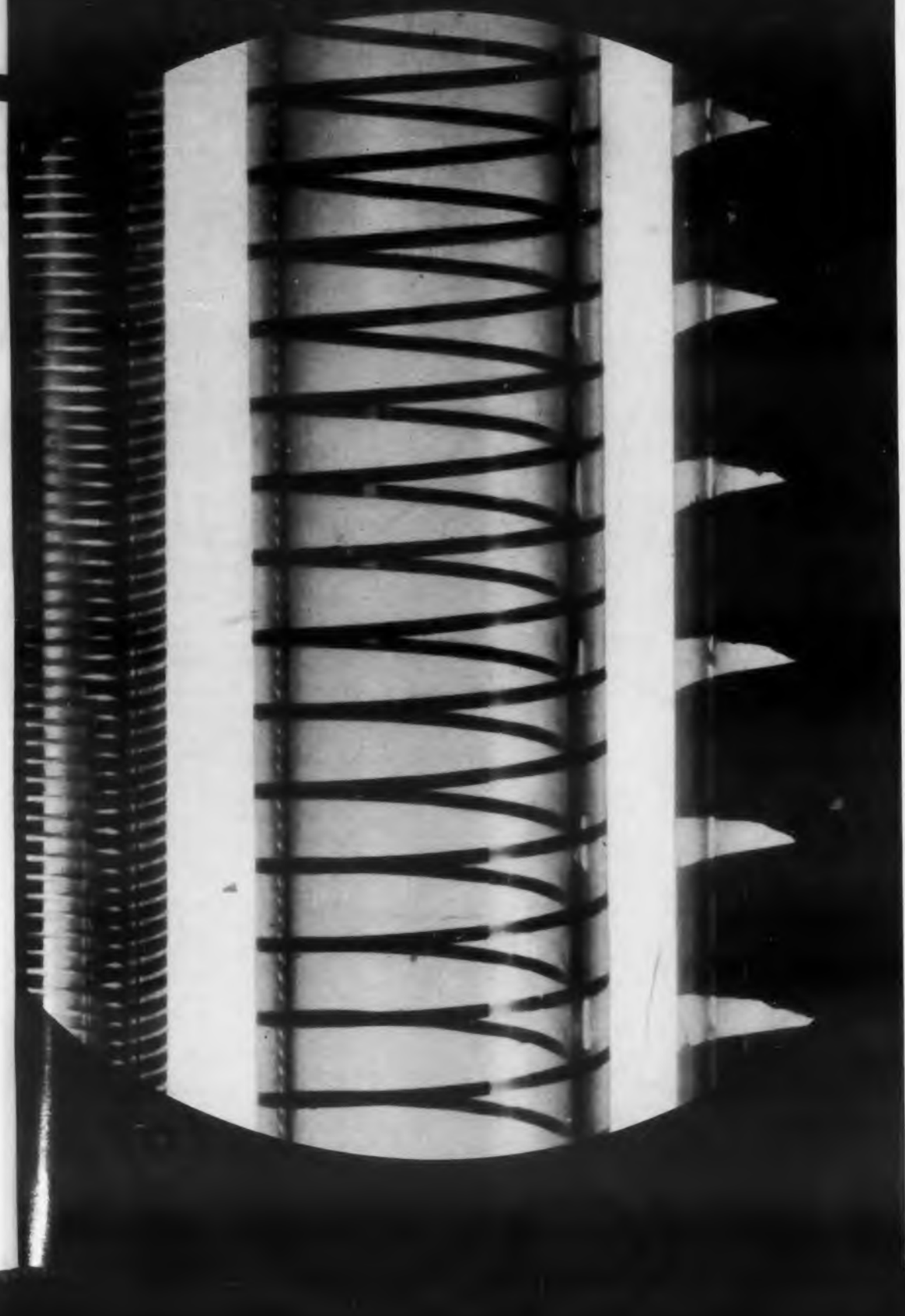
ELECTRONIC *design*



Depositing metallic resistance film on the inside surface of the glass-tube body of a new line of precision resistors results in these interesting patterns. A one watt unit, approximately actual size, is shown above.

November 1954

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Any job change requires requalification.

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ELECTRONIC design

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November 1954

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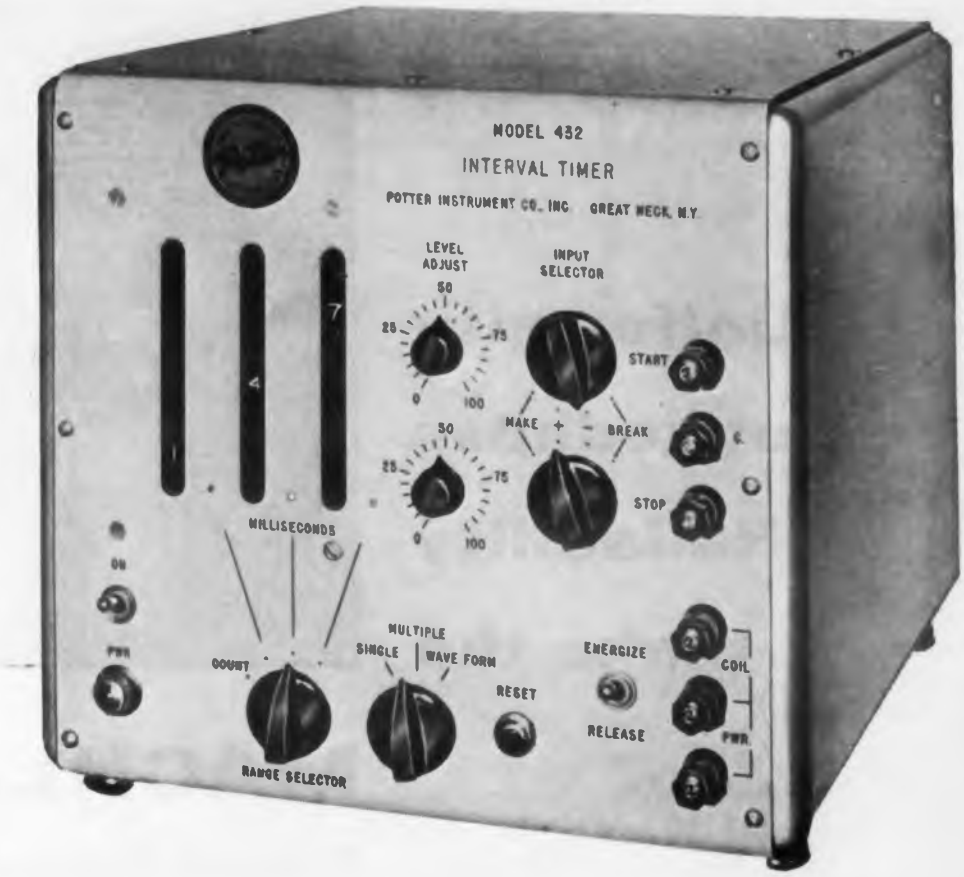

Here's a low-cost solution to your high-precision timing problems

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

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

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

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

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

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115 Cutter Mill Road, Great Neck, N. Y.

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Editorial

The Components Engineer

We would like to endorse a very valuable suggestion proposed recently at the Electronics Components Symposium in Washington, D. C. This concept, if implemented, can be of great help to electronic design engineers.

R. C. Sprague, of Sprague Electric Company, proposed the creation of a new type of engineer, the "components engineer" who would have a very special function in the design department of electronic manufacturing firms. His would be the responsibility of testing, selecting, and procuring electronic components for his company. He would have to know all about those components that were being incorporated into his company's products—their merits, limitations, performance, costs, availability, etc. He would be consulted by designers whenever a component problem arose, and would be expected to propose some practical solutions based on sound engineering and business principles.

It is pretty obvious that such an individual would be very handy to have around. It is also easy to see that such a man could save his company many hundreds of man-hours by eliminating the necessity for each designer to do his own component testing and selecting. One central source for this type of information would be established, and the components engineer would have to see that his information was up to date.

This function cannot be filled by merely assigning a title to a man. It requires special training. Probably the most important part of the components engineer's training would be in working as a design or development engineer for several years. Then with this background of solid practical experience, he would be ready to specialize in components. He would take formal courses in such topics as manufacturing techniques, testing, chemistry and physics of materials, statistics, and business practices. These subjects could very readily be organized into an excellent university graduate program. Where practical, the entire graduate program could be given in the evening or in intensive summer programs to accommodate working engineers.

We think this excellent idea can be successfully carried out in many engineering schools with the cooperation of local components manufacturers. The result would be a trained man who could fill a badly needed function in the industry. The components engineer can do much to help electronic design engineers fulfill their design functions more effectively.

Engineering Review . . .

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

Another Atomic Battery . . . An atomic battery that uses heat from radioactivity to produce electrical energy has been developed by John H. Birden and Kenneth C. Jordan of Mound Laboratory, Miamisburg, Ohio. It produces power comparable to that of the ordinary dry cells.

The new atomic battery utilizes polonium, while previously announced atomic batteries (*ED, February, 1954, p. 15; May, p. 8; and September, p. 15*) employ strontium-90 or tritium. One hundred and fifty curies of polonium is sealed in a small capsule, the surface of which is in contact with the hot junctions of 40 thermocouples. The capsule is thermally insulated with a silica aerogel and is mounted within a surrounding container on the surface of which are the cold thermocouple junctions. A temperature difference of about 450°F is maintained between the thermocouple junctions, producing a current flow.

The voltage-current rating of the battery can be varied by proper choice of wire size and the number of thermocouples. In this cell, the polonium capsule supplies 4.65w in heat, and the unit's output is 9.4mw. for an efficiency of 0.2%. It has an internal resistance of 15 ohms, a no-load voltage of 0.75v, and a current at maximum power of 25ma. Its output is not affected by extreme variations in the temperature of surroundings as is a flashlight cell.

Although such a battery has many obvious applications, large-scale production of the units is not economical. The Mound Laboratory is operated for the Atomic Energy Commission by Monsanto Chemical Co., St. Louis, Mo.

Faster Patenting . . . A committee has been appointed to seek new ways to speed up the processing of patent applications. Known as the Advisory Committee on Application of Machines to Patent Office Operations, it was appointed by Secretary of Commerce Sinclair Weeks. Its chairman is Dr. Vannevar Bush, President, Carnegie Institution of Washington, and Director of the wartime Office of Scientific Research and Development. It is hoped that the committee can recommend means of applying high-speed electronic devices to the time-consuming process of searching for previously granted patents in order to compare them with patent applications.

The Committee welcomes any suggestions for applying computers and other electronic devices to patent operations from professional men and industrial and research organizations. They should be sent to the executive secretary of the Committee: Norman T. Ball, Room 2322, Department of Commerce, Washington 25, D. C. Any speedup of patent operations should be an important stimulus to technological progress in the United States.

Electronic Stinger

The elongated tail of this U. S. Navy hunter-killer aircraft contains a "Magnetic Airborne Detector" for finding submerged submarines. This electronic weapon registers disturbances in the earth's magnetic field due to the presence of large metal bodies. The plane is a P2V-7 "Neptune", made by the Lockheed Aircraft Corporation, Burbank, Calif.

Engineering Review . . .

NEC Award . . . The First National Electronics Conference Award was presented to two General Electric Company men at the tenth anniversary session of the conference held at Chicago last month. Recipients of the $250 award were E. D. McArthur, manager of the electron tube section, General Electric Research Laboratory, Schenectady, N. Y., and E. F. Peterson, manager of marketing for the firm's radio and TV department, Syracuse, N. Y.

The new award will be presented annually to "the author or authors of a paper presented at a previous conference which introduced developments of a new and revolutionary character. . . ." McArthur and Peterson were co-authors of a paper entitled "The Lighthouse Tube; A Pioneer Ultra-High-Frequency Development" presented at the first NEC conference in 1944. It described the then-new development of disk-seal tubes, which played an important part in World War II radar defense.

Improved Investment Casting . . . The design of parts of greater complexity is now possible through the frozen-mercury process of investment casting because of a new feature known as "booking". This feature permits two or more pieces of frozen mercury to be almost instantly joined with only the slightest pressure. Therefore, complex patterns possessing interior coring so intricate as to make them very difficult or impractical to cast by other methods can be economically produced by the improved frozen-mercury method. This process is offered by Mercast Corp., 295 Madison Ave., New York 17, N. Y.

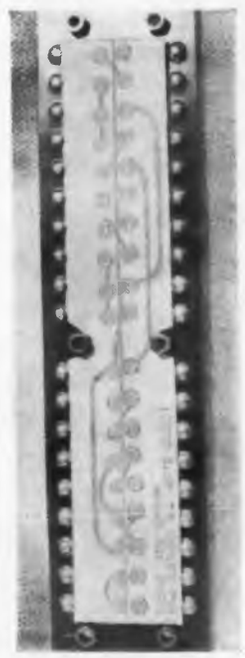
In the improved process, the original die is made in two identical halves, separated as a completed unit by a match-plate that is perfectly smooth on both sides. The two halves are linked with dowel pins extending through the match-plate. The liquid mercury is poured into the two die halves. When the material is frozen, the die is opened and the match-plate removed. Then the two sides of the die, aligned by dowels, are placed together, bringing the opposing smooth surfaces of the two halves of the frozen mercury pattern into a face-to-face contact.

When the halves are in contact, a slight squeeze or a gentle tapping against the die is enough to cause the frozen mercury to weld its surfaces to and unite the two halves into a single pattern.

"Booking" is not limited to the joining of two frozen sections only. Patterns have been made with as many as 12 separate "booking" operations producing large and intricate patterns. Lowered assembly and inventory costs could result from use of this process due to the elimination of small parts and the hardware necessary to attach them to larger parts or assemblies.

Rectangular Color Tube

This is the first model of a 21" rectangular color tube developed by Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J. An experimental unit, it has a metal-cone construction. Development of 21" and 22" tubes with glass envelopes is now in progress.



Wiring Aid

Wiring jumper wires to resistor boards is simplified by taping these removable paper wiring templates to the board. This production aid was developed at Martin Aircraft Co., Baltimore, Md.

Electronically Insured Coffee Breaks . . . Radio telephone service is now being used to speed servicemen to inoperative coffee vending machines in one of the latest applications of radio communications to industry. In one instance, a coffee machine was operating again just five minutes after it was jammed. This unique use of radio telephones in service trucks was conceived by Coffee Vending Service of Oak Park, Ill. The method could be profitably applied to other services such as air conditioning repairs.

Engineering Review . . .

Miniature Receiver . . . A newly developed miniature radio can receive either a-m or f-m signals over its reception range. Weighing less than 5oz, it is designed for use over the standard f-m range of 88 to 110Mc, but this range can be easily expanded to 20 to 174Mc.

By means of its circuitry, the receiver automatically discriminates the f-m signal or demodulates the a-m signal, as needed, without requiring any action by the listener. The earphone is a hearing-aid type, and the 3″ antenna sticks out of the 3″ x 2-1/4″ x 3/4″ case. Developed by Richard R. Florac, Ultra-Miniature Electronics Co., 246 E. 46th St., New York 17, N. Y., the radio utilizes the Raytheon Types *5676* and *6088* subminiature tubes.

Liquid Metal Pump . . . A newly developed pump for liquid metals operates on an electromagnetic principle and thereby does not require any moving parts. Designed to force liquid metal into forms in die-casting, it should have applications in industrial atomic energy installations.

When current is passed through the liquid metal in a direction perpendicular to the magnetic field that surrounds the metal, it produces a force that sets the metal in motion. A pump of this type will effectively pump those fluid metals that have a higher conductivity than the pumping section's walls. Produced by Callery Chemical Co., Callery, Pa., the direction of flow in the pump may be reversed by reversing the direction of the magnetic field. The unit operates on single-phase 60cy power.

Improved Solar Battery . . . The efficiency of the solar battery has been increased by one-third since it was announced (*ED, May, 1954, p. 5*) by Bell Telephone Laboratories, 463 West St., New York 14, N. Y. An efficiency of 6% had been achieved when the semiconductor cell was first demonstrated.

Experimental cells now convert 8% of the radiant energy striking the cell into electrical power. With maximum theoretical efficiency estimated at 22%, Bell scientists hope to gain an efficiency of 10 to 15%. The increase in efficiency has resulted from a reduction in the amount of energy reflected from the silicon wafer's surface and reduced losses inside the p-n junction cell itself.

Soluble Ceramic Coatings . . . Non-brittle ceramic coatings can be applied by spraying to a variety of materials in a new process available for licensing. When a thin sheet of metal is properly coated with a soluble ceramic, it can

be moderately bent, twisted, or even elongated without apparent damage to the coating. The highly adherent coatings have possible uses as insulations and protective coatings for resistor wire and tape, capacitors, and other electronic components and hardware.

Many different "solution ceramics" have been developed by Armour Research Foundation, Illinois Institute of Technology, 10 W. 35th St., Chicago 16, Ill. The coatings most intensively studied so far are refractory metal oxides such as zirconia, chromia, titania, ceria, and magnesia. Certain phosphates, silicates, fluosilicates, oxyhalides, and even metals can be deposited, and two or more materials may be co-deposited or applied in separate layers.

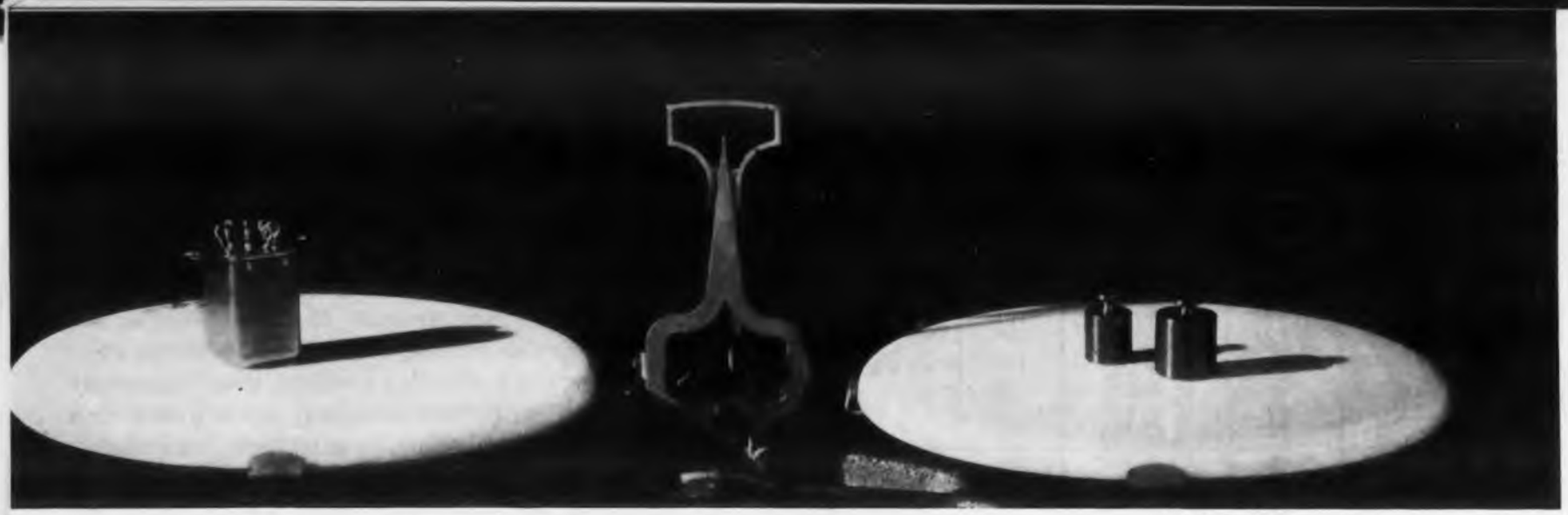
For most of the solutions tested, the temperature of the material onto which the solution is sprayed is 400 to 700°F, but adherent coatings have been obtained at temperatures as low as 300°F and as high as 1200°F. There is reason to believe that some ceramics can be deposited from chilled solutions at room temperatures.

Since solution ceramics are deposited from true solutions, the rate at which they are applied can be controlled accurately to produce extremely thin coatings. Coatings only a few millionths of an inch thick have been used to separate magnetic laminates without significantly increasing their packing factor.

Fiftieth Aniversary . . . The 50th anniversary convention of Eta Kappa Nu, electrical engineering honor society, was held at the University of Illinois, Urbana, Ill., on October 15 and 16. Founded in 1904, the association now includes nearly 23,000 members. Dr. Jesse E. Hobson, director of Stanford Research Institute and national president of Eta Kappa Nu, delivered the keynote address on the need for technical manpower in the United States.

Automatic Offices . . . Electronic mechanization of clerical work in offices will be the greatest growth area of electronics in the coming ten years, according to William J. Morlock, General Manager, Commercial Equipment Dept., General Electric Co., Syracuse, N. Y.

In his address before the Engineering Dept., RETMA, and the Professional Groups Committee, IRE, at Syracuse on October 19, Mr. Morlock also said that sales of electronic equipment, exclusive of military gear, is expected to increase to five million dollars yearly in the next ten years. He predicted that industrial electronic equipment would account for over half of the commercial sales, and marketing research indicates that this field will expand 700% while the older fields of electronics will expand 50%.



SMALLER AND LIGHTER: typical unit from new line of General Electric subminiature transformers weighs 30 grams, is 1 ⅛ in. high.

GENERAL ELECTRIC ANNOUNCES . . .

New line of subminiature transformers tailored to meet customer requirements

Wide range of ratings available in five matching case designs, 1-1/8" to 1-7/16" high

General Electric is now producing subminiature transformers to meet the wide variety of applications found in the electronic industry. As a result of our continuing program of research and development, G.E. has extended the new subminiature transformer sizes downward to serve the range of equipments utilizing printed circuits.

G-E engineers, with their extensive research and development facilities, have successfully designed units for guided missiles, servo-mechanisms, and computing systems, as well as printed circuits.

Metal-clad and hermetically sealed, the new subminiature transformers can be designed to withstand high potential test voltages of 1000 volts d-c. They are capable of operating in ambient temperatures of 125°C. and at altitudes up to 70,000 feet above sea level.

Other outstanding features:

Rectangular cases reduce cubic volume and weight to a minimum.

Base dimensions neatly fit chassis punched for standard tube sockets.

Uniform case designs enhance chassis appearance.

Compression glass bushings withstand severe thermal shock.

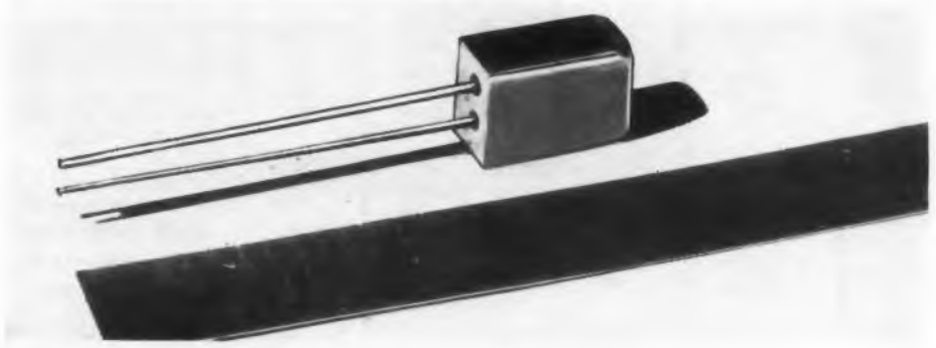
Hook-type terminals make installation easier.

Tin dip provides better protection against corrosion.

Experienced G-E engineers are eager to accept the challenge to produce the subminiature transformer you specify. For additional information call upon your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, New York. 412-116

Approximate case dimensions in inches

Height	Width	Depth	Case Designation	Tube Socket Punch
13/16	9/16	3/8	BD	(For printed Circuit Applications)
7/8	9/16	9/16	BE	Miniature
1 1/8	3/4	3/4	AF	Noval
1 7/16	13/16	13/16	BG	Noval
1 3/8	1	1	AG	Octal



SMALLEST UNIT, designed for printed circuits, has solid wire conductors two inches long for easy, direct connection to the other components.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Engineering Review . . .

Engineering Talent . . . Many of the Naval Reserve officers being released to inactive duty for budgetary reasons have valuable engineering and technical experience. Among a group of 860 officers being released in the Chicago area, 43 have electronics training, 50 have manufacturing experience, 18 were once draftsmen, 14 have mathematical and statistical backgrounds, and 4 are metallurgists. Interested employers can contact the Chief of Naval Air Reserve Training, Naval Air Station, Glenview, Ill., for the names, addresses, and resumes of these officers.

Ultrasonic Machining . . . By subjecting a brass or unhardened steel cutting tool to ultrasonic vibration, it can be used to cut materials as hard as tungsten carbide in a newly developed machining method known as "impact grinding". The tool is vibrated at 25,000 strokes per second.

In use, the tool is lowered until it is lightly in contact with the surface of the work. An abrasive suspended in liquid is flowed over the work in a continuous stream. The tool, moving up and down at high speed, drives the abrasive particles into the work. Owing to the great deceleration, the particles strike the material being cut with forces up to 10,000 times their normal weight, cutting it away.

Dimensions can be controlled to within half of one-thousandth of an inch, and finishes may be measured in microinches. Developed by Raytheon Manufacturing Co., Waltham 54, Mass., the method can be applied to alnico, quartz, optical glass, and precious and semi-precious stones. The work material need not be electrically conductive. The method has been incorporated in a device known as the "Ultrasonic Machine Tool."

Record Attendance . . . A record attendance of 7323 was recorded at the tenth annual National Electronics Conference held from October 4-6 at Chicago, Ill. Eighty-six technical papers were presented, and there were 158 exhibition booths.

◀ CIRCLE ED-9 ON READER-SERVICE CARD

Irradiated Plastic . . . By exposing polyethylene to radioactive bombardment in a newly developed process, the modified plastic is able to withstand temperatures as high as 350°F. Other improved characteristics of the irradiated plastic, which is known as "Agilene-HT", are tensile strength, elongation, and solvent resistance.

The modified polyethylene will be made available to the electrical, chemical, and food industries by American Agile Corp., 5461 Dunham Rd., Maple Heights, Ohio. Another method of producing irradiated polyethylene utilizes high-energy cathode rays from million-volt electron guns (*ED, April, 1954, p. 6*).

Linear Accelerator . . . A 15-million electron-volt travelling wave linear accelerator has been completed for use in medical research and treatment. Produced by Mullard Research Laboratories, Salfords, Surrey, England, it will be installed at the Physics Dept. of St. Bartholemew's Hospital College, London, England.

In the device, short bursts of electrons are projected from a high-voltage electron gun at a velocity of 0.4 times the speed of light into an evacuated waveguide of special design. The electrons are then accelerated by the electrical field produced by v-h-f waves fed into the waveguide from a magnetron. Leaving the waveguide at very nearly the speed of light, the electrons will be turned 90° by a magnetic field to strike either X-ray or neutron targets or the patient.

Acquired for therapeutic purposes, the accelerator will be used entirely during the next few years for research on the effect of radiation on living tissue and to determine the best methods of treating cancer. This instrument is the second 15Mev machine produced by Mullard. The other accelerator is used for nuclear physics research.

Selenium Rectifiers . . . Selenium rectifiers that show no indication of failure or decrease in output after more than 1000hr at 150°C are now being built experimentally by Bradley Laboratories, Inc., 168 Columbus Avenue, New Haven, Conn.

CIRCLE ED-5 ON READER-SERVICE CARD ➤

Engineering Review . . .

Magnetic Recording Standards . . . Four sub committees to study standardization problems and recommend procedures to be adopted have been set up by the Standards and Engineering Committee of the Magnetic Recording Industries Association, 444 Madison Ave., New York, N. Y.

Specific standardization problems to be studied are the general order of procedure to be adopted in setting standards and cooperation with allied organizations; a preliminary survey of playback standards for all tape speeds; review of the status of dimensional specifications, tapes, and reels; and investigating the preparation of industry wide standards on recording heads and track placements.

Repackaged Radar

As part of a program to reduce the weight of jet aircraft, the 172 lbs of radar gear in the foreground were repackaged into the 136-lb unit shown beside Edward H. Heinemann, Chief Engineer, El Segundo, Calif., Division, Douglas Aircraft Co., Inc.

Tactical TV Demonstration . . . A demonstration of the recently developed battle-control TV system of the Signal Corps (*ED, p. 9, June, 1954*) was held recently in which cameras were mounted in an airplane as well as on mobile units. High-ranking officers and industrialists in a command post observed the signals from each camera scanning a simulated amphibious and armored attack at Fort George G. Meade, Md.

Each of the monochrome cameras fed back to its transmitter mounted on a 3/4 ton truck. From each truck the signal was transmitted by microwave relay

to a larger monitoring truck located near the command post. Two cameras were mounted in an L-20 reconnaissance plane. One was fixed to cover terrain directly below the plane, and the other was flexibly mounted to permit oblique views of the surrounding areas. The signals from these airborne cameras were transmitted directly to the monitoring truck. Two-way radio facilities permitted instructions to be sent from headquarters or the monitoring truck to the camera locations.

During the action, carried out by units of the 3rd Armored Cavalry Regiment, the combat cameras on the ground followed a tank-infantry attack across open terrain, followed troops on a water crossing, and covered a skirmish and an assault on a fortified position at the beachhead. During one stage in the action, an "enemy" officer was captured and brought before a camera for interrogation as the regimental intelligence officer watched and interpreted the information at the command post. The airborne cameras followed the progress of the attack and spotted "enemy" concentrations. The television equipment employed was supplied by the Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y.

To demonstrate the usefulness of color TV for this purpose, a phase of the action was covered by color TV cameras of the National Broadcasting System for a nationwide color telecast that was viewed at the White House and the Pentagon. A comparison of the monochrome and color images showed that observers were able to distinguish more clearly the nature of the foliage and terrain and were able to follow more easily the movement of troops and equipment in wooden areas by means of the color broadcasts.

"Loopless" Direction Finder

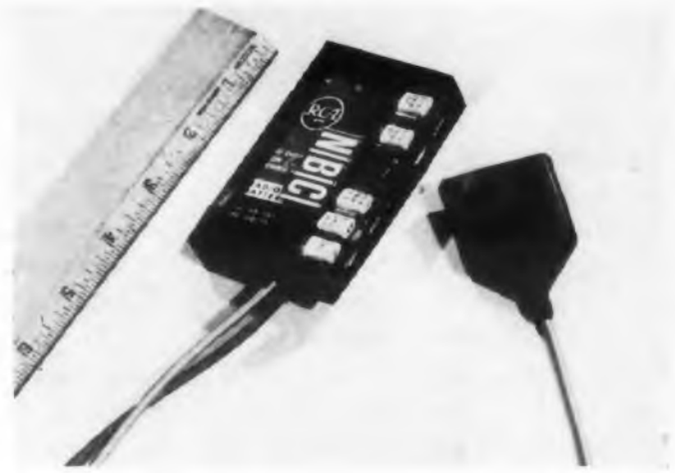
The knob-like antenna on this direction-finder radio replaces the usual loop. The antenna projects only 2". Made by Raytheon Manufacturing Co., Waltham, Mass., this portable radio weighs only 13 lb with batteries. A boat owner can take fixes on standard broadcast or special "beacon" transmitters by means of this unit.

Engineering Review . . .

"Wireless" Microphone . . . Microphone booms and cables in TV studios have been made obsolete by the transmitter-microphone illustrated below.. Hidden in the performer's costume, the transistorized assembly permits complete freedom of movement.

The transmitter's antenna is worn around the performer's waist, and the signal is picked up by a loop encircling the stage area. The signal is then demodulated for broadcast in the usual manner. The transmitter incorporates eight transistors, and it is powered by an alkaline battery. The assembly was developed by the National Broadcasting System, division of Radio Corp. of America, 30 Rockefeller Plaza, New York, N. Y.

The dimensions of the transmitter shown are 5/8" x 2" x 3-3/4". It develops about 50mw of power at approximately 530kc, but radiates less than 100-micromicrowatts.



Automatic Transformer Production . . . Transformer coils can be produced automatically by a new method of slicing rolls of metal foil and insulating paper into thin wafers. The technique was evolved by the Lighting Division Laboratories of Sylvania Electric Products, Inc., at Ipswich, Mass., at the request of the United States Air Force.

The wafer-type transformer coils are made by rolling together wide sheets of very thin metal foil and similarly thin sheets of insulating paper. The rolls are then sliced into thin wafers resembling miniature life preservers. For audio applications, a core is inserted in the hole, but at radio frequencies, the wafer can be the complete transformer. The technique can also be used also to make inductive elements.

Printed Circuit Inventor Honored . . . The British Institution of Radio Engineers has presented its Marconi Award to Dr. Paul Eisler, noted Austrian-born British physicist and the inventor of the "Technograph" process of printing electrical circuits. Dr. Eisler heads the Research Laboratories of Technograph Printed Circuits, Ltd., London, England.

CIRCLE ED-398 ON READER-SERVICE CARD ➤

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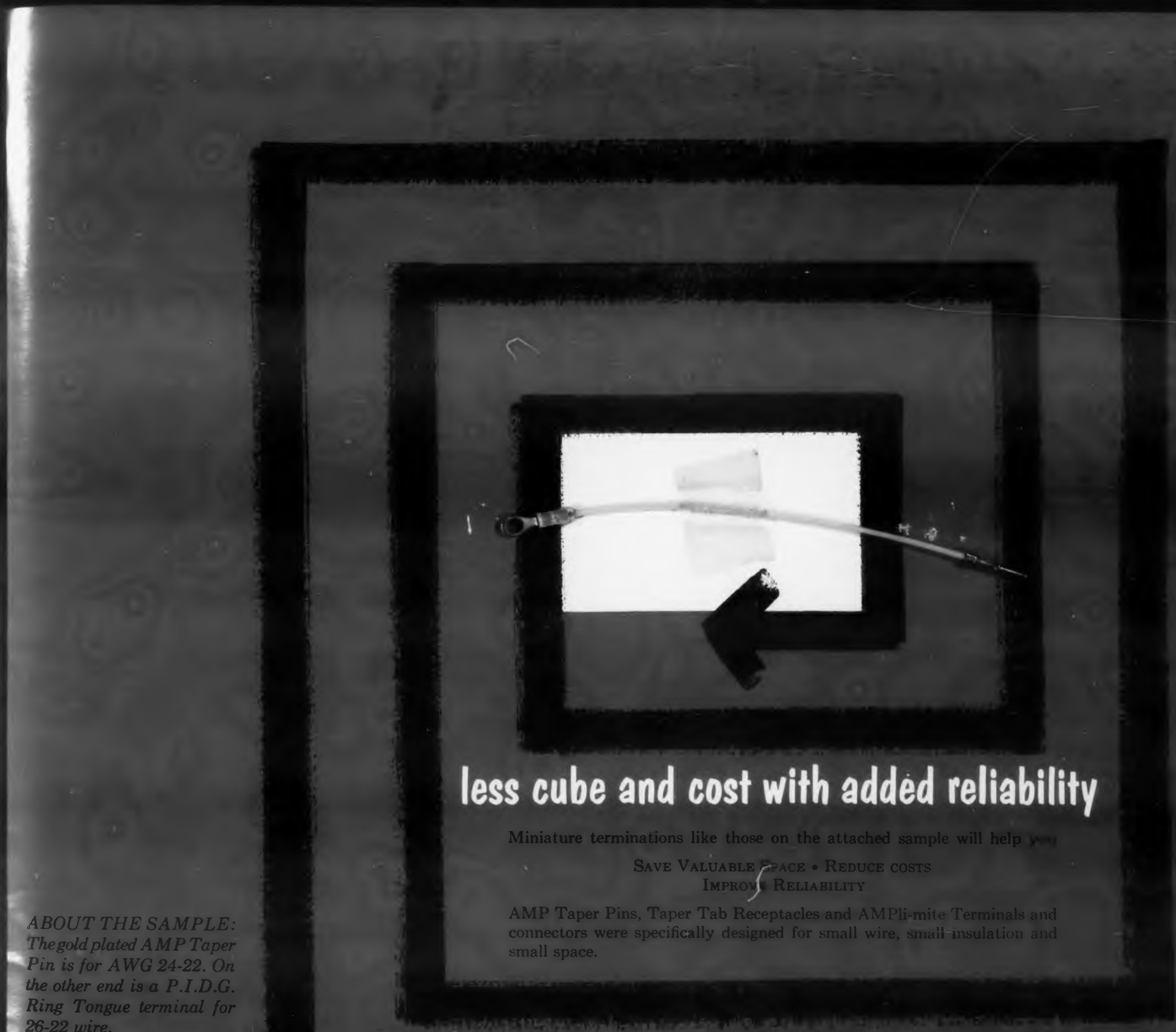


less cube and cost with added reliability

Miniature terminations like those on the attached sample will help you

SAVE VALUABLE SPACE • REDUCE COSTS
IMPROVE RELIABILITY

AMP Taper Pins, Taper Tab Receptacles and AMPli-mite Terminals and connectors were specifically designed for small wire, small insulation and small space.

ABOUT THE SAMPLE: The gold plated AMP Taper Pin is for AWG 24-22. On the other end is a P.I.D.G. Ring Tongue terminal for 26-22 wire.

AMP

AIRCRAFT-MARINE PRODUCTS, INC.

Photo courtesy of International Business Machines Corp., manufacturers of Electronic Business Machines.

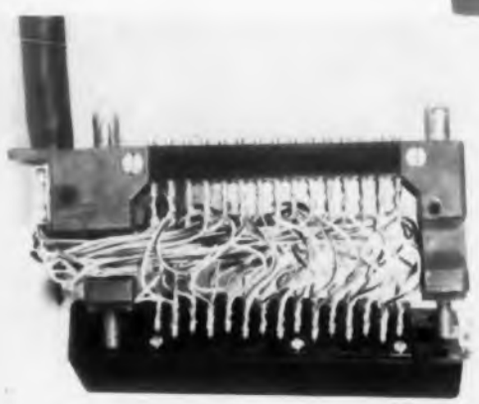
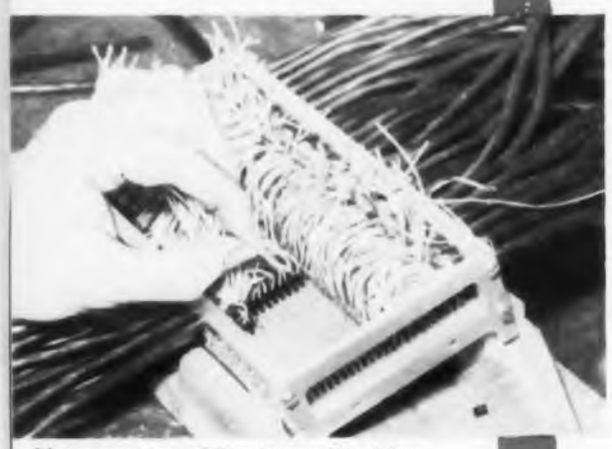


Photo courtesy of Stromberg Carlson, manufacturers of Commercial Electronic and Telephone equipment.



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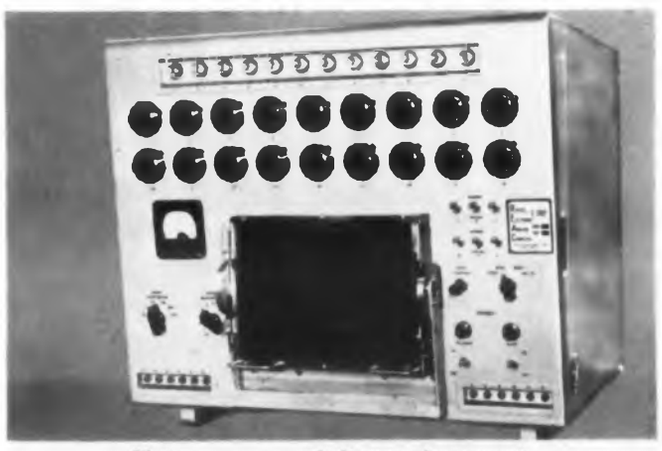

Photo courtesy of Reeves Instrument Corp., manufacturers of electronic analog computers.

Photo courtesy of E.R.A., manufacturers of electronic computers equipment

Color Measured Electronically . . . Colors of leather samples can be accurately reproduced in mass production of leather by means of a newly developed electronic instrument known as the "Hunter Color and Color-Difference Meter". The device is far more accurate than the human eye.

Technically the meter is a tristimulus colorimeter, measuring color on three scales that give uniform measures of the visual perceptibility of differences between colors. The apparatus is divided into two parts. The upper part is the exposure unit containing a light source and the means for viewing specimens with different photocells. The lower part is a measuring unit containing electronic instruments and other components for recording the values of the photocell current based on scales proportional to color.

The meter is not only used by the Ashtabula Hide and Leather Company to match samples, but also during the production run to insure uniformity. The formula for color difference is based on the unit of color difference devised at the National Bureau of Standards, Washington 25, D. C. The meter itself is produced by Henry A. Gardner Laboratory, Inc., Bethesda, Md. In addition to this application, the color-difference meter could conceivably be employed in the textile, printing, and paint industries.

Process Redesign Tester . . . An electronic testing system that will permit engineers to estimate the effect of the addition of new equipment to an industrial operation without actually test-installing such equipment has been developed by Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Known as servo analyzer, the new system automatically translates behavior characteristics of equipment into a chart record. This record, in turn, is analyzed to determine how such a component will affect the over-all behavior of the operation. It is claimed that the new system can save 30 to 60% of the research time involved in redesigning a process.

In operation, the system puts a control or a group of controls into an operating situation to see if they perform correctly when specific conditions are altered. This is accomplished by automatically introducing a rhythmic change into a process. The analyzer then automatically measures and plots the results. It can test a unit in as little as eight minutes.

The system, which is portable, is made up of four components, a signal generator, a potentiometer, a control box, and a function plotter. It provides three forms of test energy: pneumatic, mechanical, and electrical. In addition to measuring frequency response characteristics of servomechanisms, piping, tanks, valves, actuators, and control instruments, the analyzer is also used for analog tests and in the development of precision controls, pipelines, refineries, air foils, and jet engine components. This instrument could find wide application in field tests, in addition to its obvious use in the design laboratory.

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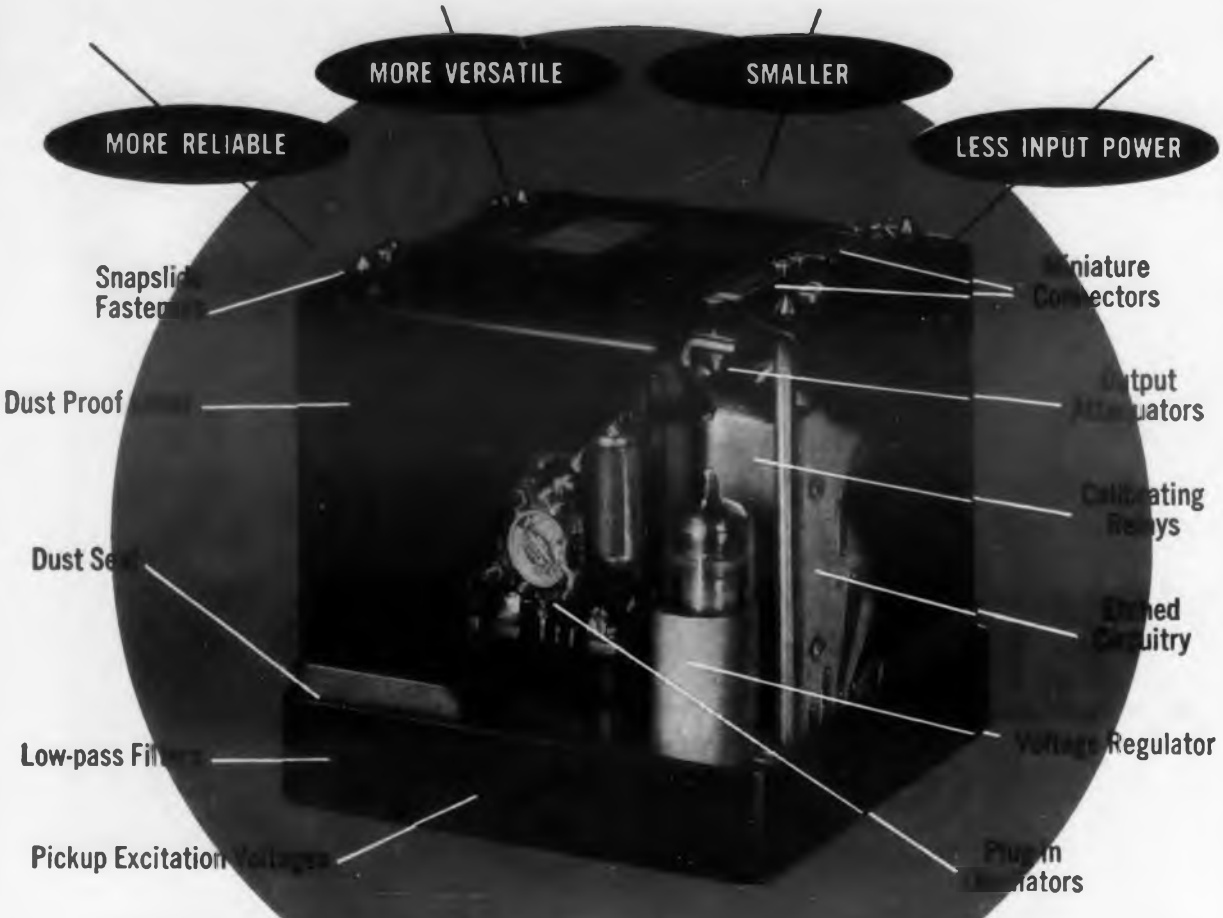

BENDIX-PACIFIC TATP-4&5 PACKAGES

These compact Bendix-Pacific Telemetering [illegible] offer users of telemetering systems a **better** means to instrument such quantities as pressure, force, temperature, voltage, acceleration and vibration.

The units are smaller and various combinations may be used to provide compact multi-channel systems of up to 18 subcarrier bands. Each unit operates on **unregulated** +150 VDC and 28 VDC since it contains its own voltage regulating circuits. Each unit may be provided with individual relays for switching oscillator inputs from signal to calibrate position. Model TATP-4 contains four and Model TATP-5 contains six separate and independent regulated +5 VDC excitation voltage [illegible] for use with resistance type pickups.

No vacuum tubes are required in mixing the outputs of the individual subcarrier oscillators to the composite audio signal for direct modulation of the RF transmitter, thus greatly improving the reliability of the system at a point where a tube failure would affect **all** subcarrier channels.

Standard Bendix Model TPP-6 Power Supplies are available to handle from one to three of these telemeter packages plus a 2 watt crystal controlled RF transmitter. Many types of interchangeable subcarrier oscillators are also available. RF amplifiers are available for increased power outputs up to 100 watts.

CHARACTERISTICS

	TATP-4	TATP-5
No. of bands	4	6
Subcarrier bands	1.7 kc. to 70 kc.	1.7 kc. to 70.0 kc.
Oscillator Types	TOE-30V, TOE-31V, TOR-8V, TOR-9V, TOL-9V	Same as TATP-4
Input Voltages	6, 12, or 24 VDC ±10% 150 VDC $\pm^{10}_{5}$%	6, 12, or 24 VDC ±10% 150 VDC $\pm^{10}_{5}$%
Weight (Less Oscillators)	Approx. 2 lbs.	Approx. 3 lbs.
Dimensions	5.0" x 5.0" x 4.5"	5.0" x 7.5" x 4.5"

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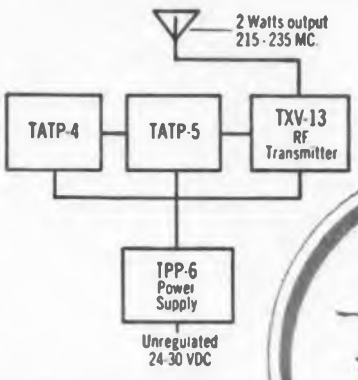
TYPICAL 10 BAND SYSTEM



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Engineering Review . . .

Industrial Research Study . . . The 2-1/2 billion-dollar-a-year research and development program of American industry will be surveyed by the Department of Labor for the purpose of recommending policies to strengthen the nation's research efforts.

The new survey will provide data on research spending and research manpower in every major industry. The Department will seek information on the cost of research performed by the companies themselves and on the amounts spent by companies to purchase outside research. Besides dollar figures, the survey will determine the number of engineers and scientists employed in research.

The industrial survey will be supplemented by studies of research work in Government agencies, colleges and universities, trade associations, commercial laboratories, and nonprofit research institutes.

The survey will be carried out by the Bureau of Labor Statistics for the National Science Foundation. Since the survey is being conducted on a sampling basis to reduce cost, replies are greatly needed from all firms receiving questionnaires.

Gaseous Discharge Transducer . . . A highly accurate gaseous discharge transducer is the key element in two new measuring devices. The transducer, various types of which are illustrated below, is a gas discharge tube with two electrodes. When placed in an r-f

electric field, a voltage is developed across the electrodes. This voltage varies with any movement of the tube.

The instruments, a pressure gage and a comparator micrometer, and the transducers are manufactured by Decker Aviation Corp., 1361 Frankford Ave., Philadelphia 25, Pa. The transducers can be employed to measure physical displacement or an unbalance caused by a variation in the circuitry outside the tube. The voltage across the electrodes can be either negative or positive, and the output of the unit is independent of frequency over a wide frequency range. The output is also independent of wide variations in source voltage.

Meetings

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

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

November 19-20: *Fall Meeting, Operations Research Society,* Sheraton-Park Hotel, Washington, D. C., For information, write to D. A. Katcher, 7100 Connecticut Ave., Chevy Chase 15, Md.

November 29-December 3: *First International Automation Exposition,* 242nd Coast Artillery Armory, N.Y.C. Write to First International Automation Exposition, 845 Ridge Ave., Pittsburgh 12, Pa.

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

December 27-29: *The Society for Industrial and Applied Mathematics* will hold its first national meeting in conjunction with the annual meetings of American Mathematical Society, the Mathematical Association of America, and the Association for Symbolic Logic, Univ. of Pittsburgh. Write to H. W. Kuhn, Dalton Hall, Bryn Mawr College, Bryn Mawr, Pa.

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

January 20-21: *Printed Circuit Symposium,* University of Pennsylvania, Philadelphia, Pa. Sponsored by the Engineering Dept., Radio-Electronics-Television Manufacturers Association. Tentative subjects of the six sessions are: "Product Design Applications"; "Reliability and Serviceability"; "Management Considerations"; "Techniques of Producing Printed Wiring Boards" (panel session); "Printed Components and Components For Use With Printed Wiring"; and "Production Techniques and Manufacturing Methods". Submit papers to and request information from Donald E. Cottle, General Electric Co., Electronics Park, Syracuse, N. Y.

Design of Optimum Horns for Rectangular Waveguide

by Helmut E. Schrank

Bendix Radio Div., Bendix Aviation Corp., Baltimore, Md.

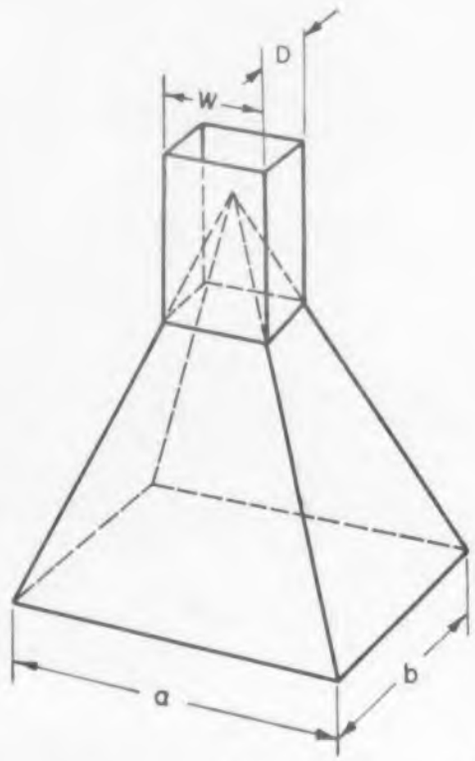


Fig. 1. A true pyramidal horn. The best ratio of *a* to *b* does not correspond to standard waveguide proportions.

OPTIMUM design horns are desirable not only for their provision of maximum gain for a fixed horn length, but also because their apparent source of radiation is known to be located at the throat, i.e., in the plane where the flare begins[1]. This latter fact, which does not hold for horns in general, is helpful in making accurate gain measurement of the horns after their design and construction.

It can be noted that the available design curves[2, 3] provide the dimensions of true pyramidal horns. illustrated by Fig. 1. For this type of horn, the ratio of the aperture dimensions a/b must equal the ratio of the waveguide dimensions W/D. The available design curves give a ratio of 1.23 to 1, which unfortunately does not correspond to standard waveguide proportions. Attempts to use the dimensional data

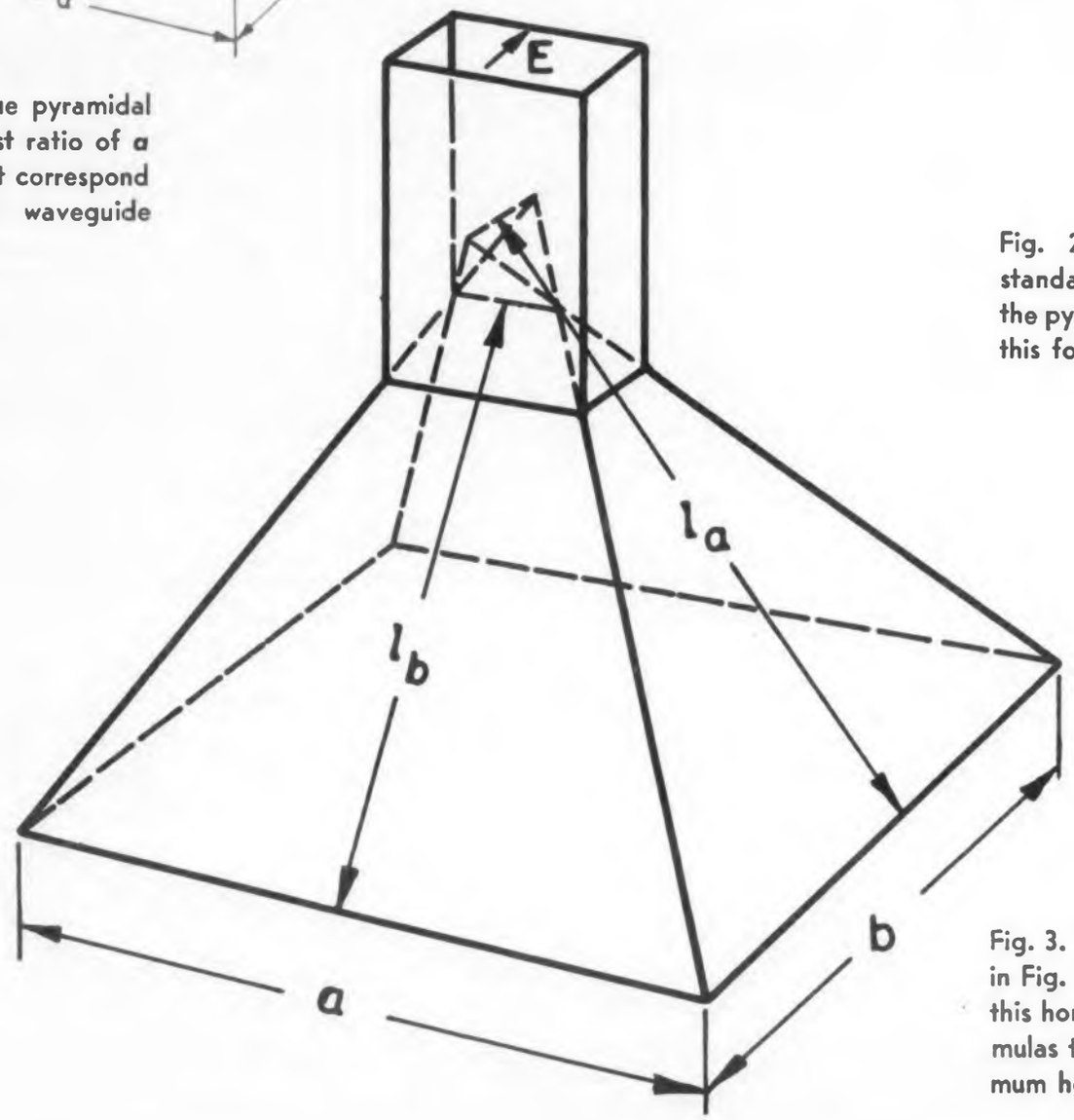


Fig. 3. The same as the horn in Fig. 3, the slant lengths of this horn are used in the formulas to determine the optimum horn.

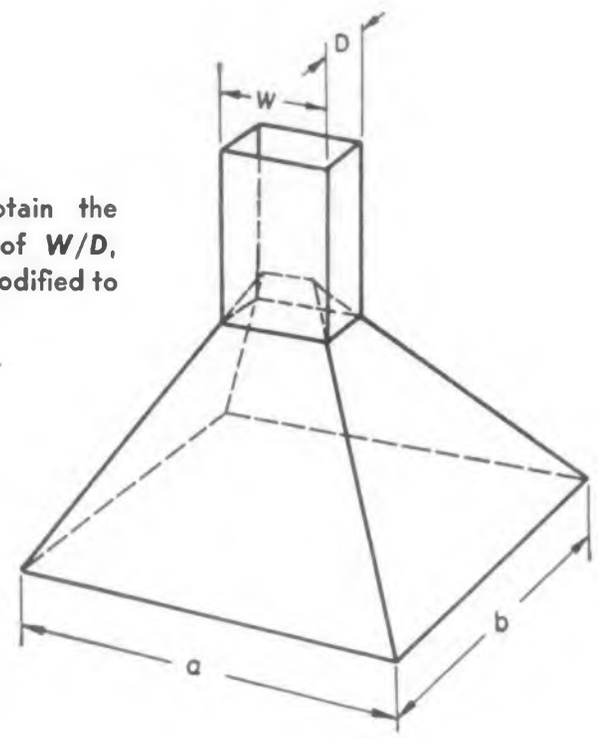
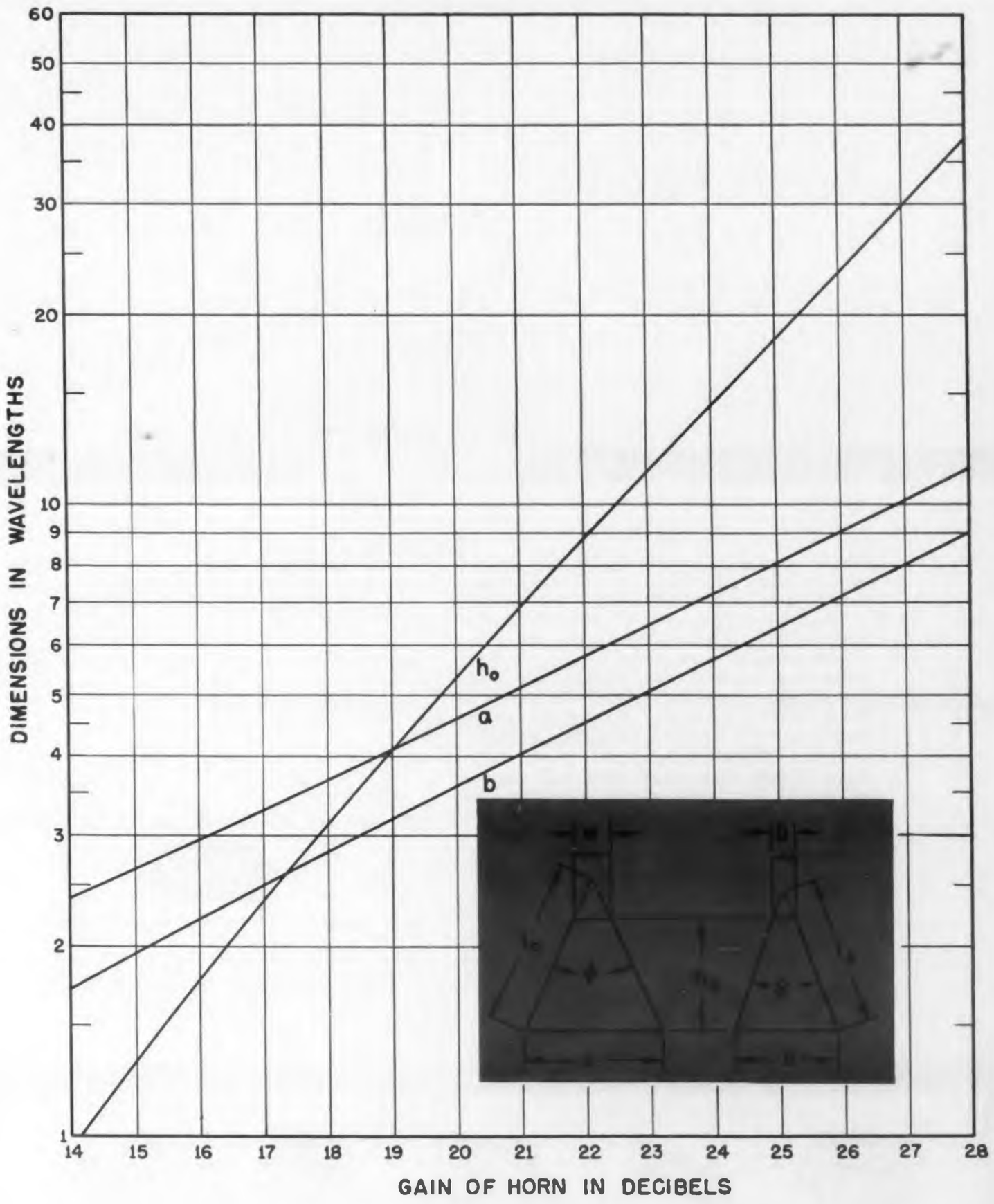


Fig. 2. To obtain the standard ratio of W/D, the pyramid is modified to this form.

Fig. 4. The normalized aperature dimensions and axial height for optimum horns can be determined from these plots, which are derived on pp. 20 and 21.



from these design curves with standard waveguides shows that dimension "L" becomes ambiguous, which makes the calculation of horn dimensions somewhat awkward. When this is done, it is reasonable to wonder whether the resulting horn still has optimum gain. It can be shown that for horns having gains greater than about 24db, the results are still optimum, but for lower gain horns the differences are appreciable.

Modified Design Curves

To facilitate the design, a modified set of design curves was developed, using the results of Schelkunoff's horn antenna theory[4, 6], and similar information in other references[7]. When this theoretical data was combined with the geometrical condition that the horn fit standard waveguide proportions (as described in the next section) the resulting horn was found to be no longer of true pyramidal form, but of the form illustrated in Fig. 2. It is to be noted that the four planes forming the horn do not intersect at a common point, and that there are therefore two different slant length dimensions l_a and l_b as shown in Fig. 3. The modified design curves, shown in Fig. 4, provide the normalized aperture dimensions a and b and the normalized axial height h_o for horns having optimum gain in both the electric and magnetic planes.

Although these curves were computed for X-band waveguide (RG-52/U) at a single frequency (9,050-Mc), they are equally accurate for any waveguide at a frequency at which $W = 0.689$ wavelengths and $D = 0.306$ wavelengths. At other frequencies, the horn dimensions a, b, and h_o will result in a gain slightly different from the value given by the curves

of Fig. 4. As computed from theory, this difference amounts to about ±0.1db when the frequency varies ±10%, for a 14.5db gain horn. The difference is less for higher gain horns. In terms of X-band, if the curves are used to design a 14.5db horn for use at 8,200Mc, the dimensions will produce a horn having an actual gain of 14.4db. Similarly, if the curves are used to design a 14.5db horn for use at 10,000Mc, the gain will actually be 14.6db. Thus the design curves (Fig. 4) give results well within a reasonable gain tolerance over a 20% band of frequencies. In terms of wavelengths, the curves are valid to within a ±0.1db theoretical gain tolerance for the following range:

$$1.31W \leqq \lambda \leqq 1.60W$$

corresponding to

$$2.95D \leqq \lambda \leqq 3.60D.$$

At the extreme upper end of the waveguide operating band (12,400Mc for RG-52/U) the computed gain error is +0.3db for a 14.5db horn, and less for higher gain horns.

Derivation of Design Curves

The curves of gain versus aperture dimensions given in the figures of references 4, 6, and 7 show that for a constant slant length l (in either plane) there is a corresponding aperture dimension which maximizes the gain. In other words an optimum horn is one for which the flare angles in both the electric and magnetic planes are so chosen that for a given length of horn the gain is a maximum[5]. Plotting the slant lengths l_a and l_b against their corresponding optimum aperture dimensions a and b results in straight parallel lines on log-log paper. From these graphs the following relations for optimum gain were determined:

$$(a/\lambda)^2 = 3.18(l_a/\lambda) \quad (1)$$

$$(b/\lambda)^2 = 2.10(l_b/\lambda) \quad (2)$$

This represents a more exact development of footnote 2 in Jakes' paper[1].

From the triangles in Fig. x, it can be seen that

$$l_a = (a/2)/\sin(\phi/2) \quad (3)$$

and

$$l_b = (b/2)/\sin(\Theta/2) \quad (4)$$

Combining equations (3) with (1), and (4) with (2), gives the conditions for optimum gain in terms of the flare angles:

$$(a/\lambda) = 1.59/\sin(\phi/2) \quad (5)$$

$$(b/\lambda) = 1.05/\sin(\Theta/2) \quad (6)$$

Again using Fig. 4, the axial height of the horn h_o can be expressed in terms of either the E or H plane dimensions as follows:

$$h_o = (a\text{-}W)/2\tan(\phi/2) = (b\text{-}D)/2\tan(\Theta/2) \quad (7)$$

This equation relates the optimum dimensions in the H plane to those in the E plane for any given waveguide dimensions W and D. Thus, if either a or b

is specified, all other horn dimensions can be obtained from equations (5), (6), and (7). A direct relation between a and b from equation (7) is most readily found graphically by plotting each versus h_0.

From the data in references 4, 6, and 7, the values of the "partial" optimum gains (i.e., gains of sectoral horns) in each plane were also plotted against the respective aperture dimensions. This again resulted in straight parallel lines on log-log paper, from which the following relations for optimum conditions were determined:

$$g_H = 7.86(a/\lambda) \quad (8)$$

$$g_E = 7.96(b/\lambda) \quad (9)$$

The total gain G of optimum rectangular horns was found by substituting equations (8) and (9) into equation (50), p. 587 of reference 7:

$$G = \pi(g_H)\ (g_E)/32$$

so that

$$G = 6.14(a/\lambda)\ (b/\lambda) \quad (10)$$

The curves of Fig. 4 were constructed by choosing convenient values of (a/λ) and calculating all other parameters from the above equations. The results were then plotted against the total gain G, which is the most convenient starting point in most horn design problems. Note that all dimensions are normalized in terms of wavelength λ.

Experimental Verification

The curves of Fig. 4 were used to design a standard optimum horn for RG-52/U waveguide, with a gain of 20db at 9,000Mc. Two such horns were built and the gain was measured using the distance between the throats, rather than the distance between apertures, as recommended by Jakes[1]. The measured gain was found to be 19.9db at the design frequency. This is an average of several measurements made at various distances.

Acknowledgement—This work was done under U. S. Navy contract NORD-11299 at the Johns Hopkins University Radiation Laboratory, Baltimore, Md.

References

1. Jakes, W. C., Jr., "Gain of Electromagnetic Horns", *Proceedings of I.R.E.*, Vol. 39, No. 2, 1951, p. 160.

2. *Reference Data for Radio Engineers.* Third Edition, New York. Federal Telephone and Radio Corp., 1949. Fig. 23, p. 389.

3. Southworth, George C., *Principles and Applications of Waveguide Transmissions.* New York: Van Nostrand, 1950. ibid Fig. 10.1-13, p. 413.

4. ibid Fig. 10.1-10, p. 410 and Fig. 10.1-11, p. 411.

5. ibid Footnote 18, p. 410.

6. Schelkunoff, Sergei A., *Electromagnetic Waves.* New York: Van Nostrand, 1943. Fig. 9.20, p. 363 and Fig. 9.21, p. 365.

7. Silver, Samuel (ed.), *Microwave Antenna Theory and Design* (M.I.T. Radiation Laboratory Series, Vol. 12). New York: McGraw-Hill, 1949. Fig. 15.20, p. 588 and Fig. 15.21, p. 589.

Attenuation Constant Measurement With a Lossy Variable Short Circuit

Helmut M. Altschuler

Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Editor's Note: This article is also based on material (see ED, pp. 24-27, September, 1954) from the Handbook of Microwave Measurements, edited by Moe Wind, Research Assistant Professor, and Harold Rapaport, Research Associate, Polytechnic Institute of Brooklyn. It is taken from the chapter on "Measurement of Propagation Constant". The Handbook, recently published by the Institute, is available from the Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y. It is printed in two volumes and is priced at $12.00.

SPECIAL instrumentation is not required for the method of measuring attenuation constant of waveguides at microwave frequencies described here. Although the measurement of this constant is conceptually quite simple and can be carried out in a variety of ways, the numerical values obtained may be in large error unless great care is exercised. The possibility of large error is inherent in the relative smallness of the dissipation which must be measured when samples of reasonable length are tested. It can generally be overcome by the use of special instrumentation not readily available to most workers. Since the expense and time involved in such an approach is often not justifiable, methods that promise good accuracy and which are based on the equipment to be found in even the smaller microwave laboratories become of particular interest.

Basically, in the method described here, the magnitude of the reflection coefficient of a lossy short circuit is measured with and without the sample line in place. The attenuation constant of the sample line is then computed directly from the ratio of these reflection coefficient magnitudes. The detailed reasoning, however, is more complex than this statement implies.

Apart from a power source and a detector, the present method requires only the use of a slotted line and of a variable short circuit which has been deliberately made lossy. Good accuracy is achieved since the loss introduced in the short circuit reduces the otherwise high values of VSWR (voltage standing wave ratio) to a lower range where they can be measured more readily. In addition, the method of analysis is not based on a single data point, but on a number of distinctly different datum points which are effectively averaged. Moreover, since the method automatically takes into account any discontinuities that are located between the slotted line probe and the sample, the slotted line and the sample may, but need not be, of different cross-sections. The cross-sections of the sample and the short circuit, however, must be identical and the connector between these components (if any) must have a negligible VSWR.

The measurement components, as assembled for the two main steps of the measurement, are shown in Fig. 1. All these, save the lossy short circuit, are standard items. The slotted line on one hand, and the short circuit and sample line on the other, are shown as guides of different cross-sections (and of characteristic impedances Z_{01} and Z_{02}) to underline the method's applicability to this situation.

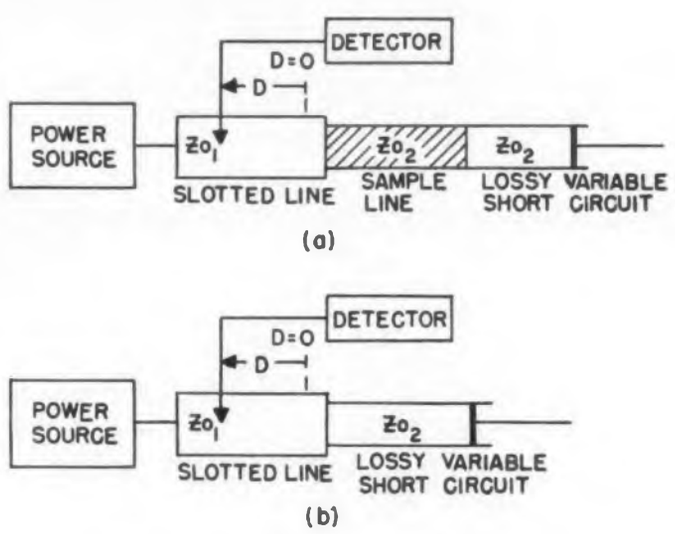


Fig. 1. Two arrangements of equipment for measuring attenuation constant.

Although the short circuit must be variable, no accurate position scale need be associated with it. Any good standard variable short circuit may be made "artificially" (i.e., deliberately) lossy by attaching some dissipative material to the shorting plunger. Two examples of how this may be done are shown in Fig. 2. It is to be noted that the plunger and the lossy material are an integral unit, and that the lossy material may be of relatively arbitrary value (in regard to amount of loss) and shape.

Measurement Procedure

1. With the equipment connected as shown in Fig. 1, (top), and with the lossy shorting plunger set at some arbitrary point, carefully measure the corresponding VSWR in the slotted line and the position of the voltage minimum, D. The plane $D = 0$ is any arbitrary, but fixed reference plane.

2. Repeat step 1 for a number (for example, 10) of arbitrary, but spaced, positions of the lossy shorting plunger.

3. Remove the sample line and connect the lossy variable short circuit directly to the slotted line (see Fig. 1, bottom).

4. Repeat steps 1 and 2 (without the sample line).

5. Determine $\lambda_g/2$, the distance between adjacent voltage minima in the slotted line. λ_g is defined as the guide wavelength in the slotted line.

Analysis of Data

6. From each measured point (VSWR, D) compute

$$\theta = 720D/\lambda_g \text{ degrees, and}$$

$$|\Gamma| = (\text{VSWR} - 1)/(\text{VSWR} + 1)$$

7. Using the values of θ and $|\Gamma|$ obtained by steps 1, 2 and 6, plot θ vs $|\Gamma|$ on polar coordinate paper ($0 < |\Gamma| < 1$; $0° < \theta < 360°$).

8. Carefully draw that circle (which best fits the distribution of points) through the plotted points. Theoretically the points must fall on a circle.

9. Determine ρ_a, the radius of the circle, and r_{oa} the radial coordinate of the center of the circle (see Fig. 3).

10. Repeat steps 7, 8, and 9 using the values of θ and $|\Gamma|$ obtained by following steps 4 and 6. Designate the radius of this second circle as ρ_b and the radial coordinate of its center as r_{ob}.

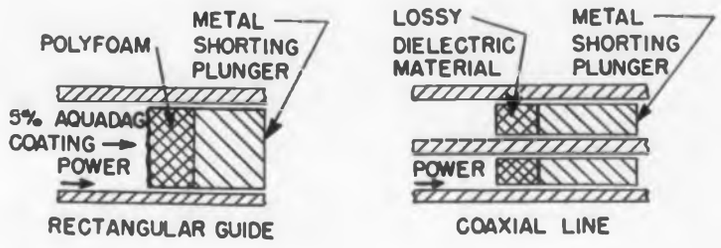


Fig. 2. Two shorting plungers with deliberately introduced losses.

11. The attenuation constant, α, is then given by

$$\alpha = \frac{1}{2L} \log_e \frac{(A_a + B_a)\,(A_b - B_b)}{(A_a - B_a)\,(A_b + B_b)} \text{ nepers/unit length}$$

where L is the length of the sample line and where

$$A_a = \left[(1+\rho_a)^2 - r_{oa}^2\right]^{1/2}, \quad B_a = \left[(1-\rho_a)^2 + r_{oa}^2\right]^{1/2}$$

and

$$A_b = \left[(1+\rho_b)^2 - r_{ob}^2\right]^{1/2}, \quad B_b = \left[(1-\rho_b)^2 + r_{ob}^2\right]^{1/2}$$

The quantities ρ_a, r_{oa}, ρ_b and r_{ob} found in steps 9 and 10 above can, when accuracy requires it, be obtained in a precision fashion. ρ, r_o and the angle θ_o (i.e., θ_{oa} and θ_{ob}), which is defined as the angular coordinate of the center of the data circle as shown in Fig. 3, must first be read directly from the circle. The quantities obtained in this manner serve as first order values in an analytical correction procedure which yields the values of the parameters ρ, r_o and θ_o more precisely. Space does not permit the presentation of the general correction procedure, which is given completely in the *Handbook*, section 6, pp 40–42. However, the special case given below is applicable when r_o is small. This is the situation when, as often happens, the discontinuity between the probe and the sample waveguide under test is small.

Correction Procedure for r_o Small

It is assumed that ρ and r_o, for the particular circle in question have, been found via steps 9 and 10 and that r_o is very small.

12. From the values of $|\Gamma|$ determined in step 6 compute the differences $\triangle d$ for each $|\Gamma|$ from

$$\triangle d = |\Gamma| - \rho$$

13. Plot the small differences $\triangle d$ found in step 12 against the corresponding values of θ found in step 6. Plot these points on rectilinear graph paper, as shown in Fig. 4.

14. Draw the best sine curve, with a periodicity of 360° in θ, through the plotted points. Determine the center axis (or average level) of the sine curve.

15. Determine $\triangle\rho$, the distance between the center axis and the ordinate axis ($\triangle d = 0$) and $\triangle r_o$, the amplitude of the sine curve. Note: $\triangle\rho$ is positive if the center axis lies above $\triangle d = 0$ (as in Fig. 4) and negative if the center axis lies below $\triangle d = 0$. On the other hand, $\triangle r_o$ is always taken to be positive in this case.

16. The corrected circle parameters, ρ' and r'_o, are obtained from

$$\rho' = \rho + \triangle\rho, \; r'_o = |\triangle r_o|.$$

If (by inspection) r'_{oa} and r'_{ob} are both sufficiently small to be judged negligible in step 11, the attenuation constant is given directly by

$$\alpha = \frac{1}{2L} \log_e \frac{\rho_b}{\rho_a} \text{ nepers/unit length}$$

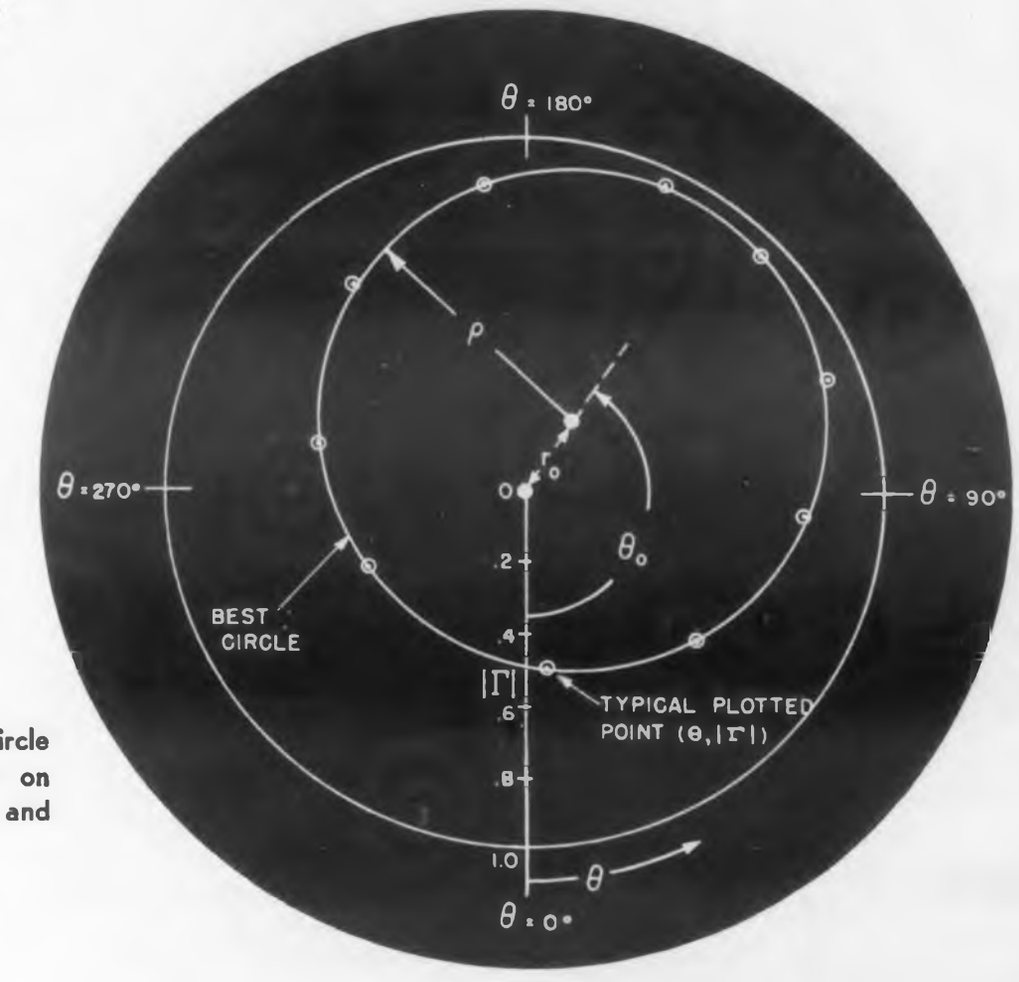
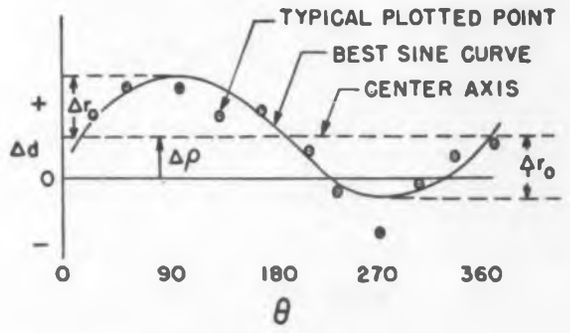


Fig. 3. By drawing the best circle through the plotted points on polar-coordinate paper, ρ, r_o, and θ can be determined.

Fig. 4. The correction procedure for ρ and r_o is based on this plot.



The procedures described above are also applicable when, instead of a lossy variable short circuit, an open-ended sample line of "variable length" is employed. Since, in general, the open end of a transmission line radiates, it constitutes a lossy termination comparable to a lossy shorting plunger. When small lengths of this line are then cut from the end in a systematic fashion, the motion of the lossy variable short circuit is simulated. (The assumption has been made that the loss in a half wavelength of the sample line is so small that it can be neglected.) This procedure is useful when applied to such guides as coaxial cable or strip line where no proper lossy variable short circuits constructed of the same type of guide as the sample are possible.

The measurement procedure already given is followed exactly in this case except for the following changes: Step 1—the sample line and the lossy variable short circuit together must now be taken as an open-ended length of sample line; Step 2—short lengths are cut from the end of the sample line to simulate the plunger motion; Step 3—most of the sample line is cut off; a sufficient length must remain so that small cuts can again be made in step 4. One must be careful that the open end, as well as the surrounding space, is similar after each cut so that the lossy termination always retains the same reflection factor.

extruded TEMPREX teflon* HOOK-UP WIRE

for reliability

Temprex Extruded Teflon Wire

Temprex Extruded Teflon Wire-Shielded (Metal)

Temprex Extruded Teflon Wire-Fiberglas Braid, Teflon Saturated

50-70-90 Ohm Coaxial Cable also available

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Furnished in 14 solid colors extruded over silver-plated, stranded copper wire, or a solid conductor. Sizes 26—10 AWG in production lengths. Delivery within 10—14 days . . . Write for complete engineering information and price list.

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NEBROC TEFLON-FIBERGLAS LACING CORD
TEMPTUBE TEFLON-FIBERGLAS TUBING

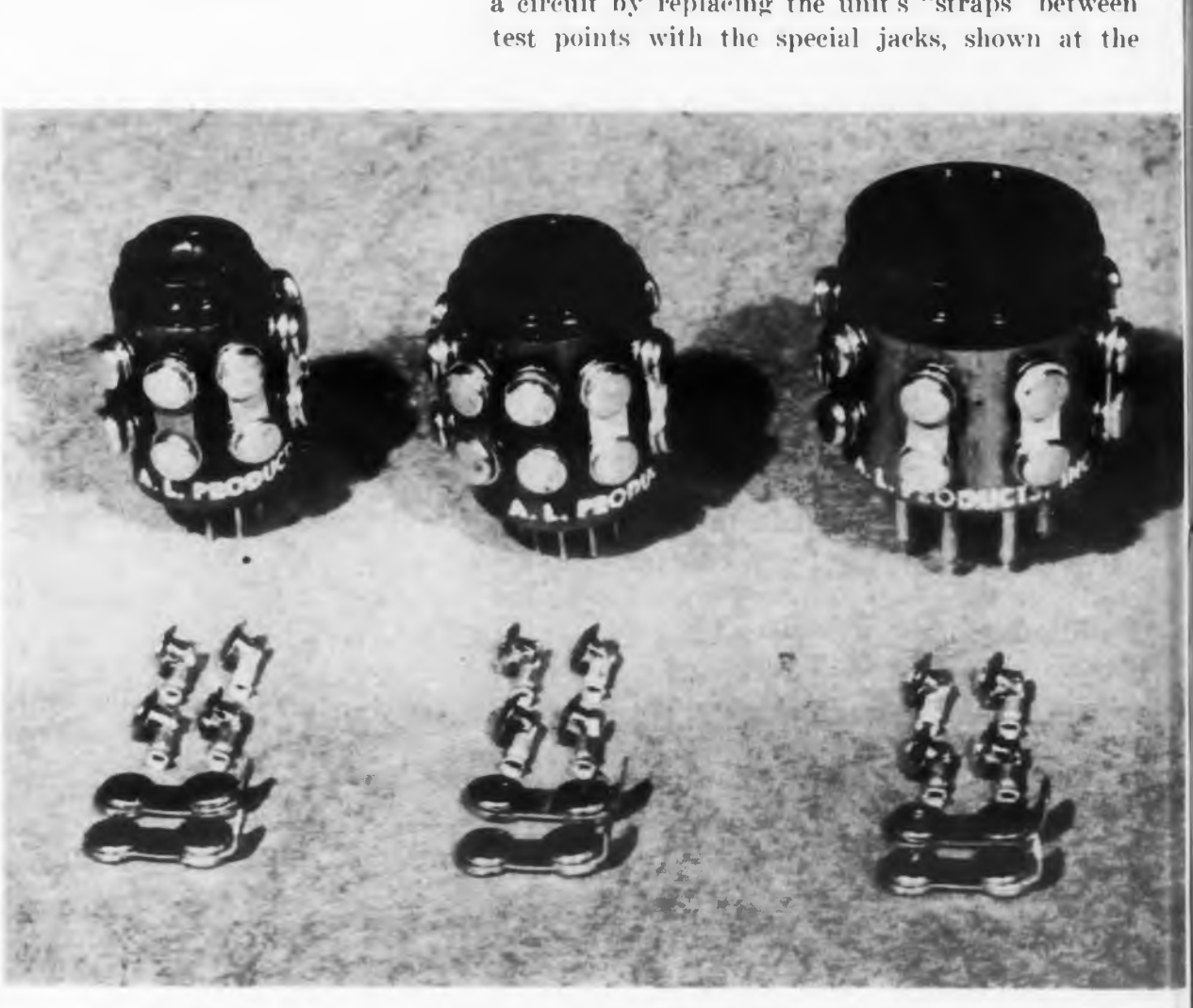
*Du Pont's Trade Name for Polytetrafluoroethylene

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

Tube Socket Test Adapters

OVER 90% of the characteristics of most circuits can be controlled by means of the Tube Socket Test Adapters shown on these pages without unsoldering a single connection. The electronic engineer can utilize these design aids to quickly modify a circuit to obtain desired performance, or to test a newly developed circuit by removing a tube, inserting the adapter in its socket, and then replacing the tube in the adapter.

In addition to making test points readily available, resistors or capacitors can be inserted into a circuit by replacing the unit's "straps" between test points with the special jacks, shown at the



Each type of adapter is furnished with four "jacks" for inserting components and two special "straps" with lugs for alligator clips.

left. The jacks are made to receive leads of the diameter generally furnished with components. In addition to the four jacks supplied with each adapter, two special straps with lugs are furnished for use with alligator clips connected to ammeters or decade boxes, as shown below. These adapters are made by A. L. Products, Inc., 311 Hickory St., Kearny, N. J.

The adapters are made in three types, for 7-pin and 9-pin subminiatures, and octal base tubes, respectively. The terminals are color coded according to the RETMA standard. For more data, turn to Reader's Service card and circle **ED-19.**

Two types of the adapters in use showing how the jacks and special straps are employed.

Technical Problems Affecting National Defense

Ideas for Design

THE NATIONAL Inventors Council has published a new list for 1954 of "Technical Problems Affecting National Defense". Those problems listed below are of interest to electronic design engineers and allied professional personnel. Actual or suggested solutions to any of the problems are welcomed.

No special forms are required for submitting proposals to the Council, and the services of an attorney are not necessary. The description should be as nearly complete as the inventor can make it and might well include: (1) some reference to underlying principles; (2) any experimental work or tests that have been conducted; and (3) the particular points of novelty or superiority of the invention as compared to existing devices. The written material may be supplemented by sketches or diagrams, but these need not be professionally prepared.

These problems include a number taken from earlier lists that have not been solved satisfactorily. Copies of the list will be supplied free of charge to any individual or organization. The address of the Council is as follows:

National Inventors Council
U. S. Department of Commerce
Washington 25, D. C.

Components

Gas-Driven Servo. A rugged, compact, high-power gas-driven servo capable of operating in a severe environment.

Quick Disconnect. Jam-proof, ice-proof, dust-proof, quick disconnect, multi-contact umbilical plugs.

Long-Life Batteries. Batteries with a long "shelf life" and a constant power output over a widely varying temperature range.

Coaxial r-f Switch. Coaxial r-f switch of broadbank characteristics to handle 1 to 10kw of power.

Frequency Insensitive Rotating Joint for Coaxial and Waveguide Circuitry.

Hermetically Sealed Cartridges. Develop miniature hermetically sealed cartridges for transistors and crystal diodes which may be sealed off at a temperature below 100°C.

Underwater Acoustic Transducer. Underwater acoustic transducers with directional discrimination at low sonic frequencies, and consistent with low weight and small size.

Improved or New Type Commutating and Decommutating for Telemetering.

Simple, Light-Weight, and Producible Inertial Components; Gyros, Accelerometers, Computers, etc.

Supersonic Radome. Supersonic radome with minimum aberration and reflection, and immune to dust, rain, and ice erosion.

Improved Magnetostriction Units or Other Frequency Control Devices for Use in Communication Equipment. To develop magnetostriction units or other frequency control devices which can be used in lieu of quartz crystal units for frequency control in communication equipment. Because of the diminishing supply of natural quartz it is necessary that other means of frequency control for communication equipment be investigated. Two items which offer possibility are: (1) magnetostriction units and (2) frequency stabilized electrically controlled oscillators.

Miniature Batteries. Initial production of RM cells was spotty and while some batteries gave good performance, other batteries did not provide any life at all because of open circuits, short circuits and other defects. Low temperature dry batteries, while affording some service life at temperatures as low as —40°F, have not provided sufficient life at these temperatures. (1) Batteries should be as small and light as possible, (2) Require as little as possible, or no effort to put them into operation, (3) Keep indefinitely in storage, whether at low temperatures or high temperatures, such as encountered in arctic or tropical climatic areas, (4) Provide relatively even service life over a range of temperatures from —100°F to +160°F.

High-Power Electron Tubes. High-power electron tubes with negligible current drain.

Cathode-Ray Tube. Large-screen (12″) cathode ray tubes in which the glass envelope is much lighter in weight, shorter and more rugged.

High-Voltage Power Supply and Components. To develop a high voltage power supply that is lightweight and extremely small in size. Need exists for a high voltage power supply (20,000-40,000v) with dimensions and weight that will permit its use as a component of man-carried electronic equipment. The power supply must be small, lightweight and conveniently packaged so as not to restrict the movements of or cause premature fatigue to the individual carrying and operating the electronic device. Design studies are now being made on the following: (a) Low cathode power, high voltage (20,000v and higher), rectifier tube for direct current not exceeding 50μamps; (b) Capacitors for filtering pack from 10,000 to 40,000v; (c) Insulating material to withstand 10-40kv.

Electronic Equipment

Microwave Oscillator. There is a need for a microwave oscillator suitable for continuous wave or pulsed applications of 1kw or higher power output.

Efficient, Compact, Light, Quiet Power Source. There is a continuing need for an efficient, compact, light, quiet power source for mobile and man-portable field applications. Existing sources such as batteries have limitations in that they require frequent charging or, in the case of throw-aways, heavy logistic support. They are also considered too heavy for many uses. Internal combustion engines are in general too noisy for front-line operations. The recently announced solar and atomic batteries are still in the developmental stage.

Recorder for High-Frequency Range. Recorder for the frequency range of 5 to 1000Mc with immediate playback or long time storage before playback.

Microwave Direct Storage or Memory Circuit. Microwave direct storage or memory circuit in which the frequency and/or modulation may be read off after a time delay of 1 to 100sec.

Non-Heterodyning Type of Frequency Divider. A non-heterodyning type of frequency divider for microwave frequencies.

Instruments

Ambient Temperature Measurement. Presentation is desired for one or more methods of measuring the ambient temperature of the atmosphere through which an aircraft is passing. This project has as its primary objective the methods which may be employed to nullify the effects of frictional heating on the sampling or measuring instrumentality. The method presented should be capable of being incorporated into an instrument which will have the minimum time lag and provide direct readings. Two speed ranges are under consideration: 200-600 and 200-1000mph.

Ambient Humidity Measurement. Presentation is desired of one or more methods of measuring the relative (or absolute) humidity of the atmosphere through which an aircraft is passing. Nullification of the effects of frictional heating is a primary objective. The method(s) presented should be capable of being incorporated into an instrument which will be direct reading and have minimum time lag. Two speed ranges are under consideration, 200-600 and 200-1000mph.

Rugged Portable Lightweight Ammeter. A rugged portable lightweight ammeter with a sensitivity 20 to 100 times that of the conventional D'Arsonval type. Device should be simple, requiring no external power supply or electron tube amplifiers.

Flux Meter. A means of measuring small changes in the earth's magnetic field that does not require the measuring device to maintain a fixed position relative to the direction of the earth's field.

Pre-Stress Measurement in Nut and Bolt Assemblies. A portable device (sonic, electrical or otherwise) is needed to measure the pre-stresses set up in nut and bolt assemblies.

Non-Destructive Tester. The problem is to develop a simple reliable device or technique for non-destructive testing of adhesion in bonded joints.

Helicopter Attitude Indicator. A relatively simple, lightweight instrument that will indicate the correct attitude of the helicopter fuselage in the hover condition as well as in flight and which will indicate drift in any direction.

Helicopter Airspeed Indicator. A simple, dependable, lightweight device is required to measure and indicate the forward speed of a helicopter through the surrounding air at very low speeds (0-20 mph) involved in hovering. Ordinary airspeed measurement is ineffective due to the great disturbance of the air mass by the motor downwash.

True Vertical Indicator. A simple means of determining true vertical, not employing a gyroscope, that will not be affected by accelerations in the horizontal plane.

Non-Magnetic Compass. A simple directional device capable of being carried by a foot-soldier which can determine true north within an accuracy of 5 mils, independent of the earth's magnetic eld.

Detection of Defects in or General Inadequacies of Structural Sandwich Materials. To develop non-destructive means for determining the presence of defects or inadequate bonding of sandwich materials, which can be used by relatively unskilled personnel. Rapid means of inspection of structural sandwich assemblies as used in aircraft are required to determine if adequate strength is provided. Increasing use of sandwich construction in aircraft makes this problem increasingly important.

Special Devices

Concealment Studies for Combat Vehicles. Development of a device or devices applicable to vehicles to permit combat operation of vehicles under cover of darkness without disclosing the location of the vehicles through the usual means of radiation, light, and noise.

Detection of Buried Explosives. A device or technique capable of positively detecting and locating explosives, as such, buried at shallow depths.

Presenting Three-Dimensional Information. There is a need in the radar display field for a means of presenting three-dimensional information. Stereoptical techniques are considered inadequate particularly where reasonable high accuracy of all three quantities must be retained.

Homing Navigation System. Simple homing navigation systems, including homing heads, gyros, etc. Rugged and light.

Artillery Orientation System. Development of a system of orientation of artillery to a reference independent of line of sight, earth's magnetic field, or earth's rotation, with azimuth accuracy of 1/4 mil.

Ultra-Light-Weight Collapsible Field Antenna Masts or Vertical Radiators. To develop a structure, usable as an antenna support mast or as a vertical radiator, which is much lighter and more portable than present types, and capable of rapid installation by a small crew. Mobility of military radio communication equipment is often limited primarily by the portability of its antenna system. New masts of the collapsible type are required to increase effectiveness by enhancing portability of equipment and, when used as radiators, to afford increased efficiency in that the antenna can be readily adjusted to resonance at a particular frequency.

Desired characteristics of the structure include: (a) Maximum height, 100′; minimum, not more than 10′; readily adjustable to any intermediate height. (b) Minimum weight and bulk consistent with requisite mechanical strength; preferably portable by one or two men. (c) Minimum of guys; preferably none for lower masts and radiators. (d) Completely weatherproof. All components to be capable of outside storage in any climate, and usable in the Arctic and in the tropics.

New Methods of Converting Light Energy into Electrical Energy. An equipment that could convert light energy into electrical energy for power applications should be capable of operating on a minimum amount of light; should be capable of producing electrical energy at a reasonably efficient rate of conversion, and, if possible, the electrical output should have a constant curve to insure good voltage regulation; equipment should be rugged and not affected by atmospheric conditions; should be capable of operating from −65°F to +165°F; should be of minimum weight and size and should not be difficult to operate.

Equipment for Converting Heat Energy into Electrical Energy. Equipment for converting heat energy into electrical energy should have efficient and fool-proof heating and heat transfer mechanism; should be capable of using several types of fuel such as gasoline, diesel oil, kerosene, alcohol, etc.; should be portable; thermocouples should be of such construction and composition as to provide efficiency above 5 or 10%, if possible; equipment should have good voltage regulation and should have reasonably constant power output during variation of temperature.

Electronic Telegraph Printer. To provide a telegraph printing device in which the functions of translating the transmitted signals and the operation of the printing elements are accomplished by electronic circuits. The equipment shall be light in weight and capable of efficiently operating at speeds greater than the conventional mechanical teletypewriter. Combat military operations require a lightweight telegraph printer that is capable of man-pack and installation by small battle units. The equipment shall also be suitable for aircraft installation.

Measurement of Ballistic Data. A simple means of getting ballistic wind and ballistic air density data from surface measurements and observations which will continuously furnish data sufficiently accurate for AA fire control purposes.

Destructive Ray. To develop equipment of usable size capable of producing destructive or death rays effective at 500 yards without excessive power input. Investigations to date indicate that tremendous amounts of power would be required using present techniques and that a completely new approach is indicated.

Weather Observation Apparatus. Development of an economical automatic weather observation apparatus that records weather elements (including humidity, wind speed, wind direction, etc.) and makes a permanent record or broadcasts weather conditions under extreme cold or heat situations.

Lightweight Equipment for Translating Speech into Writing. To develop equipment of size suitable for general use, capable of translating ordinary speech into the written word. All approaches to date show that apparatus required using existing techniques would be extremely complicated and bulky.

Trajectory Indicator. Indicator to indicate trajectory of a missile with respect to a target aircraft.

System of Transmitting Fire Control Data. A method of automatically transmitting and receiving three elements of data over a twisted pair of field wires with an accuracy of one part in twelve thousand. The transmission of all three elements of data need not be carried on simultaneously, provided that each element is transmitted at least twice per second.

New Type of Communication. The development of a revolutionary new method of transmitting intelligence to augment or replace present systems. Present systems in general depend on electrical impulses, electromagnetic waves, sound waves, etc. A system utilizing completely new concepts is desired.

Materials

Semi-Conductor Material. Develop a semi-conductor material suitable for use in transistors, the color of which is to depend upon its conductivity type, that is, n type material one color, p type material a different color.

High Resistance Material. Discover an insulating material which has a resistance of at least 10^{11} ohms per centimeter. The material recommended for this application should have a low temperature coefficient, good resistance to vibration and shock, but need have only limited external mechanical strength. This material is required in providing very high resistance elements for use in radiation detection instruments. The resistors must be producible within 20% accuracy.

Casting Resins. Potting or casting plastic compounds for protecting electronic components and sub-assemblies. Such compounds are required to have low viscosity at relatively low temperatures, should set up and cure quickly with a minimum cracking over a wide temperature range, (−55°C to 200°C.)

High-Temperature Molding Compound. Molding compound having resistance to high temperatures, (200°C), low dielectric loss, and good mechanical properties. The material will be a plastic, preferably thermosetting, with good dimensional stability, and a short molding cycle.

Coil Impregnants. A low cost, easily applied r-f coil impregnant, which will satisfy general military service conditions such as high temperature, (125°C), high humidity, low temperature storage, (−62°C), with minimum effect on physical or electrical performance. Such impregnant may be a wax, varnish, or resin. The impregnant must be such that the "Q" of a coil which it protects must be maintained after exposure to the adverse environmental conditions mentioned.

High Quality Synthetic Quartz or Other Piezoelectric Crystals. Development of high quality synthetic quartz or other piezoelectric crystals which can be used in lieu of natural quartz in frequency control devices. Because of the diminishing supply of natural quartz, it is necessary that synthetic materials be developed for frequency control devices. The following types of materials are being investigated: (a) synthetic quartz; (b) aluminum phosphate crystals; (c) various types of water soluble crystals; (d) nepheline and (e) tourmaline.

Methods

Growth of Large Single Crystals. Develop a simple and economical method for the growth of large single crystals of silicon with desired resistivity and lifetime.

Electro-Chemical Stability. Develop a method of achieving electro-chemical stability of semi-conductor surfaces especially in the case of germanium and silicon.

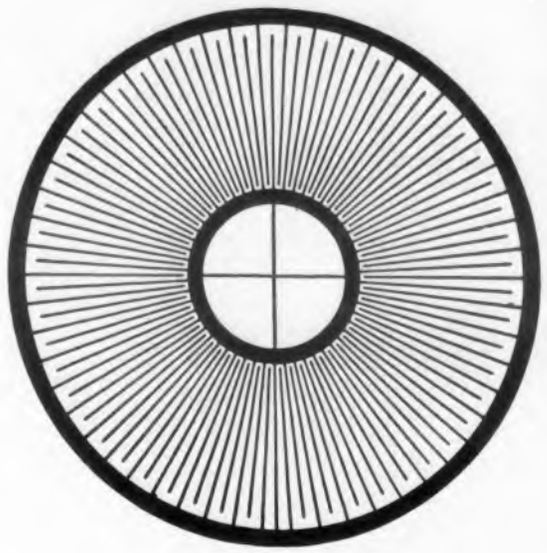
New Miniature Radio Equipment Construction Methods. Utilization of miniature equivalents of standard size component parts in the development of subassemblies which will permit construction of ultra-compact radio equipment, and simplify maintenance; and design of miniature components not already available. Weight and volume are all-important considerations in the design of military electronic equipment.

Precision Synchro Element

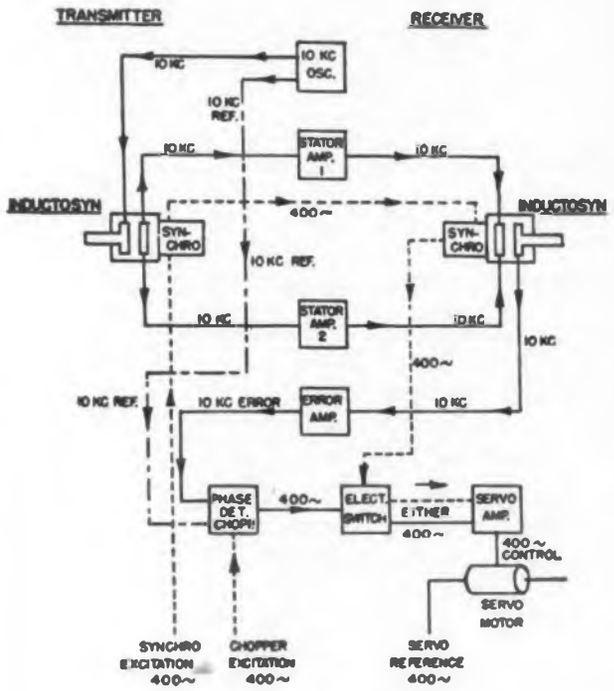
FUNCTIONALLY similar to a resolver, the "Inductosyn" is an angular data transmission device of high accuracy. This synchro element can serve in automatic machine controls, as a position servo, an analog-to-digital converter, an electromechanical transducer, a high-speed phase shifter, an electronic back-lash-free gear ratio, a distance measuring device, an angular pickoff, and in many other applications, one of which is illustrated.

The conductors of the unit are etched silver on glass discs, one of which is illustrated. The single rotor disc is arranged in space quadrature with the two stator discs without any magnetic cores. Because of this construction, the electrical coupling between the rotor and stators is very low. To improve coupling, the rotor is energized at a higher frequency, typically 10kc. The oscillator supplies about 0.25v to the 0.5-ohm impedance rotor. The Inductosyn is manufactured by Farrand Optical Co., Inc., Bronx Blvd. and East 238th St., New York 70, N. Y.

The unit illustrated has 108 poles for 54 synchronous points per revolution, but the Inductosyn can be constructed with varying numbers of poles depending on the particular application. For more information on these high precision synchros, turn to the Reader's Service Card and circle **ED-22.**



The "printed" conductors of this 108-pole rotor are etched silver on a glass disc.



In this closed servo loop the amplifiers offset rotor-to-stator coupling losses.

Only 3" in diameter, the Inductosyne has the angular accuracy of precision mechanical devices many times larger.

PHOTOGRAPH ANY SCOPE PATTERN

with the FAIRCHILD Oscillo-Record Camera

The Fairchild Oscillo-Record camera will accurately record continuously varying phenomena as well as single transients and stationary patterns. Continuously variable electronic control of the film speed from 1 to 3600 inches per minute allows you to select the optimum speed for the greatest clarity and detail, without film waste. The entire length of the 35 mm. film (100, 400 or 1,000 feet) can be run off continuously at any speed. The film is sprocket-driven so there is no slippage at any speed.

The Oscillo-Record camera mounts directly on the top of the scope. No tripod is needed and the oscilloscope controls are always accessible.

FOR IMMEDIATE EVALUATION of individual exposures the Fairchild-Polaroid® Oscilloscope Camera is economical, fast, and convenient. The trace reads from left to right, and is exactly one-half size. Each 3¼" x 4¼" Polaroid print (available in only 60 seconds) records two separate images.

For more information, write *Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, L. I., N. Y., Department 120-21G2.*

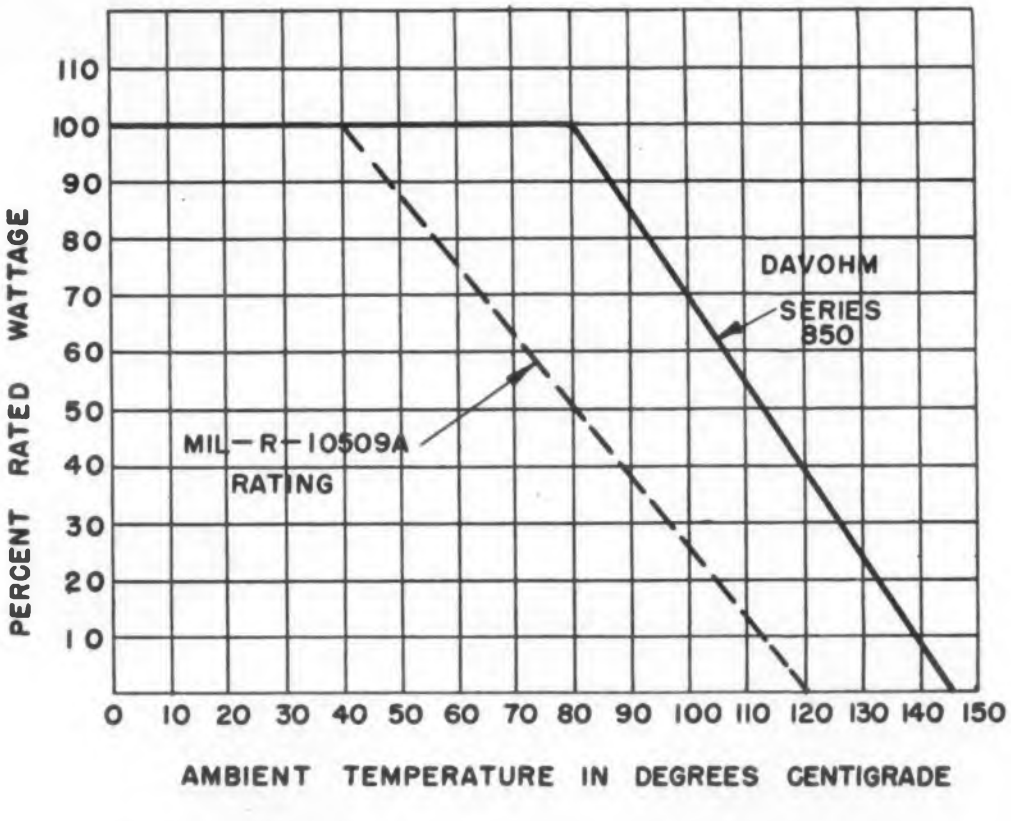
FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

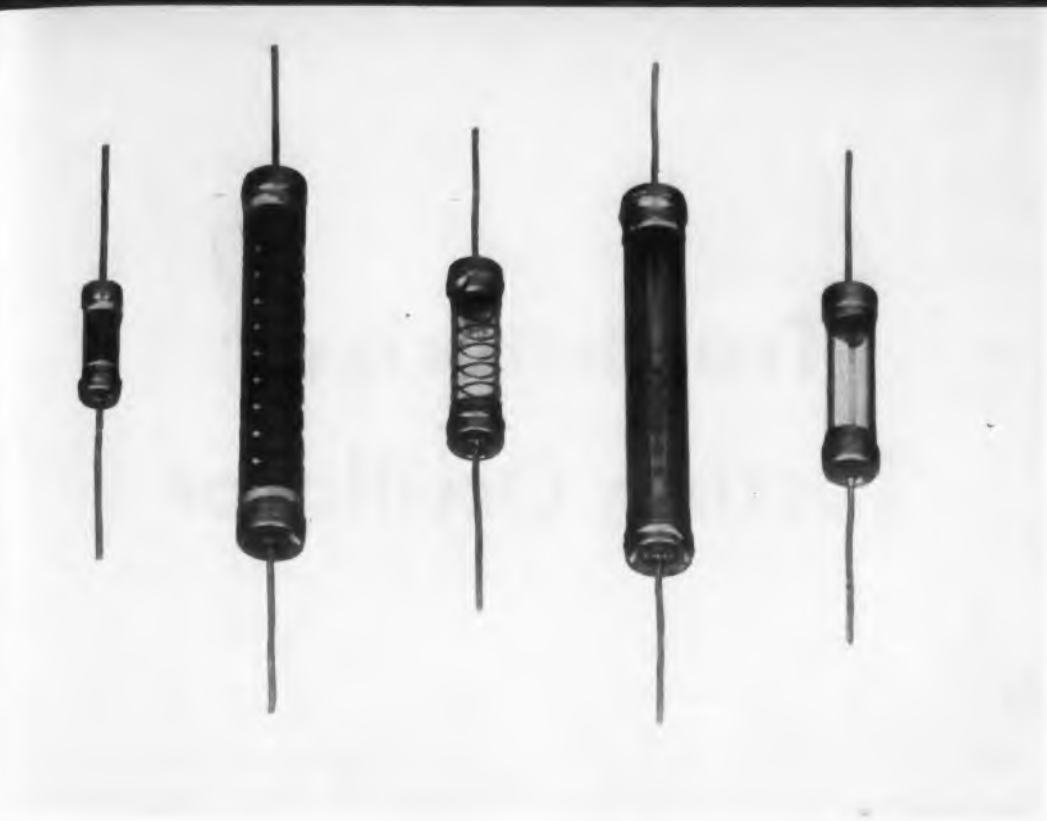
CIRCLE ED-24 ON READER-SERVICE CARD FOR MORE INFORMATION

Metal-Film Precision Resistors

COMPARABLE in cost to metal-film precision resistors with ceramic bases, the Series 850 Metal-Film-Type Precision Resistors shown at the right and on the cover feature a design in which the glass tube that forms the body of the resistor has the resistive element deposited on its inside surface. This construction makes for simple hermetic sealing, high stability, and good mechanical strength. By depositing the



The temperature derating curve for metal-film resistors compared with allowable derating under Government specifications.



The resistive film covers the entire inside glass surface of the resistor at the left. The right-hand unit has parallel strips of film for low inductance.

resistive lines with good uniformity, a low-noise characteristic is achieved.

Resistance variations are obtained by making the resistive film in different shapes as illustrated. Electrical connections are made to the resistive element by silver bands fused to both it and the glass. The end seals are applied with true metal-to-glass seals providing hermetic sealing to more than 60psi.

The noble metal resistance film has the same resistivity and temperature coefficients as the bulk base material, and do not vary with thickness of film. In a 1000hr load-life test, the resistance of units varied less than 0.2%, compared to an allowable change of 1% according to Specification MIL-R-10509A. The units tested showed comparable high performance for the other tests required by this specification. The resistors exhibit a linear and positive change in resistance with change in temperature, with a very low variation in temperature coefficient from one resistor to another.

The resistors are available in the three sizes illustrated with wattage ratings of 1/2w, 1w, and 2w, respectively, and dimensions of 5/8″ long x 13/64″ diam, 1″ long x 1/4″ diam, and 2-1/16″ long x 21/64″ diam, respectively. All three sizes are available in resistance values 10 to 100,000 ohms. Standard accuracies are ±1%, ±1/2″, and ±1/4″. An accuracy of ±0.1% and other resistance values can be specified. All leads are No. 20 AWG tinned copper wire, 1-1/2″ long. By specifying sealing of the end caps to the glass with high-temperature solder, units can be used at full rated power up to 150°C. Where there is the danger of the metal end caps shorting to some other component, these resistors can be supplied with plastic covers over the end caps. These covers add about 1/16″ to the diameter and 3/32″ to the length of the resistors.

Manufactured by the Daven Co., 191 Central Ave., Newark 4, N. J., the resistors have a very low reactive component of impedance. For units with resistances above 1000 ohms, this component is inherently capacitive with an shunt capacity of about 0.6 to 0.8$\mu\mu$fd. Below 1000 ohms, they tend to become inductive. If high frequency characteristics are important in a certain application, the resistors with metal film covering the entire inner surface of the glass tube are recommended. They can be furnished with resistances to about 50 ohms. If higher resistances are required for the application, the types with metal-film lines that run parallel to the tube's axis can be specified with resistances up 1000 ohms in all three wattage ratings. For more data on these resistors, turn to the Reader's Service Card and circle **ED-25.**

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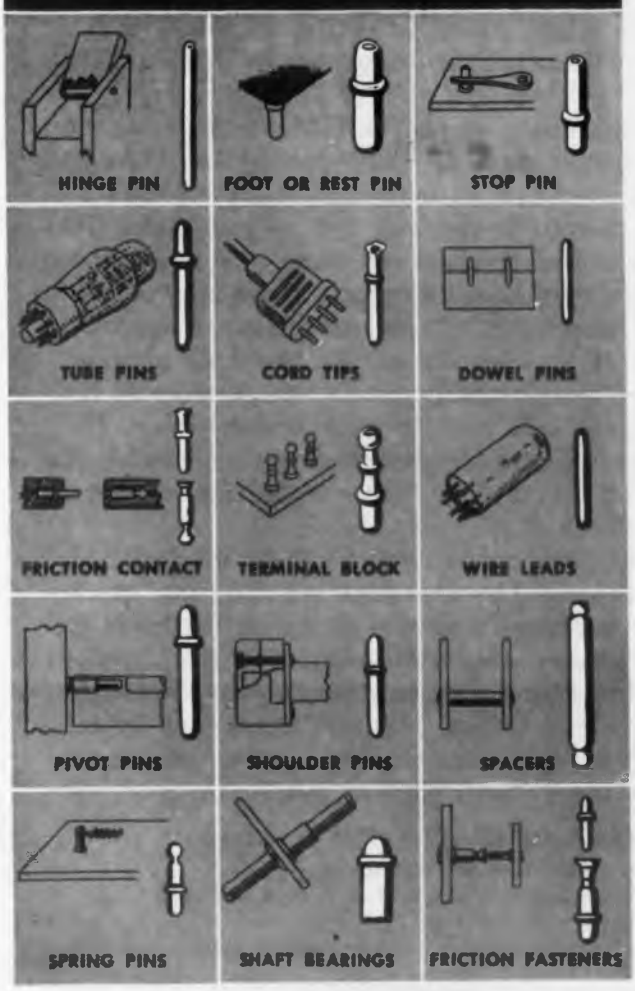

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The advanced manufacturing method developed and used exclusively by Bead Chain swages practically any type of small tubular part from flat stock into precision forms with positive, tight seams . . . and does it *Automatically*. If you can use high-volume production . . . we can deliver it at a much faster rate . . . and at far less cost! Scrap is eliminated! Deliveries to you are dependably prompt!

We can supply you with parts that are beaded, grooved, shouldered and made with almost any metal. Diameters up to 1/4", lengths to 1 1/2"

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GET PROOF-POSITIVE COST COMPARISONS!

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THE BEAD CHAIN MANUFACTURING CO., BRIDGEPORT 5, CONN.

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

Give High Speed, High Temperature Electrical Equipment the Steadfast Protection of IMC's Growing Line of TEFLON® Electrical Insulations

DIEFLEX® — TEMPTUBE TEFLON-TREATED GLASS SLEEVINGS • VARTEX TEFLON-COATED GLASS CLOTH • RM* TEFLON TAPES, TUBES, RODS, AND SHEETS.

Remarkable electrical, thermal, mechanical, and chemical characteristics are ideally combined in Teflon electrical insulations. This means that more and more electrical insulating requirements involving high temperature, high frequency, corrosion, and abrasion are being met by IMC's Teflon materials.

Thin .0025" RM Teflon film tapes, as well as RM sheets, tubes, and rods, thrive on temperatures in the range of −80°F to+500°F. Thin RM film tapes are also unique because at high temperatures they contract to insure a tight fit; for use in motors, generators, and coaxial cables. RM Teflon sheets, tubes, and rods can be fabricated into component parts. These RM Teflon insulations combine toughness, resiliency, and a zero moisture absorption factor to assure successful service under severe operating conditions. Teflon insulations do not readily adhere to sticky materials, are inert to chemicals (except molten alkali metals and fluorine at high temperatures and pressures), and will not carbonize under arcing. They offer excellent electrical properties over a wide thermal range, exhibit low power loss, and low dielectric constant. All of these properties are present to a modified degree in the different Teflon materials.

In addition to the RM Teflon insulations, available IMC insulations include Dieflex-Temptube Teflon-treated braided glass sleevings that qualify as flexible Class H materials, and serve perfectly for insulating leads and wires. Also there is Vartex Teflon-coated glass cloth that has excellent physical strength and extreme abrasion resistance for use as a coil separator, slot liner, coil wrapper, or layer insulation in transformers and motors.

Ask your IMC sales office for technical data, prices, engineering suggestions or samples on IMC's Teflon electrical insulation.

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

Transistorized Testing Oscillator

WEIGHING only 30 oz, the Type 1307-A Transistor Oscillator shown in the photograph is a highly compact source of 400 and 1000cy signals. Useful for making continuity checks of audio equipment, setting operating levels, checking the sensitivity of oscillographs, and as a power source for bridge measurements, it can be held easily in one's hand.

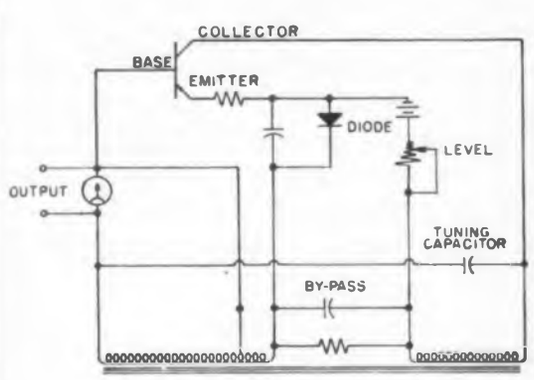
The unit uses a Raytheon Type *721* p-n-p junction transistor in the Hartley circuit illustrated. The inductor of this tuned circuit is an iron-cored coil with an air gap. The germanium diode helps set the bias voltage for the base. The operating characteristics of this diode approximate those of the transistor emitter-base junction so that oscillations will start for a wider range of temperature, battery voltage, or transistor employed that is obtainable with a linear resistor in the bias circuit. The small resistance in the emitter circuit provides degenerative feedback to improve the waveform.

The outputs of the oscillator are 400 and 1000cy accurate to ±3% at 2v output into a 600-ohm resistor. Distortion is less than 5% at 400cy, full output. It may be slightly higher at

The Type 1307-A Oscillator requires no warm-up time, thereby greatly increasing battery life.

1000cy. The 2-1/2″ output meter reads 3v, full scale. The unit is powered by three mercury "A" batteries, which have an average life of 100hr. No warm-up time is required for the oscillator, which is manufactured by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Packaged in a 6″ x 3-1/8″ x 2-1/2″ aluminum enclosure, the oscillator is



The Hartley circuit for the oscillator incorporates one transistor and one type *1N34-A* diode.

also provided with a leather carrying case. The output is terminated in a 274-MB double plug. Other uses for the unit include standardizing sound measuring equipment and in making preliminary calibrations of electronic systems. For more information on this device, turn to the Reader-Service Card and circle **ED-28.**

CIRCLE ED-29 ON READER-SERVICE CARD ➤

A Miniature Tape Recorder

All parts are readily accessible by removing the enclosure from the "Tapette".

SETTING forth clear-cut design objectives and working towards these goals is a consistently tried-and-true way of producing a well designed product. This was the way in which the "Tapette", a miniature portable tape recorder, was created.

The objectives were to design a unit about the size of a foreign wire recorder known as the "Minifon" whose general features had gained some acceptance in the American market; to use tape instead of wire to avoid the problem of fragility; to make editing easy; and, to give the user a ready means of knowing how much tape had been used and how much was left (a difficult problem with wire). Reels that could be played back in any standard tape reproducer were to be used, and all the standard operating functions common to tape recorders were to be employed. Finally, the unit was to be constructed for ready servicing by the average technician.

These objectives were cleverly achieved by A. C. Pravis, Jr., who designed the "Tapette", a product of Broadcast Equipment Specialties Co., 135-01 Liberty Ave., Richmond Hill, L. I., N. Y.

This compact unit measures about 6-1/2″ x 4-1/2″ x 1-1/2″, weighs about 2 lb, and can be easily carried about in a coat pocket. Since tape is bulkier than wire, stacked reels are employed as well as 1/2mil "Mylar" based tape, which is about 0.0011″ thick compared with ordinary 0.0022″ thick tape. The reel

Tape time can be estimated by observing the reel through the window. The wristwatch contains a microphone.

The reels are stacked for a more compact design. The entire unit only weighs 2 lb.

carries 625′ of tape providing 1/2hr in each of two tracks for a total of 1hr of recording time. Tape speed is 3-3/4″ sec, which is standard in most home recorders. The 3-13/16″ diam reels have a 1″ hub. They are designed with a detent to snap into the "Tapette", and a key and hole to fit standard players.

To provide all the standard functions of a tape recorder (record, erase, monitor, reverse at high speed, and playback) only three controls are employed: one for "Forward", "Off", & "Rewind"; one for "Record" and "Play"; and the third for volume. The controls are recessed to eliminate projections from the case.

An interlock arrangement is provided so that the machine cannot be started in the "Record" position until after forward tape motion is stopped. This prevents accidental erasure of the tape. Dialing the "Rewind" function causes the "Play-Record" switch to come to the "Playback" position, where it remains until the forward motion is initiated and the switch is placed in the "Record" position.

To provide economy of manufacture and easy interchangeability, standard parts are employed. The recording head is a standard Brush unit and the amplifier is a standard Centralab "Ampec" Model 3 printed circuit unit, which includes tube sockets for two type *CK538DX* and one type *CK548DX* Raytheon subminiature tubes. A U.T.C. "Sub-Ouncer" choke is used as well as 22-1/2v batteries for the "B" supply and a pen light cell for the "A" supply.

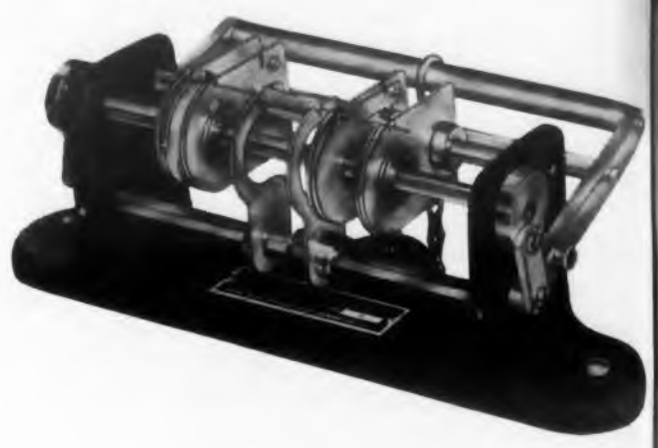
Stacked Mallory M1 cells (two stacks of 5 cells each with about 15 hrs of life) furnish power for the permanent-magnet field 7/8″ diam x 1-1/2″ length Globe Industries motor. Use of "Miniature Precision Ball Bearings" helps to reduce the load on the motor.

Provision can be made to operate the "Tapette" from the cigarette lighter outlet in an automobile, or, with a special adapter, it can be run directly from a 110v a-c line. Other accessories such as the "wristwatch" microphone also can be furnished.

Printed Circuit Design

III—Choosing Components for Printed Circuits

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



INCREASING availability of circuit components designed or adapted for use in printed circuit assemblies is making the printed circuit designer's job much easier. Component manufacturers as a group have recognized the need and the large potential market for such items and are responding to it. The purpose of this article is to bring the designer as nearly up to date as possible on the products of this type presently or. the market. In addition, components such as inductors and capacitors that can be printed by the etched-foil method and included in the conductor pattern will be discussed.

In general, components for printed circuits fall into three categories:

1. Components originally intended for conventional assembly methods that may be used with no modification of design.
2. Components that have been designed or modified specifically for printed circuits (some examples are shown on p. 38).
3. Components that are actually a part of the printed circuit pattern design.

In the first category are such components as resistors, capacitors, coils, chokes, diodes, transistors, subminiature tubes, etc., which have pig tail leads or tabs protruding from the component in such a fashion that they may be easily formed to pass through holes or slots in the printed boards prior to dip soldering. Some manufacturers, such as International Resistance Corp., supply resistors with leads preformed and precut for insertion in printed boards. In the cutting of the resistor leads they are flattened in such a way that they "snap" into the board and are held in position until permanently secured by soldering. Special pliers, which flatten the lead at the point where it emerges from the board and cut it to the proper length, are available. The tool is limited in use because of the limitation on minimum hole diameters in circuit fabrication. Sufficient flattening of the leads to prevent the component from falling out of its lead holes during handling is difficult to obtain.

Most printed circuit assemblers processing large numbers of components with wire lead terminations have constructed machines or fixtures for bending and cutting the leads to the proper size and shape. The various automatic assembly systems now under development (*ED, September, 1954, pp. 12, 13, 32, and 33*) usually provide for hopper feeding of wire lead components in their presently available form. Such machines would cut, shape, and insert the leads automatically.

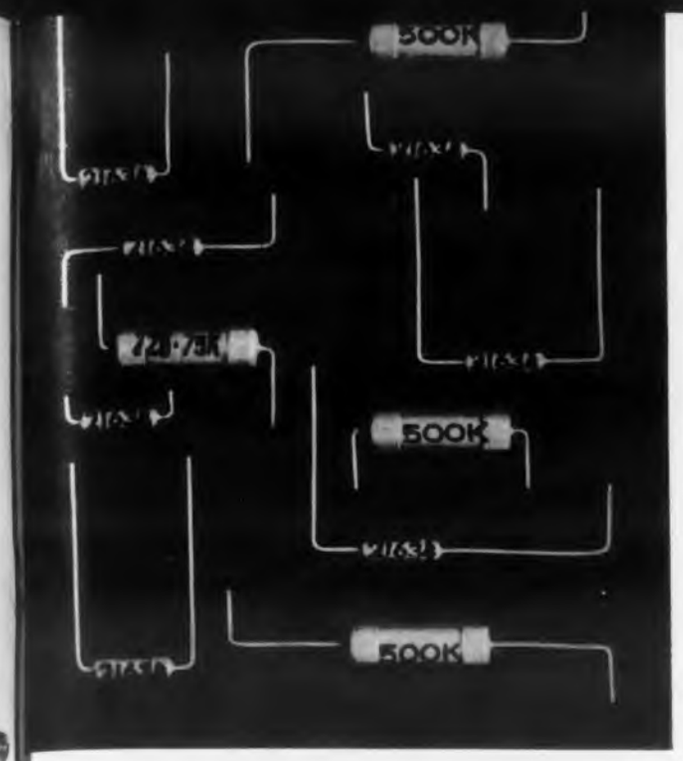
The second category includes those components such as tube sockets, i-f cans, volume controls, etc., which were previously mounted on the metal chassis and then connected by wires to other circuit elements. The terminations of these units are usually solder lugs. The approach of the manufacturers has been to adapt existing designs to printed circuits by replacing the former terminations with tabs, wires or other devices which make possible the mounting of the component on the printed circuit board and the dip soldering of all connections. If possible, a "snap on" feature utilizing some spring metal extension is added so that the component is held securely on the board during any handling before dip soldering.

From the assembler's viewpoint the most important component to have been adapted is the tube socket. First to appear were molded sockets whose contacts were modified so that they could be inserted in the board and dip soldered as shown on p. 38. They are made with a key to orient the socket if desired. These sockets are obtainable in various plastic mould materials to suit a variety of applications.

Of particular interest is the appearance of a laminated wafer socket for printed circuit assembly. In addition to a price advantage, the socket offers pattern design flexibility in that shorting bars are un-

Conventional components that do not require modification for use with printed circuits.

Component	Description
Resistors	Carbon composition—up to and including 2w sizes Wire wound types
Capacitors	Tubular paper Tubular electrolytic Mica and silvered mica Ceramic disc Metallized ceramic tubular
Capacitors	(Semi-adjustable) Tubular trimmers Mica trimmers and padders
Coils and transformers	Unshielded wound on paper tube or similar types
Chokes	Radio frequency types
Hardware	Stamped lugs Machined lugs Hollow pins Eyelets Rivets Threaded bushings
Diodes	Semiconductor crystal



Known as the "Pig-Tailor", this production machine shapes the leads of components with axial-leads, as shown above, for insertion in printed circuit boards (Bruno-New York Industries).

necessary since the conductor pattern may be continued across socket terminals. Each socket terminal is inserted into a separate hole into which a component lead may be included.

Connectors are an example of components designed specifically for printed circuits. By designing the printed circuit so that conductors terminating in the connector are brought to a common edge, the circuit board becomes the male portion of the connectors. These connectors are available in varying numbers of contacts for one side or both sides of the printed circuit board. Connecting devices which permit stacking boards in parallel planes or at 90° angles are available (H. H. Buggie, Circon). Other types of connectors where the male portion of the connector is attached to the printed circuit are also available (Cinch, Buggie, Circon).

A switch wafer, for dip soldering into a circuit pattern, otherwise similar to rotary wafer switches and using standard detents, has been designed by Oak Manufacturing Co., Chicago, Ill. Little tabs extending from each contact fit into a circular pattern of slots punched in the laminate.

The table at the right lists all of the components for printed circuitry presently known to the writer.

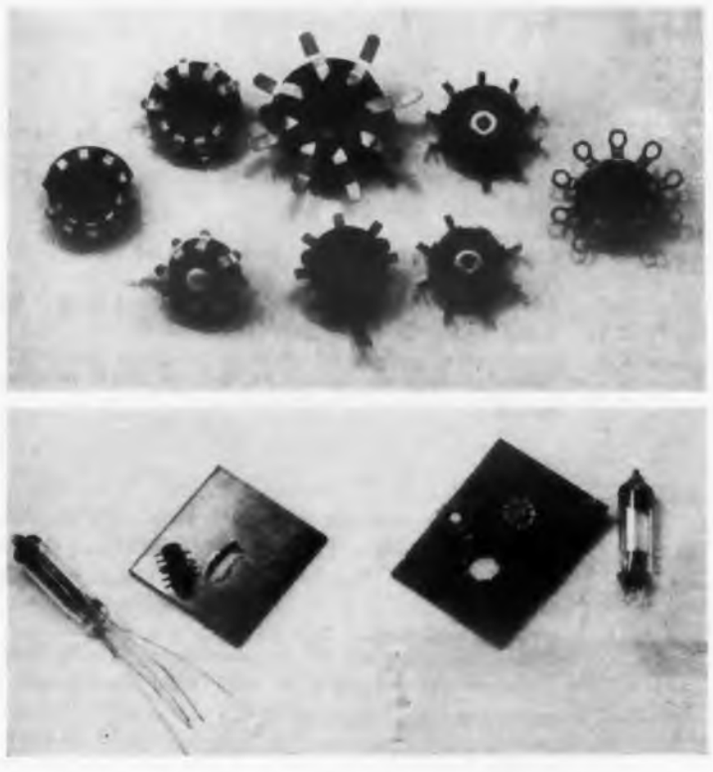
"Printed" Components

The third group of components are those which are a part of the printed circuit pattern. Small inductors,

These components have been modified for use with printed circuits. Some examples are shown on p. 38.

Component	Supplier	Method of Installation
Tube socket, 7- and 9-contact moulded	Cinch Mfg. Co., Chicago, Ill. Hugh H. Eby, Phila., Pa. Methode Mfg. Corp., Chicago, Ill. National Fabricated Products, Inc., Chicago, Ill. Elco Corp., Phila., Pa.	Press into round hole. Design of lugs hold socket in printed circuit. Contact secured by fillet of solder between contact and circuit. Socket supplied with key, if desired, for positioning.
	Mycalex Corp., Clifton, N. J.	Similar to above but contacts secured by eyelets.
	Sylvania Electric Products, Warren, Pa.	Has tabs to penetrate slots in circuit. Designed for mechanical insertion.
Tube socket, moulded-octal	Methode Mfg. Corp.	Mounting same as for 7- and 9-contact types.
Tube socket, laminated wafer 7- and 9-contact	Cinch Mfg. Corp. Industrial Hardware, New York, N. Y.	Fits into circular configurations of round holes. Lugs holds socket in place until soldered.
Tube socket - subminiature types for horizontal and perpendicular tube positioning	Cinch Mfg. Corp.	Extended lugs on socket fit through holes in circuit board.
Variable resistors, volume controls, etc. with or without on-off switch	Centralab Corp., Milwaukee, Wis. Chicago Telephone Supply, Chicago, Ill.	Terminals on controls passed through slots in circuit board held in place by soldered connections. Obtainable with shaft parallel or perpendicular to circuit pattern.
Transformers—i-f types or similar in cans	Automatic Mfg. Corp., Newark, N. J. Raypar, Inc., Chicago, Ill. Radio Corp. of America, Camden, N. J.	Metal tabs in base of transformer penetrate circuit pattern. Snap feature in tabs hold transformer in place pending soldering.
Pulse Transformers	Gudeman Co., Los Angeles, Calif.	Leads in base fit into holes in laminate; dip soldered.
Selenium Rectifiers	Federal Telephone & Radio, Clifton, N. J.	Rectifiers have tabs designed to snap into slots in circuit pattern.
Tuning Condensers	Radio Condenser Corp., Camden, N. J. All Star Products, Defiance, Ohio	Tabs or lugs attached to frame and stator sections penetrate holes in circuit pattern. Held into place by soldering.
Capacitors-electrolytic	Sprague Electric Co., North Adams, Mass. P. R. Mallory, Indianapolis, Ind. Planet Mfg. Corp., Bloomfield, N. J.	Can types. Lugs modified to penetrate circuit board. Modification of tubular electrolytic. Lugs from one end penetrate pattern. Lead from other end passed alongside of container into hole in circuit pattern.
Capacitors-ceramic disc	Centralab Corp., Milwaukee, Wisc.	Short leads or tabs to penetrate circuit pattern. Similar to regular ceramic disc types.
Coupling devices (audio coupling units)	Centralab Corp.	Metal tabs arranged along common edge to penetrate circuit pattern. Held in place by soldering operation.
Rotory switches, wafer type	Oak Mfg. Corp., Chicago, Ill.	Tabs attached to lugs of switch for soldering to printed circuit through holes in pattern. Switch uses some detent and hardware as regular line of switches.
Resistors	Cinema Engineering Corp., Burbank, Calif.	Both leads extend from the same end of the resistor anticipating eventual automatic insertion techniques. (See pp. 40 and 41.)
Connectors	DeJur-Amsco Corp., Long Island City, N. Y. Cinch Mfg. Corp. Winchester Electronics, Glenbrook, Conn. Circon Component Co., Northridge, Calif. Richardson Co., Hollywood, Calif. H. H. Buggie, Toledo, Ohio. (Angular connectors and cord stocking devices are also available from this firm). Viking Electric Co., Los Angeles, Calif.	Connectors consist of a receptacle designed to accept a printed circuit having all conductors terminating in the connector brought to a common edge at right angles to the edge. The circuit board is shaped to fit the connector and is the male portion of the connector. Connectors fit 1/16" and 3/32" thickness boards and polarizing keys may be obtained.

The spring-metal contacts on this electrolytic capacitor hold the unit in position until dip-soldered (Sprague Electric).



Examples of tube sockets designed for use with printed circuits. The lower photo shows the shapes of holes required in the laminate to receive these subminiature electron tube sockets.

The shaft of this volume control extends through and is perpendicular to the board after mounting (Centralab).

This selenium rectifier "snaps" into the printed circuit board (Federal Telephone and Radio).

An i-f transformer modified for use with printed circuits (Raypar Corp.).

As shown, the printed circuit is the male connector that fits into these connectors (DeJur-Amsco).

capacitors and a variety of wiping contact switches are included in this group. (The subject of printed switches is so broad that space does not permit a discussion here: they will be considered in a later article detailed in this series.)

Capacitors are readily included in the circuit pattern by using the pattern on both sides of the circuit board. The pattern on one side is made slightly larger than the corresponding pattern on the other side to allow for small errors in front-to-back registry in printing.

The formula for parallel plate capacitors may be readily applied:

Capacitance (in micromicrofarad) = (0.2244KA)/d

where: K = Dielectric constant
A = Area of smallest plate in square inches
d = Thickness of circuit board in inches

Since etched circuits are usually on materials of 1/16" and 1/32" thickness, these thicknesses are of greatest interest. In terms of these thicknesses for plastics where K equals approximately 5, the 1/16" thickness will result in a capacitance of 20$\mu\mu$fd per square inch. Greater capacitance can be obtained in a smaller area through the use of thinner materials. For example, parallel capacitors etched on opposite sides of 0.006" thickness phenolic-impregnated glass cloth have a capacity of about 200$\mu\mu$fd per sq-in.

A method of obtaining small capacitance values by interweaving or meshing conductors on a single side of a circuit pattern has been used. The relatively large amount of distributed inductance derived from this method has resulted in little use of this system. Capacitance between adjacent conductors spaced at a distance of 1/32" is less than 1$\mu\mu$fd per linear inch of pattern.

Capacitors placed in the central portion of spiral inductors provide the capacitive element of a resonant circuit and, in addition, provide an electrical "feed-through" to avoid the use of an eyelet or other means of "feeding through" the laminate at this point. When this is done, a double space must be provided between the disc and the first turn of the spiral to avoid a lower Q caused by the disc acting as a shorted turn in the coil. This system is particularly useful in L-C resonant circuits such as traps or filters. The plastics used in printed circuits have a high loss factor, as compared to the low-loss ceramic and mica capacitors. Considering the economies in their manufacture however, etched capacitors are a valuable characteristic of the printed circuit.

Inductors

Low value inductors are commonly printed as part of the etched pattern. These inductors are in the form of spirals of varying shapes having a certain mean radius. Small line widths and spacings are desirable

order to get the maximum number of turns in a mall area. There is a limitation, however, in etching pattern of fine lines and spaces. Line widths and paces of 0.010" can be printed, but it is recommended that wider lines and spaces be used wherever possible. A common line width and space is 0.015".

As examples of sizes in a spiral coil for a certain inductance, the following are typical:

Inductance (Microhenries)	OD (See nomograph for illus-	ID tration of OD and ID)	Widths of Lines & Spaces
0.75	7/8"	5/8"	0.020"
1.75	3/4"	3/8"	0.010"
3.50	1-1/4"	1/2"	0.015"

Where two circuits are to be coupled via a mutual coupling design, two spirals are wound about a common center. This method is used in the design of i-f transformers in television receivers and in elements where the capacitance and inductance in such an arrangement is utilized to develop a characteristic impedance. These have been used in connection with transmission line accessories such as baluns.

The Q obtainable in a printed inductance may vary from 50 to 200. The determining factors here are the same as in conventional windings, i.e., the base on which the coil is printed, the size of wire, and surrounding conditions. Coils on paper phenolic laminates display lower Q values than coils on glass fiber-epon, phenolic, silicone, and melamine laminates.

The nomograph at the right is useful in the design of spiral coils. The use of the nomograph is demonstrated by the following procedure:

1. Assume a winding pitch of 30 mils (one line width plus one space) and a ratio of average radius to winding depth, "A/C Ratio", of 2.
2. Draw a line through the pitch and A/C Ratio values intersecting the "reflect axis".
3. Draw a second line from this point on the reflect axis to the desired inductance value.
4. Read the number of turns required at the point of intersection with the "turns" scale.

The following formulas derived from the nomograph are helpful to the electronic designer, if other variables are fixed:

C(Winding Depth) = P(pitch) x N(turns)

C(Winding Depth) = (Outside diam − Inside diam)/2

A(Average Radius) = (Outside diam − Inside diam)/4

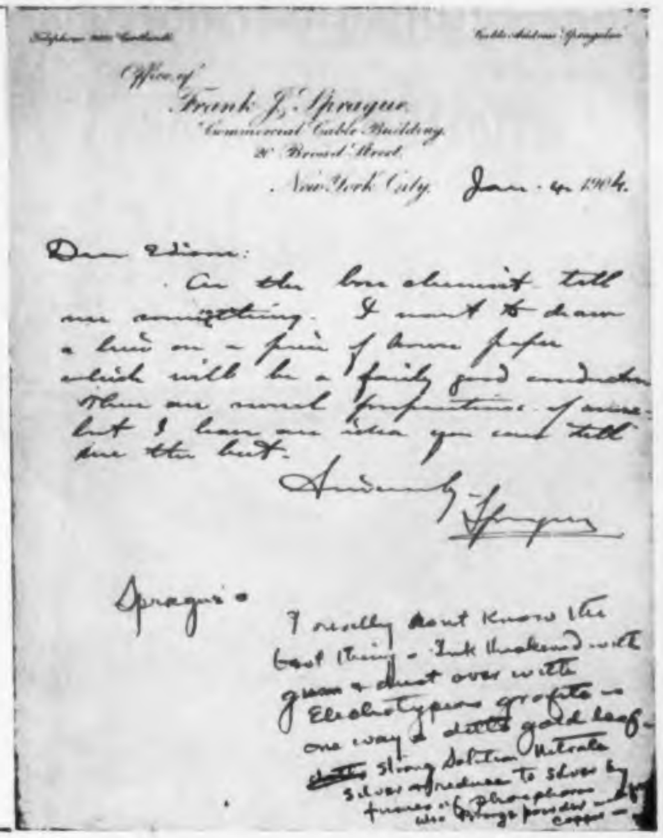
As printed circuitry comes into more general use, standards for lead diameter, hole spacing, and other factors in the design and fabrication of printed circuits will undoubtedly be adopted. In the meantime, the electronic designer must carefully follow the announcements of new products designed for use in printed circuits in order to achieve the best or most economical design.

As this recently discovered letter indicates, printed circuits were being investigated 50 years ago. From Frank Julian Sprague to his business associate, Thomas A. Edison, the letter reads as follows:

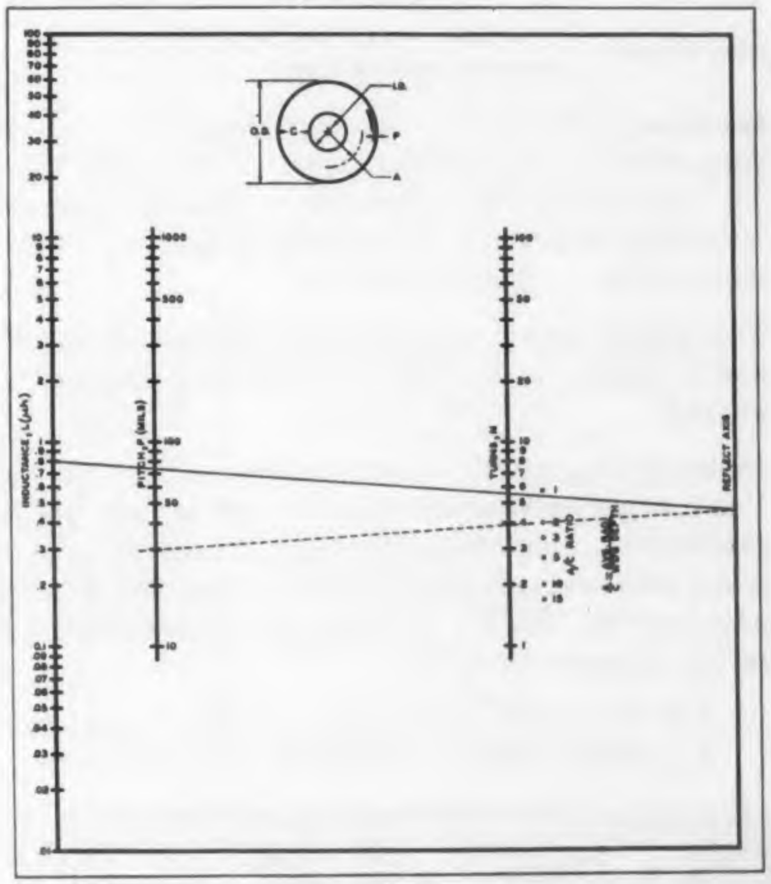
"Dear Edison: As the boss chemist—tell me something. I want to draw a line on a piece of brown paper which will be a fairly good conductor. There are several preparations—of course—but I have an idea you can tell me the best. Sincerely, Sprague."

Edison's pencilled reply on the letter reads:

"Sprague—I really don't know the best thing. Ink thickened with gum and dust over with electrotyper's graphite is one way—ditto gold leaf—strong solution nitrate of silver and reduced to silver by fumes of phosphorous. Also bronze powder made from copper—E."


Office of Frank J. Sprague, Commercial Cable Building, 20 Broad Street, New York City. Jan. 4. 1904.

The upper unit is a high-pass filter combining printed capacitors and inductors. The lower unit is a matching inductive impedance. The inductances are bifilar wound.



A nomograph for designing printed inductors.

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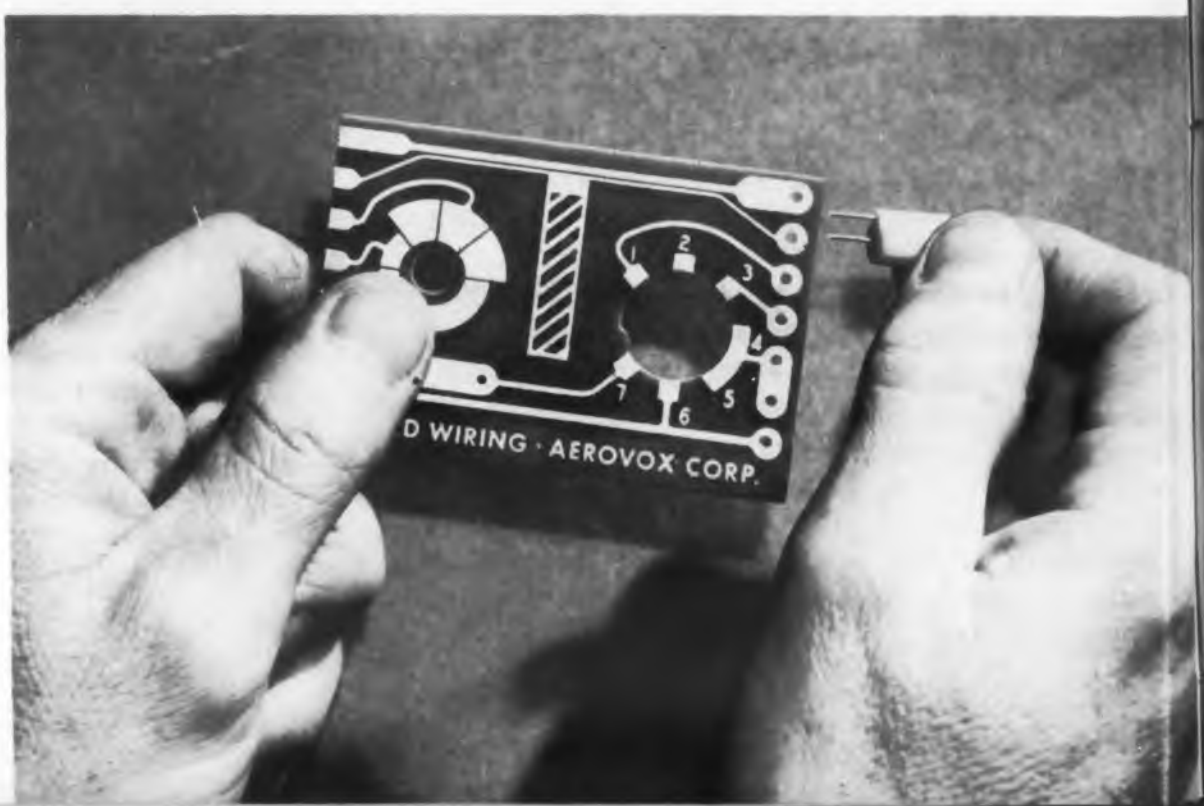
CIRCLE ED-32 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors for Printed Circuits

DESIGNED for automatic assembly on printed circuit boards, the "PW" Series of Precision Wire-Wound Resistors features an indexing key along one side. Entirely encapsulated in an epoxy resin, these units meet the humidity resistance and aging requirements of Specification MIL-R-93A. A group of these resistors is shown mounted on a printed circuit board at the right.

The two terminal leads extend from one side of the cylindrical body, as shown below. One lead is located in the center of the cylinder, while the other is located at the center of the key. The leads for all sizes of the resistors are 1/4" long. The distance between the centers of the wires vary in multiples of 0.025".

Where machinery for the automatic insertion of the resistors into printed circuit boards is not available or undeveloped, the units can be installed manually with special tools. Designers can, therefore, utilize the resistors in present printed

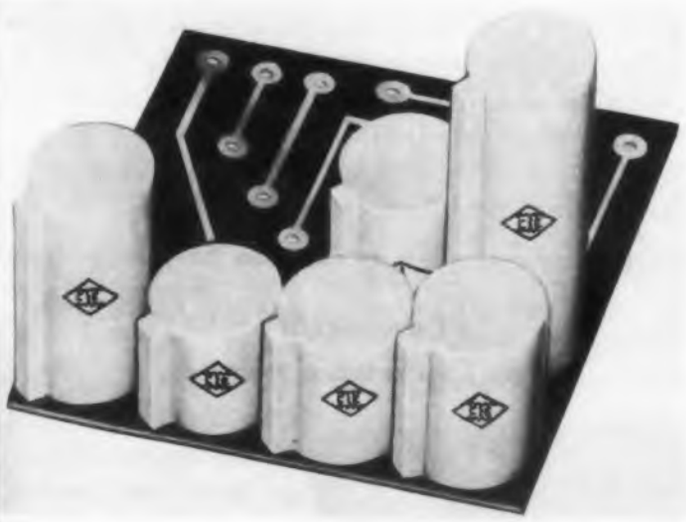


The resistors have a key along one side to facilitate insertion by automatic machinery.

circuit designs pending the development of automatic insertion devices.

Manufactured by Cinema Engineering Co., 1100 Chestnut St., Burbank, Calif., the resistors are furnished with ratings from 1/8w to 2w in a wide range of resistances. The units are available in tolerances 1% to 0.05%. The PW100 Series is

A group of PW Resistors mounted in a printed-wire board that was designed with the proper spacing between lead holes.



rated at an ambient temperature of 100°C, while the PW200 Series is rated at an ambient temperature of 125°C.

Body lengths of the resistors, exclusive of leads, vary from 1/2″ to 2″, with weights of 1gr and 1oz, respectively. The resistance wire is known as "Alloy E", and has a temperature coefficient of resistance of ±25 parts per million per degree centigrade. For more data on these resistors, turn to the Reader's Service Card and circle **ED-33.**

New Products . . .

Ceramic Capacitor

Rugged, Subminiature Component

The Style "S-3", u-h-f stand-off subminiature ceramic capacitor has rugged characteristics which enable it to be handled in production without the precautions normally used in assembling subminiature parts. It incorporates a tin-plated copper mounting which almost completely encloses the dielectric material, thus allowing the supporting member to take most of the stress placed upon the wiring terminal and avoiding strain upon the ceramic body that causes failure in less rugged units.

The capacitor may be had in any one of the various types of ceramic dielectric materials, in capacitance values ranging from 2mmfd to 3300mmfd, depending on material used and working voltage rating. Overall height above chassis is approximately 9/16" and mounting area is 5/16" x 1/4", with a 0.127" hole to accommodate a No. 4 or No. 5 screw. The low inherent series inductance of Style "S-3" units makes them especially useful in ultra-high frequency designs. Mucon Corp., Dept. ED, 9, St. Francis St., Newark 5, N. J.

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

Tube Characteristics Sheets

Includes 48 Types

Calculations of tube parameters for circuit design are implemented by the 8-1/2" x 11" tube characteristic curve sheets in the second edition of "Vacuum Tube Characteristics and Design Sheets". Forty-eight of the most popular standard, miniature, and subminiature types are included. Each sheet is removable for use on a drafting table, and it can be kept for record purposes. A short explanation of how to use the design sheets is given. Single sheets are also available for each of the types in the tablet. Vacuum Tube Research, 4624 W. Rosalie St., St. Louis 15, Mo.

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

Potentiometer

1"diam Multi-Turn Design

Eighth in a series of new potentiometers, the Type 920 is designed to offer optimum accuracy, reliability, and versatility in a multi-turn potentiometer with small size, high mechanical rigidity, and electrical stability. With a size of 1" diam x 2-1/2" long, it has 26-1/2" of coil length, making it possible to guarantee an accuracy of ±0.25% standard in a resistance range of 4,000 ohms to 200,000 ohms, with an accuracy of ±0.1% for special applications. Mechanical and electrical rotations are 3600°+5°−0° standard.

The type 920 is available with three mountings: standard 3-hole mounting, servo mounting, and threaded bushing mounting. The unit is gangable. Single wire all-welded taps can be provided, and it has a 1/4" diam shaft.

Starting torque of 1 oz-in and running torque of 1/2 oz-in make it possible to utilize small servo motors with low power, thus reducing size requirements in equipment. Despite its small size, the unit incorporates all-metal construction throughout the body and supporting members. Fairchild Camera & Instrument Corp., Potentiometer Div., Dept. ED, 225 Park Ave., Hicksville, L. I., N. Y.

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

Potting Compound

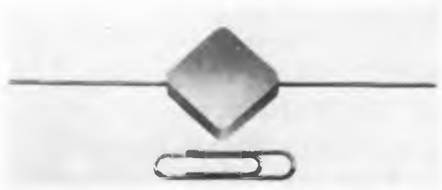
Heat Distortion Temperature of 120°C

"Hysol 6040" is the designation of a new potting compound with a heat distortion temperature of 120°C. It is supplied with Hardener AN, and is for use in potting resistors, capacitors, etc. Heat distortion temperatures were determined in accordance with ASTM D648-45T. Houghton Laboratories, Inc., Dept. ED, 322 Bush Street, Olean, N. Y.

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

Toroid Coil

Postage Stamp Size



This "postage stamp" Toroid Coil consists of a subminiature molybdenum permalloy toroid core with a winding having a residual hole as small as 1/16". Windings are impregnated with a special compound, and the finished coil is encased in a tough epoxy plastic. Tinned No. 20 AWG wire leads are provided. Dimensions are 13/16" x 13/16" x 3/8" thick.

The coil is available in any inductance up to 1h. The useful frequency range covers 1500cy to 150kc, depending upon inductance value. The unit is capable of withstanding temperatures from −55° to +125°C, plus extreme environmental conditions. These coils are also available in the un-encapsulated form, with the winding ends exposed for making direct connections. Un-encapsulated dimensions are only 5/8" OD x 9/32" thick. Hycor Company, Inc., Dept. ED, 11423 Vanowen St., North Hollywood, Calif.

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

Connector

With 15 Pressure Switches

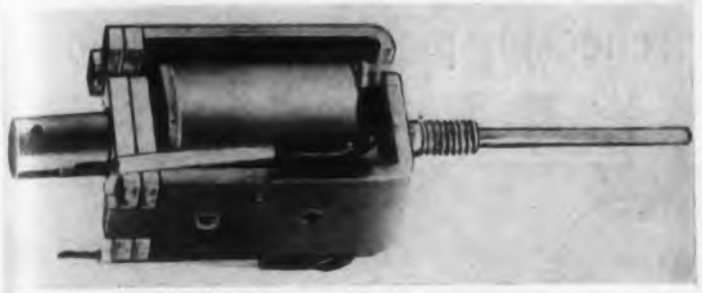
No. 3372 female mating strip is designed for permanent base mounting, and to be used with this firm's male connectors, Nos. 3367 and 3369. Fifteen pressure type sockets of beryllium copper are provided.

Nominal creep in the design is 3/32". Solder tabs are supplied for No. 20 wire. Plating is gold over silver. Standard insulating material is 3700 green mineral filled phenolic. The strip is also available in mineral filled phenolic type MFE, diallyl phthalate MDG, or general purpose phenolic CFG. H. H. Buggie, Inc., Dept. ED, 726 Stanton St., Toledo 4, Ohio.

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

Solenoids

Available in 300 Variations



Three hundred different types of custom solenoids may be assembled from 20 standard parts in the Series 100 and 300 lines of d-c solenoids. This feature means that exact requirements of custom-type solenoids can be met without sacrificing economy and interchangeability.

Another unusual feature of the line is simplified change-over to push or pull type by adding a threaded 3/32" diam push rod to any plunger. Other features include miniature, lightweight, compact design; maximum power for minimum size; and a wide variety of mountings, coils and wire sizes. Joseph Pollak Corp., Dept. ED, 81 Freeport St., Boston 22, Mass.

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

Toggle Switches

Can Control Four Circuits

Each assembly in this series of 3-position, panel-mounting, subminiature toggle switches has two spdt basic switching units, providing control of as many as four circuits. One basic switching unit is actuated in each extreme toggle position. Neither unit is actuated in the center toggle position. However, due to the fact that there are two spdt switching elements, it is possible to have three different combinations of two circuits open and two circuits closed at any time.

The maintained toggle positions are detented to provide a positive feel of the position, and momentary positions are spring loaded to return to the center "off" position. The catalog listings and their toggle positions are: 13AT1, "momentary on, maintained off, momentary on;" 13AT2, "maintained on, maintained off, maintained on;" and 13AT3, "momentary on, maintained off, maintained on."

The electrical rating of the switches used in each assembly is: 125/250v a-c, 5amp; 30v d-c, 3amp, inductive at sea level, 2.5amp inductive at 50,000 feet, 4amp resistive at sea level, and 4amp resistive at 50,000 feet. Switches have a standard (AN and/or JAN type) bushing and bat handle. Micro Switch, Dept. ED, Freeport, Ill.

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

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

New Products . . .

Time Delay Relay

In Two Easily Adjustable Ranges

The MEK-2110 is an electronic time delay relay designed for use wherever a dependable, easily adjustable time delay is required. Incorporated are such advantages as ease of installation, long life, and timing accuracy. Two timing ranges are available, 1.5-120sec or 0.75-60sec. Dpdt load contacts are provided for control of external circuits. Load contacts are rated at 5amp 115v a-c.

Repetitive accuracy, with constant line voltage, is better than ±2%. Variations in line voltage will cause a slight increase or decrease in the preset time. Reset time of 3% of set time must be allowed between operations.

The timer allows a choice of two sequences of operation. In Sequence A, load contacts are de-energized during "Reset" and "Timing", and energized when "Timed Out". In Sequence B, load contacts are energized during "Reset", de-energized during "Timing", and energized when "Timed Out". Sequences are obtained by interchanging terminal strip connections. The unit is recommended for interval timing or time limiting operations. Two or more units may be connected together for complex timing sequences. Open or enclosed forms are available, as well as remotely adjustable units. Machinery Electrification, Dept. ED, Northboro, Mass.

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

Power Supplies

With Three Outputs

"Power in a Package" units are designed to give the research man, technician, or designer a wide range of power outputs from one compact cabinet.

The unit illustrated provides regulated power, simultaneously, as follows: 0-600v d-c at 0-500 mils, regulated ±0.25%; 6v or 7v d-c at 1.5-15amp, regulated ±0.2%; 110-120v a-c, 0-1000va load range, regulated ±0.1%. Practical single-cabinet combinations can include a variety of other outputs. Sorensen & Co., Inc. Dept. ED, 375 Fairfield Ave., Stamford, Conn.

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

Galvanometer Amplifier

Extends Usefulness of Pickups

This high input impedance galvanometer amplifier, Model 2609, extends the usefulness of piezo-electric accelerometers, and pressure, force, and other pickups by providing sufficient output current to drive high-frequency galvanometers and magnetic recording heads. The input impedance of 1000 megohms permits useable operation with piezo-electric pickups to below 1cy.

Sensitivity is flat to within ±1% over the frequency range from 1cy to 20,000cy (without transformer) and from 5cy to 5000cy with this firm's Model 2609.1 output transformer. This output transformer will be available as an accessory package, providing a low source impedance for use with high frequency galvanometers and an output of 50ma peak to peak into a 17-ohm load. Without the accessory transformer, an output of 14ma peak to peak into 1000 ohms is available.

The small physical size of the amplifier (1" x 3" x 5-1/2", including the special shockmount) permits its use in close proximity to the pickup, thus reducing the length of high impedance cable required. It will withstand extreme environments of temperature, vibration, shock, etc. The amplifier is applicable for use with gages other than the piezo-electric types, such as strain gages, photocells, and inductive generators. Endevco Corp., Dept. ED, 689 S. Fair Oaks Ave., Pasadena 2, Calif.

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

Impedance Bridge

Handles Multiple Circuits

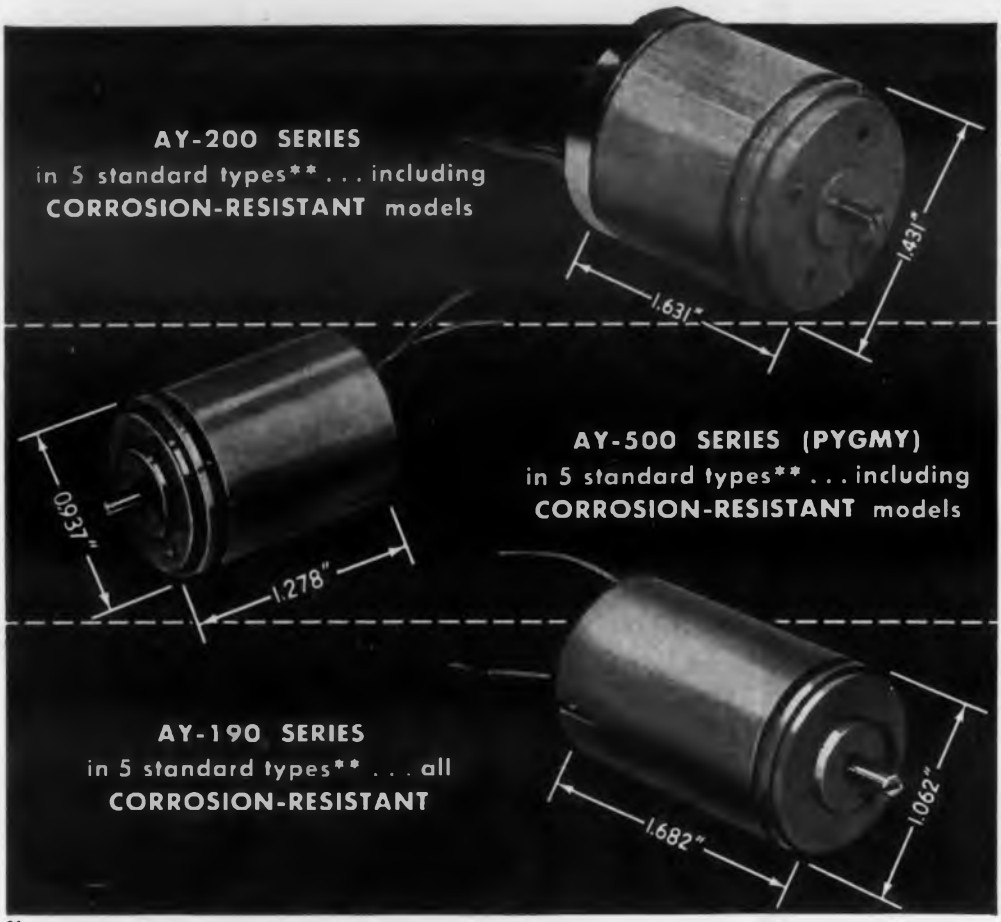
This automatic impedance bridge was originally developed to test a specific multi-circuit electronic assembly. It checked all circuits completely, including extraneous wiring. It has a built-in audio oscillator to furnish bridge excitation. Provision is made for front panel selection of percentage limit tolerance. It can be readily adapted to test similar electronic assemblies.

The unit illustrated accommodates 30 circuits; it can be re-designed to handle any required number of circuits. Cal-Tronics Corp., Dept. ED, 11307 Hindry Ave., Los Angeles 45, Calif.

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

PRICE IS RIGHT! DELIVERY IS RIGHT!

ECLIPSE-PIONEER AUTOSYN* SYNCHROS



**TRANSMITTERS, RECEIVERS, CONTROL TRANSFORMERS, DIFFERENTIALS AND RESOLVERS

And there's a type to meet every need!

Our Autosyns provide the perfect answer to synchro requirements for three good reasons. First, they're priced attractively to keep down your initial cost. Second, they can be delivered in prototype quantities *at once*. Third, they're available in all standard types in production quantities . . . as well as practically any special type you could ever need. And, of course, military specifications are used as design objectives in all cases. Only at Eclipse-Pioneer can you find the combination of experience, facilities, and production techniques that make possible all these important advantages. So, *whatever* your synchro requirements, it will pay you to see Eclipse-Pioneer.

OTHER STANDARD AND SPECIAL ECLIPSE-PIONEER AUTOSYN SYNCHROS INCLUDE models 1, 11, 15, 18, 23 and 2R as well as high temperature, high frequency, linear, and other types for special needs.

*REGISTERED TRADE-MARK BENDIX AVIATION CORPORATION.

WRITE DEPARTMENT F

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Division of Bendix AVIATION CORPORATION — THE NAME MILLIONS TRUST

TETERBORO, NEW JERSEY

West Coast Office: 117 E. Providencia Ave., Burbank, Calif.
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

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

New Products . . .

Probe Light

Combines Three Functions

With the mirror and plastic probe removed, the handle of this instrument provides a powerful insulated-top flashlight. When the probe is inserted, the light is beamed to the probe tip, which offers a flood of light at the tip end. When the 1-1/2x mirror is slid onto the probe, a powerful illuminated reflection permits ready inspection of tight wiring. In electronic instrumentation, the probe provides a handy light inspection instrument that can be readily carried by an engineer to provide light at the exact desired spot. Moore Manufacturing Co., Dept. ED, Swedesboro, N. J.

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

Noise Figure Meter

For Use With Transistors

The Model NFT Transistor Noise Figure Meter is a noise measuring instrument that automatically and accurately measures noise figures of transistors, transistor amplifiers, and related devices. The instrument eliminates manual, step-by-step noise figure measurement. By automatically comparing the internal noise of the transistor with a calibrated noise source, a continuous direct reading of noise figure is obtained, which reduces the measurement to the status of a simple meter reading.

The noise figure measurement is made to IRE standards and is proportional to one cycle bandwidth at 1000cy. Noise figure range for both transistors and transitor amplifiers is 5-60db ±1db accuracy. Noise figure is presented directly on a 4-1/2″ indicating meter, and is divided into three ranges for convenience and accuracy in reading. As an aid in simplifying transistor measurement, an internal power supply for supplying both emitter and collector biases is incorporated into the instrument. These biases can be varied over a wide range for optimizing the parameters for minimum noise figure.

The unit is self-contained in a hardwood cabinet, 19″ x 8″ panel, 13″ deep, and operates from an input source of 115v a-c, 60cy. Electronic Research Associates, Inc., Dept. ED, 715 Main St., No. Caldwell, N. J.

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

Picture Tubes

Feature 72° or 90° Deflection

A 90-degree magnetic deflection 17″ picture tube designated the *17AVP4* is supplied with an external conductive coating. Not aluminized, it has a grey spherical face. The tube is electrostatically focused and requires a single-field ion trap magnet. It is only 15-5/8″ long. These tubes are for black-and-white reception only.

The new 21″ aluminized TV picture tubes are now available. They offer 265 sq in of useful picture area. One of the types is electrostatically focused. The other is magnetically focused, but both use a single-field ion trap. They feature a deflection angle of 72°. They are supplied with an external conductive coating of 750 to 1500$\mu\mu$fd capacitance. Sylvania Electric Products, Inc., Dept. ED, 1740 Broadway, New York 19, N. Y.

CIRCLE ED-105 ON READER-SERVICE CARD

Powdered Iron Cores

Available from Stock

Known as the "EE" Series, standardized "preferred-type" powdered iron cores designed to meet many radio, TV, and communication needs are available from this firm's stock at substantial savings over custom-made cores. The cores meet the mechanical specifications of the Metal Powder Association. Available types include conventional round cores with threaded brass inserts and threaded cores with either hex holes or screwdriver slots. Electronic Components Div., Dept. ED, Stackpole Carbon Co., St. Marys, Pa.

CIRCLE ED-106 ON READER-SERVICE CARD

More Positions

The sub-headline of a new product notice published on p. 87 of last month's ELECTRONIC DESIGN incorrectly stated that this pushbutton switch has "7 to 12 positions". As correctly stated in the text, the switch, made by General Control Co., Boston, Mass., is made with from 2 to 12 positions.

CIRCLE ED-107 ON READER-SERVICE CARD ➤

LOWER YOUR SET COSTS WITH THIS LOWER-PRICED DEPENDABLE SPEAKER

A line of 4" and 5" speakers designed for peak performance. Break off or cast magnet may be used.

Low priced only because of unusually efficient manufacturing techniques.

Produced under rigid quality control. Metal stampings completely manufactured in our own Tool, Die and Punch Press Departments. Exceptionally thorough final inspection.

Plugs, transformers and/or brackets to your specifications.

Lower your set costs with this dependable speaker. Write for further information TODAY.

OTHER HEPPNER PRODUCTS:
Ion Traps, Centering Devices, Fly-Back Transformers and Focomags.

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MANUFACTURING COMPANY
ROUND LAKE, ILLINOIS
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Specialists in Electro-Magnetic Devices

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

New Products . . .

Magnetic Servo Amplifier

Features One Cycle Response

The R40G10W1 magnetic servo amplifier will deliver up to 10w reversible phase a-c output into the control phase of MK7 and MK8 servo motors for reversible phase a-c or reversible polarity d-c input. Design emphasis has been to achieve minimum size and weight compatible with operation at high temperatures in control or servo systems where one cycle response is mandatory. The reactor unit is only 2-1/2" high x 2-1/4" diam. It weighs less than 12 oz.

The R40G10W1 is completely encased in a molded resin except for the moisture and fungus proofed rectifier, which is supplied for external mounting. It is rated for operation at temperatures up to 85°C with normal servo duty cycles. Containing a minimum number of components, it is designed for ruggedness and long, trouble-free life at minimum cost.

The amplifier can be supplied either as illustrated or with a built-in magnetic, transistor, or vacuum tube preamplifier. In all cases, the only power supply required is 115v 400cy, single-phase. Polytechnic Research & Development Co., Inc., Dept. ED, 202 Tillary St., Brooklyn 1, N. Y.

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

Peakpower Meter

For Measurements in X-Band

The "Model 100X" Microwave Peakpower Meter is used with an external synchroscope and standard wattmeter bridge. It provides direct-reading measurements of peak power in X-band transmission systems.

Direct-reading peak power measurements accurate to 0.2db are made of any amplitude-modulated wave train having the following variables: pulse repetition rate, 10-20,000pps; pulse width, 0.1-10μsec; pulse minimum power level, 10μw; maximum power level, 3mw. Through the use of directional couplers or attenuators of known characteristics in the transmission system, direct-reading peak power measurements at any level up to the megawatt region are quickly and accurately accomplished. Cubic Corp., Dept. ED, 2841 Cannon St., San Diego 6, Calif.

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

Voltmeter

Measures Short Duty Cycle Pulses

Model VM-1 is a portable, true peak reading, vacuum tube voltmeter capable of measuring pulses with very short duty cycles. Designed to operate over a wide bandwidth (50-cy to over 100Mc), it can be used to measure positive peak, negative peak, or the peak-to-peak voltage of a waveform. Voltage range is 100v full scale, with multipliers available to 30kv, designed to permit rapid selection of voltage ranges. The actual measuring elements are housed in a probe, to allow direct connection to the voltage source with a minimum of shunt capacity and series inductance. A convenient probe storage compartment is included.

Circuitry consists of a pair of diodes, housed in the probe, which are arranged to give a positive d-c output voltage equal to the peak positive, peak negative, or peak-to-peak voltage being measured. This voltage is fed to a stabilized feedback amplifier utilizing an electrometer tube which drives the indicating meter. The detector and amplifier circuits and components are of such a nature that the back resistance of the diode detector is greater than 10^{12} ohms, giving an exceptionally long discharge time constant to the whole circuit. All critical voltages, including the electrometer tube filament and diode filaments, are regulated. Gertsch Products, Inc., Dept. ED, 11846 Mississippi Ave., Los Angeles 25, Calif.

CIRCLE ED-45 ON READER'S SERVICE CARD FOR MORE DATA

Header

Crack-Proof, Hermetic Unit

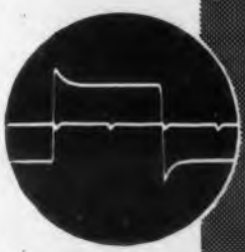
This hermetic seal header entirely eliminates the use of glass or ceramics as well as thermal shock and expansion problems. It meets the MIL-T-27 Moisture Resistance Test with polarizing voltage, and is the smallest compression seal available from this firm. It is being made in production quantities with any number of terminals from 2 to 16. Industrial Accessories, Inc., Dept. ED, Long Branch, N. J.

CIRCLE ED-46 ON READER'S SERVICE CARD FOR MORE DATA

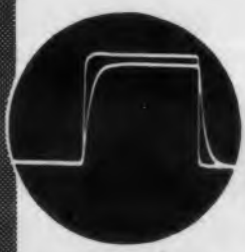
WIDE-BAND ELECTRONIC SWITCH

DC to 15 MC Dual Trace Oscilloscope Presentations

Model ES-180



Overshoot, Rise-Time Duration Measurements



Accurate Shape, Time, Amplitude Comparisons

Simultaneous Display of Related Waveforms

Simultaneous Display of Non-Sync. Signals

- Signals displayed on alternate sweeps, switched at sweep-end, rate to 100 kc
- Amplifier rise-time .023 microseconds, megohm input, 93 ohms load impedance
- Unity-gain, feedback, regulated power supplies for linearity and stability
- Index trace calibrated in volts and % amplitude eliminates parallax errors
- Time-signal input allows accurate and rapid measurement of pulse parameters

TELETRONICS LABORATORY, INC.

54 Kinkel St., Westbury, L. I., N. Y.

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

New Products . . .

Rejection Filter

With Attenuation Over 50db

The use of high-stability, accurate, precision wire-wound resistors, coupled with selected silver mica condensors, has resulted in the development of a stable twin "T" bridge type 60cy rejection filter, with attenuation greater than 50db. Known as the "T-100 CW", it is encased in a plug-in type can, measuring 2" x 2" x 3", with a tube socket base for easy mounting. This rejection filter can be made with mechanical design variations. It is also available for rejection of other frequencies on special order. Eastern Precision Resistor Corp., Dept. ED, 130-11 90th Ave., Richmond Hill, N. Y.

CIRCLE ED-325 ON READER'S SERVICE CARD FOR MORE DATA

Oscilloscope

For the TV Laboratory

The Model 104, a 7" oscilloscope, is an exceptionally high-gain, wide-band instrument created especially for designing and servicing TV receivers. Its vertical sensitivity is 10mv per inch, and vertical response is flat from 10cy to 2Mc, and useful to 4Mc. A faithful square wave response is available to 500kc, and the instrument has excellent tilt, rise-time, and overshoot characteristics. A four-position frequency-compensated step attenuator and a low-impedance, distortion-free smooth attenuator insure undistorted wave shapes at any gain setting.

The instrument has low internal hum level, and an input impedance of 5.0 megohms and 26mmfd for negligible circuit loading. High voltage and demodulator probes are included as accessories. It is supplied with a Type *7VP1A* (green trace) tube and can use a standard 7" picture tube, Type *7JP4* (white trace). Weight is 50 lb. Color is grey with wrinkle finish. Sylvania Electric Products, Inc., Dept. ED, 1221 W. 3rd St., Williamsport, Pa.

CIRCLE ED-326 ON READER'S SERVICE CARD FOR MORE DATA

What Makes A Good Industrial Housing?

A *good* industrial housing is made to solve *your* particular need! Its shape, size, metal, and finish meet *your* requirements for future usage. It consists of the *finest* quality in design and workmanship, yet is *inexpensive* and *quickly* available.

These are exactly the advantages of ordering OLYMPIC Metal Housings because OLYMPIC offers you:

PROMPT DELIVERY at Mass Production Prices from a stock of over 3000 Sizes and Shapes.

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For more information write for illustrated folder RE-4 Today!

STANDARDIZE WITH OLYMPIC

METAL PRODUCTS COMPANY, INC.
ALPHA, NEW JERSEY

CIRCLE ED-112 ON READER-SERVICE CARD

Capacitors

Require No Derating at 130°C

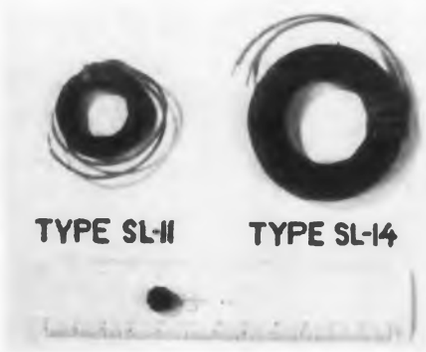
This series of "Miniroc" tubular sub-miniature capacitors requires no voltage derating at +130°C, and provides maximum moisture resistance, exceeding MIL-C-91 requirements. These improved characteristics are made possible through the use of steatite-tubular cases, "Mylar" polyester dielectric, and special processing techniques. Exceptionally high insulation resistance is achieved throughout the entire temperature range.

To insure low r-f impedance, the non-inductively wound extended foils are firmly soldered to the wire leads. The capacitor ends are sealed with "Polykane" fill, which tightly bonds to the steatite walls and to the lead wires to prevent the entrance of moisture, thus enabling the units to withstand extremes of handling, soldering temperature, and vibration. Cornell-Dubilier Electric Corp., Dept. ED, S. Plainfield, N. J.

CIRCLE ED-113 ON READER-SERVICE CARD FOR MORE INFORMATION

Toroid Inductors

In Values from 1.5mh to 4.7h



These inductors are particularly suited to applications requiring small size, wide range of inductance values, high Q, and high astaticism. They are ideally suited for use as inductor elements in vacuum tube and transistor circuits, as well as in wide-range filter networks and other applications requiring a compact and durable inductor.

Coils are toroidally wound on "Ferroxcube 3C" cores with coated wire. Wound coils are checked for inductance and Q and then vacuum impregnated with tropicalized r-f wax. These inductors combine the inherently efficient structure of the toroid with the excellent characteristics of these high permeability cores.

Inductors are compact and occupy a minimum volume of space, and operate over a wide frequency range (5-500kc). They are offered in values of inductance from 1.5mh to 4.7h. Nominal tolerance is ±5%, with other tolerances available on special order. Sizes range from 1-5/8" to 2-7/8" OD and 7/16" to 11/16" high. Mico Instrument Co., Dept. ED, 80 Trowbridge St., Cambridge 38, Mass.

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

It takes more than parts to make an

ARGA RESOLVER

15 size 23 size
Uncompensated
Resistor compensated
Feedback winding compensated

maximum error ▶ **Grade 1—.05%**
Grade 2—.10%
Grade 3—.20%

Null voltage less than 1 millivolt per volt
Built to military specifications

Write for data file, 10-11

BECKMAN

Arga *division*

BECKMAN INSTRUMENTS, INC.
220 PASADENA AVE., SOUTH PASADENA, CALIFORNIA

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

New Products . . .

Porous Carbon

Has High Conductivity

A highly porous yet extremely fine grain carbon is 75% air, but retains the usual desirable characteristics of carbon, such as high electrical conductivity, resistance to chemicals, and stability at high temperatures.

Its extremely fine grain results in a large carbon surface despite the high porosity. The product is available in blocks or sheets up to approximately 10″ x 10″, and comes in practically any thickness to 1-1/2″. Stackpole Carbon Co., Dept. ED, St. Marys, Pa.

CIRCLE ED-116 ON READER-SERVICE CARD

Casting Resin

Has Wide Temperature Range

"Stycast" 2850 GT casting resin can be used from —100°F to +400°F. For short periods it can be used at 500°F. The cured plastic has a low thermal coefficient of expansion, approximately the same as that of aluminum and brass. This means that even large metallic inserts can be embedded without cracking on temperature cycling. Another important feature is low shrinkage during cure. It has a dielectric strength of 455v/mil. Emerson & Cuming, Inc., Dept. ED, 869 Washington St., Canton, Mass.

CIRCLE ED-117 ON READER-SERVICE CARD

Magnetic Tapes

On High-Strength Backing

Magnetic tapes No. 111AM and No. 120AM are now available with high-strength polyester backing as well as conventional acetate backing.

The backing has a tensile strength enabling the 1/4″ wide tape to withstand a 9-lb pull. The tapes, which are silicone "dry-lubricated", are available in standard 1/4″ width on 1-1/2mil backing in 600-, 1200-, 2400-, and 4800-ft lengths. Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.

CIRCLE ED-118 ON READER-SERVICE CARD

CIRCLE ED-119 ON READER-SERVICE CARD ➤

Perforated Sheets
Have No Resonant Frequency

Offering virtually no obstruction to the output of loudspeakers over the entire audio frequency range, "Standard Acouperf", a line of perforated non-metallic sheet materials can be fabricated by a number of means. The materials have no resonant frequency. They can be used as decorative grills and as a retaining wall for fiber glass and other sound-deadening blankets.

The materials can be outline-diecut with very low cost tooling, stapled, nailed, glued, screwed, or cut with shears, knife, or scissors. They are made in 10 perforating patterns, 10 colors, and four gages (0.010", 0.030", 0.050", and 0.080"). Furnished in flexible or rigid grades. A sample kit is available to designers. Pearson Industries, Dept. ED, 4624 N. Sheridan Rd., Chicago 40, Ill.

CIRCLE ED-120 ON READER-SERVICE CARD

Three Picture Tubes
Feature 90° Deflection

Two new monochrome TV picture tubes feature 90° deflection and are also shorter than comparable 70° deflection types. The tubes are the 17" *17AVP4*, which measures only 16" in maximum overall length, and the 21" *21ALP4-A*, which has a maximum length of 20-7/16". Both are rectangular, glass types with low-voltage electrostatic focus and magnetic deflection.

The 21" 90° deflection *21AMP4-A* monochrome picture tube is only 20-3/8" long. The rectangular, aluminized screen is 19-1/8" x 15". It provides a screen area of 263 sq in. The tube has both internal and external conductive coatings forming a supplementary filter capacitor.

The *17AVP4* has a screen area of 14-1/4" x 10-3/4", with slightly curved sides and rounded corners, and a nominal screen area of 145 sq in. The 21" type features a metal-back screen measuring 19-1/8" x 15". It has a nominal area of 263 sq in. Tube Div., Dept. ED, Radio Corporation of America, Harrison, N. J.

CIRCLE ED-121 ON READER-SERVICE CARD

◀ CIRCLE ED-119 ON READER-SERVICE CARD

There is no one "cure all" for system instability. The desired stability of a servo loop is attained through the proper selection of components that satisfy the various conditions under which the loop will operate. Kearfott offers four basic motors and combinations for providing system stability. All feature high speed of response; low inertia and high stall torque.

SYSTEM STABILITY

SERVO MOTORS: Servo motors with high torque to inertia characteristics possessing (built-in) inherent damping ranging in size from ¼" to 1¾" diameter are available. Low speed, low power motors for use in simple instrument servos where high damping and/or low time constant is required can also be provided.

VISCOUS DAMPED SERVO MOTORS: Provide integral viscous damping for simple instrument servos. Any degree of damping can be provided. These units reduce no load speed of standard motors to 50% or 75% of normal, providing 70% or 50% of critical damping respectively.

(shown ⅔ size)


(shown ¼ size)


(shown approximately ½ size)


(shown ⅛ size)

INERTIAL DAMPED MOTORS: Integral inertially damped motors for use in high speed and/or high gain servo systems—damping on acceleration or deceleration basis with little loss in normal no load speed. These units make possible system cut off frequencies up to 25 cps using magnetic amplifiers.

SERVO MOTOR TACHOMETER GENERATORS: For system stabilization by voltage feedback from an integral tachometer generator. May be obtained as damping generators for use in simple rate servos or as rate damping generators for use in very high gain systems. The latter feature high linearity, high output and maximum output to fundamental null ratios.

These servo motors are suitable for most exacting requirements. Write today for descriptive bulletin giving data of components of interest to you.

KEARFOTT COMPONENTS INCLUDE:

Gyros, Servo Motors, Synchros, Servo and Magnetic Amplifiers, Tachometer Generators, Hermetic Rotary Seals, Aircraft Navigational Systems, and other high accuracy mechanical, electrical and electronic components.

Kearfott

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

Sales and Engineering Offices: 1378 Main Avenue, Clifton, N. J.
Midwest Office: 188 W. Randolph Street, Chicago, Ill. South Central Office: 6115 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

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

New Products . . .

Rotary Switch

Weighs Less Than 1/4 oz

This subminiature rotary switch is 0.908″ long x 0.875″ maximum diam. It weighs less than 1/4 oz, including the knob. For use in low-current applications, it is manufactured in 1-pole, 2-pole, and 3-pole types (15 terminals per switch). It is also available in 2-gang, 3-gang, and 4-gang models. Specifications include: maximum working voltage, 300v rms; maximum working current, 1amp; maximum working power, 100w; maximum contact resistance, 0.05 ohm; breakdown voltage, 1500v rms. Electro Development Co., Dept. ED, 6006 W. Washington Blvd., Culver City, Calif.

CIRCLE ED-36 ON READER'S SERVICE CARD FOR MORE DATA

Electromagnetic Counter

Takes 1200 Counts per Minute

The Model F 106 Electrical Impulse Counter, is specifically designed for panel mounting. It is a long-lived, accurate, high - speed, heavy-duty electrical counter for use where space is restricted, or where a large number of counters must be mounted on a panel. Life is approximately eight times that of previous models of the same size made by this firm.

Current consumption is 8w. Speed is 1200 counts per minute. The number of digits is five. The counter is supplied with or without knob reset (one turn resets all digits to zero). Size of digits is 3/16″.

Overall size of the counter, exclusive of face plate and screw terminals is 1-3/4″ wide x 1-3/16″ high x 2-1/2″ long. It is available for operation from 6v to 220v a-c or d-c. Machined throughout, it has all parts subject to heavy wear made of case-hardened steel. Made by Irion & Vosseler, Germany. Available from Presin Co., Dept. ED, 5225 Wilshire Blvd., Los Angeles 36, Calif.

CIRCLE ED-37 ON READER'S SERVICE CARD FOR MORE DATA

Analog Computer Service

Available on a Rental Basis

The "MILAC" Analog Computer is now available on a rental basis for solving a wide variety of general industrial and engineering problems. The service is particularly valuable to organizations faced with analyzing a dynamic system on a point-by-point calculation basis but whose continuing engineering load does not justify purchase of a computer.

It is valuable for both linear and non-linear systems. This computing service permits "testing" of a system, device, or component while it is literally still on the drawing board. A change in design parameters is accomplished simply by changing coefficient settings on the computer. MILAC Computer Laboratory, Dept. ED, Wm. Miller Instruments, Inc., 325 N. Halstead Ave., Pasadena 8, Calif.

CIRCLE ED-39 ON READER-SERVICE CARD

TV Picture Tube

Features Shorter Length

Designated the type *17AVP4*, a 17″ monochrome picture tube features an overall length of only 15-5/8″ ±3/8″. A 90° deflection type, it has electrostatic focus and magnetic deflection. Receiving Tube Div., Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE ED-48 ON READER-SERVICE CARD

Anti-Static Solution

Harmless to Most Materials

"Anstac-2M", an anti-static and cleaning solution renders treated articles anti-static. It is harmless to vinyls, polystyrene and many other plastics and materials.

It is relatively fast drying and may be applied by dipping, spraying or wetting the article with a cloth dampened in the solution. Only a microscopic amount is necessary. Chemical Development Corp., Dept. ED, Danvers, Mass.

CIRCLE ED-49 ON READER-SERVICE CARD

CIRCLE ED-50 ON READER-SERVICE CARD ➤

New Products . . .

Phase Meter

Features Expanded Scale

Phase angle indications from 0 to 360° are presented directly on a large meter with an absolute accuracy of ±1° on the Type 322-A Precision Phase Meter. Incremental changes in relative phase angles are read with an accuracy of ±0.1° on a 30° expanded scale. This expanded scale may be made to cover any 30° increment of the range.

Although frequency range is 20 to 20,000cy, readings may be obtained at frequencies up to 1Mc with slightly decreased accuracy. Principles of operation are similar to this firm's Type 320-AB Phase Meter, with additional circuitry providing faster response time. Input range is 2 to 30v. Input impedance on each channel is 4.7 megohms in shunt with 13μμfd. Available in relay rack mount or aluminum cabinet. Technology Instrument Corp., Dept. ED, Acton, Mass.

CIRCLE ED-312 ON READER'S SERVICE CARD FOR MORE DATA

Holding Coil Switch

Acts as Relay and 2 Switches

Known as the A1200 Series Holding Coil Switch, this unit performs the functions of a relay plus two conventional switches. The device has a built-in solenoid that holds the switch on contact until the solenoid coil circuit is externally interrupted. This circuit as well as the external switch circuit may also be broken manually by pulling the knob.

Weighing only 3 oz, it has a body diameter of 15/16" x 3-3/8" overall length. The case is fitted with a threaded bushing for mounting in a 5/8" diam panel hole. Knobs are available with built-in lights to indicate when the holding coil circuit is energized. The 240-ohm coils operate on 30v, d-c. Contacts are rated for a 5amp inductive load at 30v, d-c. For additional humidity protection, the unit can be fitted with a silicone rubber boot. Modifications can be specified. Hetherington, Inc., Dept. ED, Sharon Hill, Pa.

CIRCLE ED-313 ON READER'S SERVICE CARD FOR MORE DATA

Servo Motor

Lightweight, Highly Applicable

The Type M-130 Servo Motor is designed to give maximum flexibility for ready adaptation to many military and commercial applications. Built in the popular 1.062" diam size, it features a hermetically sealed stator providing high operating stability, and a high torque-to-inertia ratio for rapid acceleration and deceleration service as encountered in servomechanism and computing applications. The unit is designed to be inoperative under single-phase conditions, and a sloping speed-torque characteristic provides viscous damping in control applications.

Motor characteristics include: voltage, 115v (fixed phase), 115/57.5v (control phase); frequency, 400cy; phases, 2; poles, 6; no load speed, 6200rpm; stalled torque, 0.63 oz-in; rotor inertia, 1.1 gr-cm²; weight, 4.5 oz. Infra Electronic Corp., Dept. ED, 553 Eagle Rock Ave., Roseland, N. J.

CIRCLE ED-318 ON READER-SERVICE CARD FOR MORE INFORMATION

Cabinet Rack

For Multiple Installations

This heavy-duty cabinet rack for multiple installations is constructed of heavy gauge steel and welded throughout. It has detachable sides, permitting multiple assembly of cabinets in double, triple, or larger units by bolting together.

Equipped with handle and lock, the front and rear doors are hung on loose jointed hinges that may be hinged for right or left hand opening by rotating the door 180°. Perforations are furnished if desired. Panel-mounting angles are 3/16" thick, tapped 12/24 on universal spacings, and are adjustable to any position. Tops supplied either solid or with cut-out. Rectangular cut-out is also provided in the bottom for leads, etc.

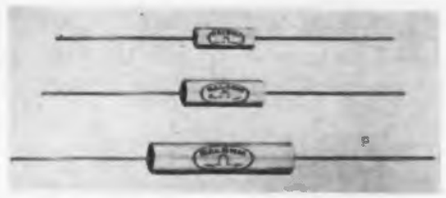
Racks are 22" wide, 18" deep, and come in three heights: 67-3/8", 76-1/8", and 83-1/8". They are furnished in black or gray wrinkle, with brown or gray hammertone slightly extra. Premier Metal Products Co., Dept. ED, 3160 Webster Ave., Bronx, New York.

CIRCLE ED-319 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Resistors

With 1% Standard Tolerance



Type HC hermetic sealed-ruggedized deposited carbon resistors are completely solder-sealed in a newly developed envelope of non-hygroscopic ceramic, and are ruggedized for incorporation into "snap-in" component clips. They are production tested for resistance to thermal shock, salt water immersion, and humidity.

The resistors are available in three wattage ranges (1/2w, 1w, and 2w) and in resistance ranges to 200 megohms. Standard tolerance is 1%. Dale Products, Inc., Dept. ED, Columbus, Neb.

CIRCLE ED-161 ON READER-SERVICE CARD FOR MORE INFORMATION

Synchronous Motors

For Magnetic Tape Drives

This series of low and high speed direct-drive synchronous motors features synchronous speeds from 300rpm to 1800-rpm. Combining a high torque rotor with flywheel and precision ground capstan, these motors provide accurate and constant tape velocities for magnetic recorders without gear reductions.

Standard capstans presently available and the large variety of motor speeds provide tape velocities of 1-7/8, 3-3/4, 7-1/2, 15, and 30 inches per second. Special features, such as extended or double-ended shafts, and variations in mounting details, direction of rotation, line voltage, and frequency, are available.

All motors are supplied with a magnetic shield eliminating the high-torque flux field from the region of the capstan. Twelve cooling impellers located on the flywheel-rotor provide ventilation. Motors are reversible and supplied with single or dual-speed windings. A series of 50cy motors, as well as the standard 115v, 60cy line, is also available. Motors measure approximately 5-7/16" diam and extend 4-19/32" from the mounting surface. Mounting is simply accomplished by a four-hole flange. Technical Development Corp., Dept. ED, 4060 Ince Blvd., Culver City, Calif.

CIRCLE ED-162 ON READER-SERVICE CARD FOR MORE INFORMATION

Epoxy Resin

Has Low Viscosity

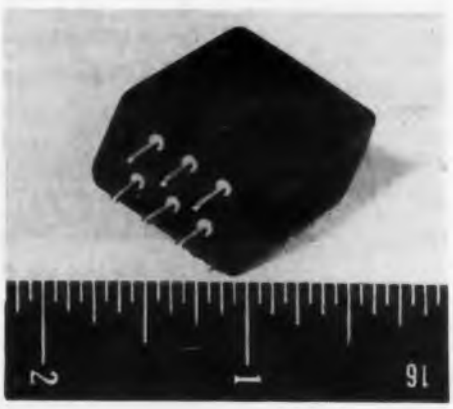
Called "Scotchcast" electrical insulation resin No. 3, this product has a usable life of from 3 to 5 days before setting up. Yet cure time for the resin, which comes in a two-part liquid form, is from two to four hours at 250°F. The product should be useful where production techniques call for a resin that can be mixed in large quantities for use over a period of days rather than for minutes or hours.

Because of its low viscosity, it could be used for impregnation of coils instead of conventional varnish-impregnated paper and cloth impregnation. It has excellent electrical and physical properties. Minnesota Mining & Manufacturing Co., 900 Fauquier St., Dept. ED, St. Paul 6, Minn.

CIRCLE ED-165 ON READER-SERVICE CARD FOR MORE INFORMATION

Subminiature Relay

High Sensitivity, Stable Unit



The P-100 subminiature relay is designed for applications requiring small size, light weight, high sensitivity, thermal and shock stability, and fast reaction time. It weighs only 1 oz and has overall dimensions of 1-3/16" x 7/8" x 11/16". The relay is of the polarized type and has a resistance of 3500 ohms with tolerances from 25% to 5% as required. Sensitivity is less than 20mw, and the relay can be adjusted to make contact at 1ma and to break at 0.8ma. The balanced movement employed in the unit is unaffected by mounting position or movement of the relay.

Reaction time is 1/200sec, and the relay may be operated at rates as high as 90cy. Spst changeover contacts are used with contact materials available in standard silver, palladium, or platinum. Contacts can handle up to 0.25amp at 250v. Contact adjustments are not normally required, but may be made without removing the protective case.

The relay is housed in a protective plastic case which helps provide high thermal and shock resistance. It is equipped with a six-pin plug which fits a molded or laminated socket supplied with the relay. Polarity may be reversed by simply reversing the relay in its socket. Pins and socket are both heavily silver plated. It can be produced in a wide number of modified models to meet individual specifications. Made by Telecommander, Ltd. of England. Available from American Telasco Ltd., Dept. ED, Huntington, N. Y.

CIRCLE ED-166 ON READER-SERVICE CARD FOR MORE INFORMATION

Eimac HR Connectors

HEAT TRANSFERRING ELECTRICAL CONNECTORS FOR EIMAC TUBE TYPES

Eimac HR connectors are especially designed to give proper electrical connections with the plate and/or grid terminals of Eimac tube types while providing efficient transfer of heat to the air from the tube element and glass seal. Machined from solid dural rod, these heat radiating connectors are available in ten types to accommodate Eimac internal anode type tubes — rectifiers, triodes, tetrodes or pentodes.

For further information on Eimac HR connectors, contact our Application Engineering department.

Eimac

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes

CIRCLE ED-167 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Tantalum Capacitors
For Low-Voltage Applications

Trademarked "Tantalex", these Series 103D subminiature capacitors employ tantalum as the anode. They are valuable for low-voltage use where they provide relatively large values of capacitance in a minimum of space. Typical applications are for by-pass, coupling, and filter requirements in low-voltage transistor circuits, including hearing aids and amplifiers for military needs.

Use of tantalum, a most stable anodic film-forming material, gives them great stability of performance. They exhibit no shelf aging under long periods of test and have extremely low leakage current. They are only 5/16" long x 1/8" diam. Sprague Electric Co., 347 Marshall St., North Adams, Mass.

CIRCLE ED-142 ON READER-SERVICE CARD FOR MORE INFORMATION

Resistors
Economical Card-Wound Units

For many precision wire-wound resistor applications where space is at a premium, these flat, card-wound resistors provide a workable, economical solution in place of the usual spool or bobbin type. The cards are 1/8" thick and 5/8" wide. The length is determined by the number of individual resistance sections required for a particular application. Normal power rating is 0.6w. Up to 5,000 ohms per section may be obtained. Accuracies to 0.1% are available.

Card-wound resistors can be Ayrton-Perry wound where frequency response is a factor and inductance must be kept to a minimum. The cards can be furnished bent into circles for mounting on a round switch and are used in many printed-wire applications. Miniature designs can be mounted on ceramic wafers such as Project "Tinkertoy" types. The card design is an economical way of obtaining multi-section precision resistors in the smallest size. Up to 40 sections can be furnished. Cards can be impregnated to withstand severe military or industrial environmental tests. Daven Co., Dept. ED, 191 Central Ave., Newark 4, N. J.

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

PANEL HARDWARE

C.T.C.'s high quality panel hardware is precision made, of exceptionally fine finish, and meets applicable military specifications.

PANEL SCREWS. (X1786). Brass, with polished nickel plated head or black oxide finish. Panel sizes: 1/8"; 3/16"; 1/4".

THUMB SCREWS. (1120). Brass, with polished nickel plated head or black oxide finish. Thread sizes: 6-32; 8-32; 10-32.

DIAL LOCKS. (X1552). Brass, with nickel plate or black oxide finish. Captive assembly, no loose parts, positive locking.

SHAFT LOCKS. (X1774). Brass, with nickel plate or black oxide finish. Fit standard 1/4" shafts.

HANDLES. Brass, with nickel plate or black oxide finish, in sizes: 6 3/4" x 1 3/4"; 4 7/8" x 1 1/2"; 3-5/16" x 1-5/16". *Aluminum* (X1884) black aluminite or special colors in lacquer or enamel. One size: 4 3/8" x 1 7/8".

Order parts by number in bracket adding suffix BO for black oxide finish. Send for catalog 400 containing details of C.T.C.'s complete line of electrical and electronic hardware and ask for prices.

CAMBRIDGE THERMIONIC CORPORATION
457 Concord Ave., Cambridge 38, Mass.

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

Template

With JIC Standard Symbols

The No. 311 Electronic JIC Symbols Template contains JIC standard symbols for the use of designers and draftsmen. Designed for industrial use, it is made of 0.030" matte finish plastic. All cut-outs are milled, not punched, for precision smoothness. Overall size of the template is 7" x 5". Rapidesign, Inc., Dept. ED, Box 592, Glendale, Calif.

CIRCLE ED-148 ON READER'S SERVICE CARD FOR MORE DATA

Stripping Tool

Cuts and Strips Coaxial Cable

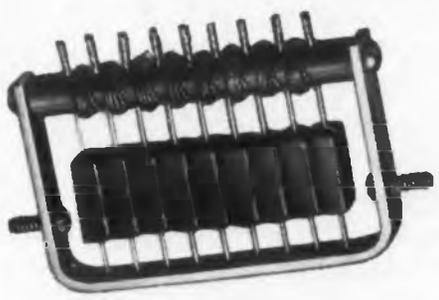
Coaxial Cable Stripping Tool No. 400 strips RG8U, RG11U, and smaller sizes of coaxial cable in a matter of seconds. A smaller tool, the No. 300, has also been developed to take RG59U and smaller-sized coaxial cable.

The cable is inserted in the holes, the handles squeezed shut against the stops, and the tool is rotated 180°. Three such twists prepare the cable for the connector. The cutting blades are adjustable for various sizes of coaxial cable. K. Miller Tool & Mfg. Co., Inc., Dept. ED, 6 Cass St., Springfield 4, Mass.

CIRCLE ED-149 ON READER'S SERVICE CARD FOR MORE DATA

Delay Line

Lumped or Distributed Types

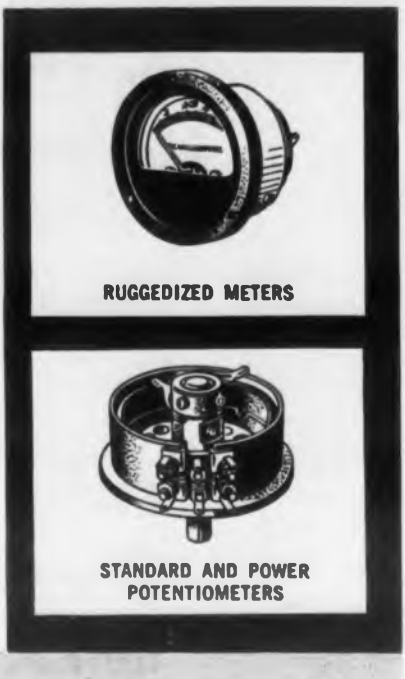


These encapsulated and open-style lumped parameter delay lines can be specified for use as compensating delays for color TV, signal delays for TV, synchronizing generators and as coupling elements for wideband distributed type amplifiers. Many other styles, including distributed parameter types, can be specified. Shallcross Mfg. Co., Dept. ED, Collingdale, Pa.

CIRCLE ED-150 ON READER'S SERVICE CARD FOR MORE DATA

sealed . . . ruggedized **instruments by DeJUR**

Simplify your panel meter problems



RUGGEDIZED METERS

STANDARD AND POWER POTENTIOMETERS

SEALED MODEL 150

SEALED MODEL 152

New DeJUR 1½" sealed meters

Built to MIL M-3823 specifications

Here are new, high precision panel instruments designed for use in a wide variety of environmental applications. They're sealed, waterproof and have high resistance to shock. Even damage to the scale window will not destroy the watertight seal to the panel. Featured also are the DeJUR miniaturized external pivot D'Arsonval movements for high stability and accuracy, and high flux density Alnico magnets.

These meters are also available as self-contained AC rectifier types, and with various scales and ranges to meet your prototype or production requirements. In addition, we manufacture sealed and ruggedized meters in 1", 1½", 2½", 3½" and 4½", round or square. For detailed engineering literature write Dept. ED, DeJUR-Amsco Corporation, 45-01 Northern Blvd., Long Island City 1, N. Y.

SEALED METERS SQUARE AND ROUND

FULLY ENCLOSED POTENTIOMETERS

HIGH RESOLUTION POTENTIOMETERS

Electronic Sales Division **DeJUR**

45-01 NORTHERN BLVD., LONG ISLAND CITY 1, N. Y.

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

New Products . . .

Compound Delay Packages

Store Digital Pulses

This firm offers miniature plug-in compound delay packages. Two designs already available are "Distributed Constant Lines", used as pulse storage elements in digital computers.

Each of the two distributed constant lines consists of a plug-in brass can, hermetically sealed, with maximum dimensions of 7/8" thick x 1-5/8" wide x 4" long, and a standard Amphenol Type 26 base.

Unit No. 1 contains delay times of 3.65, 3.75, 4.00, and 4.25μsec. Unit No. 2 covers 0.25, 0.50, 0.75, 1.00, 1.25, 1.50, and 1.75μsec. The tolerance on any delay is $\pm$0.05μsec. Both designs have 1000 ohm impedance. In both cases, maximum attenuation is 6db, and spurious response is 20db. Each unit is completely encapsulated and potted to operate over a wide temperature range. PCA Electronics, Dept. ED, 2180 Colorado Ave., Santa Monica, Calif.

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

Yoke

For High Speed Writing

Designed for 2-1/8" neck diameter tubes, this magnetic deflection yoke is for high speed writing, data presentation, and other military and commercial oscilloscope applications. Deflection angle is up to 70°. It fits any 2-1/8" maximum neck diameter cathode ray tube. The yoke is especially suited to push-pull applications requiring maximum resolution, negligible yoke distortion, and high efficiency.

Five advanced design features give optimum performance at any impedance level. These are: 1) exceptionally low astigmatism; 2) minimum nonorthogonality (angular error between deflection areas is reduced to less than 1/3°); 3) spot shift due to residual magnetism eliminated; 4) fast recovery and minimum starting delay; 5) compensation provided to achieve fast, accurate settling. Syntronic Instruments, Inc., Dept. ED, 100 Industrial Rd., Addison, Illinois.

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

Rivet Contacts

Stocked in 70 Designs

These fine-silver headed rivet contacts are available from stock in 70 standard designs, which represent the efforts of this firm's engineers to standardize from thousands of different customer specifications. Use of these rivets is intended to eliminate the need for designing new rivets for each application. They include flat-faced and radius-faced types in head diameters from 0.062″ to 0.375″. P. R. Mallory & Co., Dept. ED, 3029 East Washington St., Indianapolis 6, Ind.

CIRCLE ED-197 ON READER-SERVICE CARD

Ceramic Parts

For High-Temperature Uses

Extremely small ceramic parts made of a high-temperature, high-strength alumina material designated "AlSiMag 576" are available on special order. The material is imperious, chemically inert, non-magnetic, and has excellent resistance to heat shock. It can be used safely under continuous heat as high as 2000°F. It does not rust, corrode or deteriorate with time. It has superior electrical insulation qualities.

As an example of the parts that can be produced, tubes one inch in length with an OD of 0.030″ were fabricated with two holes 0.006″ in diam evenly spaced. The parts are made with close tolerances. American Lava Corp., Dept. ED, Chattanooga 5, Tenn.

CIRCLE ED-198 ON READER-SERVICE CARD

Ferrites

Stock and Custom-Made

In addition to offering a line of ferrite cores for use in TV-receiver components and other applications, this manufacturer will also make ferrites to customer specification. These products can be utilized for i-f transformers, r-f chokes, radio coils, etc. Tube Div., Dept. ED, Radio Corporation of America, Harrison, N. J.

CIRCLE ED-199 ON READER-SERVICE CARD

CIRCLE ED-200 ON READER-SERVICE CARD ➤

New Products . . .

Variable Transformers

For Laboratory Use

The Model PA-3 Variable Auto-Transformer is a low-cost unit adaptable for work bench or other applications such as line voltage control for power supplies and instruments, and control of heat, motor speeds, light intensity, and other phenomena.

The design features a toroidally wound variable transformer with the new "Lo Res" commutator surface and a new brush assembly which maintains almost constant pressure from full brush to no-brush. Dimensionally small and compact, the unit is 6-1/2" x 6-1/8" x 6-1/2" in size. It is equipped with jeweled pilot light, on-off switch, convenient fuse, cord, plug, and receptacle. It has a gray wrinkle finish.

Input is 115v 50-60cy; output is 0-135v. Maximum load rating is 0.4kva. Maximum output current is 3.0amp. The Standard Electrical Products Co., Dept. ED, 2240 E. 3rd St. Dayton, Ohio.

CIRCLE ED-126 ON READER-SERVICE CARD FOR MORE INFORMATION

A-C Voltmeters

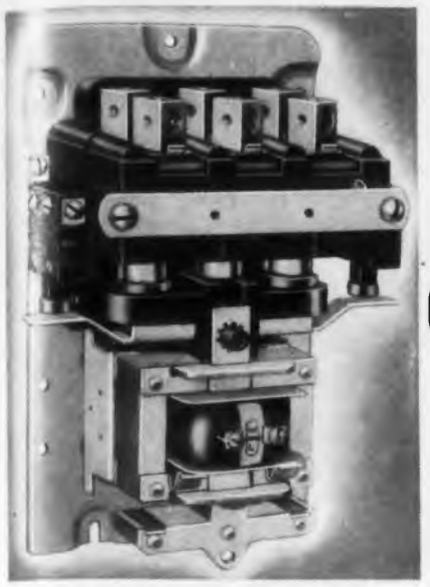
Employ Expanded Scale Principle

Portable Expanded Scale A-C Voltmeters use the meter movement for just the top 5% to 10% of the range, permitting these instruments to obtain high accuracies from a rugged, low-accuracy meter movement. Only the voltage range of interest is expanded full scale—by a circuit without electron tubes. Guaranteed accuracy is ±0.5% of input voltage.

The voltmeters offer overvoltage protection, wide frequency range (50-2000cy) and voltage expansions of ±5v, ±10v or ±15v at 115v or 230v. They are designed for applications where exceptional ruggedness and reading ease are required.

Additional features include a ruggedized, hermetically sealed meter and hermetically sealed circuit elements. Temperature range is 0-60°C. Input power required is 0.5w max. Dimensions are 8" x 5" x 3" depth. Weight is 2-1/2 lb. Arga Division, Beckman Instruments, Inc., Dept. ED, 220 Pasadena Ave., South Pasadena, Calif.

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



1000 contactors in 1

You're looking at the most versatile solenoid contactor ever developed for building electrical controls.

This Ward Leonard Size 2 contactor is available in *three* basic models, *six* major variations, *one thousand* combinations.

Your savings: reduced stock, minimum panel space, lower assembly costs, less layout and drafting time. Write for Bulletin 4450 to Ward Leonard Electric Co., 77 South St., Mount Vernon, N.Y. 4.15

WARD LEONARD ELECTRIC CO.

Result-Engineered Controls Since 1892

RESISTORS • RELAYS • MOTOR CONTROLS • CHROMASTER

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

Laboratory Testing

of Electronic and Electro-Mechanical Components

Qualification Under All Environmental Conditions!

YOUR GUARANTEE that your product will meet all SERVICE REQUIREMENTS

The prime purpose of General Testing Laboratories is to provide a complete service in the field of environmental testing. Our reliability record is attested to by our many customers who continually receive accurate and dependable test data relative to their product's performance under all possible combinations of anticipated service conditions.

The services of General Testing Laboratories are divided into two basic categories, namely research and development testing, and complete qualification (type or brand approval) testing. All tests are performed in strict conformance to specification requirements. All test data and evaluations of any product are kept in strict confidence and become the property of the customer. A certified test report is provided with each project.

Write for Illustrated Brochure.

GENERAL TESTING LABORATORIES

Telephone ELliott 8-0168

227 WEST CHESTNUT, MONROVIA, CALIFORNIA

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

Input Transformer

Gives 200:1 Impedance Step-Up

The Type 0-16, a new addition to the "Ouncer" Series, is a highly shielded input transformer. A high-fidelity unit, it is designed to operate from a low impedance microphone or line to grid, and provides a 200:1 step-up impedance ratio. Frequency response is within 1db from 30cy to 20,000cy.

The primary of this transformer is center-tapped, balanced to 1%, and is suitable for sources of 150, 200, 250, 500 or 600 ohms. With a 250-ohm source, secondary impedance is 50,000 ohms. Very high shielding for minimum hum pickup is effected through the use of two heavy gauge "Hipermalloy" shields. Overall dimensions are only 1-1/16" x 1-1/2" x 1-1/2", including the orientable mounting bracket. United Transformer Co., Dept. ED, 150 Varick St., New York 13, N. Y.

CIRCLE ED-86 ON READER'S SERVICE CARD FOR MORE DATA

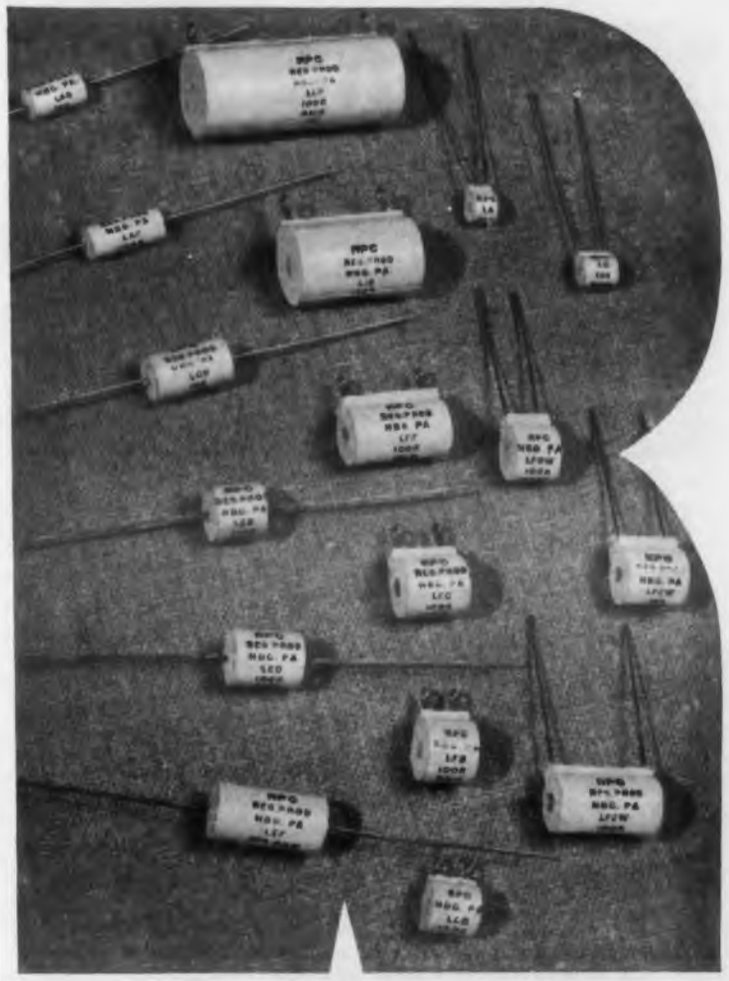
Capacitors

Feature Leakage Protection

Previously available only in oval cases, these fixed, paper - dielectric capacitors are now furnished in drawn rectangular cases, which are designed to give greater protection against leakage than fabricated cases. Elimination of the soldered seams common to fabricated cases provides the added protection.

The units have the same base area as comparable types in fabricated cases and are interchangeable with them, allowing users to convert to the new capacitors without even changing blueprints. The capacitors can be mounted upright or inverted. They have welded bushing studs, welded taps, aluminum foil, low-loss kraft paper, and "Pyranol" dielectric. They are available in capacities from 0.05μfd to 16μfd, and with voltage ratings of 400 to 12,500v, d-c, and 236 to 660v, a-c. Capacitor Dept., Dept. ED, General Electric Co., Hudson Falls, N. Y.

CIRCLE ED-87 ON READER'S SERVICE CARD FOR MORE DATA



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

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

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

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

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

RESISTANCE PRODUCTS CO.

714 RACE STREET • HARRISBURG, PENNA.

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

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

New Products . . .

Capacitor

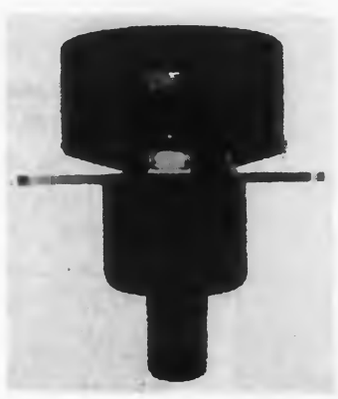
For High Temperature Uses

The "Hy-Therm" subminiature capacitor, a hermetically sealed and metal encased unit, is available in all standard values and tolerances, for all applications requiring exceptionally high insulation resistance and unusual stability at high temperatures. Insulation resistance quality exceeds military requirements (MIL-C-25A). A variety of bracket designs is also offered. In addition, special designs to meet customer requirements are furnished. Hopkins Engineering Co., Dept. ED. 2082 Lincoln Ave., Altadena, Calif.

CIRCLE ED-170 ON READER'S SERVICE CARD FOR MORE DATA

Magnetic Recording Systems

With 60,000 Impulse Capacity



These magnetic recording systems are designed for the efficient handling of problems involving large amounts of information in a wide variety of recording and memory applications. The systems employ drums which rotate on bearings operated at a small fraction of their normal rated load. Present systems have a medium storage capacity up to 60,000 impulses or binary digits on their magnetic oxide coated drums. (The 60,000 impulse drum has 1-1/2" diam).

The recording heads in the systems are designed to record and reproduce frequencies up to 1Mc. Their all-ferrite magnetic circuits have multiple shielding, allowing information to be read on any one channel while other information is being written on any other channel at the same time. In conjunction with suitable write-and-read amplifiers, information can be read out of one cell and new information recorded in the same cell during a single pass beneath the head.

Information can be stored permanently or erased so the drums can be reused. The magnetic drums need no developing or processing for use as permanent records. Kollsman Instrument Corp., Dept. ED, 80-08 45th Ave., Elmhurst, N. Y.

CIRCLE ED-171 ON READER'S SERVICE CARD FOR MORE DATA

DESIGN and PRODUCTION NEWS

FOR ELECTRICAL AND ELECTRONIC ENGINEERS

Published by TECHNICAL SERVICE, Chemical Manufacturing Division, The M. W. KELLOGG Company OCT.-NOV. 1954

Hermetic-Seal, Shock-Resistant Tube Sockets of Kel-F® Polymer Cut Heat, Moisture "Fade-Outs" at High Altitudes

KEL-F polymer plastic, molded into a special metal base permitting complete enclosure of an electronic tube, provides this premium socket with a hermetic seal that defies heavy shock loads, extreme thermal cycling and aging. Tube "fade-outs", due to moisture condensation and collection, are eliminated, tube altitude "ceilings" have been raised significantly.

Positive electrical insulation is maintained under all thermal and moisture service conditions because of the high dielectric strength and low RF loss characteristics of KEL-F polymer.

The high impact and compressive strength of KEL-F polymer helps the socket withstand shock loads up to 100 G's without cracking or chipping of vital insulation.

The Elco Corporation, Philadelphia, Pa., injection-molds the complex socket from KEL-F polymer Grade 300. A metal tube cover with a silicone rubber gasket completes the assembly.

For further information ask for Application Report E-128

Electronic "Memory" Drum Insulated with Kel-F® to Eliminate Carbonization, Wear Damage . . . Extend Service Life

Two obstacles to efficient operation—carbonization shorting and insulation "wiping" onto vital contacts—are eliminated through the use of KEL-F plastic as insulation in this special commutator.

High dielectric strength and heat resistance assure positive insulation under all operating temperature and humidity conditions, prevent formation of carbonization tracks between drum contact points. Zero water absorption cuts moisture "shorts", arcing.

W. S. Shamban & Company of Culver City, Calif., transfer-molded this new commutator of unplasticized KEL-F polymer Grade 300 for use in a special digital-type converter manufactured by Genisco, Inc., Los Angeles, California.

For further information ask for Application Report E-129

® *Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.*

(SEE REVERSE SIDE)

CONTINUED FROM PRECEDING PAGE

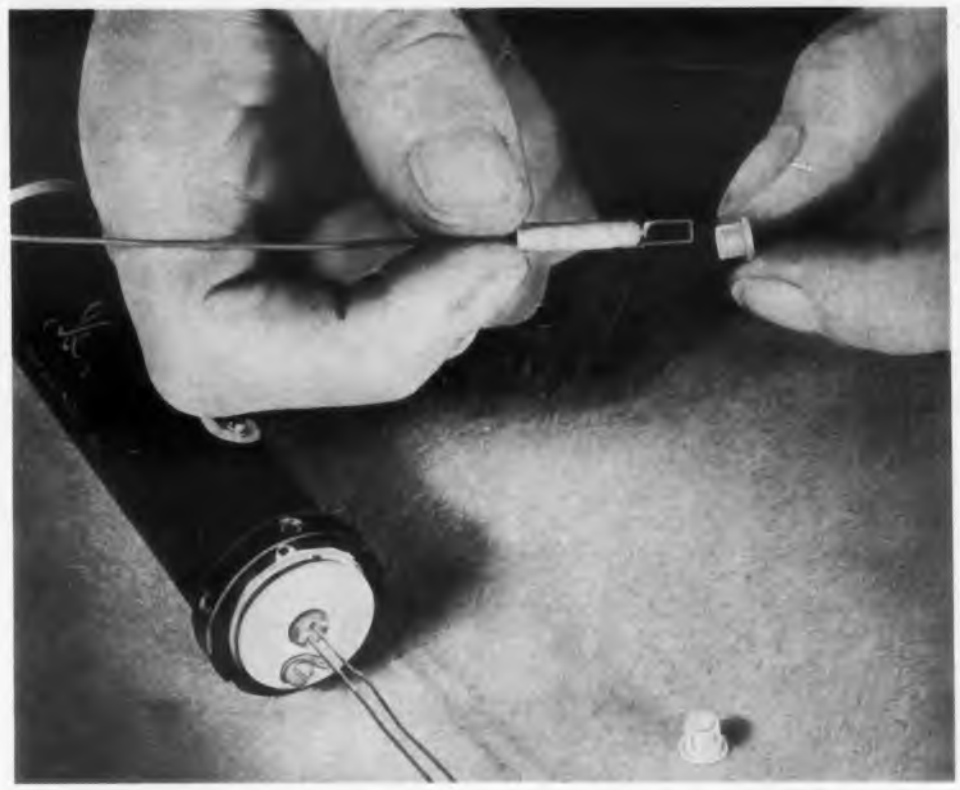
Paper-Thin Insulator of KEL-F® Polymer Solves Space, Precision "Specs" Problem in Microwave Cavity

Found to be the *only* high-frequency dielectric capable of being machined to close tolerances in this .009″ thick insulator, KEL-F plastic effectively prevents pulse leaks between cavity and probe. These units, producing hundreds of watts peak power output, depend largely on the insulator for their 0.0005% per °C temperature coefficient.

The fluorocarbon's high dielectric strength over a wide temperature range and its dimensional stability assure complete insulation in the limited space provided. Zero water absorption of this fluorocarbon guards the insulator against any changes caused by moisture.

The precision insulator is machined from KEL-F polymer rod and installed in microwave oscillator assemblies by C.G.S. Laboratories, Inc. of Stamford, Conn. C.G.S. obtains its rod stock from the Resistoflex Corporation, Belleville, N. J. who extrude it from unplasticized KEL-F polymer.

For further information ask for Application Report E-127



Molders & Fabricators of the Month

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

Booker & Wallestead, Inc.
Minneapolis, Minn.
Injection molding
Compression & transfer molding
(Specialize in short runs)

H & R Industries
Nazareth, Pa.
Extrusion & injection molding
Machining & forming
Rod, tube, tape & strip
Resistor sleeving

Electronic Wave Products, Inc.
New York, N. Y.
Sealing of film
Forming
Container liners; gaskets

Reiss Manufacturing Corporation
(Rway Synthetic Products Div.)
New York, N. Y.
Extrusion, compression & transfer molding
Machining & forming
Rod, tube & sheet
Gaskets & diaphragms
Valve seats

Recent Significant KEL-F Polymer Developments . . .

Blending equipment is now coated with "baked-on" KEL-F polymer dispersions to eliminate wasteful sticking of special plastics during processing. Chemical inertness and non-stick qualities of coating have cut maintenance and contamination.

Switch seals of the plunger type are now molded of fluorocarbon polymer to provide a hermetic seal that will withstand high altitudes and temperatures.

Valve seats machined from KEL-F polymer rod stock are used in a special valve required in nuclear research. Non-porous, tough plastic effectively keeps active Helium isotope from diffusing through the seat. Low "cold flow" keeps seats smooth and undamaged even after many "high torque" closings.

Covers for high-frequency components are compression molded of fluorocarbon polymer for electrical insulation as well as maximum visibility of contained parts. High impact strength and resistance to aging eliminates need for special protective or reinforcing shields or guards.

OFF THE PRESS . . .

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

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

Technical Service
CHEMICAL MANUFACTURING DIVISION
THE M. W. KELLOGG COMPANY
P. O. Box 469, Jersey City 3, N. J.
or offices in Boston, Chicago, Dayton, Los Angeles and New York

KELLOGG PULLMAN

® Registered trade-mark for The M. W. Kellogg Company's fluorocarbon Polymers.

Power Supply

Utility Unit for Designers

In the Model 701 adjustable power supply, emphasis has been placed on convenient packaging of a utility unit, useful in electronic design. The Model 701 is an unregulated supply, providing d-c voltages from 0 to 250v at maximum load of 90ma (360v open circuit), and a-c filament power, 6.3v at 3amp, center tapped. Ripple has been kept to the low value of 20mv rms by use of a two-section choke input filter.

An auto transformer in the primary permits the adjustment of d-c output to any desired value from zero to maximum. The output voltage is constantly monitored by a front panel meter, which can be switched to indicate current when desired. Separate terminals for positive, negative and ground are provided. Shasta Division, Beckman Instruments, Inc., Dept. ED, P. O. Box 296, Richmond, Calif.

CIRCLE ED-176 ON READER'S SERVICE CARD FOR MORE DATA

Strain-Gage Transducers

For Fluctuating Pressures

In the redesigned "Sierra Brand" strain-gage transducers, the reference pressure tube has been been brought directly out the rear together with the electrical terminals, permitting the unit to be threaded into its flush-mounting position from either direction.

The transducers provide a resistance change that is a true representation of pressure fluctuations. Electrically, the units coordinate with the general practices of dynamic strain-gage work; usually the transducer is installed as an active arm of a 120-ohm bridge. Standard units have 1/2" diam and are available in two lengths: 1/4" and 3/8". Seven pressure ratings are supplied: 2-1/2, 5, 10, 25, 50, 100 and 200psi. Linearity is 2%; operating temperature range is —40° to +250°F; acceleration effect is 0.02% per g; and resonant frequency of the diaphragm is 8000cy. Electronic Engineering Associates, Ltd., Dept. ED, 959 Brittan Ave., San Carlos, Calif.

CIRCLE ED-177 ON READER'S SERVICE CARD FOR MORE DATA

‹ CIRCLE ED-399 ON READER SERVICE CARD

New Products . . .

Panel Meters

In 300amp to 800ma Ranges

These sealed, ruggedized panel meters are to be offered with d-c ranges showing any practical scale from 300amp to 800ma. Meters are available in two sizes: 2-1/2″ and 3-1/2″. Simpson Electric Co., Division American Gage & Machine Co., Dept. ED, 5200 W. Kinzie St., Chicago 44, Ill.

CIRCLE ED-80 ON READER'S SERVICE CARD FOR MORE DATA

Voltage Standard

For Measuring and Calibrating

The Model A-23 "Calivolter" provides a means of accurately measuring the emf of voltage - producing vibration, pressure, and seismic pickups, as well as strain measuring devices. It can be used to precisely calibrate voltage detectors and voltage-sensitive devices; for over-all calibrations of recording systems; and to measure the frequency response of amplifiers, recording systems, transformers, high impedance meters, etc.

Accuracy is ±1/2%, and the instrument will operate on any 12v battery or any oscillator (of suitable frequency range) capable of delivering 100mw into a 1000-ohm load. Voltage range runs from 10μv to 10v in five continuous ranges. Current range goes from 1μamp to 10ma in five decade steps. Frequency ranges from d-c up to 10kc at ±1/2% accuracy—useful to at least 20kc. There is no waveform error, because the thermocouple monitor indicates true rms value regardless of waveform. Max output impedance is 1000 ohms.

The unit is extremely portable. The instrument weighs only 6-1/4 lb, measures 8″ x 8-1/2″ x 4″, and comes equipped with carrying handle, protective rubber feet, and plastic dust cover. The cast-aluminum case provides complete shielding. Calidyne Co., Dept. ED, Winchester, Mass.

CIRCLE ED-81 ON READER'S SERVICE CARD FOR MORE DATA

A-C INDUCTION TYPE SERVO MOTORS and MOTOR GENERATORS

G-M Miniature Servo Motors are available in various sizes, down to .980-inch diameter and in various speeds and electrical characteristics; principally for 60- and 400-cps. circuits. They can be supplied to meet rigid military specifications with regard to humidity, salt spray, temperature, vibration and altitude. All stators are completely embedded in an insulating compound of extreme dielectric strength, high temperature stability, and low temperature coefficient of expansion. The low mechanical coefficient of expansion and great stability of this material at high temperature permits the use of G-M Servo Motors at high ambient temperatures. All stator windings are treated with an effective fungicide. All motor laminations are of high nickel steel which provides corrosion resistance of the surface adjacent to the air gap. Available with stainless steel or aluminum housings and with stainless steel or SAE 52100 steel ball bearings. Write for Servo Catalog No. 4.

G-M LABORATORIES, INC.
4284 N. Knox Ave., Chicago 41, Ill.

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

★ **Reduced cost distinguishes the Series 47 composition-element, twist-lug-mounted, control. Twist-lug mounting eliminates the usual bushing, lock washer and nut, thus effecting considerable economy. Electrically, it is the same as the standard 15/16" dia. composition-element controls.**

Lugs slip through slots in chassis and are twisted to hold firmly in place.

☆

Resistance range, 500 ohms to 5 megohms, 0.5 watt rating.

☆

Choice of tapers and taps. Metal or plastic shafts.

☆

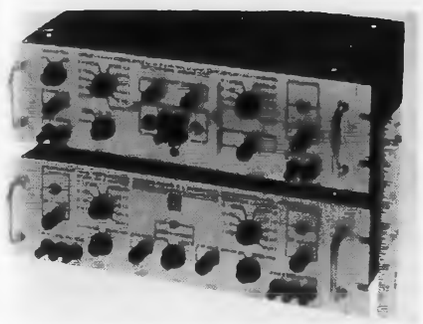
Shown actual size. Measures 15/16" in dia.

CLAROSTAT® *Controls and Resistors*
CLAROSTAT MFG. CO., INC. DOVER, N.H.

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

Amplifiers

For Instrumentation Purposes



Two amplifiers, the Model BL-520 Universal Amplifier and the Model BL-530 Dual Channel D-C Amplifier have many laboratory and instrumentation applications. The Model BL-520 is a very high gain carrier amplifier that accepts signals from both resistive and inductive transducers. It will measure and record on a direct writing oscillograph a wide range of physical phenomena. The unit has a maximum sensitivity equivalent to 1/2microv per chart millimeter, or, for strain measurements, 0.25 microinches per inch.

The Model BL-530 will accept both single-ended and differential signals with a 50mv sensitivity and provides for accurate calibration of the recorded signals. Both amplifiers provide for balancing out voltages up to 10 times full scale at input signal levels up to 500v. Both amplifiers are furnished for 19" rack mounting. Panel height is 5-1/4". The panels are finished in aluminum. Brush Electronics Co., Dept. ED, 3405 Perkins Ave., Cleveland 14, Ohio.

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

Power Supplies

Magnetic-Amplifier Regulated

A complete new line of wide voltage range d-c power supplies utilizes selenium rectifier stacks and magnetic amplifier regulation circuitry with no moving parts or contacts. The unit illustrated is rated 5-32v at 15amp, with a 1% regulation over this entire d-c output voltage range and a 1% ripple.

All units of the line, identified as the "MR Series", have these similar characteristics in addition to a 0.2sec response time. Other standard catalog units are rated at 10-40v at 30amp, 10-32v at 50amp, 24-30v at 100amp, 24-32v at 200amp, and 22-32v at 300amp. Units in this series are also stabilized for a-c input voltages of 105-125v, except for the 50, 100, 200 and 300amp units, which are stabilized for 230/460v ±10%. Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

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

New Products . . .

Slide Screw Tuner

Incorporates Choking Sections

These economically priced slide screw tuners operate over the entire X-band frequency range: 8,200Mc to 12,400Mc. They are used primarily for "flattening" lines and cancelling the vswr's inherent in the other elements of a system. Loads, terminations, attenuators, antennas, bolometer mounts, adaptors, and other components can be matched to the characteristic impedance of the waveguide.

The unit consists of a slotted waveguide and a precision carriage to which an adjustable probe is attached. The longitudinal position of the probe is controlled through a rack and pinion drive, and the depth of insertion is varied by means of a knurled screw. Locks are provided for both carriage position and probe depth.

Carefully designedd "choke" sections are incorporated into the unit; they insure that any radiation or contact losses are negligible. Values of vswr to 20 can be corrected to 1.02 or less, and small reflections can be completely cancelled. The entire unit is silver plated. Transline Associates, Dept. ED, 57 State St., Newark 4, N. J.

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

Pulse Magnetron

Operates at High Altitudes

This 3cm pulse magnetron, Type *6527*, is designed for reliable operation without pressurization up to 60,000'. Primarily for use in airborne radar gunsights, it provides weight saving. The tube is a forced-air cooled, fixed-frequency, pulsed-type oscillator, with 9kw peak power output. It operates at frequencies between 9345Mc and 9405Mc.

Weight is 3 lb. Electrically and mechanically, the tube is interchangeable with the type *2J42* magnetron. The feature of the *6527* which allows non-pressurized reliable operation at high altitudes is its evacuated wave-guide. General Electric Company, Tube Department, Dept. ED, Schenectady 5, N. Y.

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

Plate Circuit Relay

Low Cost, Long Life Design

The Series "LB" low-cost, long-life, plate-circuit relay is available in coil resistances up to 34,000 ohms with a pull-in rating of 3ma (approximately 0.09w). The relay is equipped with a one-piece back spring and contact arm which can be adjusted for desired pull-in. A permanent air armature gap eliminates residual sticking.

Contacts are silver, (1 Form C), rated 5amp (3/4hp) 115v a-c non-inductive load. The coil is varnish impregnated centrifugally. Insulation will withstand 500v rms breakdown. The base is laminated phenolic, easily adapted to screw or rivet mounting. Terminals are tinned for easy soldering. Dimensions of the relay are 2-5/8" x 1" x 1-3/8" high, with 2-1/4" mounting centers. Potter & Brumfield, Dept. ED, Princeton, Ind.

CIRCLE ED-74 ON READER'S SERVICE CARD FOR MORE DATA

400cy Circuit Breaker

For Polyphase Circuits

These 400cy circuit breakers are available in one, two, or three-pole models. Polyphase operation of the units is accomplished by linking them together externally at the handles. Tripping out of any one phase causes simultaneous interruption of all phases. A special kick spring within each pole makes the force available for tripping far in excess of requirements.

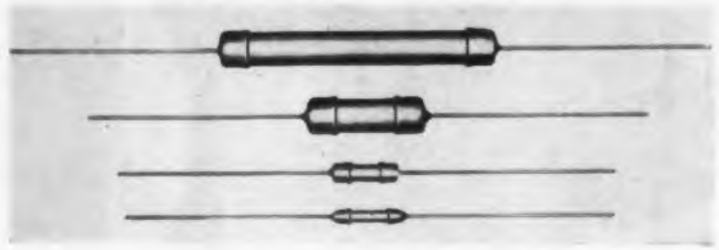
The units operate on the hydraulic-magnetic principle in which current capacity, minimum and instantaneous trip points are constant regardless of ambient temperature (*ED, May, 1954, pp 14-15*). No thermal elements are employed. Ratings from 100ma to 50amp are available. Heinemann Electric Co., Dept. ED, 449 Plum St., Trenton 2, N. J.

CIRCLE ED-75 ON READER'S SERVICE CARD FOR MORE DATA

New Products . . .

Resistors

Deposited Carbon Types



"Stemag Chemo-Carbon" Resistors offer the advantages of small temperature coefficients, greater stability when exposed to humidity, stable resistance values, greatly reduced noise level, extremely low frequency characteristics, and high uniformity on large production runs.

The resistors are available in two types. Type "A", an economical capless type, is made to 5% tolerance. It is comparable in price and size to fixed composition types and is available in ratings of 1/2w, 1w, and 2w.

Precision cap type "D" is available in 1% to 0.5% tolerance. It is manufactured to meet MIL-R-10509A requirements, and is available in wattage ratings of 1/4w, 1/w, 1w, and 2w. Arnhold Ceramics, Inc., Dept. ED, 1 East 57th St., New York 22, N. Y.

CIRCLE ED-420 ON READER-SERVICE CARD FOR MORE INFORMATION

Phase Counter

For Ultra-Low Frequencies

The Ultra-Low Frequency Counter consists of three plug-in units, a decade counter and switching circuit, a timing unit, and a function unit. The function unit can be replaced by another unit manufactured by the same firm and thereby convert the instrument into a frequency counter, a time interval counter, or a universal time interval and frequency counter.

The instrument measure frequencies from 0.0001cy to 1000cy, but the lower limit can be extended to +0cy with an external timing unit. For measuring phase angle, the input sensitivity is 1v peak minimum, and the input impedance is about 24,000 ohms shunted with 30mmfd. Power requirements are 200w, at 115v ±10%, a-c. The unit is 20-3/4" wide x 18" high x 15" deep. Accuracy is ±1 count per 100,000, or ±0.5°. Advance Electronics Co., Inc., Dept. ED, 451 Highland Ave., Passaic, N. J.

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

Relay

Rugged, Sensitive Subminiature Unit

Previously made only for the military and now being released commercially, the BR-1 sensitive subminiature relay plugs into standard 7-pin miniature tube sockets. With a 10,000 ohm coil, it may be adjusted to operate under 1ma. Where vibration or shock are present, it may be adjusted to pull-in at 2.5ma, drop-out at 1.25ma, stand 10g vibration and 100g shock. For stationary use in other coil resistances, it can be adjusted to operate on less than 10mv. Where high vibration exists, adjustment is recommended for pull-in of 60mw, drop-out of 15mw.

Speed of operation is over 100cy with normal adjustments operating at 60mw coil power. Contacts are rated at 2amp, 28v, non-inductive load. Life of contacts is minimum of 100,000 operations. The relay is hermetically sealed in a tin-plated brass container. The armature is balanced both statically and dynamically. The coil bobbin consists of compression molded plastic of extreme thermal stability and shock resistance. Coil resistances are available from 6 ohm to 16,000 ohm.

The unit is made only in spdt. It is for airborne electronics of all types under all conditions. Babcock Radio Engineering, Inc., Dept. ED, 7942 Woodley Ave., Van Nuys, Calif.

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

Hybrid Junction

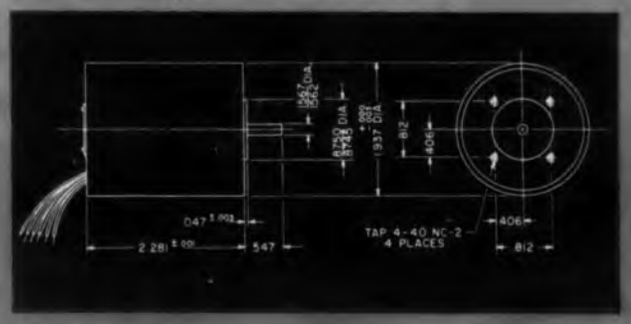
Low Cost Units for X-Band

These hybrid junctions are for the X-band, operating from 8200Mc to 9700Mc. Top wall construction plus integral flanges make the component small, compact, and easy to install. It is designed for low cost.

Input vswr is less than 1.07, isolation is in excess of 35db, and the coupling (power division) is 0.25db. High precision casting of beryllium copper or aluminum to close tolerances assures exceptional electrical performance and mechanical strength. The Gabriel Laboratories, Dept. ED, 135 Crescent St., Needham Heights, Mass.

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

Dimensions:

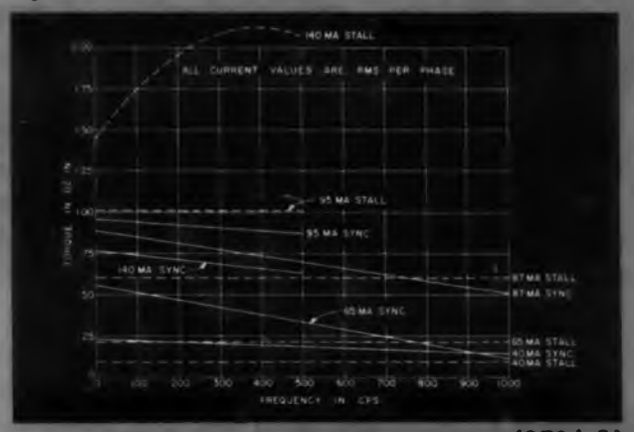


Tabulated Performance Data:
(For continuous operation)

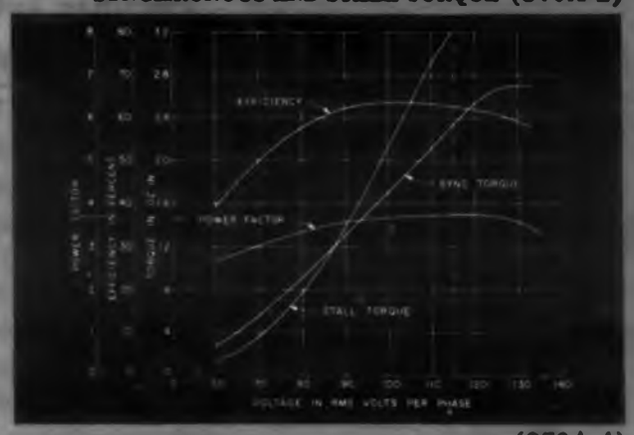
Type	*370A-1*	*370A-2*	*370A-3*	*370A-4*
Frequency (CPS)	0-1000	0-500	60	400
Voltage (RMS)	20-1000*	20-1000*	115	115
No. Phases	2	2	2	2
No. Poles	4	4	4	4
Synch. Speed (RPM)	30X Freq.	30X Freq.	1800	12000
Max. Synch. Torque (oz.-in.)	0.9	2.0	1.8	2.3
Stall Torque (oz.-in.)	0.9	0.6	1.6	3.2
Max. Efficiency (%)	*	*	33	62

*Dependent upon excitation frequency and driver tubes. 370A-1 and 370A-2 may be driven by 4-6146's (4-6CM6's at reduced torque).

Synchronous Performance Curves:



SYNCHRONOUS AND STALL TORQUE (370A-1)



TORQUE, EFFICIENCY, POWER FACTOR (370A-4)

Compact, efficient

Collins

HYSTERESIS MOTORS

Absolutely synchronous and independent of line and load fluctuations

The Collins Hysteresis Synchronous Motor is the answer to the need in the electronic industry for a high efficiency instrument-type motor having the added capacity of operation from vacuum tube amplifiers. The precision construction of Collins Hysteresis Motors yields high starting and synchronous running torques, produces absolutely synchronous rotation, and minimizes power consumption.

The hysteresis synchronous motor is useful for driving timing devices, facsimile equipment, commutators, recorders, or any device which must rotate at an absolutely constant speed regardless of load or line voltage variations. Because a Collins 370A Series Hysteresis Motor operates *directly* in the plate circuits of two push-pull direct coupled amplifiers, output transformers and the attendant poor low frequency response are eliminated and power and space economies are achieved.

The Collins Type 370A-1 Wide-Band Motor can be employed in automatic frequency control systems having error signals as high as 1000 cps. Speed of synchronous rotation is 30 times input frequency, ranging from 0—30,000 rpm.

Type 370A-2 Motor, with split windings similar to Type 370A-1, is designed for operation over a narrower frequency band in the range of 0—500 cps, with higher torque. Types 370A-3 and 370A-4 motors have standard two phase windings for operation at 60 cps and 400 cps respectively. Synchronous motors for use with other voltages and frequencies are available on special order.

Write today for complete information.

COLLINS RADIO COMPANY CEDAR RAPIDS, IOWA

261 Madison Ave., NEW YORK 16
1930 Hi-Line Dr., DALLAS 2
2700 W. Olive Ave., BURBANK
Collins Radio Company of Canada, Ltd., 74 Sparks Street, OTTAWA, ONTARIO

CIRCLE ED-401 ON READER-SERVICE CARD FOR MORE INFORMATION

SPECIAL OPPORTUNITIES FOR

ELECTRONIC ENGINEERS

Convair in beautiful, sunshiny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in missiles, engineering research and electronics development. Positions open in these specialized fields:

Microwave Antennae	**Dynamics Testing**
Microwave Components	**Telemetering**
Electronic Packaging	**Servomechanisms**
Mathematical Physics	**Electron Tubes**
Electronic Components	**Radome Design**
Electronic Systems	**Digital Computers**
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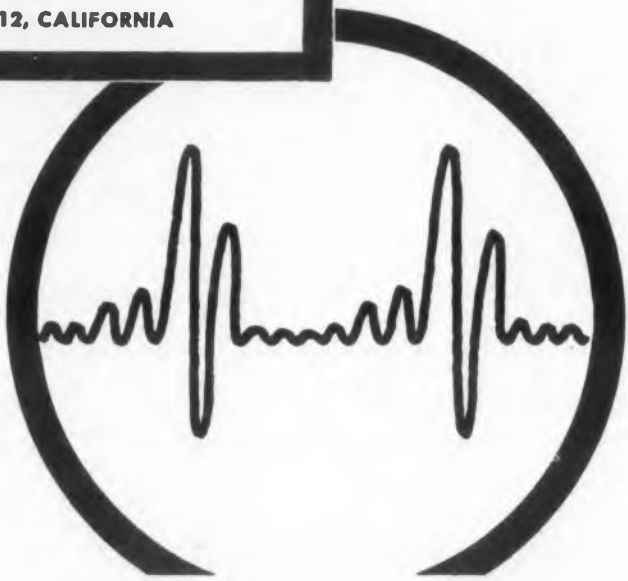


New Products . . .

Connector

Pressure-Tight Miniature

Designed to provide continued and dependable service under adverse operating conditions, the CM5-2 miniature electrical connector is pressure-tight, with die-cast aluminum shells for maximum mechanical protection. Individual synthetic rubber O-rings around each contact provide pressure sealing while allowing the contacts to "float", thereby precluding alignment difficulties. Air leakage is less than 1 cu in/hr at 30psi pressure differential.

Outstanding features include: easy removal of the knurled cap at the back of the plug for soldering cable wires to contacts: coupling lock ring for quick engagement and disengagement; and positive polarization of mating parts.

Mineral-filled melamine insulator bodies for high dielectric and mechanical strength house five No. 20 AWG contacts (5amp) and two No. 18 AWG contacts (7amp). Contacts are gold plated over silver. One-piece molded bodies eliminate unnecessary creepage paths and reduce the number of moisture and dust pockets. The shells are cadmium plated with an olive drab iridite finish. Other platings and finishes are available on special request. Winchester Electronics, Inc., Dept. F., Glenbrook, Conn.

CIRCLE ED-222 ON READER'S SERVICE CARD FOR MORE DATA

Rectifier Tube

Long-Life Type

This mercury vapor rectifier tube, the Type *6508,* is designed to meet the demand for a comparatively inexpensive, long-life rectifier for relatively high voltage and current operation. It is intended to be used instead of standard tubes, which have not been used in many communications and industrial power and control applications because of initial and replacement cost.

The rectifier has a peak inverse voltage rating of 21kv and a voltage drop of 14v. The cathode is directly heated, oxide coated. Amperex Electronic Corp., Dept. ED, 230 Duffy Ave., Hicksville, L. I., New York.

CIRCLE ED-223 ON READER'S SERVICE CARD FOR MORE DATA

Miniature Pentode

Withstands Cut-Off Conditions

The *CK6485* is a heater-cathode type, high transconductance, sharp cut-off pentode of miniature construction designed for use as a wide band or i-f amplifier. It will maintain its emission and freedom from excessive cathode interface resistance even after long periods of operation under cut-off conditions. The tube is otherwise identical with the *6AH6*.

The unit has a miniature button seven-pin base. Design center maximum ratings are: heater voltage, 6.4v; plate voltage, 300v; Grid No. 2 voltage, 150v; plate dissipation, 3.2w; grid No. 2 dissipation, 0.6w; cathode current, 25ma. Raytheon Manufacturing Co., Dept. ED, 55 Chapel St., Newton 58, Mass.

CIRCLE ED-227 ON READER'S SERVICE CARD FOR MORE DATA

Pressure Potentiometer

Withstands High Shocks

Capable of withstanding 50g longitudinal acceleration with less than 1% error, Bourns Model 408 Absolute Pressure Potentiometer is designed to measure altitude, fuel pressure, throat pressure, and static pressure in aircraft, missile, and industrial applications. An evacuated aneroid-type bellows provides the absolute reference pressure.

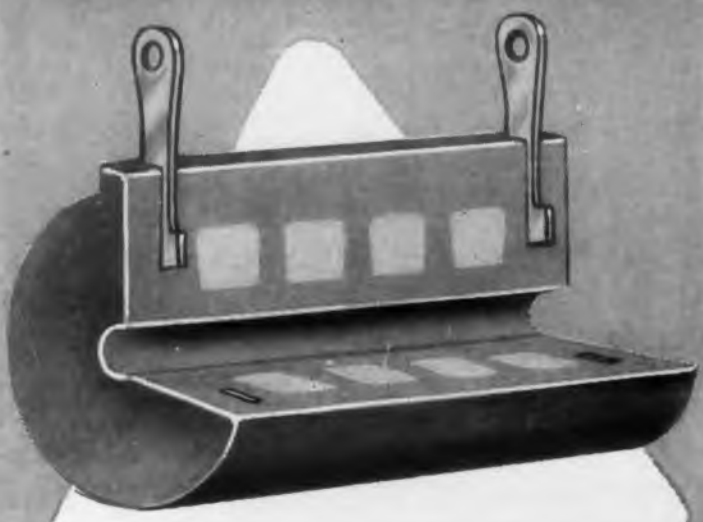
Compact and lightweight, this rugged precision instrument features an electrical contact arm with counter-balanced linkage that pivots in a miniature ball bearing assembly, thereby providing accurate and dependable performance even during conditions of extreme temperature, shock, vibration and acceleration. Simplified circuitry is possible, because the electrical output of 1/2w requires no amplification and may be fed directly into telemetering transmitters and control systems.

Performance characteristics include resolution of 0.25% to 0.50% for resistances from 1000 ohms to 10,000 ohms. Weight is 7 oz, and size is 2-1/4" diam x 2-3/8" long. Power rating is 1/2w at 160°F. Typical pressure ranges are: 0-2, 0-4, 0-8, 0-11, 0-15, 0-20, 0-30, 5-10, 3-14psia, and others. Bourns Laboratories, Dept. ED, 6135 Magnolia Ave., Riverside, Calif.

CIRCLE ED-226 ON READER'S SERVICE CARD FOR MORE DATA

EPR

N-CAPS®



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CIRCLE ED-228 ON READER-SERVICE CARD FOR MORE INFORMATION

Save Time, Reduce Errors... Determine and Record Data Automatically with These Two Versatile Berkeley Instruments

Model 5510 Universal Counter and Timer offers direct-reading digital display of count, frequency or microsecond time interval. Time bases from 1 mc. to 1 cps; gate times from .00001 to 10 sec. Accuracy ± 1 count, ± crystal stability (1 part in 10^6). Price $1,100.00 f.o.b. factory.

1. UNIVERSAL COUNTER AND TIMER, Model 5510, combines the functions of four instruments in one single, compact unit. It will:

a. Count at speeds to 1 million per second.
b. Count events occurring during a selectable, precise time interval.
c. Measure time intervals in 1 microsecond increments, from 3 microseconds to 1 million seconds.
d. Determine frequencies or frequency ratios from 0 cps to 1 megacycle.
e. Operate directly the BERKELEY printer (below), BERKELEY digital-to-analog converter, or BERKELEY data processor to drive IBM card punches, typewriters or teletype systems.

2. BERKELEY DIGITAL RECORDER, Model 1452, combines scanner and high speed printer in a single unit; prints up to 10 digits on standard adding machine tape. Can be modified to print "Time" or "Code" information simultaneously with count data on same tape.

Model 1452 prints 6 digits (8 or 10 on special order) on standard adding machine tape. Is only 19" wide x 10½" high x 14" deep, weighs 60 lbs. Price, $750.00 f.o.b. factory.

Write for complete specifications and data; please address Dept. D 11

M-43

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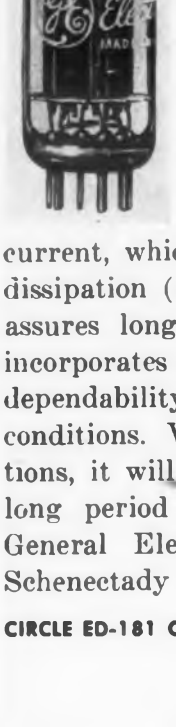
CONTROL SYSTEMS • COMPUTERS • COUNTERS • TEST INSTRUMENTS • NUCLEAR SCALERS

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

New Products . . .

Twin Triode Tube

Increases Speed of Computers



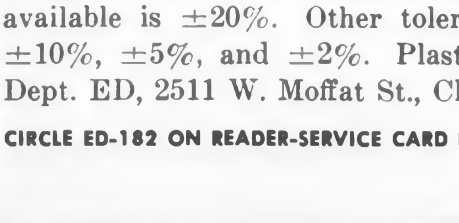
The *GL-6463* miniature twin-triode tube has high perveance and plate current to allow the design of faster speed electronic computers. Developed primarily for amplifier or counter service in digital computers, it fills a need for a moderately high current rating tube designed specifically for computers.

In order to increase computer speeds appreciably, the tube plate load resistance must be lowered. This reduction in turn calls for a higher plate current, which the tube is designed to supply. Plate dissipation (4w per plate and 7w total for the tube) assures long and dependable operation. The tube incorporates a special heater-cathode construction for dependability under frequent "on-off" switching conditions. When used in "on-off" control applications, it will maintain its emission capabilities after long period of operation under cutoff conditions. General Electric Tube Department, Section ED, Schenectady 5, N. Y.

CIRCLE ED-181 ON READER-SERVICE CARD FOR MORE INFORMATION

Miniature Capacitor

Uses Plastic Film Dielectric



Type LS miniature capacitors incorporate plastic film as the solid dielectric. They feature small size and light weight coupled with the excellent electrical characteristics. Temperature range is from −70° to +140°C. Suitable derating must be used for temperatures greater than 85°C.

Three types are available: LS1 has a maximum voltage of 150v, d-c, at 85°C, 100v at 125°C, and 75v at 140°C; available in 17 ratings from 0.01-0.5mfd. Type LS4 has maximum voltages of 400v (85°C), 300v (125°C), 150v (140°C); 40 ratings from 0.0033-1.0mfd. Type LS-10 has maximum voltages of 1000v (85°C), 700v (125°C), 350v (140°C); 44 ratings from 0.001-0.5mfd.

Capacitors are capable of passing the 30-day humidity test as described in MIL-E-5272A, paragraph 4.4.2. They meet all applicable environmental requirements of MIL-C-25A. Standard capacitance tolerance available is ±20%. Other tolerances available are ±10%, ±5%, and ±2%. Plastic Capacitors, Inc., Dept. ED, 2511 W. Moffat St., Chicago 47, Ill.

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

Transistor Sockets

For RETMA 3E15 Base

Designed to accommodate transistors having the standard RETMA 3E15 base, these sockets are furnished mounted on phenolic strips in groups of 10. Other models are under development will hold 30 or more sockets in a single strip. The transistor contacts are of phosphor bronze, and the solder contacts are copper. Internal connections are handled by a printed circuit. Dimensions of the 10-socket model are 6″ x 1″ x 1/4″. Electronics Div., Dept. ED, Hydro-Aire, Inc., 3000 Winona Ave., Burbank, Calif.

CIRCLE ED-185 ON READER-SERVICE CARD FOR MORE INFORMATION

Nylon Bearing

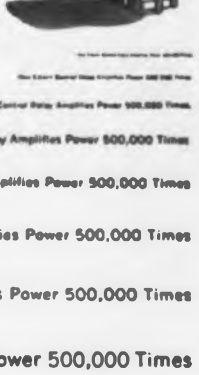
Eliminates Lubrication

"Nyliner" flange-type Nylon bearings, which are used primarily to eliminate lubrication and to increase bearing life, incorporate the compensation gap principle which permits circumferential expansion and contraction of the Nylon material without appreciably affecting the bore diameter.

The flange on the "Nyliner" has two main purposes. One is to permit the bearing to carry end thrust against a shoulder in addition to radial loads. The other purpose is to afford a simple, inexpensive means of axial retention of the bearing in at least one, and in some cases both directions. For relatively heavy thrust loads, a continuous flange can be provided which is interrupted only at the compensation gap. This affords a surface of maximum bearing area. In most cases an interrupted or clover leaf flange is used which precludes slight distortion of the bearing that might result from gradual release of internal stresses in the flange.

Either type of flanged bearing can be provided with an anti-rotation boss or lug under the flange which engages a notch or slot in the bearing housing. This is particularly desirable when the bearings are used in die-cast metal or other relatively soft housing materials which could wear under intermittent rotation of the mounting in the housing. Thomson Industries, Inc., Dept. ED, Manhasset, N. Y.

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



New Edison Control Relay Amplifies Power 500,000 Times

New Edison Control Relay Amplifies Power 500,000 Times

New Edison Control Relay Amplifies Power 500,000 Times

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New Edison Control Relay Amplifies Power 500,000 Times

Edison Control Relay Amplifies Power 500,000 Times

Control Relay Amplifies Power 500,000 Times

Relay Amplifies Power 500,000 Times

Amplifies Power 500,000 Times

Because there is an amplification factor of approximately 500,000 between the input power to the operating coils and the load capacity of its own contacts, Edison's Magnetic Control Relay actually eliminates the need for electronic boosting—operates *directly* from a thermocouple, photocell, or from vacuum tube currents. Yet this precision instrument stands up even under the shock and vibration of aircraft service.

Designed and developed in the world-famous Edison Laboratory, this small relay has features of particular interest to designers of electronic equipment.

Low power operation—Standard types operate at as low as 30 microamperes—do not drain power from other circuit components, such as gyro motors.

Versatility—Coils can be supplied with resistances from 0.5 to 20,000 ohms. Differential operation is made possible by separate connections from each coil with polarized operation as an inherent characteristic.

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

Rugged Movement—Dissipates overloads up to 10,000 times normal operating input—withstands 50 g shock in all planes (unenergized).

Contacts—Platinum-iridium wire, either SPST or SPDT, with capacity of ⅓ ampere at 28 volts d.c. non-inductive.

Write us—especially if you are now using a single-stage electronic amplifier—for more complete information.

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A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

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CIRCLE ED-187 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Turret Tuner

Handles V-H-F and U-H-F Channels

The Type TV 99 82-channel turret tuner switches stations, whether v-h-f or u-h-f, with the same ease as v-h-f tuners. It features automatic switching, improved performance over the entire spectrum, electrical and mechanical simplicity, compactness, nonradiation, and low cost.

The tuner may be mounted in the same space devoted to any v-h-f turret tuner, or it may be mounted on the side of the cabinet, if desired. The heightened performance is achieved with the use of *6AN4* tubes. One *6AN4* is employed as an r-f amplifier that functions on all 82 channels; it improves picture quality and functions to reduce radiation to a negligible value. The other *6AN4* is used in place of a crystal mixer. Instead of a conversion loss, an actual gain is realized in this circuit.

Low cost is achieved by a design whereby pretuned fixed-frequency channel segments can be simply snapped into the rotor. These segments are inexpensive tuned circuits individually mounted. Shipping boxes contain three segments and one marked with correct channel numbers. Anchor Radio Co., Dept. ED, Chicago, Ill.

CIRCLE ED-403 ON READER-SERVICE CARD FOR MORE INFORMATION

D-C Solenoids

For Remote Control

The No. 1700 Series of miniature solenoids is for applications requiring the use of d-c solenoids smaller in size and lighter in weight than standard They may be used for operation of keyboards, control board signal flags, light springs, and similar remote control applications.

The solenoids measure just 1/2″ diam x 1-3/8″ long. Weight is 0.06 lb. They can be produced for a wide range of current and voltage requirements. An example of pull characteristics is the 24v, 1.4amp type, which is operated on intermittent duty at a 25°C ambient to pull 75lb through a 1/16″ stroke. Carruthers & Fernandez, Inc., Dept. ED, 1501 Colorado Ave., Santa Monica, Calif.

CIRCLE ED-404 ON READER-SERVICE CARD FOR MORE INFORMATION

Pulse Generator

With Continuously Variable Waveforms

The Model PG-200A Pulse Generator is now housed in a new cabinet that provides greater cooling. In addition, the stability of the instrument has been improved by the utilization of components that were not available at the time of original design.

The generator is a medium power, precision instrument for generating adjustable rectangular waveforms having fast rise and decay times. Wide ranges of pulse duration, amplitude, recurrence rate, and positioning are provided. It may be operated self-synchronous or driven by an external signal.

Pulse width and pulse position with respect to the sync output trigger are continuously variable by means of calibrated controls from 0.05μsec to 50μsec. Both ranges may be extended to 1000μsec by means of an auxiliary unit. Rise and decay times of pulse are constant and equal to 0.03μsec or less from 0.05μsec to 1000μsec pulse width. Pulse repetition rate is from single pulse to 20,000 pulses/sec. Output is 100v open circuit, with 50 ohms driving impedance.

The waveshape is rectangular, with crest and baseline overshoot or ripple less than 5% of average pulse amplitude. Teletronics Laboratory, Inc., Dept. ED, 54 Kinkel St., Westbury, L. I., N. Y.

CIRCLE ED-407 ON READER-SERVICE CARD FOR MORE INFORMATION

Rotary Actuators

For Capacities to 2000 oz-in

These miniature, high-torque rotary actuators are small, lightweight packages. Custom-made units can be developed for possible applications, including low backlash, water proofing, limit switches, dynamic braking, slip clutches, follow-up potentiometer, speed governors, etc.

The design has the dimensions of 2″ x 5-1/16″ maximum, and capacities up to 2000 oz-in, with torque depending on output speed. Voltage ranges vary from 6v to 100v. The unit can also be arranged for different speeds, torques, angular rotation, and to include reversing relays, if desired. Units consist basically of this firm's permanent magnet "Moto-Mite" and planetary gear reduction. Globe Industries, Inc., Dept. ED, 1784 Stanley Ave., Dayton 4, Ohio.

CIRCLE ED-408 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Saturable Reactors

Control Pulse or Sine-Wave Power

A series of "Magnestats", small saturable reactors, is available to control pulse or sine wave power ranging from microwatts to deciwatts at frequencies from 100kc to 20Mc. The units are as stable as transformers and do not depend on resonance. The control and the controlled circuits are electrically independent.

"Magnestats" are made for use in computers and other complex systems such as amplifiers, gates, flip-flops, switches, and arithmetic elements. For example, Type AH 25 is an amplifier which operates on 15Mc power. It will drive two other similar amplifiers with a signal rise time of less than 1/2μsec. Snyder Laboratories, Dept. ED, 601 Chapel Ave., Merchantville 10, N. J.

CIRCLE ED-412 ON READER-SERVICE CARD FOR MORE INFORMATION

Strain Scanner-Recorder

Can Handle 50 Gages

Records from SR-4 strain gages at 50 points can be taken continuously and automatically in a total of 30sec to 90sec with these strain scanning and recording instruments. The equipment greatly reduces the time and skill required during any testing project requiring numbers of SR-4 strain gages.

The recorder provides three ranges of measurement; 0-2000, 0-5000, and 0-10,000 microinches, and can handle gages with mixed resistances ranging from 60 ohms to 500 ohms. A gage factor control is included to accommodate strain gages with gage factors ranging from 1.7 to 2.25. On each range, zero can be set at left, center, or right of the recorder chart.

The scanner unit contains the electrical circuits and controls for switching. In addition to full automatic operation of the system, it can be manually advanced through each of the 50 strain gage channels, one at a time. A rapid advance pushbutton permits advancing the system at the rate of at least two channels per second without recording. The channel in use at any given instant is indicated by a rotating hand on the face of the strain scanner unit. Strain gage output can be indicated without recording by means of a pen-lifting mechanism. No d-c standardizing circuit or associated components are required. Baldwin-Lima-Hamilton Corp., Dept. ED, Philadelphia 42, Pa.

CIRCLE ED-416 ON READER-SERVICE CARD FOR MORE INFORMATION

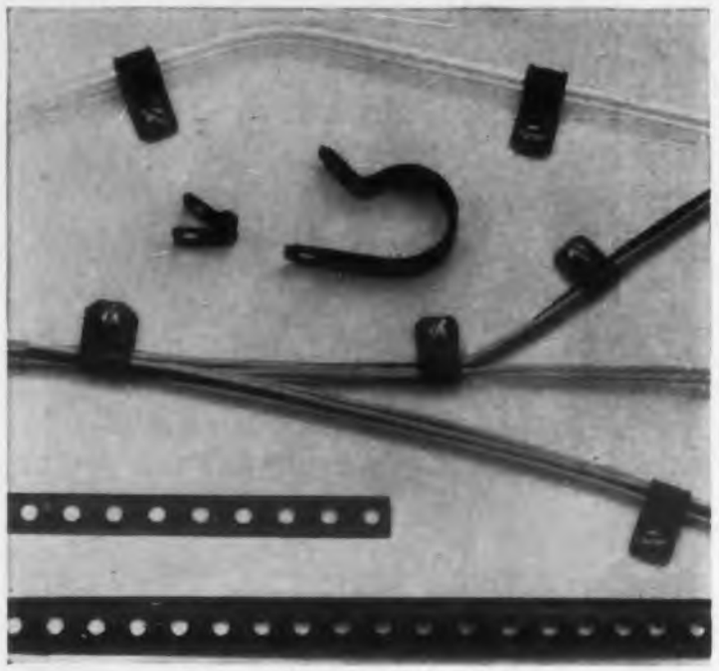
Earphones

Clip-Ons for Many Uses

This line of hearing-aid quality, clip-on miniature earphones is designed to meet a wide variety of requirements. Some suggested uses for "Fen-Tone" clip-ons are: dictating machine transcribing, monitoring phone order desks, simultaneous listening, radio communication, factory communication and control, and private sampling of recordings of important meetings.

The clip-ons are available in 128 ohm, 100 ohm, and 2000 ohm models, with flesh colored plastic clasp or earmold, complete with 5′ cord and standard coaxial phone plug. Fenton Company, Dept. ED, 15 Morre St., New York 4, N. Y.

CIRCLE ED-417 ON READER-SERVICE CARD FOR MORE INFORMATION



HOLD — wiring — fragile glass tubing — mercury switches—components—etc. with these **NyGrip*** (all Nylon) plastic cable clips and perforated strapping—light weight — tough — flexible — strong — chemically resistant—use from —60 to 250°F—send for free samples and literature. *TM

WECKESSER CO.

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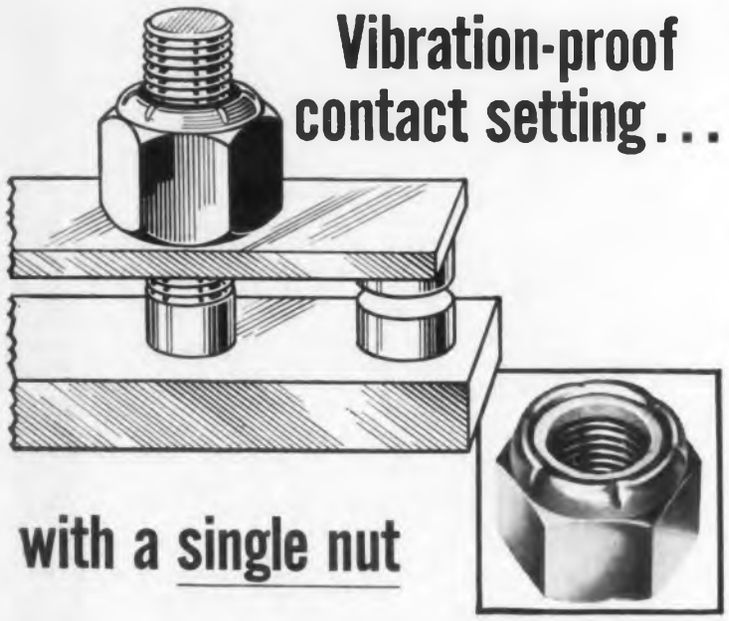
CIRCLE ED-419 ON READER-SERVICE CARD FOR MORE INFORMATION



Vibration-proof contact setting . . .

with a single nut

Easily wrenched on to an exact setting, the one-piece, self-locking Elastic Stop® nut won't shake loose. The red elastic locking collar grips the stud threads tightly . . . maintains a precision adjustment without any secondary locking devices. Usable over and over again. Many types available in miniature sizes for electronic and instrument assemblies—hex nuts as small as .109 across flats!

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DESIGN HEADQUARTERS FOR SELF-LOCKING FASTENERS

CIRCLE ED-421 ON READER-SERVICE CARD FOR MORE INFORMATION

New Products . . .

Communications Receiver

Has Continuous Calibrated Band

"Pro-130" Communications Receiver has a precision differential tuning system which makes it possible to read the exact frequency to which the receiver is set, anywhere from 550kc to 35.5Mc. The rotary turret construction for selecting any one of the six bands permits extremely short leads between the circuits and tubes, and makes possible the separate removal of individual circuit sections. The WWV standard frequency signals can be received on this set.

The set is double conversion from 2.2Mc to 35.5Mc, the top four bands, for high image rejection. High stability is achieved because of the crystal-controlled sound conversion oscillator. Improved front-end selectivity is obtained with a single tube, triple-tuned, r-f section. Hammerlund Manufacturing Co., Dept. ED, 460 W. 34th St., New York 1, N. Y.

CIRCLE ED-422 ON READER-SERVICE CARD FOR MORE INFORMATION

❶ **Glasseal hermetically sealed sub-miniature paper tubulars. Manufactured to the highest commercial standards and engineered to the exacting performance requirements of Military Specification MIL-C-25-A.**

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❸ **Electrolytics of superior commercial performance characteristics, meeting Jan-C-62.**

Write for Catalog J-8 for further detailed information. Or call your local Pyramid Sales Representative or write to:

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PYRAMID ELECTRIC COMPANY

Dept. 123, 1445 North Hudson Blvd., North Bergen, New Jersey

CIRCLE ED-423 ON READER-SERVICE CARD FOR MORE INFORMATION

Fielden TEKTOLOG

ELECTRONIC RECORDER

✳ *Accurate to ±1% of Full Scale*

✳ *Operates directly from Low Energy Sources*

✳ *Simplified Design— Only 4 Principal Units*

✳ *Available with Electric or Pneumatic Controls*

The Fielden TEKTOLOG has a sensitivity of ±0.1%, mechanical reproducibility of ±0.5%, yet because of its simplified design, circuitry and construction is priced substantially lower than other types. Various recording speeds to suit applications. Pen equipped with non-clogging capillary tip suitable for high or low speed recording auxiliary control apparatus. Available with dust-tight, weather-proof cast aluminum housing. Easily installed . . . flush or surface mounted. Can be supplied with portable carrying case for mobility since critical leveling is not needed. Designed for *accurate* recording at low cost. Write today for details to Dept. M.

Robertshaw-Fulton CONTROLS COMPANY

FIELDEN INSTRUMENT DIVISION

2920 N. 4th St., Dept. Q, Philadelphia 33, Pa.

Dollar for Dollar— Your Best Instrument Value

CIRCLE ED-424 ON READER-SERVICE CARD FOR MORE INFORMATION

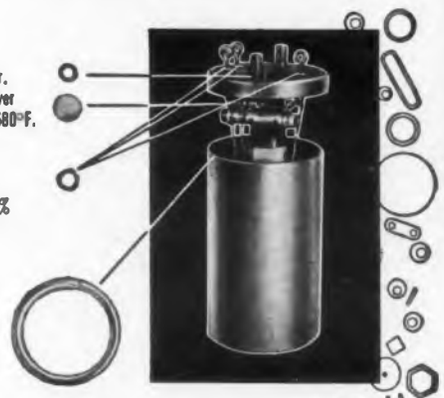
3 Soldering Operations in 1 Easy as ABC

with KESTER® "SOLDERFORMS"

A Solder screws and stud to can cover. "Solderform" Disc & Rings 5% Silver —95% Lead Alloy. Melting Point 680°F.

B Solder glass terminals to cover. "Solderform" Rings 63% Tin—37% Lead Alloy. Melting Point 361°F.

C Hermetically seal cover on can. "Solderform" Ring 28.5% Bismuth—28.5% Tin—43% Lead Alloy. Softening Point 250°F.



Here's a typical example of a tough resistance soldering job involving progressively lower melting temperatures. Kester "Solderforms" made sure this high precision oscillator coil came through every test successfully.

WRITE TODAY for free "Solderform" samples and literature.

KESTER SOLDER COMPANY

4266 Wrightwood Avenue • Chicago 39, Illinois
Newark 5, New Jersey • Brantford, Canada

CIRCLE ED-425 ON READER-SERVICE CARD FOR MORE INFORMATION

Amplifier

For Examining of Circuits

The Model 60 "Video Probe Amplifier" is an electronic instrument designed to facilitate circuit examinations with all types of oscilloscopes. Because of its low input capacity, its use with any oscilloscope permits observation of the circuit under study without loading, detuning, or other adverse effects on normal performance of the circuit. The unit's video probe system introduces no attenuation, so oscilloscope may be used at full gain for accurate observation of small signals.

The amplifier has uniform frequency response from 50cy to 12Mc within ±3db. It also serves as an excellent general-purpose amplifier with gain of 40 and more than 12v peak-to-peak output. Each instrument is supplied with a clip-on type probe for use as an oscilloscope accessory, and an RG/62U cable input with u-h-f connectors for use with the instrument as an amplifier. Donner Scientific Co., Dept. ED, 2829 7th St., Berkeley 10, Calif.

CIRCLE ED-243 ON READER-SERVICE CARD FOR MORE INFORMATION

You'll find them all in the new

CHICAGO CATALOG of

the World's Toughest Transformers

These are just a few of the popular types of transformers for military, new equipment, general replacement, control and power circuit applications listed in CHICAGO's new Catalog . . . over 500 transformers, with complete physical and electrical specifications on each unit.

And more important—they are all *in stock* for quick delivery from your local CHICAGO distributor.

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New York 13, N. Y.

CIRCLE ED-251 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature...

Electron Tubes 252

This valuable reference guide (Seventh Edition) lists all miniature tubes, regardless of make. It includes pertinent data for 329 types, of which 79 are new, 135 basing diagrams, numerous operating conditions, and indicates larger prototypes. CBS-Hytron, Div. of Columbia Broadcasting System, Inc., Danvers, Mass.

Magnetic Electrodes 253

A newly developed magnetic electrode, designed for packaging-machine applications and permitting the unobstructed high-frequency welding of large area plastic sheets, is described in this leaflet designated Form E654. Described in the literature is the general arrangement, which demonstrates how the high-frequency electrode is completely enclosed by the steel magnetic structure and keeper bar. This, at the same time, applies welding pressure to the plastic sheet. A close-up cross-section of the unit makes clear the manner in which its construction completely eliminates the overhead interference of conventional hydraulic and pneumatic presses, and provides optimum r-f shielding. Electronic Processes Corp., 1076 San Antonio Road., Los Altos, Calif.

Scale Models 254

Scale models, their application and manufacture are described in a 4-page, 2-color brochure. Precision models of any product, prototype design, or piece of equipment are made to user specifications to aid in development and research work. The booklet illustrates a number of models produced by the company in metal, wood, and plastics, and outlines services available. Arthur B. Johnson & Co., Inc., 392 East 201 Street, New York 58, N. Y.

Color TV System 255

The G-E "Chromacoder" color TV system is described in this 4-page brochure. It explains what it is, how it functions, and what advantages it has over other live systems. The booklet includes a detailed explanation of the use of the Chromacoder with color-modified black-and-white cameras to obtain an NTSC color signal. A simplified block diagram of the equipment illustrates how the simultaneous color signal is obtained from the sequential signal produced by the pick-up cameras in the studios. General Electric Co., Broadcast Equipment Div., Electronics Park, Syracuse, N. Y.

A-C Rate Generator 256

A 4-page illustrated bulletin illustrates and describes a line of extremely stable, linear, a-c rate generators with high functional voltage output. The units covered are offered in 60cy and 400cy models and are available with temperature compensation for a wide environmental operating range. Information on construction, applications and design features and characteristics and specifications are provided. Also included is a section on rate generator-servo motor packages which combine in single shaft units, rate generators and high-precision servo motors. Ford Instrument Co., 31-10 Thomson Ave., Long Island City 1, N. Y.

Laboratory Ovens 257

Catalog No. 331 describes a wide range of precision laboratory ovens, incubators, and related equipment. Fifty-four models are discussed with dimensions, temperature range, power requirements, weight, accessories, and other pertinent information given in convenient tabular form. Precision Scientific Co., 3737 West Cortland St., Chicago 47, Ill.

Tube Manual

Descriptions and characteristics of this firm's 600 vacuum tubes, 110 premium tube types, 170 cathode ray tubes, 85 crystal diodes, and a line of dial lamps are listed in the 20th edition of this 200-page tube manual. Drawings of bases, contacts, and tube outlines, including obsolete types, are given. The color codes for resistors, capacitors, and transformers, as well as a 15-page tube substitution chart are included. An explanation of the ballast tube numbering code appears on pages 173 and 174. Six typical electronic circuits are included among the many illustrations. *Price: $0.75. Write directly to Tung-Sol Electric, Inc., 95 Eighth Ave., Newark 4, N. J.*

Metallized Paper Capacitors 258

Technical data and operating characteristics of this firm's "Hy-Met" high temperature paper capacitors are described in folder No. AB-19A. It contains information on types of "Hy-Met" available, their capacitance stability, voltage rating and derating, insulation resistance, sizes, etc. Designed for operation over a wide temperature range, these units feature the unique self-healing characteristics of metallized paper capacitors and have good capacitance vs temperature stability, low power factor, and long life. Astron Corporation, 255 Grant Ave., East Newark, N. J.

Pulse Transformers 259

This 8-page catalog (Section No. 44-250) of pulse transformers for radar applications lists both high- and low-power types. Construction, applications, ratings, list prices, and mounting illustrations are included. Ordering data for d-c charging reactors is also given. Westinghouse Electric Corporation, Transformer Division, P. O. Box 231, Greenville, Pa.

"Mylar" Properties 260

The physical, electrical, chemical, and thermal properties of "Mylar" polyester film are listed in this 8-page brochure. Each electrical property is given for at least two different conditions. A list of proposed applications and a table of types and gages currently available are also given. E. I. Du Pont Nemours & Co., Inc., Film Department, Wilmington 98, Del.

Laminate 261

Valuable information for the designer of printed circuitry is included in this 12-page booklet (No. 457) on copper-clad laminates. The various methods of manufacturing printed circuits and a chart of the overload currents for the various widths and thicknesses of copper foil are also given. The laminates are available with nylon and silicone bases. Formica Co., 4614 Spring Grove Ave., Cincinnati 25, Ohio.

New Literature . . .

Quartz Crystals 265

A 4-page bulletin on quartz crystals describes the most used units in this company's line. They range in frequency from 16kc to 100Mc and include the RH-7B TV designed specifically for use in color TV. Comprehensive data pertaining to dimensions, frequency range, and corresponding military specifications are given. Reeves-Hoffman Corp., Cherry and North Sts., Carlisle, Pa.

Protective Coatings 266

"Check List of Metal Protective and Paint Bonding Chemicals and Processes" is the title of this 8-page brochure. It lists metal-protective and paint-bonding chemicals for steel, zinc, aluminum, and other metals having industrial applications. American Chemical Paint Company, Ambler, Pa.

Valves 267

A 16-page bulletin, designated No. 1010, covers a complete line of standard 4-way hand, foot, power and solenoid operated valves, as well as a new line of pilot valves. Dimensions and weights, application diagrams, circuit diagrams, parts lists, and accessories are also included. Ledeen Manufacturing Co., 1600 South San Pedro St., Los Angeles 15, Calif.

Coil Winders 268

Bobbin, repeater, solenoid, resistor, armature, variable pitch, spacewound, latticewound universal, and filed coils are described in the firm's 46-page Catalog (No. 54). Several accessories also are covered, and one page is devoted to winding formulas. Geo. Stevens Manufacturing Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill.

Relays 269

An attractive 18-page booklet (GS) illustrates and describes this company's complete line of standard relays. A complete list of uses, special features, specifications, and a dimensional drawing are given for each relay illustrated. Additional features are also available for special applications. Kurman Electric Co., Inc., 35-18 37th Street., Long Island City 1, N. Y.

Coaxial Connectors 270

A 24-page illustrated catalog lists this firm's latest connectors for both government and commercial use. Designed for efficient use by the design engineer, the booklet also includes allied components for use in u-h-f through microwave frequencies. Tru-Connector Corp., 416 Union St., Lynn, Mass.

Data Processing 271

"Data Processing Instruments" is the title of a 12-page catalog which furnishes information on a complete line of data-processing equipment ranging from miniature transducers to entire instrumentation systems. Photographs, technical specifications and functional diagrams accompany the text. Consolidated Engineering Corp., 300 North Sierra Madre Villa., Pasadena 8, Calif.

Crystals 272

A 12-page illustrated brochure, designated Catalog No. 354, incorporates a military chart designed for the user's guidance in selecting proper crystal types for particular requirements. The booklet features the company's complete line of crystals, from subminiature, hermetically sealed, plated units to crystal ovens. Standard Crystal Company, 1714 Locust, Kansas City, Mo.

Servomechanism Parts 273

This well-illustrated brochure covers the company's line of precision gear heads, gear trains, and speed reducers. The technical information, specifications, electrical and mechanical data given should be of interest to all those engaged in instrumentation, automation, and analog computer design. All illustrations are actual size. Feedback Controls, Inc., 1332 North Henry St., Alexandria, Va.

Custom Wire Leads 274

This 4-page brochure covers the manufacturer's available services. These include end and center stripping, counterstripping, stripping of shielded wire and multiple conductors, coding, terminating, solder dipping, straightening, and wire supply. The custom wire leads are made to civilian and military specifications, and adherence to specified tolerances is assured. Manger Electric Co., Miller St., Stamford, Conn.

Soldering 275

Entitled *Solder—Its Fundamentals and Usage,* this 80-page, paper-bound book by Dr. Clifford L. Barber, Research Director, Kester Solder Company, is inclusive enough to serve as a reference book or textbook on soldering. It is divided into six main sections: "The Nature of Solder", "The Soldering Flux", "Flux-Core Wire Solder", "External Soldering Fluxes", "Solid and Special-Type Solders", and "The Application of Solder". The various types of soldering methods, including the soldering of printed circuits, are discussed. A number of charts, tables, and photographs are included. Kester Solder Company, 88 Ferguson St., Newark 5, N. J.

Tinkertoy Kit 276

A kit for making Project "Tinkertoy" modular units is included among a wide variety of laboratory equipment such as variable-frequency generators, regulated power supplies, and oscillators described and illustrated in this 16-page catalog. Enough parts to make over 200 modular assemblies are included in the kit. Communication Measurements Laboratory, Inc., 350 Leland Ave., Plainfield, N. J.

Temperature Measurement 277

"How Temperatures Are Measured", by Dr. G. M. Wolten, is an informative booklet about a subject in which there is a great deal of misunderstanding and confusion, even among technical personnel. Selectively illustrated, some of the topics covered are: heat and temperature as separate concepts; the history of the commonly used scales for measuring temperature; physical effects associated with a rise in temperature and how thermometers and pyrometers utilize some of these effects; and monitoring surface temperature by means of changes in color or physical state. Tempil Corporation, 132 West 22 St., New York 11, N. Y.

Precision Resistors 278

This 32-page catalog is intended as a guide to basic data on resistors for the application and design engineer. It also presents in concise, usable form, information on the firm's line of precision, wirewound resistors in such a way to permit their accurate selection and application for any specific purpose. It contains basic design information on these resistors and includes new charts and data on resistance wire, "Seald-Ohm", hermetically sealed, and encapsulated types. Divided into sections starting with broad general data and continuing into detailed specifications of each type, the book is well illustrated with engineering drawings and photographs. MIL and other government ratings are listed. Where applicable, government specifications are cross-referenced. The Daven Company, 191 Central Ave., Newark, N. J.

New Literature . . .

Electrical Insulation 281

Designers and developers of electronic equipment will find a good source of information on silicone materials in this 32-page, illustrated catalog. Complete technical data, descriptions, and information on applications, sizes, stocks, and uses of silicone materials for high temperature Class H electrical insulation is included. In addition the booklet covers silicone laminated glass cloth plastics; silicone bonded mica products; silicone rubber and resin coated glass cloth and tape; silicone treated glass cord; Silastic pastes and Silastic R tape and cloth; and silicone varnishes, resins, adhesives, compounds, and grease. Publications Dept., Insulation Manufacturers Corp., 565 West Washington Blvd., Chicago 6, Ill.

Instruments 282

Many highly accurate instruments and recording devices are illustrated and discussed in this handsome 22-page booklet. The devices are employed to detect and record a variety of physical and electrical phenomena of interest to design and development engineers. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Precision Fabrication 283

A 12-page illustrated catalog covers this firm's line of Swiss automatic screw machine products made in a range from 0.5 to 25mm diam. Showing a cross-section of their manufacturing facilities, the catalog emphasizes the firm's additional facilities for custom made precision parts for electronic industries. American Laubscher Corp., 333 W. 52 St., New York 19, N. Y.

Transformers 284

Over 500 stock transformers for use in original equipment or as replacements in all types of electronic devices are listed in this 24-page catalog (No. S-654). Complete electrical and physical specifications are given. An ultra-linear output transformer No. A-8072 for adapting a Williamson circuit to ultra-linear operation is featured on the back cover. A line of filter chokes is also given. Chicago Standard Transformer Corporation, Addison and Elston Streets, Chicago 18, Ill.

Components 285

Subminiature resistors, precision and power resistors, camera- and receiver-type deflection yokes, focus coils, and i-f and r-f transformers and coils are listed in this 36-page catalog (No. R200). Charts, tables, drawings, as well as selection and application information are included. I-T-E Circuit Breaker Co., 19th and Hamilton Sts., Philadelphia 30, Pa.

Capacitors 290

This 20-page catalog (No. X-100) illustrates and describes the company's complete line of miniature hermetically sealed high temperature (−55°C to +125°C) tubular paper capacitors. Dimensional drawings, electrical characteristics, engineering data and tables of voltages, capacitance values, and tolerances are presented, and information for ordering is included. Gudeman Company, 340 West Huron St., Chicago 10, Ill.

Catalog 291

A wide variety of instruments, recording devices, gages, industrial thermometers, valves, relays, and switches, etc., suitable for installation in industrial control systems are described in this 24-page composite catalog (No. 5001). Various industrial control systems are also depicted. Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa.

Zirconium Facts 292

"Facts About Zirconium" is a concise 64-page booklet about the history and production of zirconium. Mechanical and physical properties, chemical characteristics, and facts about fabrication of the metal are discussed in detail. One section of the booklet is devoted to zirconium chemicals such as zirconium tetrachloride, dioxide, sulphate, and Carbo-Cast-Aid. Low neutron absorption and high corrosion resistance have made zirconium metal important in atomic energy applications, and its growing value in chemical, electronic, and metallurgical fields is considered extensively in this informative publication. An appendix gives data on crystallographic features, atomic, and nuclear properties. The Carborundum Metals Co., Inc., Akron, N. Y.

Iron Core Materials 293

Data sheets No. PMS-12-A-R2 and B-R2 list the composition and characteristics of electronic iron core materials as submitted to the Metal Powder Association by this company. Engineers will find useful the coverage of particle size, apparent density, frequency range, relative permeability, and "Q" value, and the itemized list of electronic uses for various iron powders. Plastic Metals Div. The National Radiator Co., Johnstown, Pa.

Printed-Circuit Laminate 294

Technical information on two grades of copper-clad "Insulrok" laminates for printed circuitry is given in this 4-page bulletin. The laminate is a paper-base phenolic to which copper foil of 0.0014" or 0.0028" thickness is applied. Richardson Co., 2734 Lake St., Melrose Park, Ill.

CIRCLE ED-295 ON READER-SERVICE CARD ➤

New Literature . . .

Resistors 297

Specifications for many different types of resistors are given in tabular form on this large chart, which is suitable for wall mounting. Lines of chokes, capacitors, selenium rectifiers, and germanium diodes are also listed. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Transformers 298

Five hundred transformers for every purpose plus related inductance and coil products are listed and described in this 28-page catalog (No. TR-54). Two photo-flash transformers are included in the list of new items. Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Tin 299

The many industrial uses of tin are described and illustrated in this handsome 20-page booklet. The story of the mining and processing of this useful metal are also given. The Malayan Tin Bureau, 1028 Connecticut Ave., Washington 6, D. C.

Marking Machines 300

A wide variety of fully automatic, motorized, and hand-operated "Rejafix" marking machines are listed and described in this 8-page catalog. The machines can mark on many different types of surfaces. Popper & Sons, Inc., 300 Fourth Ave., New York, N. Y.

Aluminum Coating 301

"Alondine" No. 1200, a protective coating for aluminum that is also a good paint bond, is described in this 4-page bulletin. The process for applying the coating is also depicted. American Chemical Paint Co., Ambler, Pa.

Reference Cavities 302

Three fixed-frequency, vacuum-sealed, transmission-type reference cavities are described in this 12-page bulletin. They have a maximum drift of only ±0.4Mc. Applications and complete technical data are included. Tube Department, General Electric Co., Schenectady 5, N. Y.

Potentiometer 303

The high-resolution rotational potentiometer discussed in this technical bulletin has been tested successfully for over 15 million revolutions at 600rpm. The resistance element is a conductive plastic. The unit is furnished in standard resistances of 2000 to 100,000 ohms. Markite Corp., 155 Waverly Pl., New York 14, N. Y.

Printed-Circuit Connectors 332

The printed-circuit connectors described in this 4-page bulletin are made in miniature and subminiature sizes. Both types are available in 2-, 4-, 6-, and 12-contact sizes and in three gages to accommodate 1/32", 3/64", 1/16" thick printed circuits. Circon Component Co., 17544 Raymer St., Northridge, Calif.

Wave Analyzer 333

The automatic wave analyzer described in this 10-page brochure (No. 54-C) performs automatically plotted analyses of complex signals having components in the range of 3 to 2000cy. It has two channels. Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.

Capacitors 334

This 31-page catalog (No. 800B) describes lines of electrolytic, molded paper, oil-filled paper, and mica capacitors. Many capacities, sizes, shapes, and mounting arrangements are available in each type. A line of "button" mica capacitors for high-frequency applications is included. The color codes according to RETMA and Specifications JAN-C-5 and MIL-C-5-A are given. Each class of capacitor is illustrated. Sangamo Electric Co., Capacitor Div., Marion, Ill.

Wires and Cables 335

Wires and cables for every application in the electronics industry are covered in this 32-page catalog (No. 104). A line of plugs, outlets, and connectors is also described and illustrated. The last page is a table of cross-section area and weight in pounds per 1000' of copper wire for each AWG size. Columbia Wire & Supply Co., 2850 Irving Park Rd., Chicago 18, Ill.

Wire Handles 336

The full-size illustrations of 73 different styles and sizes of standard wire handles and clips in this catalog should aid the designer in choosing the proper handle for a particular application. Each style is available in a range of wire-gage sizes. A series of photographs showing the firm's production methods is given. E. H. Tichener & Co., Binghamton, N. Y.

Solenoids 337

This handsomely bound catalog (No. 2) consists of blue prints of this firm's line of solenoids for aircraft applications. The physical and electrical characteristics of each solenoid are given on the blueprints. West Coast Electrical Mfg. Corp., 233 W. 116th Place, Los Angeles 61, Calif.

Shock Absorbers 338

A line of shock absorbing mountings, bearings, and bushings for instruments and machinery are described in this two-color catalog (No. 701). Tables of loads each size of shock absorber can carry are given along with a design nomograph to facilitate selection. General Tire Co., Industrial Products Div., Akron, Ohio.

New Literature . . .

Computers 342

This 12-page illustrated product brochure describes the company's line of electronic computers and plug-in components and, in addition, provides a summary of the company's design philosophy and available services. An informative description covers many of the company's latest developments in machine computers, master air data computers, accelerometers, positioning mechanisms, etc. Servomechanisms, Inc. Westbury Div., Post and Stewart Aves., Westbury, N. Y.

Alloys 343

Properties of "Ternalloy", an aluminum base alloy series for high strength castings without heat treatment, are available in a new file folder brochure. The booklet includes complete information on the alloy series' mechanical and physical properties together with a discussion of its castability and machinability. Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.

Radiation Equipment 344

A well illustrated, 2-color, 40-page catalog describes this company's complete line of radiation measuring equipment. The line includes scalers, count rate meters. Geiger, proportional and scintillation counters, complete radioisotope laboratories, etc. A price list is included. Nuclear Instrument and Chemical Corp., 229 West Erie St., Chicago 10, Ill.

Panel Instruments 345

A 12-page bulletin, designated GEC-368F, describes the company's line of panel instruments and gives description, construction, and application details of both d-c and a-c instruments. Well illustrated, it also contains complete dimensional and price information, and physical, operational, and electrical data. General Electric Co., Schenectady 5, N. Y.

Counting and Timing 346

Bound in loose-leaf form, this catalog includes a group of counters and timers along with applications. Each device is illustrated. Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

AN Connectors 353

This 30-page catalog gives complete information on the line of connectors. Organized into two sections, the first provides full information on the various types of connectors—their application, advantages, construction and assembly details, and mechanical dimensions. The second section consists of selection tables, ordering information, insert arrangements, electrical data, available shell types, and other pertinent material. General Electric Co., Wiring Device Dept., Construction Materials Div., 95 Hathaway St., Providence 7, R. I.

Miniature Rigid Controls 354

Among the uses for the miniature rigid push-pull controls described in this 2-page bulletin are manual reset operation of inaccessible controls, direct transmission of motion in compact mechanism, power transmission through confined areas, and remote indication. Engineering drawings of these applications and general specifications for the controls are also given. Arens Controls, Inc., 2017 Greenleaf St., Evanston, Ill.

Test Instruments 355

This 4-page illustrated folder describes high precision test instruments which include recording oscillographs, galvanometers, instrument amplifiers and bridge balances, analog computers, function generators, and related equipment. William Miller Instruments Inc., 325 North Halstead Ave., Pasadena 8, Calif.

Components 356

A 24-page illustrated booklet (No. 55) lists a complete line of plugs, jacks, connectors, switches, terminals, panel fasteners, linen and nylon cable, nylon plastic cable clamps and many other electronic components and accessories. Schematic dimensional diagrams are found throughout. Herman H. Smith, Inc., 2326 Nostrand Ave., Brooklyn 10, N. Y.

High Frequency Resistors 357

Comprehensive data on 43 types of MP high frequency resistors, their characteristics, construction, individual specifications, applications, and installations are given in this 8-page brochure. Charts, graphs, and photographs, as well as ordering information is also included. International Resistance Co., 401 No. Broad St., Philadelphia 8, Pa.

Signal Generators 347

This organization's complete line of instrument and signal source generators is presented in a brochure designated No. El-1A. It is clip-bound for easy inclusion of supplementary data. Detailed electrical and physical specifications are listed along with performance curves and dimensional drawings for all "Elinco" permanent-magnet and wound-field d-c, a-c, and sine wave generator types. Electric Indicator Co., Inc., Springdale, Conn.

Control Knobs 348

In this catalog, (No. E) the company presents their line of standard control and electronic knobs, available without additional mold charges. Among those shown are pointers, indicators, and rounds in a variety of design treatments, and most models shown are available in matched sets. Featured in the catalog are actual size photographs of each knob with full scale engineering drawings with all essential data to make knob selection easier. Romar Plastics, Inc., 1317 East Main St., St. Charles, Ill.

Tube Clamping Shields 350

This catalog on miniature and subminiature electron tube clamping shields is attractively printed in two colors with contents arranged for easy reference. A wide range of miniature and subminiature tube shield types and sizes are illustrated and keyed to appropriate dimensional drawings. Information on pure silver, beryllium copper, aluminum alloy and special purpose tube shields is also presented. International Electronic Research Corp., 177 W. Magnolia Blvd., Burbank, Calif.

Interval Timers 351

Data sheet No. 400 describes techniques and equipment for measuring time intervals from a fraction of a microsecond to 1sec or longer, if desired. Accuracies as high as ±1.8microsec are obtained by electronically counting the exact number of pulses produced by a highly stable, crystal-controlled, high-frequency oscillator during the unknown interval. Potter Instrument Co., 115 Cutter Mill Road, Great Neck, N. Y.

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The New PRD DC POWER SUPPLY

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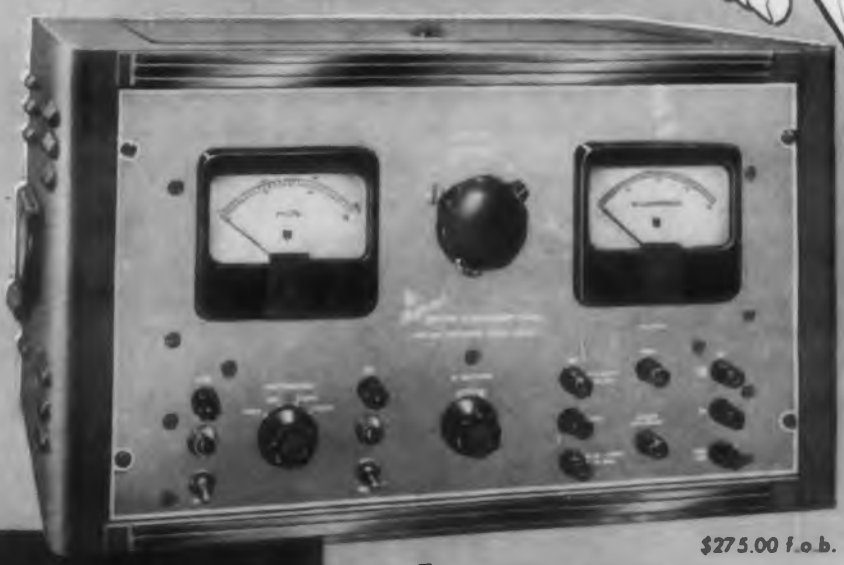

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Flexible ground permits stacking of supplies to provide up to −600V cathode voltage and an additional 0 to −250V for the reflector of low voltage klystrons

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- Unregulated 6.3V., 10A. C.T. filament supply
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- Input 115/230 Volts ac,
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The PRD Type 807 is a general purpose, constant voltage power supply, competitively priced to fit any instrument budget. It is conservatively rated for continuous service. Panel voltmeter monitors either supply voltage; milliameter indicates "B" supply current. Write for bulletin.

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HICO Instruments Division

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CIRCLE ED-360 ON READER-SERVICE CARD FOR MORE INFORMATION

New Literature . . .

Deflection Yokes 361

A catalog page pictures and describes new rotating coil deflection yokes with deflection angle up to 52° or 70°. Complete data includes four advanced design features, three dimensional drawings, and tables of electrical and mechanical characteristics with full explanations to assist electronic design engineers. A table listing a wide variety of coil inductance combinations is also shown. Syntronic Instruments, Inc., 100 Industrial Road., Addison, Ill.

Cables and Components 362

This catalog contains 44 pages of electronic wires, cables and components available from the manufacturer. It lists every type of wire and cable now in use for micrphone, intercom, broadcast and other electronic uses with detailed technical information on each type. The section on plugs, jacks, and connectors carries full descriptions of every item. Birnbach Radio Co., Inc., 145 Hudson St., New York 13. N. Y.

Toroids 364

This booklet describes a cross-section of the type of service this organization offers to users of toroidal coils and components. Among them are fine wire winding, miniature magnetic amplifier coils, coils for high temperature applications, balanced C.T. High-Q choke, and large coils. Finished components discussed include a miniature choke presented as a complete miniature, hermetically sealed unit with a locking feature that prevents turning when mounted on a chassis. Others shown are a stable oscillator coil, and a 50,000-ohm low pass filter flat within 1db to 6kc with a maximum loss of 1db. Torwico Electronics, Inc., 961 Frelinghuysen Ave., Newark, 5, N. J.

Ultrasonic Delay Lines 365

Solid ultrasonic delay lines with particular reference to the superiority of quartz to mercury and metal lines are the subject of this 12-page Technical Bulletin 54. Theory, performance, circuitry, and specification data are included. Andersen Laboratories, Inc., 39 Talcott Road, West Hartford 10, Conn.

Die Castings 366

"Die Castings . . . Unlimited" is the title of an impressive 24-page brochure which describes all the die-casting processes. Starting with the design of dies, it then goes on to die building, alloying, casting, trimming, machining, plating, finishing, and inspection. The booklet contains over 75 illustrations, drawings, and charts. Precision Castings Co., Inc., Fayetteville, N. Y.

Contact Assemblies 367

This 59-page catalog, devoted entirely to electrical contacts and contact assemblies, contains detailed specifications of this firm's contact materials, plus sketches, line drawings, charts, and tables. An outstanding feature is a Contact Material Selector Guide, which contains descriptions of contact materials, and the applications for and advantages of each. Designed for easy reference, the booklet is intended to aid in the selection of the proper contact material for any application, and presents detailed assistance toward design of contacts and contact assemblies. P. R. Mallory & Co., Inc., Contact Div., 3029 E. Washington St., Indianapolis, Ind.

Power Drives 369

A line of combination power, and, speed needs of fractional horsepower drives is detailed in this 8-page bulletin, designated FAS. Known as "Adjusto-Spede" drives, the units are an integral combination of a-c constant speed induction motors, eddy-current couplings, and electronic speed controls. They are readily adaptable to many and varied applications requiring closely controlled adjustable speeds. The numerous photographs in the booklet detail various aspects of the equipment together with charts, graphs, and line drawings. The brochure also covers fundamentals of operations, capacity of units available, mechanical construction features, control, etc. Eaton Mfg. Co., Dynamatic Div., Kenosha, Wisc.

O-Rings 371

Detailed information on compounds, groove dimensions and sizes is given in this 12-page brochure on O-rings. The booklet contains diagrams of typical applications and should be useful to designers and to users of O-ring seals for many types of applications. Goshen Rubber Co., Inc., Goshen, Ind.

TSIGMA INSTRUMENTS

THIS IS T/SGT [redacted] [redacted] COMMUNICATIONS CENTER MAINTENANCE
[redacted] AFB [redacted] WOULD LIKE T SPEAK
SOME ONE IN YOUR RESEARCH AND DEVELOPMENT SECTION PLS

WITH REGARD TO WHAT TZEV

IN REGARDS TO SIGMA RELAYS I WHICH WE REC THIS STATION
THE ARE NUMBERS 137 138 AND 139

MIN PLS
RITE
SORRY TO KEEP YOU WAITING SO LONG WILL BE HERE IN A SEC
RITE THAT IS OK
OK I HAVE A MAN HERE NOW WHAT IS YOUR QUESTION

WELT WE HAD A MISFORTUNE ON ONE OF TE RELAYS
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YOU ARE WRITING ON THE END OF LIEYXX LINE AND I XXXX DIDNT GET
ANYTHING AFTER WE WERE USING IT
CA PLS

WE WERE USING IT ON A 75 UPM CIRCUIT AND THE MARKING CONTACT
SPRING BROKE
HE WAS WONDERING IF WE COULD GET A COUPLE FM YOU
AS WE HAVE NO STOCK NUMBERS OR ANY WAY TO ORDER ANY THRU AIR FORCE CHA

RPT AIR FORCE SUPPLY CHANNELS
MIN PLS

DO YOU KNOW THE TYPE OF RELAY THAT YOU HAVE
RCB THEY ARE US NEW TYPE ADJUSTABLE
RELAY THAT REPLACED THE SEALED OCT BASE
DID YOU RECEIVE THEM FROM [redacted] A F B AND ARE THEY SERIES 72 RELAYS

MIN PLS I KNOW WE GOT THEM FM [redacted] A F B
AND THE ERAL NUMBERS OF THE RELAYS ARE 137 138 AND139
OK THAT IS ALL WE NED TO KNOW
WE WILL SEND YOU THE 2 CONTACTS THAT YOU WANT
CA
WILL THERE'E ANY CHARGE ON THEM AS WE HAVE NO
OPERATING ACCOUNT THIS TATION
THEY WILL GO OUT TO YOU NO CHARGE
RITE CAN YOU SEND A NE A LIST OF STOCK NUMBERS
FOR THAT TYPE RELAY SO WE CAN ORDER THEM THRU
NORMAL AIR FORCE SUPPLY CAHAKXXXX CHANNELS ALSO
A MORE DETAILED INSTRUCTION ON THEM AS
ALL [redacted] GAVE US HERE THE
MECH ADJUSTMENTS ON THEM CA
UES WE WILL DO THAT WE WILL GET IT OUT TO YOU BY NEXT WEEK
CA
RITE THEY HAVE TE OLD RELAY BEAT BY ABOUT 1000 PERCENT
[redacted] WERE HAVING A LOT OF TROUBLE ON 75 AND 100 UPM TILL THESE
IN AND NOW NO BIAS OR DISTORTION ON THE CKT AT ALLL.

QUERY WOULDYOU LIKE TO HAVE A PERFORMANCE REPORT ON THISE RELAYS
IN OPERATION AT 75 AND 100 WORD SPEED
CA
YES WE WOULD LIKE TO HAVE A PERFORMANCE REPORT
JUST TO GET THE RECORDS STRAIGHT THE OLD EXXX RELAYS WERE NOT
INTENDED FOR MORE THAN 60 UPM
CA PLS
RITE WILL DO WHERE CAN WE SEND THE REPORT
PLEASE SEND IT TO
MR LAURENCE B STEIN
SIGMA INSTRUMENTS INC

RITE WILL DO AND NOW ON THE PARTS IF YOU WILL

PLS END THEM TO
T/SGT [redacted]

OK [redacted] WILL DO AND TKX FOR THE COMPLIMENTS ON OUR 72 RELAYS
WE THINK THAT THEY ARE PRETTY GOOD TOO

WELL FM THE EXPERIENCE I HAVE TH HAD WITH THEM I KNOW THEY RE GOOD
AND HAS A MILLION AND WILL GET THE REPORT OUT BEFORE 1 OCTOBER
THIS IS [redacted] [redacted] OUT

OK TKX END AND BYE

Tech. Sgts., though obviously not so hot at operating teletype machines, are, in our opinion, the ones who keep the military wheels going around. We wish there were more of them using our relays (Tech. Sgts. *and* teletype machines).

This is a picture of the Sigma Series 72 polar telegraph relay to which the Sgt. referred. Neither major carrier of telegraph traffic regularly use it. They should not however be criticized for this. Each makes, or is responsible for someone else making, one of their own design; and although there is nothing "modern" about either, each has the virtue of thirty or so years of service proof. Like the DC3 Airplane, against which let nothing be said!

What we hope is that by making a pulse relay that can "copy" at 500 cps (1200 wpm) and "rattle" at 1500 cps, we may succeed rather well at normal speeds. Also, while service life of these admittedly new relays seems to be exceptionally good, we have even this aspect well hedged. All vital parts can be changed by the user like phonograph needles.

SIGMA

SIGMA INSTRUMENTS, INC.
81 PEARL STREET
SO. BRAINTREE, BOSTON 85, MASS.

CIRCLE ED-372 ON READER-SERVICE CARD FOR MORE INFORMATION

Patents . . .

Beam Shift Electron Tube . . . *Patent No. 2,672,573. Paul W. Charton (Assigned to National Union Radio Corp., Orange, N. J.)*

Variable transconductance tubes are well known, their characteristic being a gradual cut-off of the current through the tube as the control grid becomes more negative. The characteristic curve of such tubes is well rounded over a considerable portion of the curve. This effect is secured by making the control grid with progressively increased spacing between the grid wires.

The results and effects that can be secured from a variable-mu tube can be considerably extended by providing a pair of control grids (*18* and *19*, Fig. 1) Grid *18* has narrow spacing between the wires at the top or at one end of the cathode (*13*) with progressively increased spacing between the wires towards the other end. The control grid (*19*) is similarly made, but its more closely spaced wires begin at the bottom or the other end of the cathode. By controlling the grid bias on control grid *18*, the electron beam from the cathode can be made to be narrow at the bottom.

Upon decreasing the negative bias, the width of the beam increases. Similarly, the same effect is secured by decreasing the bias on control grid *19*. In this case, the beam is first narrow at the top of the cathode because of the wider spacing of the grid wires and the beam progressively widens downwardly. By varying the bias on both control grids, a beam of uniform width may be made to shift from the top to the bottom of the cathode. The beam can also be made wider or narrower. By applying alternating voltages to the grids, these beam effects may be made to travel continuously along the cathode.

The tube may have a single plate anode; however, greater usefulness is secured by providing a plurality of anodes or target electrodes (*22*). In a circular tube, such as the one illustrated, these anodes may be rings circling the cathode and grids. As the beam shifts or travels along the cathode, the anode in the path of the beam carries current. By changing the width of the beam through control of the bias on the two control grids, the beam may be made to impinge on more than one anode as it shifts along the cathode. Many other effects can be secured with the tube.

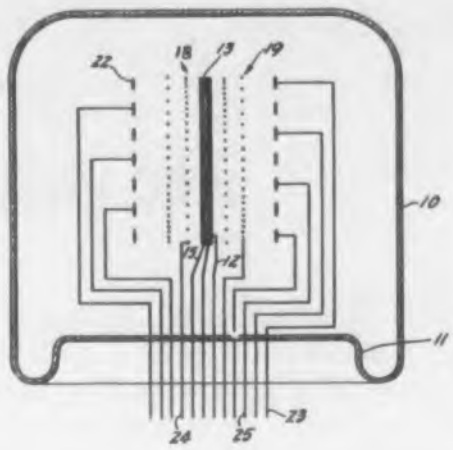

Fig. 1. One form of a beam-shift tube.

The concept of the variable-mu tube has been expanded into many other forms in order to produce additional results. These modifications are illustrated and described in the patent. The most unusual forms of these modifications are a tube in which the beam is rotated so that the target or targets are scanned in a circular area as well and a tube in which the target or anode is scanned in two directions.

RAYONIC
CATHODE RAY TUBES

by Waterman

TYPE 3XP

ANOTHER EXAMPLE OF Waterman PIONEERING

3XP RAYONIC CATHODE RAY TUBE provides a brilliant and sharply-defined trace and high deflection sensitivity at medium anode potentials. When comparing 3RP operating at 1000 volts second anode against 3XP operating at 2000 volts, the results are astonishing. For the same spot size, 3XP light output is improved by a factor greater than 4, vertical deflection sensitivity improved by a factor of 2, while the horizontal sensitivity remains unchanged. Because 3XP is enclosed in a short envelope and has half the inter-electrode capacities of the 3RP, the tube lends itself admirably to high frequency video work as well as for low repetitive operation.

TECHNICAL DATA The basic properties of the cathode ray tube that concern the designer or the user are: deflection sensitivity, unit line brightness, line width, static voltage requirements and physical size. A comparison between cathode ray tubes manufactured by Waterman Products Company is shown in the table below. These tubes are available in P1, P2, P7 and P11 phosphors. 3JP1, 3JP7, 3SP1 and 3XP1 are available as JAN tubes.

TUBE	PHYSICAL DATA			STATIC VOLTAGE			DEFLECTION*		LIGHT OUTPUT**
	Face	Length	Base	A3	A2	A2 Max.	Vert	Hor	
3JP1	3"	10"	Med Diheptal	3000	1500	2000	111	150	352
3MP1	3"	8"	Sm Duodecal		750	2500	99	104	33
3RP1	3"	9⅛"	Sm Duodecal		1000	2750	61	86	44
3SP1	1.5x3"	9⅛"	Sm Duodecal		1000	2750	61	86	44
3XP1	1.5x3"	8⅞"	Loctal		2000	2750	33	80	218

*Deflection in volts per inch.
**Light output of an element of a raster line (one mm long and not exceeding .65mm in width) in microlumens.

All heaters 6.3 V AC, .6 AMP.

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PHILADELPHIA 25, PA. *CABLE ADDRESS: POKETSCOPE*

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WATERMAN PRODUCTS

WATERMAN PRODUCTS INCLUDE

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AEC Patents For Industry

Additional patents owned by the Atomic Energy Commission have been made available for licensing. Licenses will be granted to applicants on a non-exclusive, royalty-free basis. Applicants should apply to the Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. Of the 20 patents released, the following ones are particularly interesting to electronic design and development engineers.

Contacting Device (Patent No. 2,682,583); F. R. Shonka and R. F. Selman, inventors. The patent pertains to electrical switches that are adapted to be used in radiation dosimeters. The device eliminates the electrical leakage caused by physically separating an electrode of the ionization chamber from its terminal on the outer surface of the casing of the dosimeter. This is accomplished entirely within a sealed moistureproof chamber by means of a magnetic switch, thus providing a highly precise instrument for the measurement of radiation.

Radioactivity Measurement (Patent No. 2,685,027); L. W. Alvarez, inventor. The patent relates to a method and means for measuring and analyzing radioactivity that decays rapidly. The irradiated samples are placed in a counter, pulses from which and timing pulses 1/4 sec apart are amplified and fed into a coil. The pulses are transferred as magnetic domains on a wire passing through the magnetic circuit of the coil. The wire is wound on a reel and may be played back to obtain data for determining the decay rate.

Speed Regulating Circuit for Generators (Patent No. 2,685,670); M. W. Horrell, inventor. The invention relates to circuits for regulating the speed of an alternator so that the frequency of the voltage from the alternator will be substantially constant. The current through the resonant inductance and capacitance of the circuit varies

in one phase as the speed of the alternator changes from the desired value. This shift in phase is employed to vary the conduction period of a thyratron tube that conducts the current through the field winding of the motor driving the alternator.

Radioactive Logging Apparatus (Patent No. 2,688,703); H. J. DiGiovanni, R. T. Graveson, and H. H. Voli, inventors. The present invention relates to radiation measuring apparatus for use with drill hole boring apparatus, which includes a sub-surface unit and a surface unit connected by a coaxial cable. The sub-surface unit includes a radiation responsive means for developing voltage pulses proportional to the impinging radiation. These pulses are transmitted along the coaxial cable to the surface unit. The surface unit includes means for amplifying the output pulses, oscillating means responsive to the output pulses for developing a rectangular pulse of predetermined height and width for every amplified output pulse, a rate-meter circuit responsive to the rectangular pulses for detecting the rate of arrival and amplitude thereof, and a power supply providing operating voltages to the sub-surface unit.

Translating, Rotating Bearing Device (Patent No. 2,689,753); J. J. Wechsler, inventor. The patent relates to translating, rotating, bearing devices and more particularly to a device that allows translating and rotation, or any combination thereof, in parallel planes, of bodies under load. The device utilizes three parallel plate members separated from one another by ball bearings and interconnected so that the first plate moves with respect to the second plate only in translating, and the second plate moves with respect to the third only in rotation, whereby a body affixed to or mounted upon the first plate may be moved in a plane parallel to a second body affixed to or mounted upon the third plate through any combination of straight lines and curves with no precessing of the ball bearings.

Telemetering System (Patent No. 2,689,949); J. F. Kalbach and C. W. Johnstone, inventors. The patent relates to a multi-function telemetering system for controlling and observing a large number of items in the high voltage electrodes of Van de Graaff generators. The system utilizes a light beam link between the transmitter and receiver and employs only one carrier in each direction while reliably communicating a plurality of items of information.

Ion Source Units (Patent No. 2,690,521); C. M. Turner, inventor. The patent relates to a gaseous electric discharge device and especially to an electric-arc discharge device capable of producing in quantity a substantially continuous supply of gaseous ions under vacuum such as those required in procedures and apparatus for separating or concentrating isotopes by appropriate selective operations upon the ions of different mass contained in an ion beam.

Books . . .

The Technical Report . . . *Edited by B. H. Weil. 485 pages. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. $12.00.*

Technical developments that remain locked in their inventors' brains might as well never have been conceived as far as the rest of the technical community is concerned. Often one of the first steps in communicating knowledge of scientific and technical progress is the technical report that is distributed within a company. On the basis of such reports management or the sponsoring government agency will grant additional research funds and encouragement, or grant permission to publicize the development.

This handbook-style work covers all of the steps in the preparation, duplication, distribution, and utilization of the technical report. It is the work of 23 experts edited by the Manager of Information Services, Research and Engineering Dept., Ethyl Corp., Detroit, Mich., himself the author of numerous books and articles. The book is the outgrowth of a symposium on the research report sponsored by the American Chemical Society, but it applies, of course, to all branches of science and engineering.

The volume is divided into five parts: "Functions", "Preparing and Processing", "Distributing", "Filing", and "Using". Part 1 is made up of two chapters on the technical report in industry and government, respectively. The longest section, and rightly so, is the second one on preparation. It includes chapters on the oral report, processing the report (including many illustrations of duplicating and binding machinery), and a chapter entitled, "Making Graphs and Tables More Effective". This chapter includes many examples

of both informative and poor graphs.

Part 3 on distributing includes a chapter on security of government reports. The best methods of filing reports for maximum utilization are discussed in part 4. The last part tells how to put the reports to work, including the use of industry survey reports as market research tools. One of the two appendices is an example of a style book to aid those who wish to prepare such a book for their respective firms.

All of the personnel who are concerned with the technical report, those who write, process, read, and finally take custody of them, will find this volume of interest. The designer interested in the best possible presentation of his work to a remote and often non-technical management will find it to be of great value.

Dielectric Materials and Applications . . . *Edited by Arthur R. Von Hippel, 438 pages. Technology Press and John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $17.50.*

Edited by the director of the Laboratory for Insulation Research, Massachusetts Institute of Technology, this definitive volume includes the laboratory's Tables of Dielectric Materials covering more than 600 dielectrics in a 144-page section. Twenty-two experts in the field contributed to the work.

The study is divided into five sections. The first, on theory, is split into two parts on microscopic and molecular properties, respectively, of dielectrics. Measuring techniques are considered in the second section. The title of the third section is "Dielectric Materials and Their Applications". It includes four chapters on the use of dielectrics as rectifiers; piezoelectric transducers and resonators; magnetic and dielectric amplifiers; and memory devices, respectively. The shorter fourth section deals with "Dielectric Requirements of the Armed Services". The last section is the Tables. Tabulated dielectric data for inorganic and organic solids and liquids and graphs of dielectric constant and loss tangent versus temperature for many classes of dielectric make up the last section.

Exceptionally well illustrated with drawings, tables and charts this treatise makes a valuable addition to the design department library.

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