets. Standard subminiature sockets may be used by cutting the leads to a suitable length.

The diodes have plastic and glass cases. They are characterized by forward resistances of 10 ohms or less at 1v, and back resistances of several megohms at negative voltages as great as 125v. The major difference between the two types is that the peak inverse voltage rating of the CK742 is 125v, double that of the CK739. Raytheon Mfg., Dept. ED, 55 Chapel St., Newton 58, Mass.

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

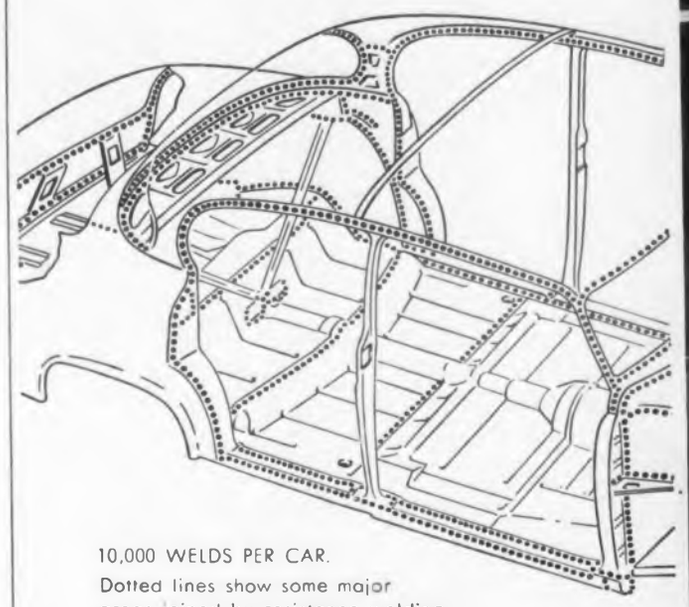
Precision Potentiometers

Single-Turn Type

These single-turn, all-metal, precision, wire-wound potentiometers can be used in a wide variety of military and general computer applications. All models are available with either low-torque bronze sleeve bearings or class 5 stainless steel ball bearings. Both linear and non-linear windings can be furnished in each size, and multi-section units are supplied with external ganging rings.

Models are available with resistance ranges (linear) of 90-140,000 ohms, 120-178,000 ohms, and 180-283,000 ohms, with resistance tolerances of ±5% or ±1% (on specification). Resistance ranges of non-linear units depend on the particular function; their resistance tolerances are ±5%. Linear accuracies are as close as ±0.075% of input voltage, depending on the model. Non-linear accuracies go down to ±0.3%. George Rattray & Co., Inc., Dept. ED, 116-08 Myrtle Ave., Richmond Hill, N. Y.

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



10,000 WELDS PER CAR.
Dotted lines show some major areas joined by resistance welding.

New Products . . .

Ceramic-Metal Terminals

For Temperatures to 1400°F

A line of high-temperature terminals and insulators of metallized ceramic is rated for brazing and service temperatures up to 1400°F, yet priced competitively with lower-temperature units. They are for hard-solder applications and are of use wherever a wide range of temperatures and severe thermal shock are encountered. The type illustrated is available as a standard item with diameters from 7/32″ through 1/2″ and ratings from 3400v to 14,000v. Larger sizes can be specified.

This firm's service includes full cooperation on design of the terminals or insulators and the related equipment in respect to the metal alloys used, as well as performing the actual brazing of the units into the metal closures or other parts.

A similar line of soft-solder terminals in the same sizes as the hard-solder units are also available. Advanced Vacuum Products, Inc., Dept. ED, 22 Liberty St., Stamford, Conn.

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

Sensitive Galvanometers

For Recording Oscillographs

Series M Galvanometers measure only 1/8″ diam x 2-21/32″ long. The magnet bank, which holds 12 active galvanometers and two static-trace galvanometers, measures 4-5/8″ high x 2-1/4″ wide x 3-1/4″ deep, including galvanometers, heater elements, thermostat, etc.

Galvanometers are inserted directly into numbered holes, making all electrical connections automatically; they are isolated from each other and from ground. The bank has individual adjusting screws which permit each galvanometer light to be adjusted in the vertical plane; in the horizontal plane, the entire galvanometer is rotated. It is not necessary to insert dummy galvanometers into vacant positions of the magnet bank to maintain the magnetic field. The standard optical lever for the Series M Galvanometers is 11.8″ (30cm). Heiland Research Corp., Dept. ED, 130 E. 5th Ave., Denver 9, Colo.

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

Expanded-Scale A-C Voltmeter

Covers 100-500v in 39 Steps

This a-c voltmeter features both scale expansion and recording over the 100-500v range. It covers the range in 39 easy-to-read steps, full scale. True rms readings are obtained with accuracies better than ±0.25% of input voltage. Frequency response is uniform between 50 and 2000cy, eliminating the need for delicate or specially built laboratory voltmeters to measure a-c voltages accurately.

The voltmeter offers built-in recorder connections for continuous recording of line voltage fluctuations with a 1ma d-c recorder, simplifying problems of voltage regulation or stabilization in a-c systems. Arga Division, Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

CIRCLE ED-127 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Current D-C Supply

Magnetic-Amplifier Regulated

Utilizing no vacuum tubes or moving parts, the "Stablvolt" Type A line of power supplies is designed for ruggedness, reliability, and maintenance-free operation. Dual magnetic regulation effectively isolates line voltage transients from the d-c output voltage. The response to a-c line variations of 95-135v is practically instantaneous, with dynamic line regulation better than 0.2%.

These low-voltage, high-current supplies have many possible applications in the field of d-c measurement, instrumentation, testing, communication, and control. Standard sizes are available in 6v, 12v, and 28v at current ratings up to 100amp. From no load to full load, regulation is better than ±1%, and the response to extreme conditions of loading is faster than 0.2sec. Ripple is less than 0.5% rms. Magnetic Research Corp., Dept. ED, 318 Kansas St., El Segundo, Calif.

CIRCLE ED-128 ON READER-SERVICE CARD FOR MORE INFORMATION

Career-chance of a lifetime for

Senior ELECTRONIC Engineers

in Lockheed's expanding Missile Systems Division

Recently formed from other Lockheed engineering organizations, the Missile Systems Division has a few openings for highly-qualified engineers in various phases of electronics.

The Division's expansion program — along with the type of work involved in its contracts — makes these openings outstanding opportunities for achievement. Engineers who qualify have probably worked on missile, radar-computer, counter-measure, IFF, AMTI or similar projects.

Lockheed has openings for:

- **Senior Electronic Engineers** with experience in the development, packaging, and specification of small, rugged components including resistors, capacitors and all types of magnetic parts.
- **Senior Servomechanisms Engineers** with circuit, auto-pilot or electro-mechanical experience (aircraft or missile experience preferred).
- **Senior Electronic Design Engineers** with experience in sub-miniature packaging techniques. Previous experience with potted plug-in units, etched and printed circuits is desirable.
- **Senior Electronic Engineers** with development and analysis experience in one or more of the following fields:

A. Guidance systems analysis
B. Microwave antennas
C. Radome design
D. Microwave transmitters
E. Advanced packaging techniques
F. Waveguide components
G. Component specification
H. IF receivers and FM discriminator circuits
I. Synchronization and timing circuits
J. Memory circuits (tubes, magnetic drums, delay lines, etc).
K. High voltage power supply and CRT display circuits
L. Analogue computors
M. Video pulse, delay, gating, range and range rate tracking circuits

In addition to outstanding career opportunities, the Missile Systems Division offers you excellent salaries commensurate with your experience, generous travel and moving allowances, an unusually wide range of employee benefits and a chance for you and your family to enjoy life in Southern California.

Coupon below is for your convenience.

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CIRCLE ED-129 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Illuminated Magnifier

For Designers and Inspectors

The "Flash-O-Lens" Illuminated Magnifier has been redesigned with a new housing that facilitates loosening and tightening of the ring that holds the lenses in the housing. The housing is now molded of durable, heat-resistant polystyrene.

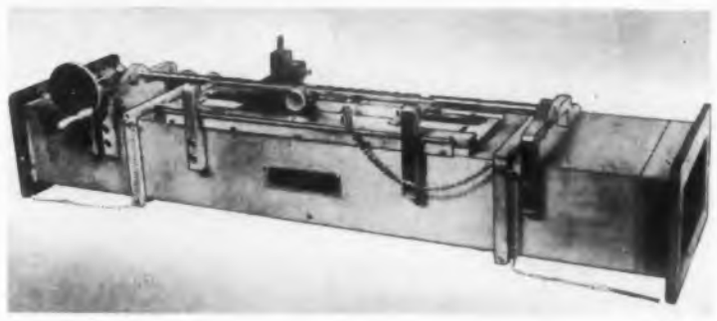
This unit is valuable both in the laboratory and on the production line. E. W. Pike and Co., Inc. Dept. ED, 492 North Avenue, Elizabeth, N.J.

CIRCLE ED-131 ON READER-SERVICE CARD FOR MORE INFORMATION

Slotted Line

1120Mc-1740Mc Range

The Model SL-28 "L" Band Slotted is a laboratory instrument for the frequency range between 1120Mc and 1740Mc. It measures the voltage standing wave ratio in Type RG-69/U, RG-103/U, and other wave guides of equal dimensions (6-1/2" x 3-1/4"). From



the standing wave pattern, the amount of mismatch between line and load may be accurately determined, the impedance of the load can be obtained, and the wave length can be measured directly. The line mates with UG-417/U and UG-418/U flanges.

The probe carriage is suspended on three widely separated ball bearings riding in precision ground "V" races. The scale is calibrated from 22cm to 54cm, and may be read to within 0.01cm.

Residual vswr is less than 1.05 with probe at maximum insertion. Slope and leakage are negligible. Size of the unit is 30" x 8-3/4" x 8-1/4". Weight is 38 lb. Press Wireless Laboratories, Inc., Dept. ED, 25 Prospect Pl., West Newton 65, Mass.

CIRCLE ED-132 ON READER-SERVICE CARD FOR MORE INFORMATION

Reference Cavities

Max Frequency Drift of ±0.4Mc

Three reference cavities, weighing only about 8 oz each, are of the fixed-frequency, vacuum-sealed, transmission type for service as frequency determining references in microwave systems. The three types are the GL-1Q26-A (resonant frequency 9280-Mc), the GL-6301 (resonant frequency 9270-Mc), and the GL-6453 (resonant frequency 9350Mc).

These small-size, lightweight units can be used in pressurized systems. They will withstand 10G vibration with only ±0.1Mc frequency drift, and temperature changes from −40° to +100°C with only ±0.4Mc drift. Maximum drift is only ±0.15Mc under ambient pressures varying from 15-45psi absolute. Tube Dept., General Electric Co., Dept. ED, Electronics Park, Syracuse, N. Y.

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

Miniature D-C Instruments

Self-Shielded, Portable Design

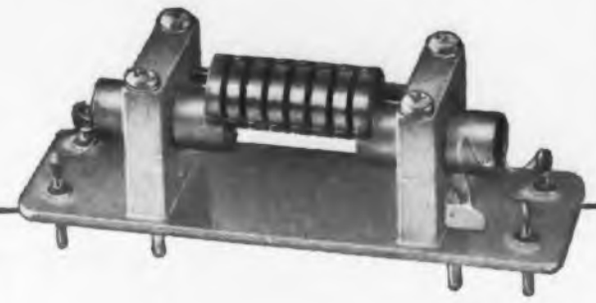
Accurate within 1%, these Model 281 Miniature Portable D-C instruments incorporate a self-shielded mechanism. Shielding is such that the magnetic field created by a conductor carrying 15,000amp at a distance of 3′ from the instrument causes a temporary error in indication of less than 1%. The instrument can also be used in close proximity to magnetic materials without affecting accuracy.

The instruments use a large moving coil with high torque-to-weight ratio. Scales are hand calibrated, with mirror and knife edge pointers combined to eliminate parallax errors. The instruments are furnished in complete Bakelite cases, in a wide variety of ranges in single and multi-range voltmeters, ammeters, and volt-ammeters. Size is about 4-1/2″ x 4-1/2″ x 1-1/2″. Weston Electrical Instrument Corp., Dept. ED, 614 Frelinghuysen Ave., Newark 5, N. J.

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

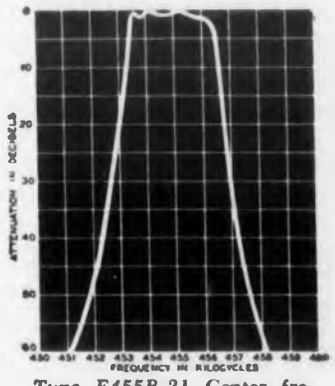
INDUSTRIAL COMPONENTS

During the past 20 years Collins Radio Company has pioneered many of the outstanding advancements in the radio-communications and electronics industry. Collins engineers had to develop unique and unusual systems and components to meet the superior standards of Collins equipment. These components, plus application recommendations, are now available to the electronics industry. Collins industrial components can help you. Send the coupon below for complete information.

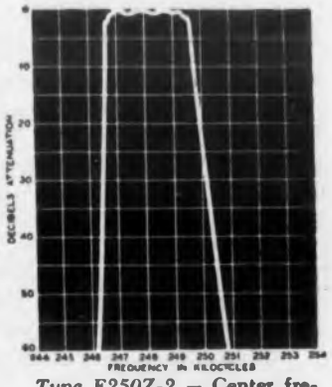


MECHANICAL FILTERS

Compact, permanently tuned band pass filters for intermediate frequency amplifier applications. Mechanical elements of the filter provide characteristics close to the ideal rectangular selectivity curve. It is a hermetically sealed component requiring no adjustments. Selectivity curves for two of the 23 standard Mechanical Filters are reproduced at right.



Type F455B-31 Center frequency, 455 kc; band-width, 3.1 kc; plug-in terminal arrangement.



Type F250Z-2 — Center frequency, 248.2 kc; band-width, 3.2 kc; solder terminal arrangement.

Collins HYSTERESIS MOTORS

Useful for driving timing devices, facsimile equipment, commutators, or any device which must rotate at an absolutely constant speed regardless of load or line voltage variations. Type 370A-1 Wide Band Synchronous Motor is illustrated . . . produces synchronous rotation from motionless to 30,000 RPM.

Collins OSCILLATORS

Long famous for their accuracy and stability, Collins Variable Frequency Oscillators are now available. They give transmitters, receivers, frequency standards or test equipment accurate linear dial calibration and superb stability. Collins Oscillators are available in a number of frequency ranges.

Collins AUTOTUNES AND AUTOPOSITIONERS

Collins Autotunes, the basis for both remotely and directly controlling automatic tuning of high quality communication equipment, are suitable for many industrial applications. Collins Autopositioners are used where up to 20, or more, pre-determined, fixed positions are needed. Available as individual units or in complete systems.

COLLINS RADIO COMPANY

Cedar Rapids, Iowa

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1930 Hi-Line Drive, DALLAS 2
2700 W. Olive Avenue, BURBANK
COLLINS RADIO COMPANY OF CANADA, LTD.
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Please send me complete information on:
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Hysteresis Motors ☐

NAME_____

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FIRM OR COMPANY_____

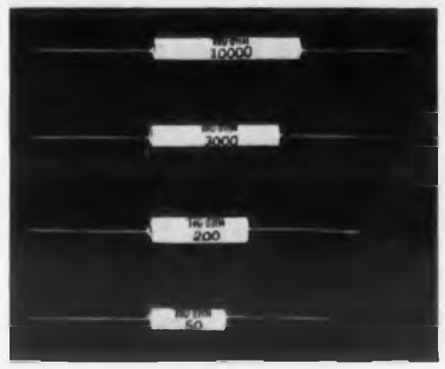
CITY_____ STATE_____

CIRCLE ED-136 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Axial Lead Resistors

Rated 5, 7 or 10w



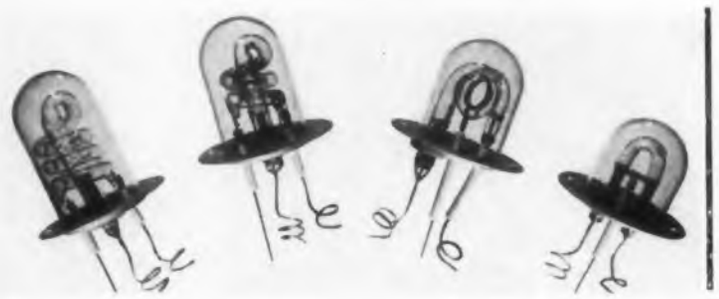
These Axial Lead Resistors are supplied in standard ratings of 5w, 7w, and 10w, and to maximum resistance values of 1000 ohms, 5000 ohms, and 7500 ohms, respectively. They are wound on fibre glass cord in continuous lengths. The cord is cut to required length, and then the leads are securely clamped to each end. The core is then coated with silicone cement and inserted in a ceramic tube for maximum mechanical protection and high dielectric strength.

Ends of the resistors are sealed with silicone cement to exclude moisture. Tru-Ohm Products, Division of Model Engineering & Mfg., Inc., Dept. ED, 2800 N. Milwaukee Ave., Chicago 18, Ill.

CIRCLE ED-139 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Efficiency Flashtubes

Flash Up to 100,000 Times



These flashtubes give the laboratory photographer more light for the same power through the use of ultra-high efficiency light sources and an increase in the working area of their reflectors. They can utilize lightweight power packs. Five new models of this trigger-type flashtube are available.

Tube focal point is adjustable without removing the Pyrex cover glass. The design of the flashtube permits construction of extremely shallow, lighter weight lampheads and eliminates the large, light-absorbing area common to the older type of basing.

New electrode developments have made higher power ratings possible, and also extended tube life so that 50,000 to 100,000 flashes from the same tube is not unusual. Tubes are available for operation at 180-300v, 450v, 900v and 2000-2500v. Amglo Corp., Dept. ED, 2037 W. Division St., Chicago 22, Ill.

CIRCLE ED-140 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-143 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-144 ON READER-SERVICE CARD FOR MORE INFORMATION

Versatile VTVM

Has Illuminated Probe Vacuum Tube

The Model 201 Vacuum Tube Voltmeter serves as a general purpose laboratory or service voltmeter for the measurement of d-c or a-c voltages, and resistances.

D-c voltages are covered in seven full scale ranges of 1.5-1500v at an impedance of 11-Meg. A-c ranges are calibrated both in rms values of sine waves (1.5-1500v, full scale) and peak-to-peak values of 4-4000v. Separate scales are provided for the 0-4v peak-to-peak and the 0-1.5v ranges for greater accuracy. Resistance values from 1000 ohms to 1000-Meg, full scale, are covered in seven ranges. Maximum accuracy is at mid-scale, which is calibrated in multiples of 10 ohms for convenience.

Standard probes include the new "Illumi-probe", with a miniature lamp built into the plastic end of the probe, providing extra light for measurements in dark corners. Also furnished is a set of "Klipzon" probes for resistance measurements. High-voltage and high-frequency probes are available as accessories. Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Sta. A, Richmond, Calif.

CIRCLE ED-145 ON READER-SERVICE CARD FOR MORE INFORMATION

Wire-Wound Resistors

With Welded Terminals

This firm's entire line of wire-wound resistors now is available with all-welded terminal construction. In this construction, the resistance wire is welded to the terminal band, and the band itself is held permanently around the core by means of welding. Every weld is tested.

The design produces permanent connections that are not affected by vibration or high temperature. The fusion of resistance wire and terminal lug provides a stable electrical connection, important in eliminating noise or instability in sensitive circuits. Terminal bands are of a special alloy whose coefficient of expansion is properly related to that of the resistance wire, ceramic core, and vitreous enamel coating. The resistance wire is welded flush to the band. Ohmite Manufacturing Co., Dept. ED, 3601 Howard St., Skokie, Ill.

CIRCLE ED-146 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-147 ON READER-SERVICE CARD FOR MORE INFORMATION

CIRCLE ED-148 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Lower installed costs,
more installations per hour . . . with
COMPRESSION TERMINALS, TERMINAL BLOCKS, AND DISCONNECT CLASPS
for all electronic applications

Space-saving, economical, dependable connectors designed for quality performance, Burndy FERRULES, HYLUGS, INSULUGS, CRABLOKS, HYCLASPS and HYCLASP lugs have wide application in the field of electronics. Burndy FERRULES, easily-installed by crimping, provide quick and efficient terminations for shielded cable. FERRULES may also be used as anchors to prevent shields from fraying or slipping. HYLUGS, compression-installed terminals adaptable to practically every electrical product, are widely used in terminating all sizes of solid, stranded or flexible cables. HYLUGS with Nylon-insulated connector barrels, INSULUGS have extensive use in terminating wire in the electronic gear of aircraft. Designed with spring-loaded socket connectors, Burndy CRABLOKS, lightweight molded phenolic terminal blocks, provide quick plug-in connections and disconnections that speed terminating and testing procedures. For equipment requiring a quick-disconnect, Burndy compression HYCLASP disconnect splices and HYCLASP lug disconnect terminals are available. All Burndy HYCLASPS remain locked under tension. HYTOOLS and HYPRESSES, Burndy installation tools for compression-type connectors, provide efficient connections at minimum cost.

For detailed information, write 54-9
Department 149, BURNDY, Norwalk, Connect.

CIRCLE ED-149 ON READER-SERVICE CARD FOR MORE INFORMATION

Portable Temperature Tester

Tests from −65° to +350°F

This portable TC-2 Temperature Test Chamber is a new version of this firm's Model TC-1. The range has been extended 75°, permitting tests from −65° to +350°F. A rugged Weston industrial thermometer is permanently mounted on the front panel. A loading port at the top of the chamber permits the addition of dry ice during extended operation at low temperature.

The working space is 7″x15″x7-1/2″ in size. The test load is carried in a removable tray provided with 15-3/8″ diam openings for connections to objects under test. The chamber may be plugged into any standard electrical outlet and requires 5amp at 115v, 50-60cy. Overall dimensions are 48″x16-1/2″x12″. Statham Development Corp., Dept. ED, 12411 W. Olympic Blvd., Los Angeles 64, Calif.

CIRCLE ED-151 ON READER-SERVICE CARD FOR MORE INFORMATION

AVAILABLE FROM STOCK FOR **IMMEDIATE** DELIVERY

acrylic rods and tubes

CLEAR CRYSTAL METHYL METHACRYLATE—Rods and tubes for industrial, novelty, display, models and all other fields.

SIZES AVAILABLE

RODS

1/8″	9/16″
3/16″	5/8″
1/4″	3/4″
5/16″	7/8″
3/8″	1″
7/16″	1 1/8″
1/2″	1 1/4″

TUBES

1/16″ wall	1/8″ wall
1/4″ O.D.	1/2″ O.D.
5/16″ ″	5/8″ ″
3/8″ ″	3/4″ ″
1/2″ ″	7/8″ ″
5/8″ ″	1″ ″
3/4″ ″	1 1/4″ ″
7/8″ ″	1 1/2″ ″
1″ ″	1 3/4″ ″
1 1/4″ ″	2″ ″

Special sizes to order

Write for price lists and samples today

ACE PLASTIC COMPANY
Precision Extruders and Fabricators

91-58 VAN WYCK EXPRESSWAY • JAMAICA 35, N. Y.

CIRCLE ED-153 ON READER-SERVICE CARD FOR MORE INFORMATION

New!

MODEL 411 Extended Range Audio Oscillator

- Wide Range—20 cycles to 1000 KC
- Compact Size— 6″ Wide x 8½″ High x 8½″ Deep
- Light Weight—13½ lbs.
- Low Distortion—less than 1% over most of range
- High Stability
- Uniform Output—± .5 db. to 100 KC
- Vernier Driven Dial
- 48″ of Dial Calibration
- Competitively Priced

Write for literature and prices

CB THE CLOUGH-BRENGLE CO.
6014 BROADWAY
CHICAGO 40, ILLINOIS

CIRCLE ED-150 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Voltage Rectifier

For Color TV Receivers

Specially designed for use in the scanning system of color TV receivers, the *3A3* may be employed in any rectifier application where high peak-inverse plate voltage and high peak plate current characteristics are necessary. Maximum peak-inverse plate voltage is 30,000v and max peak plate current is 80ma for a max pulse duration of 10microsec (15% of a scanning cycle). Maximum seated height in its octal base is 3-1/2″.

The *3A3* also incorporates a special, insulation-coated bulb to equalize bulb charge. The coating on the inside of tube also reduces the possibility of bulb puncture due to electron bombardment. The filament voltage of 3.15v is designed for a more effective match with the fly-back system. CBS-Hytron, Dept. ED, Division of the Columbia Broadcasting System, Inc., Danvers, Mass.

CIRCLE ED-152 ON READER-SERVICE CARD FOR MORE INFORMATION

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

FEATURES:

- SELF CHECKING
- AUTOMATIC and MANUAL RESET
- DISPLAY from 1 to 10 SECONDS
- LIGHTWEIGHT — only 16 lbs.
- UTILIZES STANDARD PLUG-IN DECADES
- BASIC UNIT READS OUT TO 10 KC (4 decades)
- AIR COOLED (Fan)

Write TODAY for full technical information

THE Detectron CORPORATION, Dept. 76
5420 VINELAND AVE., NO. HOLLYWOOD, CALIF.

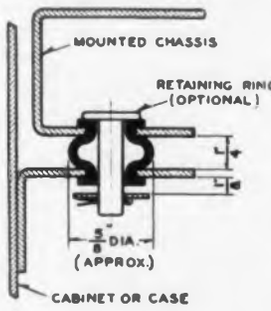
CIRCLE ED-154 ON READER-SERVICE CARD FOR MORE INFORMATION

MINIATURE VIBRATION ISOLATORS

protect light-weight components

Type 275 Type 372 Type 302 Type 371

Light-weight instrument Barrymounts are extremely easy to use, and require very little space for installation. They provide a high degree of vibration protection for small instruments, sensitive relay assemblies, electronic sub-chassis, small motors, and similar light-weight units. Available in four types, they will support up to 9 lbs. per unit isolator. Vibration frequencies as low as 30 cps are isolated in all directions, for maximum rated load. For further information, write to The Barry Corporation, 775 Pleasant St., Watertown 72, Massachusetts.



CIRCLE ED-155 ON READER-SERVICE CARD FOR MORE INFORMATION

New Silicon Diodes

Lower Noise, Broader Bandwidth

TYPE	CENTER FREQUENCY (mc)	MAX CONVER LOSS (db)	MAX NOISE RATIO (times)	VSWR (max)	IF IMPEDANCE (OHMS)
*IN21B	3060	6.5	2.0	–	200–800
*IN21C	3060	5.5	1.5	–	200–800
*IN150	6750	6.0	2.0	1.5	250–500
*IN160	6750	6.5	2.7	–	200–800
*IN23B	9375	6.5	2.7	–	200–800
*IN23C	9375	6.0	2.0	1.5	325–475
*IN149	9375	5.5	1.5	1.5	325–475
IN78	16000	7.5	2.5	–	325–625
IN26	23984	8.5	2.5	–	300–600
IN53	>30000	8.5	2.5	–	400–800
IN32	3295	Fig. Merit >85		Video Impedance: 4K–22K	

*Also available with reversed polarity

Designers and producers of microwave receivers are achieving lower noise figures over broader bandwidths plus longer life by specifying Microwave Associates, Inc., silicon diodes. High quality, low cost diodes are available for all microwave bands.

For super low noise performance, specify the 1N149 at X-band and the 1N21C at S-band. The new RF adjusted 1N32 outperforms the field for video use at S-band.

Write for catalog ED 54S, describing our complete silicon diode line. Microwave Associates, Inc., 22 Cummington Street, Boston 15, Mass. Tel., COpley 7-4441.

CIRCLE ED-156 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Transformer Kit

Includes Three Types

A sample package, designated SP-1, containing three different pulse transformers, is offered at a reasonable price for experimentation by design engineers. These transformers are of the octal tube base plug-in construction with cores of high quality magnetic material. They may be used for blocking oscillators, coupling, impedance matching, etc.

Contained in the package is a type PT-1 with a characteristic impedance of 100 ohms and a rise time of 0.04μsec; type PT-2 with a characteristic impedance of 100 ohms and a rise time of 0.04μsec; and a type PT-3 with a characteristic impedance of 120 ohms and a rise time of .03μsec. Berkshire Laboratories, Dept. ED, 578 Beaver Pond Rd., Lincoln, Mass.

CIRCLE ED-157 ON READER-SERVICE CARD FOR MORE INFORMATION

WWV Receiver

For Checking Local Standards

The Model ME-117 WWV Receiver compares a local standard to the WWV-5Mc standard. After demodulation, the 5Mc carrier is doubled to 10Mc and displayed on a 2″ CR tube as a circular pattern. A 10Mc multiple of the local standard modulates the

intensity of this pattern. The speed and sense of rotation of the pattern indicate the amount and direction of the deviation from the WWV-Standard.

The receiver will accommodate any local standard frequency in the range 50kc to 10Mc equal to a subharmonic of 10Mc, 2Mc, or 400kc. A second channel receives the audio modulation and time signals of the WWV-Standard. The bench model is 19-1/2″ x 10″ x 17″ and weighs 40 lb. Matawn Electronics Co., Inc., Dept. ED, 236 Creek Rd., Keansburg, N. J.

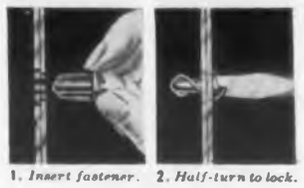
CIRCLE ED-158 ON READER-SERVICE CARD FOR MORE INFORMATION

This fastener works through thick and thin!

Spring-Lock works whether panel thicknesses run over or under specifications! Spring wire deflects automatically to handle greater or lesser thicknesses. Spring-Lock's design flexibility makes it more than a fastener: it can be adapted as a shelf support, door strike, knob or any similar panel-mounted device. Many standard shapes and sizes of Simmons Spring-Locks are available from stock.

SIMMONS FASTENER CORPORATION
1763 North Broadway, Albany 1, N. Y.
Spring-Lock • Quick-Lock • Roto-Lock

HERE'S HOW SPRING-LOCK WORKS



1. *Insert fastener.* 2. *Half-turn to lock.*

- **Installation is BLIND**
- **Installation is EASY: no special tools are needed**
- **Installation is QUICK: a half-turn locks it in place**
- **Installation is SECURE: the *spring* steel *locks* the fastener, resists vibration**

Send for details and samples, or write us about *your* fastening problem.

CIRCLE ED-159 ON READER-SERVICE CARD FOR MORE INFORMATION

Get This Informative Free Booklet on New Uses for Straits Tin

New, 20-page booklet tells important story of Straits Tin and its many new uses today. Fully illustrated. Includes sections on new tin alloys, new tin solders, new tin chemicals. Covers tin resources and supply, Malayan mining. Booklet is factual, informative—could well prove profitable to you. Mail coupon now.

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Dept. C, 1028 Connecticut Ave., Washington 6, D.C.

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CIRCLE ED-160 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Resistance Meter

Also Measures Leakage

The Model C-6 Resistance Meter has a range from 0 ohms to ten million megohms covered in 10 decade steps. All measurements may be made to an accuracy of 3% of full-scale deflection.

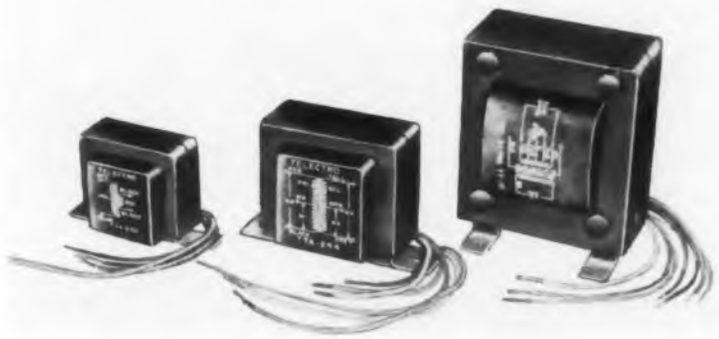
Through the use of a "Quick Charge" switch and a "Charge Adjust" control, it is possible to preset an acceptable value of capacitor leakage resistance into the meter and then determine almost instantaneously whether or not a capacitor meets the requirement, thus using the instrument as a "go-no-go" gage.

Either 50v or 500v d-c may be used in measuring resistance in the megohm range. The 500v test meets JAN and MIL specifications for insulation testing, while 50v is provided in order that condensers may be tested for leakage without exceeding their voltage limitations. A 1.5v battery is used for the ohms range. Southwestern Industrial Electronics Co., Dept. ED, 2831 Post Oak Rd., P.O. Box 13058, Houston 19, Tex.

CIRCLE ED-163 ON READER-SERVICE CARD FOR MORE INFORMATION

Transformers and Reactors

Encapsulated in Plastic



Using a new method of plastic encapsulation, these "Telectran" transformers and reactors have been approved by the Signal Corps Engineering Laboratories (SCEL) and meet the requirements of Spec MIL-T-27, Grade 1, Class A. The units are made with sealed, flexible leads that can be supplied to any length and with any type of termination.

The transformers and reactors can be custom designed for all types of audio, power, and r-f applications. They are available in sample quantities, short-runs, and in long-run production numbers. Telectro Industries Corp., Dept. ED, 35-18 37th St., Long Island City 1, N. Y.

CIRCLE ED-164 ON READER-SERVICE CARD FOR MORE INFORMATION

Tubeless Power Supply

Uses Magnetic Amplifier

The Model MR1040-30 Regulated Power Supply uses a magnetic amplifier in the regulation circuit. It is rated 10-40v d-c at 30amp continuously and has a regulation accuracy of ±1% (a) from 10-40v d-c, (b) from 100-130v a-c input, (c) from 3-30amp. Ripple is 1% rms and the unit is designed to receive an a-c input of 100-130v, single phase, 60cy.

The amplifier has a response time of 0.2sec maximum and the response is independent of the output voltage setting. The supply is provided with a 4-1/2″ ammeter and voltmeter, weighs approximately 175 lb, and measures 22″x15″x23″. This unit contains no tubes and utilizes magnetic materials plus low leakage selenium rectifier stacks. Perkin Engineering Corp., Dept. ED, 345 Kansas Street, El Segundo, Calif.

CIRCLE ED-169 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Small Trimmer Potentiometers

1000 ohm to 1 Megohm Models

Type 3A7341 subminiature trimmer potentiometers are intended for use as preset adjustable resistors in miniaturized equipment. They are readily attached to chassis or printed circuits by means of convenient mounting lugs.

Each component measures only 0.530″ diam x 0.281″ deep. Adjustment is made by means of a concentric tool which incorporates a central screwdriver for locking and unlocking the contact arm. The outer sleeve of the tool is provided with two key pins that fit and permit the setting of the contact arm for the value desired. The track is carbon composition and has linear characteristics.

Nominal rating is 1/10w at 70°C, ambient. Values range from 1000 ohms to 1 Meg. Tolerance is ±20%. Shelf stability is less than 10% after 1000 hours under normal conditions. Rockbar Corp., Dept. ED, 215 E. 37th St., New York 16, N. Y.

CIRCLE ED-176 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Voltage Beam Triode

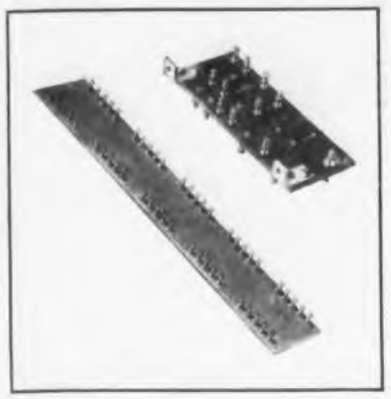
For Color TV

Designed for voltage regulation of the anode and convergence supplies of color TV receivers, the *6BD4* is a high-voltage, low-current, sharp-cutoff beam triode that can be employed for any similar voltage regulation requirements. Maximum d-c plate voltage is 20,000v and maximum d-c plate current is 1.5ma, with a maximum plate dissipation of 20w.

The large bulb of the tube provides long leakage paths and prevents corona effects. The high-voltage, electron-gun type construction of the *6BD4* incorporates a double-ended structure for high-voltage insulation. Maximum seated height is 4-5/8″ in an octal base. CBS-Hytron, Dept. ED, Division of the Columbia Broadcasting System, Inc., Danvers, Mass.

CIRCLE ED-177 ON READER-SERVICE CARD FOR MORE INFORMATION

Terminal Boards
Custom-built or standard



Whatever your needs, you can rely on C.T.C. to give you terminal boards that meet your specifications — and that are *guaranteed* by quality manufacturing.

We design and fabricate special boards of cloth, paper, or glass laminates (phenolic, melamine, epoxy or silicone resin) imprinted as required — rubber stamp, silk screen, hot stamp or engraving. Boards are lacquered or varnished to specifications MIL-V-173 and JAN-T-152. Terminals, feed-throughs, hardware and all other fixtures meet all applicable government specifications. We welcome sub-contracts for electronic parts and assemblies. Standard type boards are also available — in cotton fabric phenolic, nylon phenolic or grade L-5 silicone impregnated ceramic.

Boards and assemblies are furnished in any quantity. Write direct for complete information on the type of boards you need. Cambridge Thermionic Corporation, 457 Concord Ave., Cambridge 38, Massachusetts.

CIRCLE ED-180 ON READER-SERVICE CARD FOR MORE INFORMATION

High-Power Transistor
Diffused-Junction Type

The "Experimental Type X78" is a p-n-p diffused junction transistor of unusual capabilities. A high-power unit, it is useful principally when used in matched pairs in Class B audio amplifier applications. Subminiature matching transformers have been made available for use in such a circuit.

Although the unit is derated when used above 80°F, it has still found widespread laboratory use. It is not represented to be of high alpha, but the manufacturer guarantees minimum power gain of 10db at room temperature when used in the recommended circuit. Transistor Products, Inc., Dept. ED, Snow & Union Sts., Boston 35, Mass.

CIRCLE ED-182 ON READER-SERVICE CARD FOR MORE INFORMATION

Low-Ripple Power Supply
For Resistance-Type Transducers

The Type 3-132 Power Supply furnishes an output of 0-15v d-c at a maximum of 1amp. It is designed for the excitation of multiple strain gages and other resistance-type transducers, and it may be used as a secondary reference voltage source in many other research, calibration, and measurement applications.

Continuously adjustable over the 0-15v range, output voltage is indicated on a front-panel meter and may be varied with a 10-turn voltage-setting control. Output impedance is less than 0.1 ohm; output drift is less than 5mv per hr; and ripple is less than 1mv peak-to-peak. A 10v change or transient in a 105-125v a-c line voltage causes less than 10mv change in the output. A 0-1amp change in load causes less than 20mv change.

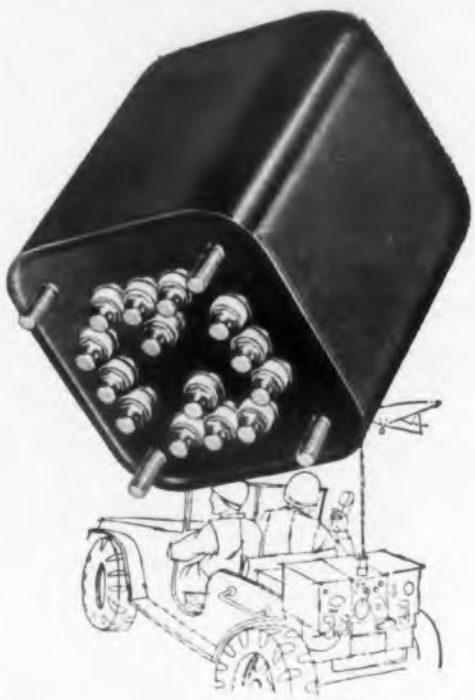
Completely self-contained in a metal carrying case which measures only 8-3/4" x 11" x 19", the 45-pound unit may be operated from any 105-125v, 50/60/400cy line. Front panel and chassis configuration permit standard rack-type mounting if desired. Consolidated Engineering Corp., Dept. ED, 300 N. Sierra Madre Villa, Pasadena 15, Calif.

CIRCLE ED-183 ON READER-SERVICE CARD FOR MORE INFORMATION

Another First for CHICAGO

The complete **MS** (Military Standard) line of Hermetically-Sealed Power & Filament Transformers

CHICAGO TRANSFORMER now offers all units in the Military Standard (MS) line, as established jointly by the three armed forces (Army Signal Corps, Navy Bureau of Ships, and Air Force) working through ASESA (Armed Services Electronic Standards Agency) and in cooperation with the transformer industry. The complete line is housed in CHICAGO'S one-piece drawn-steel cases. Outside case dimensions and mounting dimensions are within the tolerances of the Military Standard specification. Terminal arrangements and markings are also in accordance with the same specification. Tests conducted in the CHICAGO TRANSFORMER laboratories indicate that all units will meet the requirements of Grade 1, MIL-T-27 specifications for Class A operation. The Military Standard line should find wide usage in military airborne, marine, and ground communication equipment, and particularly for research and development applications, pilot runs and pre-production models.



POWER TRANSFORMERS—INPUT REACTOR SYSTEMS (PRIMARY—105/115/125 V.—Frequency 54-66 cycles)

CATALOG NUMBER	MIL-T-27 PART NO.	HIGH VOLTAGE SECONDARY A-C Volts	D-C MA.	D-C V OUTPUT	RECT. FIL. Volts	Amps.	FIL. NO. 2 Volts	Amps.	WT. LBS.
PMS-70	MS-90026	200-100-0-100-200	70	385	6.3/5	2	6.3	3	4
PMS-70A	MS-90027	325-0-325	70	260	6.3/5	2	6.3	4	5
PMS-150	MS-90028	325-0-325	150	245	6.3	5	5	3	7¼
PMS-175	MS-90029	400-0-400	175	318	5	3	6.3	8	10
PMS-250	MS-90030	450-0-450	250	345	5	3	6.3	8	13
PMS-350	MS-90031	350-0-350	250	255					7½
PMS-550	MS-90032	550-0-550	250	419					11
PMS-800	MS-90036	800-0-800	250	640					16½

FILAMENT TRANSFORMERS (PRIMARY:—105/115/125 V.—Frequency 54-66 cycles)

CATALOG NUMBER	MIL-T-27 PART NO.	SECONDARY Volts	Amps	INSULATION VOLTS RMS	WT. LBS.
FMS-23	MS-90016	2.5	3.0	2500	1½
FMS-210	MS-90017	2.5	10	2500	2½
FMS-53	MS-90018	5.0	3.0	2500	1¾
FMS-510	MS-90019	5.0	10	2500	4
FMS-62	MS-90020	6.3	2.0	2500	1¾
FMS-65	MS-90021	6.3	5.0	2500	2¾
FMS-610	MS-90022	6.3 CT	10	2500	5
FMS-620	MS-90023	6.3	20	2500	8
FMS-210H	MS-90024	2.5	10	10000	4¾
FMS-510H	MS-90025	5.0	10	10000	7

Free "New Equipment" Catalog

You'll also want the full details on CHICAGO'S *New Equipment Line* of famous "Sealed-in-Steel" Transformers. Write for Free Catalog CT-153 today, or get it from your electronic parts distributor.

CHICAGO STANDARD TRANSFORMER CORP.

3501 W. ADDISON ST., CHICAGO 18, ILL.

CIRCLE ED-186 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Deflection Amplifier 187

A 2-page data sheet describes the performance of the 6CU6 horizontal deflection amplifier. This TV receiver tube is designed to be interchangeable with the 6BQ6GT and is especially suited for heavy-duty use. Mechanical and electrical data, characteristic curves, ratings, and numerous other information is included. CBS-Hytron, Danvers, Mass.

I-F Transformer 188

A new catalog page available gives detailed information on Type TX100 Miniature I-F Transformer for any application requiring a 3/4 I-F transformer. The unique single end tuning which permits tuning of both coils from the same end from top or bottom is clearly illustrated. Also included is a complete line of TV coils, including 40Mc I-F Coils, Trap Coils Sound Take-Off Coils, and Ratio Detector Coils. Six standardized coils available for immediate delivery are illustrated. Electrometric, Inc., Woodstock, Ill.

Variable Resistors 189

A 20-page catalog (Form No. 79-7) is devoted to carbon and wire-wound potentiometers and rheostats. It contains electrical and mechanical characteristics of available designs, line drawings with dimensions, and illustrations. Also provided are charts and graphs, as well as data on available hardware (such as knobs, extension shafts, and shaft couplers). The catalog also contains descriptions and values of potentiometers which can be manufactured in compliance with MIL Spec JAN-R-19. P. R. Mallory & Co., Inc., Resistor Division, Frankfort, Ind.

Power Supplies 190

This eight-page, three-color catalog presents five standard models in the company's line of power supplies for voltage regulation, including a miniature unit measuring 8″ x 5″ x 5-1/2″ overall. Illustrations and specifications are given for each type of supply. The specifications outline input voltage requirements, voltage and current outputs, percent regulation, ripple, ambient temperature operating range, standard meters supplied, and complete mechanical specifications. Included in the manual is a detachable specification sheet for those who wish price quotations on custom-built power supplies and adaptations of standard units to meet user requirements. Allied Engineering Division, Allied International, Inc., Connecticut and Richards Aves., South Norwalk, Conn.

Kits and Instruments 191

A 12-page catalog lists and illustrates 30 kits and 33 instruments. It includes voltmeter, oscilloscope, tube tester, r-f signal generator, decade resistance box, and numerous other types of kits, and instruments of the same types, but factory wired. Also described are this firm's facilities. Electronic Instrument Co., Inc., 84 Withers St., Brooklyn 11, N. Y.

Plastic Film Capacitors 192

A four-page, two-color brochure presents in detail the electrical specifications of the company's new Type MH plastic film capacitors for close tolerances. Additional information includes dimensions, construction, applications, voltage ratings, operating temperature ranges, and capacitance tolerances, as well as complete test data. Electronic Fabricators, Inc., 682 Broadway, New York 12, N. Y.

Molecular Vacuum Gauge 193

A 4-page bulletin (GEC-986) contains application information, specifications, theory of operation, and many other detailed data on a new molecular vacuum gauge designed to measure pressures in the 1/2 micron to 20mm range without external detectors. Weighing 5 lbs., the gauge is a complete instrument in itself. General Electric Co., Schenectady 5, N. Y.

Tube Manual

A 578-page manual bound in a loose-leaf ring binder with a permanent plasticized cover is available to engineers. The catalog incorporates all general and operating data on the company's tubes, with specific detail charts and complete descriptions of each tube, so that there is no need for cross-reference. Sections are classified by tube type, and separated with protruding indicators. Price of the handbook is $2.00. Write direct to Amperex Electronic Corp., Sales Engineering Division, Dept. ED, 230 Duffy Ave., Hicksville, N. Y.

Selective Calling Equipment 195

Detailed information on selective calling equipment for individually controlling radio-equipped vehicles is available in a two-color, four-page folder. The literature describes both the push-button type of equipment by which contact with a two-way radio equipped vehicle or fixed station can be made within 0.8sec, or the economical dial operated system. The equipment is designed to help eliminate the confusion caused by overcrowded radio spectrum and skip-distance reception. Hammarlund Manufacturing Co., Inc., 460 West 34 Street, New York 1, N. Y.

Relays 196

Wiring arrangements, dimension diagrams, and tables showing differential currents of a new line of Miniature Sensitive Relays are included in a 2-page, 2-color data bulletin (No. 100). The relays measure only 1" x 1" x 1-3/4" and are extremely sensitive to low input. Signal Engineering & Mfg. Co., 154 W. 14th St., New York 11, N. Y.

New Literature . . .

Rubber Parts 200

A 4-page, 2-color brochure describes this firm's facilities for formulation and manufacture of molded, lathe-cut, die-cut, and bonded-to-metal products of many types, shapes, and sizes from natural, synthetic, and silicone rubber compounds. Numerous products and production facilities are illustrated. Goshen Rubber Co., Inc., Goshen, Ill.

Industrial Felt Products 201

A 12-page, two-color booklet describes and illustrates the firm's wool felt wheels, bobs and sheets, and hair felt sheets and wheels. In addition, there are a number of tables on felt wheel selection and specifications, application hints, and physical and chemical properties for each size and grade felt. The booklet should serve as a good source for manufacturers using felt in their products or processes. Bacon Felt Co., West Water Street, Taunton, Mass.

Aluminum Foil 202

A well illustrated, interesting tract o the development and production of alum num foil is available in reprint form fro *Connecticut Industry* where it originall appeared. The material covers the begi ning of the growth of aluminum foil in th post-war period to the present time, givin improvements in qualities, applications, and processing, and the gradual replace ment of aluminum for lead and tin foils Republic Foil & Metal Mills, Inc., Danbury, Conn.

Engraving Machines 203

A 24-page catalog, "Tracer Guided Engraving", describes the applications of various models of tracer guided engraving machines. It covers engraving of plastics, metal, glass, and wood, and also illustrates methods of calibrating, profiling, and slotting. Machines range in size from a small portable model the size of a typewriter, to a large bench type engraver and profiler. New Hermes Engraving Machine Corporation, 13-19 University Place, New York 3, N. Y.

Measuring Instruments 205

This 12-page bulletin (108) describes electrical measuring and electronic instruments for the laboratory. It includes Wheatstone bridges, potentiometers, resistances, resistance standards, capacitances, frequency meters, fluxmeters, electrometers, oscilloscopes, audio frequency oscillators, and other precision-built laboratory measuring instruments. Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Electronic Relay 206

An electronic relay which is highly sensitive to resistance changes and can be varied by a stepless dial, is described and illustrated in 4-page, 2-color Bulletin GEA-5893. Applications described include liquid-level control, sorting of small parts, operation of lights, solenoids, contactors, and fractional horsepower motors. Features of the unit are covered, as well as data on operation, dimensions, and specifications. General Electric Co., Schenectady, N. Y.

Audio Connectors 207

A 4-page, 2-color bulletin (XL8-1953) covers the XL series of low-level sound connectors. Fully illustrated with dimen sional sketches, sectional drawings, and exploded views, the bulletin contains detailed technical information. Seventeen different assemblies and two insert arrangements are catalogued. Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.

Vibration Isolator 208

The two-page Bulletin 527 presents detailed technical and application information on the Series 262 and Series 633 Barrymounts. These isolators are especially designed for use in light industrial applications, rotating and reciprocating machinery, and motors or motor-driven equipment. Information on dimensions and load ratings, installation procedure, variation of natural frequency with load, and percent efficiency of isolation is also delineated. The Barry Corp., 875 Pleasant St., Watertown, Mass.

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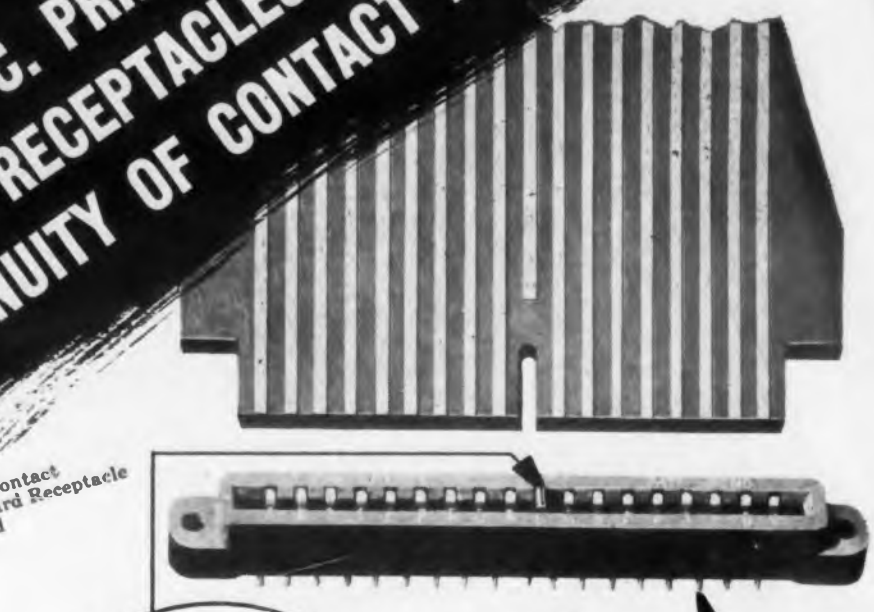

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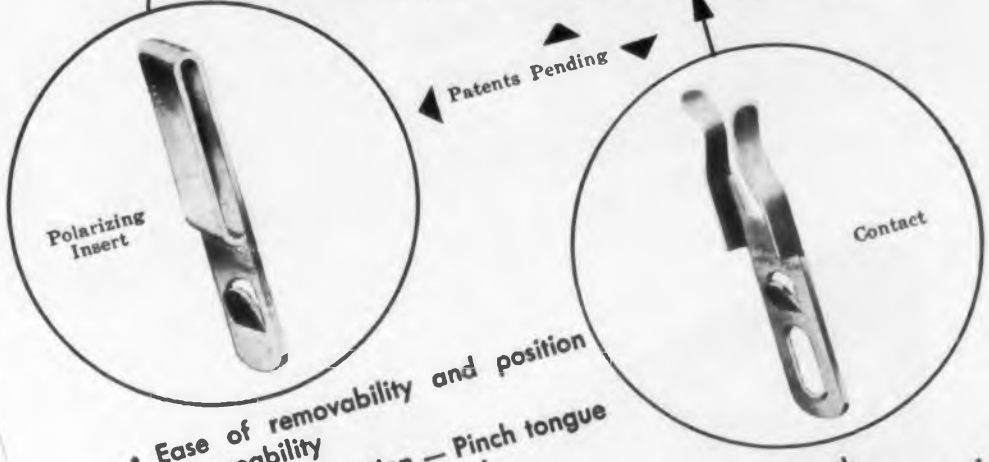

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Patents . . . By John Montstream

Inverted Grounded Emitter Transistor Amplifier . . . *Patent No. 2,659,773. Harold L. Barney, Madison, N. J. (Assigned to Bell Telephone Laboratories, Inc.).*

This transistor amplifier utilizes effects discovered when the emitter instead of the base was grounded. In Fig. 1, a circuit is shown in which the input (*10*) is fed to the collector (*4*) and the output circuit is connected with the base electrode (*2*). The emitter electrode (*3*) is common to both the input and output circuits. The usual emitter bias of a fraction of a volt is supplied by the resistors (*6* and *7*) and the usual negative collector bias of 40 to 100v is provided by a battery (*5*). A capacitor (*8*) may shunt resistor *7* for signal frequency purposes.

Several novel results can be secured when the values of the circuit elements are properly selected. The amplification characteristic of a transistor may be represented by the relation that the output voltage is equal to the product of the mutual resistance of the transistor and the collector current. By selecting a transistor having a mutual resistance which is greater than the sum of the resistances of the collector, the emitter and the external resistance in series in the emitter circuit, proper adjustment of the value of a resistor in the input circuit will make the output impedance appear to be infinite. Therefore, the output current will depend upon the magnitude of the input voltage but the current will be independent of the load impedance. Such circuit has particular usefulness as a constant-current source.

Fig. 1. Constant-current circuit.

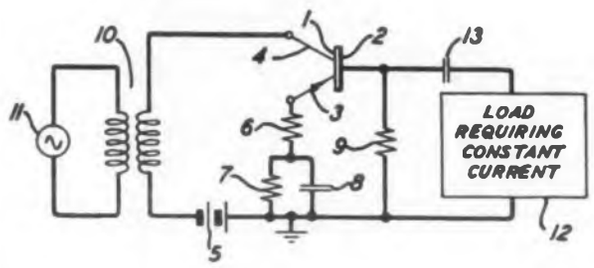
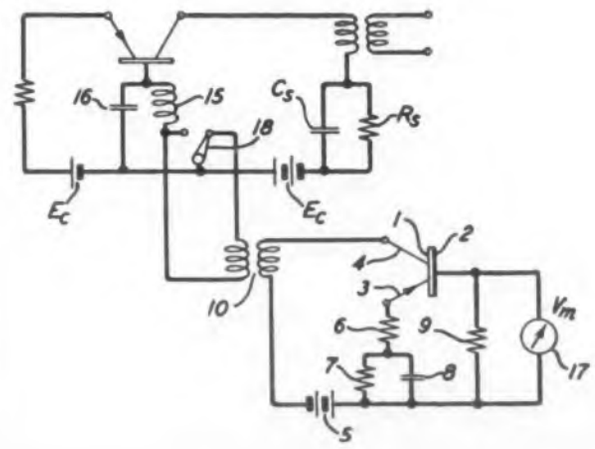


Fig. 2. Zero input impedance circuit.



By selection of proper values the circuit may be made to present essentially a zero input impedance, as shown in the circuit in Fig. 2, which has value for current measuring equipment. A circuit is also described by which substantially equal power amplification in both directions may be secured. This circuit is suitable for two-way communication with a two-wire line and repeater equipment without requiring switching apparatus.

Pulse Rectifier Circuit . . . *Patent No. 2,659,007. Eugene P. Halpin, South Bend, Ind. (Assigned to Bendix Aviation Corp.).*

In order to improve the spectrum as well as the power output of the klystron tube, a network of simple form for connection to the repeller of the tube has been developed and patented. The signal from an antenna goes to a grid (*14*, Fig. 3) of a thyratron tube that serves as a switch. When it fires, a pulse is generated that energizes the primary winding of a transformer (*20*). The transformer has two secondary windings. Winding (*26*) applies a high positive voltage to the cavity reso-

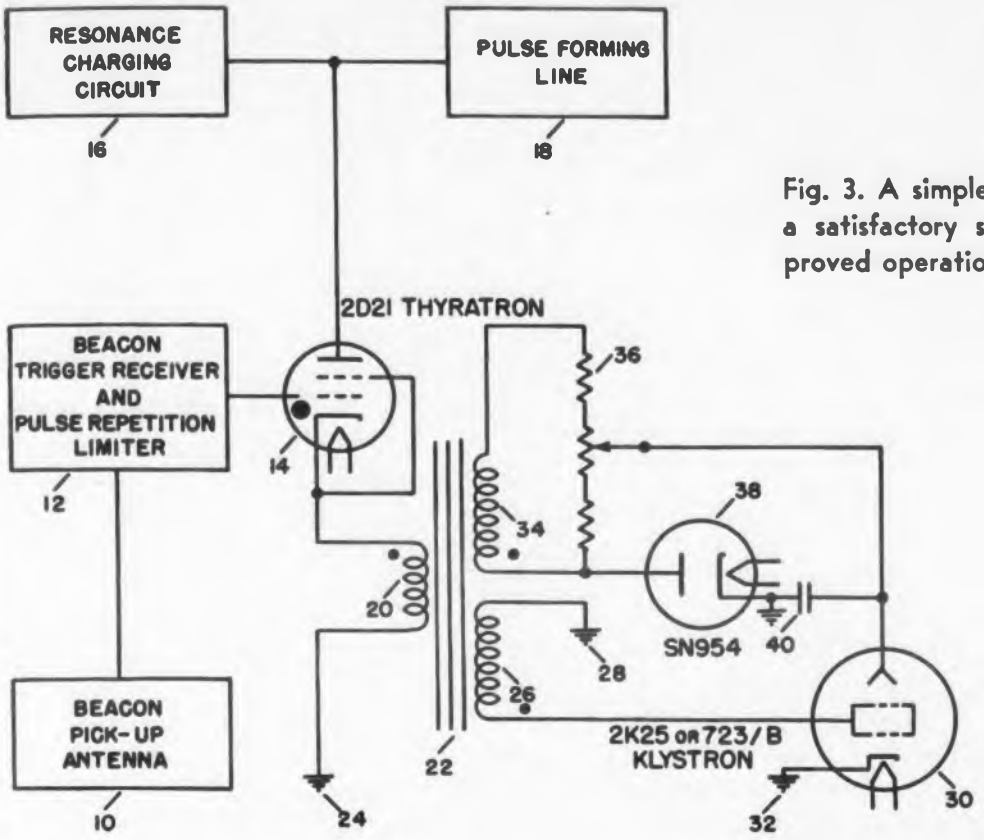


Fig. 3. A simple circuit affording a satisfactory spectrum and improved operation for the klystron.

nator of the klystron tube. The other secondary winding (*34*) is connected across a potentiometer (*36*) and generates a high voltage negative pulse which is rectified by the diode (*38*) and applied to the repeller of the klystron tube. A capacitor (*40*) in series with the rectifier smoothes out this negative pulse.

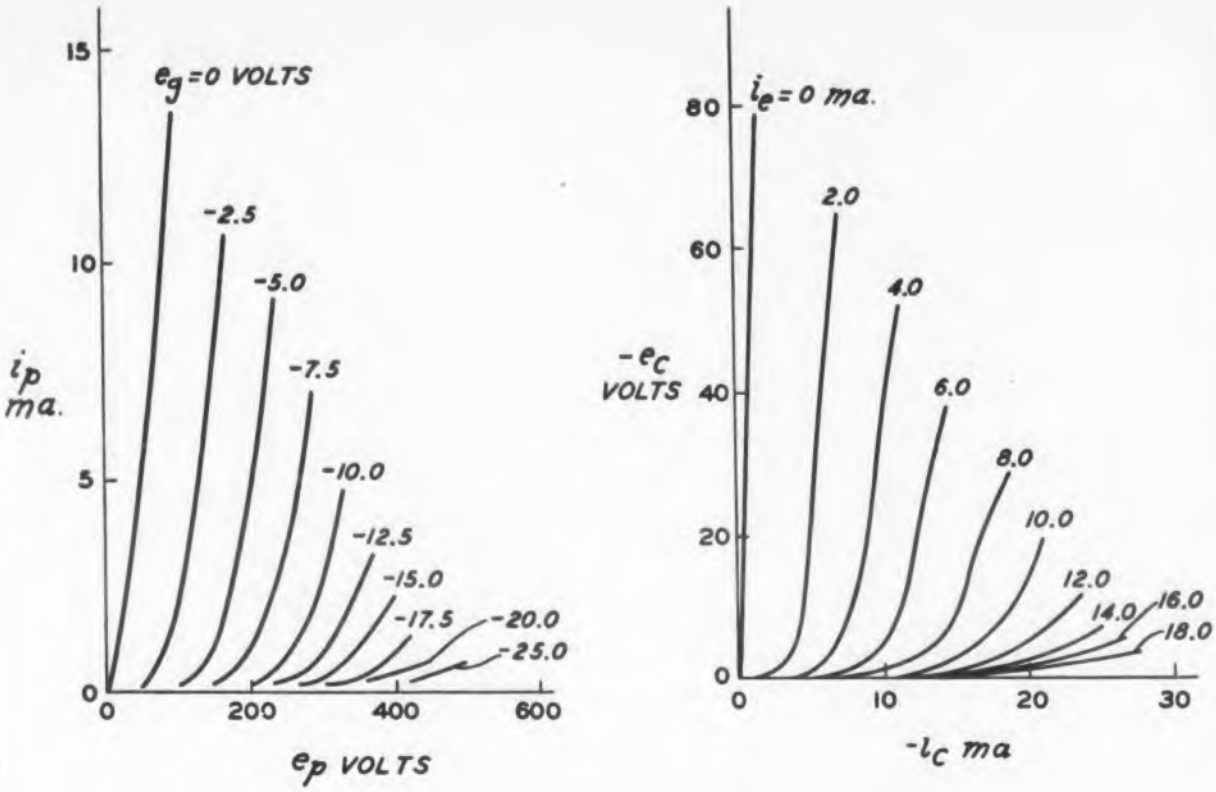
Patents . . .

Transistor Amplifier Circuits . . . *Patent No. 2,652,460. R. L. Wallace, Jr., Plainfield, N. J. (Assigned to Bell Telephone Laboratories, Inc.).*

Transistors have been thought of as substitutes for, or analogs of vacuum tubes. Hence in their use it was customary to use essentially known vacuum tube circuitry and substitute a transistor for the vacuum tube. Results achieved with such circuits were below expectations and it was thought that the achievement of better results lay in improving the transistor. The patentee points out that a transistor approximates the dual counterpart of a vacuum tube much more closely than the analog of the tube as illustrated by the characteristics of a vacuum tube and a transistor, as shown in Fig. 4, in which the roles of currents and potentials in the transistor are interchanged by comparison with their roles in the vacuum tube. The curves are closely identical in shape. As examples of what is meant by duality, the dual quantity of voltage is current, of resistance is conductance, and capacity for inductance.

With an appreciation of the dual rather than the analog character of a transistor as compared to a vacuum tube, the patentee describes improved transistor circuits for multistage amplifiers, interstage coupling networks for such amplifiers, automatic adjustment of emitter bias current of an amplifier and an efficient class B push-pull translating circuit. Illustrative of the results which can be achieved by utilizing circuits which are designed in recognition of the dual character of transistors, a push-pull amplifier circuit so designed delivered 20 to 40 times as much power as an analog transistor amplifier.

The patent sets forth each of the vacuum tube circuits mentioned above and then applies the mathematical solution by which a counterpart transistor circuit may be determined. The mathematical solutions are readily comprehended but too extensive to treat in this brief discussion. Even though a limited number of circuits are described, the theory provides a method



of determining many other transistor circuits. The patent is worthwhile having for those using or planning to use transistors.

Fig. 4. A comparison of vacuum-tube (left) and transistor characteristics.

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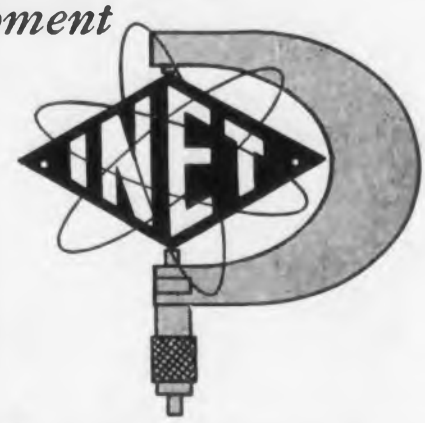

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Books . . .

Magnetic Amplifier Circuits . . . *By William A. Geyger, 277 pages. McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 36, N. Y. $6.00.*

Written for the circuit designer, this book presents the fundamental principles, characteristics, and applications of the magnetic amplifier type of circuit. It covers the basic as well as more complex circuits and emphasizes experimentally observed phenomena without going into extended mathematical considerations and proofs. Descriptive and graphical methods are widely employed for qualitative and quantitative interpretation.

The first chapter presents a classification of saturable-core devices and reviews the history of magnetic amplifiers. Chapter 2 describes magnetic core materials, various types of core construction, winding arrangements, and various types of rectifiers employed in magnetic amplifier circuits. There follows in Chapters 3 to 16, a discussion of the numerous kinds of magnetic amplifier circuits including nonfeedback circuits, single-stage and multi-stage circuits with internal or external feedback, and special circuits that make use of critical regeneration or derivative feedback. The last two chapters cover the technical properties, transient response, and typical applications of magnetic amplifiers, particularly those in instrumentation, servomechanisms, regulators, and automatic control devices.

The numerous references at the end of each chapter include many important European patents which have not been discussed in previous presentations of the magnetic amplifier art, according to the author. Engineers working in this field will find the detailed information presented useful in solving special problems.

Proceedings of the National Electronics Conference 1953, Vol. 9 . . . *992 pages. National Electronics Conference, 84 E. Randolph Street, Chicago 1, Ill. $5.00.*

This book is a compilation of the papers presented at the 1953 National Electronics Conference. It contains all of the 98 technical papers as well as the luncheon addresses presented at the conference.

As usual, the papers cover a wide range of subjects. These include reports on electronic research, development, and application in audio, circuits, communication, computers, electron tubes, engineering management, filters, instrumentation, magnetic amplifiers, materials and components, microphonics, microwaves, network synthesis, nucleonics, servomechanisms, television, transistors, and ultrasonics. It definitely deserves a place on the designer's book shelf. Readers wishing to complete their file of previous volumes in this series may still obtain Nos. 2, 4, 5, 6, 7, and 8 which are available at $5.00 per copy.

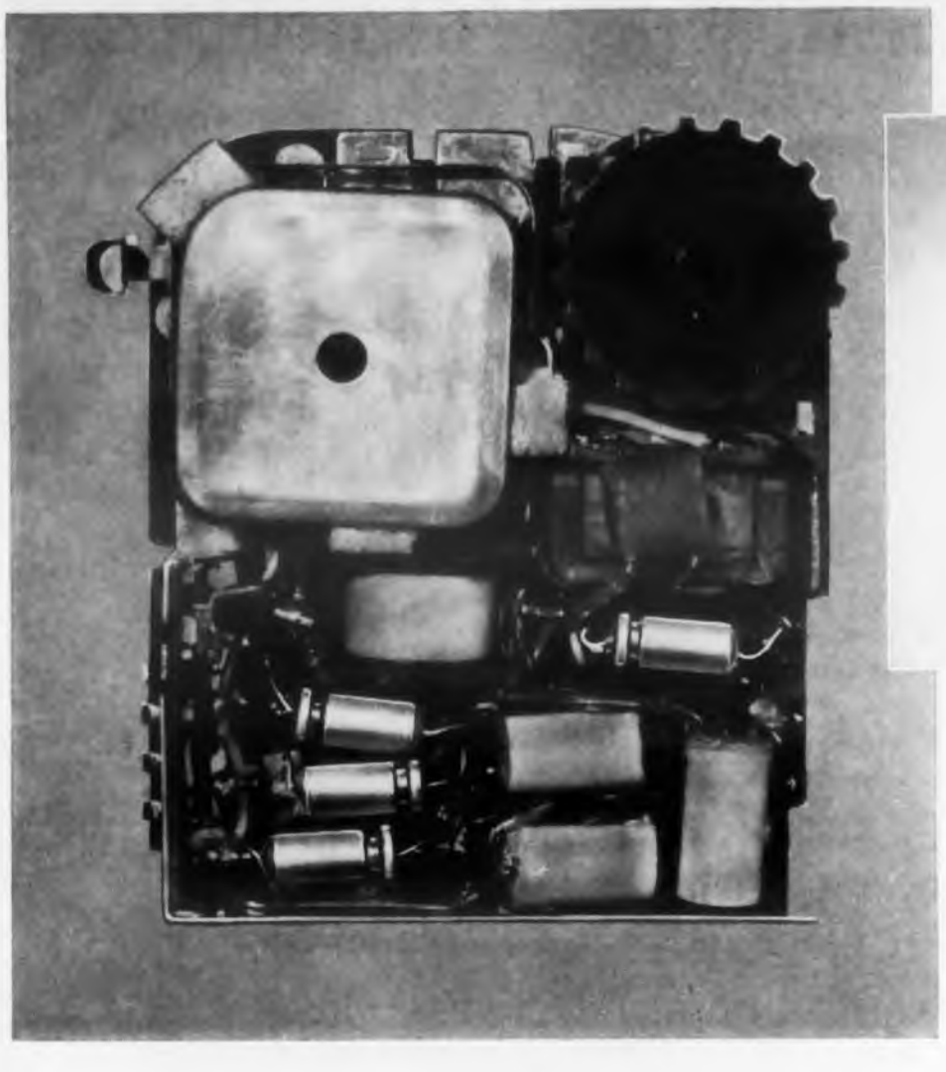
Timing Engineering . . . *By Myrten G. Saake, 255 pages. Ribble Engineering Co., Publishers, 74-80 Montgomery Street, Jersey City 2, N. J. $5.00.*

This reference book on industrial timers covers basic design, construction, and application of timers in relation to automation of machinery and processes. The electronic designer will find little in the way of electronic timers in this book. However, since many electronic engineers are concerned with process control systems in which nonelectronic timers play an important part, this book should serve as a source of information on the workings of these devices.

The subjects covered include industrial timing devices; synchronous motor driven repeating cycle timers; synchronous motor driven automatic reset timers; "Cycl-Flex", "Timoflex", and multiple circuit automatic reset timers; "Microflex" automatic reset counters, direct current timers, and timers which are not synchronous motor driven. The book is well illustrated with pictures of timers and installations employing timers, as well as timing circuits.

Symposium on Electro-Magnetic Relays . . . *70 pages. Published by Potter & Brumfield, Princeton, Ind., available without charge.*

This booklet contains a selection of 13 papers presented at a Symposium on Electro-Magnetic Relays, given at Oklahoma Institute of Technology, Stillwell, Okla. Of particular interest to electronic design engineers are: "A Comparison of Sealed and Unsealed Relays", "Dielectric Strength and Insulation of Relays", "Relay Reliability Required by the Signal Corps", "Construction and Operational Features of Magnetic-Contact Relays", "Military Specifications", and "Appraisal of Relay Design".



Four G-E Micro-miniature Tantalytic capacitors easily fit into small space provided in this new all-transistor hearing aid. Man above adjusts volume control.

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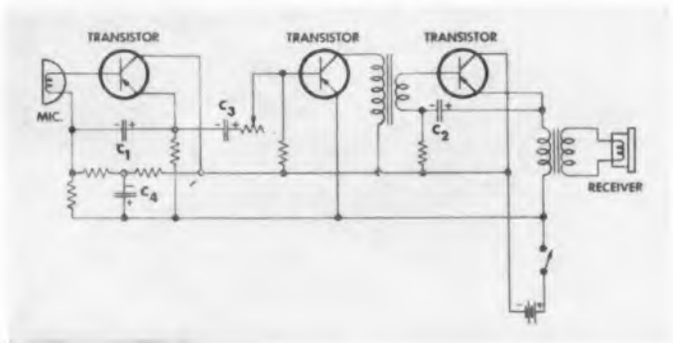
Pictures, circuit diagram, application information courtesy Sonotone Corp.



Simplified schematic diagram of Sonotone all-transistor hearing aid, showing location of G-E Micro-miniature Tantalytic capacitors.

Operating at a battery voltage of 2.5 volts, this hearing aid uses two units rated at 2 microfarads each for by-pass, C_1 and C_2 (see diagram). They give a low-impedance signal path from the source to the input of the transistor. Two 1-microfarad units, C_3 and C_4, are used for coupling and filtering respectively, where their low leakage current of .18 microamperes/uf/volt at 25 deg. C is especially important.

G-E Micro-miniature Tantalytics can be obtained in ratings up to 20 volts, or, up to 8 uf in a $\frac{5}{16}$-in. long by $\frac{1}{8}$-in. dia. case size, higher capacitance in a $\frac{1}{2}$-in. long by $\frac{1}{8}$-in. dia. case size. Capacitance tolerance is -0% to $+100\%$.

For more information about G-E Micro-miniature Tantalytic capacitors, contact your G-E Apparatus Sales Office or write for bulletin GEA-6065 to General Electric Company, Section 442-15, Schenectady 5, New York.

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